Technological Support System for Macro-Control of Shenzhen Real Estate Market

By

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CERTIFICATE OF ORIGINALITY

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Publications resulted from the PhD study

Huang F L and Wang F (2005) A study for early-warning and forecasting for real estate market. *Automation in Construction*. **14**(3), pp. 516-537.

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ABSTRACT

Real estate industry is one of the pillar industries in China. The healthy development of real estate industry plays an important role in economic growth, the adjustment of industrial structure, and the improvement of people's living level. With the continuous marketization and normalization of China real estate market (REM), the market mechanism has played an important role in the market regulation, but macro-control by the government is still an essential measure for the real estate market. How to improve the macro-control level and to make the macro-control policies and means effective but not to violate the market rule, are the important issues faced by the government in order to keep the real estate industry health development. This research taking Shenzhen real estate market as the example, constructs a synthetic technological support system including real estate warning systems (REWS), real estate confidence index systems (RECIS), and system simulation and policies experiment (SS&PE) for Shenzhen real estate market macro-control.

Based on the domestic and overseas status of relevant research, this dissertation analyzes the mechanism, purposes, meanings and functions of constructing a technological support system for the real estate macro-control, and presents the contents and methods of establishing it. The focuses of the research are on real estate warning systems (REWS), real estate confidence index systems (RECIS), and system simulation and policies experiment (SS&PE).

For the REWS, first of all, the research analyzes its effect on the technological support system for macro-control of REM and selects appropriate warning methods according to the characteristics of real estate industry. Then the warning situation is

defined and warning factors are determined by considering the real situation of Shenzhen REM. And then it presents the criteria, procedure and methods to select indicators reflecting warning signs, and selects 9 indicators. For these indicators, their warning limits are determined based upon relevant methods and at the same time the methods adjusting warning accumulation are shown. After that, the methods of warning analysis are probed into, based on which the warning analysis of single indicator and composite indicator is done. Finally, the expression and analysis of warning signals are researched and relative questions needed paying attention to are put forward.

With regard to the RECIS, at first its influence on the technological support system for macro-control of REM is discussed and key techniques of constructing the system are brought forward. Then through questionnaires investigation, the research discusses how to establish monomial indexes and composite index, which reflect efficient demand and supply (D&S), latent demand and latent supply, via adopting factor analysis methods, SPSS software, TRECI&BRE methods and index simulation methods. Thereby, a four-level RECIS is established, viz. a composite index, monomial indexes, sub-indexes and basic indexes, its functions are analyzed, and relevant models are founded by using weighted average methods, ratio methods, etc. At one time, the weight coefficients of indexes are determined with Delphi method. Otherwise, the predictive analysis of indexes at all levels is presented.

Concerning the system simulation and policy experiments (SS&PE) of real estate, the first one is that its significance is analyzed. Then the dissertation constructs the theoretical model of system simulation and the conceptual model of system simulation of Shenzhen real estate, divides residential housing systems into four

modules, namely land for housing, housing demand, housing supply, and housing price and presents the main DYNAMO equations for each of modules, in which relevant calculation and parameters are determined. According as these modules, an example is take and relevant results are analyzed. Based upon the model of system simulation constructed, the research makes some experiments on relative real estate policies and analyzes the approach for study on policies.

In the end, based on the investigation and collection data for Shenzhen REM, an application of the technology support system for macro-control is done via adopt the relative models. The performance of the system is analyzed and measured, which ensures the practicability and effectiveness of the system for the macro-control of REM.

Keywords: Real estate, Technological support system, Macro control, Warning system, Confidence index, System simulation, Policy experiments

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CHAPTER 1 INTRODUCTION

1.1 Background and Significance

Macro control is a basic control means that a country utilizes plan, economic policies and other control means to instruct and promote social-economic development, to influence social-economic structure and running, to maintain and advance the harmonious and stable development of economy. In other words, it is a functional activity of national economy in which a country synthetically applies all kinds of leading or simulative means to adjust macro social-economic structure and running. To realize scientific and effective macro control is the internal requirement of a market economy and is also the important criterion for evaluating the effectiveness of administration of a government. The focus of macro control is to effectively bring into play governmental role and to make most use of market function at the same time.

Real estate industry is one of the pillar industries in China. The healthy development of real estate industry plays an important role in maintaining the economic growth, adjusting industrial structure, and improving people’s living standard. Real estate market is a sort of multi-agent and multilevel market. Due to the huge amount of investment, long investment period, complicated constraint factors, high return and high risk, and high speculation, real estate industry is usually regarded as a weatherglass of national economy. As real estate industry is closely related to the well-being of the general public, it is important to ensure its healthy development. Therefore, real estate industry is often under close scrutiny and macro-control of the government. At all times, governments at all levels need to closely monitor the development of real estate industry. Many measures have been taken on the one hand to stimulate REM, and to avoid its overheating on the other.

With the continuous marketization and normalization of China's REM, the market mechanism has played an important role in regulating the REM. Macro-control by the government, however, is still proven to be an essential measure for stabilizing the REM. How to improve the macro-control level and to make the macro-control policies and means more effective but not to violate the market rule, are the important issues faced by the government in order to keep the healthy development of the real estate industry. Recently, the government, economists and many other people involved are very concerned with the situation of the REM, they have been arguing that whether the real estate market is healthy or overheating. And many people are also doubtful of the government's policies to interfere the market, because the existing macro-control system for REM appears to be lack of ability to regulate the market effectively. Thus, in order to improve the macro-control effectiveness and to make the macro-control policies and means useful, the government has to answer two questions urgently, one is what the criteria can be used to judge whether the REM is healthy, overheating or overcooling; and the other is how to formulate scientifically governmental policies determination of macro-control.

Especially in Shenzhen, in past over twenty years, real estate industry has become an important component of Shenzhen's economy. It plays a significant role in the economic development and people's life, many people engage in construction, trade and investment in the industry. It is very important for the government to ensure the healthy development of Shenzhen's real estate market. Thus it is very important and urgent to construct the macro-control system of real estate market, so as to provide an effective and efficient tool to guide the healthy development of the real estate market. For this purpose, this study aims to identify and develop technological support system needed to develop the macro-control system to the REM, so that the decision makers can have a theoretical basis in making decisions related to macro-control of the REM.

The key for the government to better decisions is to understand precisely the current status of the REM. To achieve this, the technological system should be able to, 1) reflect what is happening in the REM, 2) indicate what can be done by the government, and 3) what possible results would be if the government applied the macro-control measures to the REM. Many developed countries have established REWS. In addition, RECI has been an accepted and important indicator to reflect the developmental status and trend of REM, similarly to the NASDAQ index which is a weatherglass imaging the condition of stock markets or economy of the USA. To achieve effective macro-control of the REM, there are three major measures that the government can take: there are real estate warning systems (REWS), real estate confidence index (RECIS) and system simulation and policy experiment (SS&PE). These measures are further elaborated as follows.

The REWS may help the government to understand what is happening in the REM, to master the recent trends of the REM, and to judge the situation of REM. And REWS should be able to provide reference data for the government to regulate and control the REM. For investors and participators, the REWS enables them to better appreciate and grasp the developmental trend of REM, so that they can make sane investment decisions, develop relevant strategies and market sales tactics for their enterprises.

A RECIS is to measure consumers' confidence level in the REM. A RECIS provides a reliable reference for the government to predict future market demand. With this reference, rational plans for issuing macro-control policies can be made.

The SS&PE is to use system dynamics as a simulation tool to experiment the effect of various policies and decisions to the REM.

In a technological support system, the warning systems are the basis, the real estate confidence index system is the guidance and indicator, and the system simulation and policies experiments of real estate are the measuring tools. The integration of all these provides a reliable ground for the government to make sound decisions for regulating and controlling of the REM. The relationship of the three technological supporting systems is illustrated in Figure 1.1

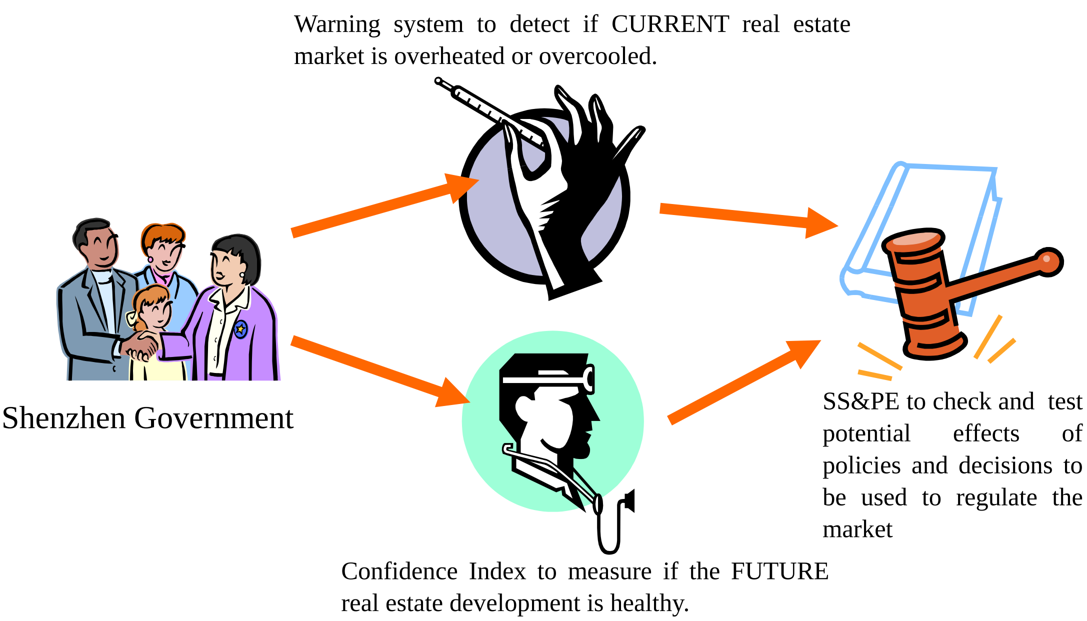


Fig1.1 The relationship of REWS, RECIs and SS&PE and roles the systems playing in the government macro-control

1.2 Framework of the Thesis and Research Methodologies

The framework of the dissertation is shown in Figure 1-2. In the framework, techniques for developing REWS, RECIS and SS&PE are illustrated. These techniques will be presented in subsequent chapters of this thesis.

The study commences with a thorough literature review through which relevant studies on real estate macro-control systems and technology support systems are analyzed.

In developing the real estate warning system, the ratio method is applied to the selection of warning methods, the establishment of index systems reflecting warning condition and warning signs, and the analysis of warning degree.

The confidence index systems is constructed using several research methods including questionnaire survey, factor analysis, Delphi method, TRECI&BRE index method, and moving average method. These methods are applied to analyze and simulate indicators representing effective demand and supply, latent demand and latent supply of the REM.

Figure 1-2 Conceptual framework of the dissertation

For the system simulation and policies experiments of real estate, system dynamics method is used to establish simulation model and set down parameters.

1.3 Organization of the thesis

Chapter 2 starts with a review of literature related to macro-control policies adopted in different countries. Then, techniques used for developing early warning systems are examined. Several confidence indices are also reviewed and compared. Finally, simulation systems that are based on system dynamics are also reviewed.

Warning systems have been widely used as a diagnostic tool, and it has been applied to the real estate industry in the recent years. Chapter 3 analyzes the effect of warning systems on the REM. Methods for selecting appropriate warning methods, and determining warning factors, indicators reflecting warning signs and warning limits according to the characteristics of real estate industry, are also explored. Then by using mathematic statistic methods, the research is to design the Shenzhen REWS, and synthetically apply single indicators and composite indicators to appraising the developmental course of Shenzhen real estate industry, monitoring its current status and forecasting its future trends. Lastly, according to the result monitored and warned, the warning system is tested and appraised.

RECIS is another sub-systems that constitute the technological support system for Shenzhen REM macro-control. Chapter 4 presents the key techniques of constructing RECI. And then the composite index and monomial indexes are compiled via synthetically considering efficient D&S, latent demand and latent supply based on Shenzhen REM.

SS&PE is the third sub-systems that constitute the technological support system for Shenzhen REM macro-control. Chapter 5 constructs the SD-based system simulation model of Shenzhen real estate and studies relative policies experiments.

Grounded on Shenzhen REM, an application of the new-type synthesis technological support system for REM macro-control, including warning systems, confidence index systems, system simulation and policies experiments, etc, is analyzed and the relevant effect is appraised in Chapter 6.

CHAPTER 2 LITERATURE REVIEW

This chapter begins with a review to uncover some of the underlying reasons related to the adoption of macro-control policies within different countries. The chapter further examines on techniques used in developing early warning system. Several confidence indices will be reviewed and compared for analysis. Finally, simulation systems based on system dynamics are also reviewed.

2.1 Macro-control of REM in other countries

(1) USA

In the US, real estate market runs entirely based on market rules. Influential factors from the government affect REM through the following position: 1) to manage and plan land use through stipulating the use of every parcel of land, building type, attitude and density; 2) to manage real estate practitioners, namely to standardize REM via a selected qualification system to filter real estate brokers, sellers and assessors; and 3) to levy taxes. Outside of these viewpoints, the government has limited influences on the REM.

Government power exerts control mainly in managing land including: levying taxes, police power and impressments. Government controls land utilization by mostly making planning and constituting planning statute [6]. In the US where land ownership is private, American laws protect public domain and private land, and various types of land may be sold or leased, establishing a suit of real estate trade system. There are three kinds of land in USA, namely private land, federal land and state-owned or local governmental land with 58%, 32% and 37% respectively, taking into account, 2% belonging to the Indians [7]. ① Deal of public domain. The condition of public domain sale is rigid. Conditions surrounding the inefficiency of management, bad location for public intent in the condition subject to a sale exceeding the limitation it needs the agreement of chamber. As the consequence, the ownership of land owned by all-level governments is clear, unambiguous and specific. Land cannot be randomly transferred among levels of the government hierarchy, whether it is from superior governments to inferior ones; inferior governments to superior and among governments at the same level virtually make no difference. If it is necessary, the sale or lease of land between the different levels of the government system must depend on relevant laws. ② Deal of private land. Government does not generally intervene in the deal of private land. All private land admitted with laws has been registered by the government. Upon agreement, as long as both sides process the change of registration in local government, the ownership can be transferred. The market value of private land is assessed and evaluated through the economic value of the land and or by private assessment company. Deal of private land must comply with the protocols and obligations regulated by relevant laws applicable to the country. In USA, a very rigid system is in place to restrict the private rights for land and managing dealings in real estate arena. The first is the restrictions of land ownership, involving the amount, type and location of land gained or owned. The second is the restrictions of land utilization, including use, building height and capacity rate. The third is the restrictions of land dealing, viz. changing registration, leasing term and the control of land speculation. Fourth is the restriction to develop public infrastructure and ensure common social interest, consisting of supplying low-cost land to some of the industries, prioritizing first for residential land use. Urban real estate dealings are influenced by urban planning.

In the past decades, with regards to the housing market, the implementation of the housing preferential policy by the US government categories the housing system into primary commercial housing and governmental participation secondary. In other words, the private capital is still governed by owners in housing management, at the same time government uses economic measures to intervene and adjust in REM. Government also invests in state-owned house in order to lease it to the low-income people or bestows allowance on them [8]. As a consequence, the macro-control system of housing mortgage market of America is quite perfect [9, 10]. ① It takes advantage of law and economic measures, and the relative independence of housing mortgage market is sufficiently taken into account. ② Governmental assurance plays a key role in stabilizing and promoting the development of primary mortgage market and acts as a link in connecting the primary market to the secondary market, alluring more investors in the commercial banks sector to enter the secondary market. ③Federal housing loans from banks exert important power over capital supply, the construction and adjustment of secondary market, driving the deposit and assurance system to perfection, stabilizing the housing finance systems and making housing mortgage organizations try their best to reduce redundant cash reserve. There are many government organizations in the playing field, participating indirectly in the secondary market and providing banks and credit organizations with short capital.

In addition, government indirectly intervenes in the running of REM by creating an impact mainly through administrative rights, taxation rights, land affairs rights and constitution of policies and statutes.

(2) Japan

In Japan, the macro control of land market and real estate industry mainly depends on economic policies and law measures, however, the government still plays an important role in it [11].

Japan real estate market is very brisk in relation to the US. Conflicts between land demand and supply are obvious. Governmental management and control appears to become more crucial. In Japan, existent land is comprised of private land (65%) and land state owned (35%). Most of state-owned land and other public land are mountain forest, river and seashore. In terms of the allocation of assets, the value of state-owned and public land only occupies less than 6% of total land assets in Japan. The private sectors and enterprises make up the main part of the real estate market. In Japan, the area is divided into 160 million sectors and the number of annual dealings reaches up to two million [4]. Governments at different locations identify land, arrange land surveyors and determine the price of real estate. They carry out land dealing permission system, land dealing report system, land dealing confirmation system, land dealing monitoring system and vacant land system. ① Land dealing permission system plays an important part for governments to control land dealing. ② Land dealing report system is advantageous to controlling large scale of land dealings which possess enough of an impact to influence land price or land use. ③ Land dealing confirmation system is the complementarities of land dealing report system. ④ Land dealing monitoring system is usually used to monitor small scale of land whose market price fluctuates and ascends rapidly. ⑤ Vacant land system prevents the speculation of land accumulation.

(3) UK

All land in England belongs to the empress or country in UK. Empress and country are the sole land owner, and individual, enterprises and other organizations just possess the use rights of land. In fact, the structure of land ownership is very complicated in UK. In general, land is divided into central government's land (2.6%), local government's land (11%), private land (65.5%), corporations and parties' land (14.4%) and others (6.5%). As long as land owners do not violate relevant laws or disrupts the interest of other people, they can legally utilize or deal with their land [4]. Land utilization needs authorizing and leasing. Government controls land market and generates a great stream of revenue from authorizing and leasing. Property in land is separated from the right of use, ownership rights belong to the state and the right of use is put into market. This pattern has an important influence on other countries belonging to Commonwealth of Nations. The land leasing market of England is very active market. These organizations owning land do not usually sell their property but rather choose to rent it to its developers. They may directly control the development and utilization of real estate through contracts to gain the most monetary return. Upon the expiration of a leasing contract, the land and building is to be returned to the land owners without any payment. The pattern of leasing is divided into four types: ① remising system, namely land owners who take over land rent for rental period; ② fixed annual land rent system, viz. land rent is calculated and taken over for each year and will not be adjusted during the rental period; ③ floating annual land rent system, viz. land rent is calculated and taken over based on each year and it is periodically adjusted in the duration of the rental period; ④ remising and annual leasing system, is a part of land rent that is accepted in advance and the rest of it is done as ③ [12].

Real estate transaction must be registered in the UK. Governmental registry department uniformly processes the examination, confirmation, registration, certification and transfer of land ownership. Land ownership certificates take on law effect and are kept in utmost confidentiality, but may be referred by lawyers. In the recent couple of years, registry department has performed more than four million real estate registrations (including mortgage registration). There is a specific transaction procedure of land which is regulated by the *Land Registry Law*, *Land Property Management Law* and *Property Law*. The compensation of land is generally calculated based on market price in UK. England assessment system of land is different from that of the American assessment system. Assessors are official or civil instead of only civil assessors. UK government monopolizes land ownership and controls the transaction of real estate with registration and assessment.

Residential policies can be divided into two kinds in UK: viz. market transaction policies and housing guarantee policies for low-income residents [12]. In order to keep housing dealing market convenient and unblocked, the government adopts housing law, planning, residential credit, housing mortgage loan rate to better manage and control REM, guaranteeing the interest of purchasers and leasers to satisfy the purchasing demand of low-income residents. Construction of houses subsidized by the government is still an important mode of housing guarantee in the UK.

2.2 Macro-control of Domestic REM

(1) Three phases of macro control of China REM exists. First phase is the Traditional macro control of REM; followed by the transitional macro control of REM; and modern macro control of REM [13].

Traditional macro control of real estate began from planned economy and transitioned to the interim of planned economy to the final market economy. At that time, one of the effects of a planned economy was that the government regulated and controlled REM via mostly administrative measure. Due to the lack of effectiveness and the absence of the efficient system of forecasting and monitoring, some problems were neglected until symptoms of trouble emerged. Figure 3-1 shows the process of the traditional macro control of REM. The advantages of this control measure were 1) that policies could become effective in time; 2) developers must change their behavior on time; 3) the results derived from these policies are easily controlled. On the contrary, disadvantages include the fact 1) that government just takes some measures for the remediation of some problems, but sometimes these problems are out of control; 2) that owing to problems happen too suddenly, it is difficult for the government to follow rigid and structured policies for remediation. Otherwise, administrative management cannot accurately grasp the controlling strength and it defeats the purpose of the healthy development of REM.

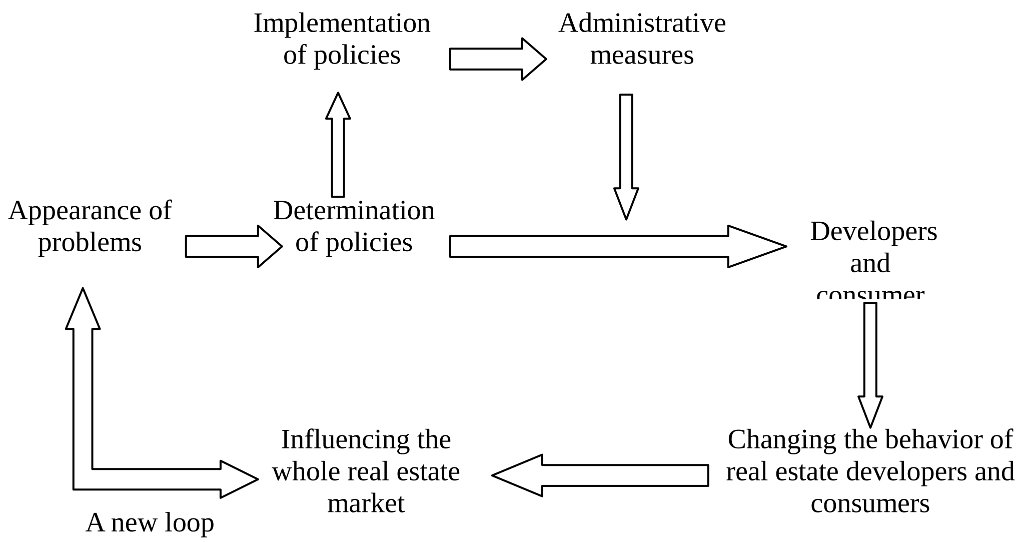


Figure 2-1 Sketch map of the traditional macro control of REM

Transitional macro control of REM is the control system in the course of perfecting the market economy in China. With the continuous strive for perfection of the market economy, governmental control measures for national economy are becoming increasingly more and more abundant. Non-administrative measures, such as financial measures, fiscal measures, industrial policies, law measures, etc, are incrementally becoming leading measures, which results in an important impact on the macro control of REM. With the significance of the real estate industry to the national economy heightening regime, we are beginning to see that the government is putting heavier emphasis on the importance to the real estate industry. In addition, government has been more aware of the important influence of real estate industry on the national economy, as a consequence, simple preliminary warning and monitoring systems have been produced. Via the usage of these systems, the government can find out the underlying reasons for many of the problems and foresee and anticipate potential problems before they arise. An alternative would be to deteriorate and constitute relevant policies to influence the decisions of developers and a consumer, which makes real estate market turn to the aim expected by the government. The process of transitional macro control of REM is shown in Figure 2-2. The advantages of this control measure are that by owing to the occurrence of forecasting and monitoring systems, the government may take some measure as soon as possible against the occurrence of the problems; otherwise, due to the diversification of control means, this control measures may not influence the sustainable and stable development of REM. However, the setbacks are that 1) forecasting and monitoring systems contain flaws that do not guard against the macro-control of REM; 2) administrative measures still play an important role in macro-control of REM, which may destroy the rules of REM. In China, there are some researches conducted on the monitoring systems for REM, such as China real estate index, national real estate index or boom index. All of these indexes put an emphasis on monitoring the situation of REM, rarely on forecasting market.

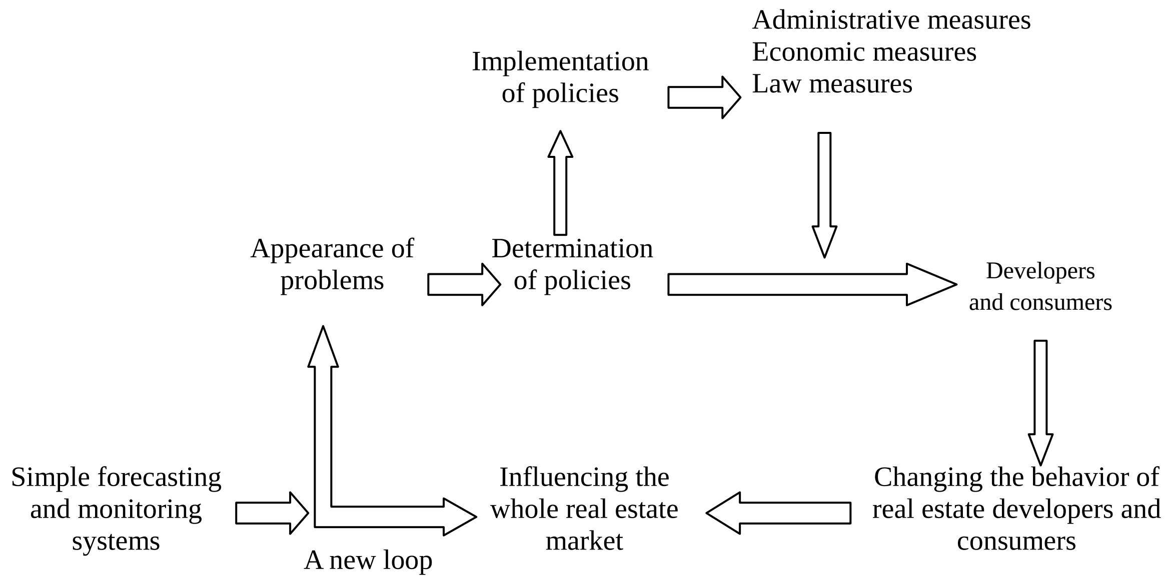


Figure 2-2 Sketch map of the transitional macro control of REM

Modern macro control of REM is an information-oriented and technology- supported macro control mode under the condition of complete market economy. With the improvement of the market and rapid development of information technology, information on REM has become much more transparent and comprehensive. On the other hand, forecasting and monitoring systems for REM is more ripe and perfect. Thus it is possible for the government to master abundant market information, to understand the dynamics of the developmental trend of REM in advance and to react accordingly by issuing relevant information. Therefore, both the developers and consumers can make rational decisions. The process is shown in Figure 2-3. The modern macro control of REM is the aim of the macro control of China REM. In the mode, the administrative intervention from government is limited to a minimal and on the contrary it completely allows REM to enter into market mechanism.

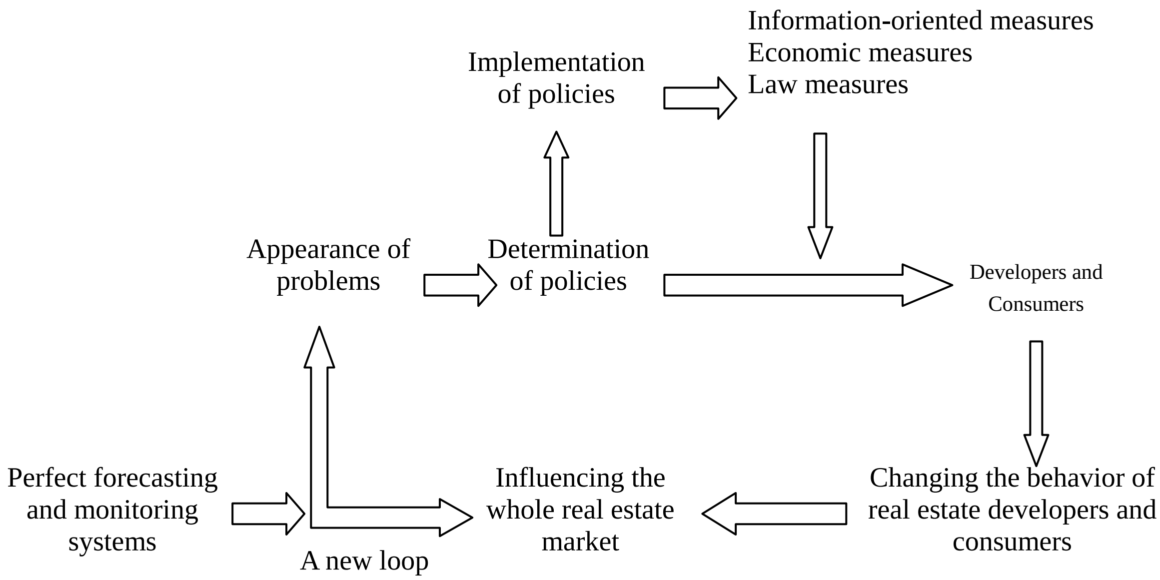


Figure 2-3 Sketch map of the modern macro control of REM

However, market system in China is not yet complete and mature. Sometimes abnormal behaviors exist, for example speculation, reasonless action, etc, occur and it is still necessary for the government to intervene frequently in REM. Therefore, at present the macro-control mode of China REM belongs to the transitional control measure. With the improvement of the market and the relevant laws associated with real estate, modern macro control mode will become prominent in China.

2.3 Real Estate Technology Systems

2.3.1 Overseas Systems

In the developed countries, some real estate technology systems are established by governments. They focus on two aspects: price index and confidence index.

(1) Price indexes In USA, real estate price index has been studied in 1963 and the regression model of real estate price index was established (M.J. Bailey, et al [14]).

Then a suit of price indexes followed, which were analyzed and tested against the housing sale data of four cities (Atlanta, Chicago, Dallas and San Fransisco) in 1987 (K.E. Case and R.J. Shiller [15]). In 1989, research on housing price indexes (HPI) was extended to standard statistical area and the distribution of housing quality was analyzed (T.G. Thibodeau [16]). In 1990, Hedonic model was applied to research on land price index (J.M. Clapp [17]). These researches mentioned above are on the basis of Hedonic model, repeat sales model, which is hybrid of the two. In 1991, these three models were analyzed in detail, including their advantages and disadvantages of their samples selection (D.R. Haurin and P.H. Hendershott [18]). Case et al [19] studied the methodology selection of housing price indexes research. The model of housing price indexes was improved to increase its accuracy rate in 1992 (W. Goetzmann [20]). In 1995, Stephens et al [21] presented a set of indexes based on housing mortgage loans and analyzed its advantages in comparison to the other models. Factors influencing housing price were also studied (R.C. Rowan and J.P. Workman [22]). As an application of price indexes, housing price indexes were applied to study the effects of restrictive land supply on housing in Hong Kong (R. Peng and W.C. Wheaton [23]). These literatures [24~27] mainly studied the differences and similarities between the applications of housing price indexes to housing long-term price risk, urban planning and national economy. At present, the most representative housing price indexes in USA is housing price indexes issued by the Office of Federal Housing Enterprise Oversight (OFHEO) since 1995. The OFHEO has completed housing price indexes from1975 to present, and releases the statistics to them quarterly. OFHEO HPI extracts data from Fannie Mae and Freddie Mac and is reported for the nation, the nine US Census divisions, and the 50 states and the District of Columbia, which provides useful data for housing and real estate industry.

In the UK, research on real estate price indexes has also been conducted. There are about ten kinds of real estate price indexes compiled by both governmental departments and nongovernmental organizations. A criterion was set up to evaluate housing price indexes compiled before and suggestions and measures were presented simultaneously in 1984 (J.H. Mark and M.A. Goldberg [28]). Among them, Halifax HPI is the UK's longest running monthly house price series with data covering the whole country going back to January 1983. The Index is compiled by HBOS (Halifax and Bank of Scotland) which is typically based on around 15,000 house purchases per month, and covers the whole calendar month. From this data, a "standardized" house price is calculated and property price movements on a like-for-like basis (including seasonal adjustments) are analyzed over a period of time. Properties over UKP 1 million are included and the index is seasonally adjusted with the seasonal factors updated on a monthly basis. It includes monthly indexes and quarterly indexes. Halifax HPI has been widely applied by government, media and business as authoritative housing price moving indexes since 1984.

In Japan, the government began to issue real estate transaction price in April of every year in 1970 [29]. This declared price is based on a parcel of land transacted in a certain date (usually January 1) with its area, shape, frontage, etc are regulated in detail. The price has become a weatherglass reflecting the governmental management and control of REM and also used as a framework of reference for properties in the second-hand market. Furthermore, in Singapore Fu [29] studied the lagging error in real estate price indices in 2003.

(2) Confidence indexes At present, overseas confidence indexes are mostly based upon price indexes or price indexes are regarded as confidence indexes, which is different from "confidence indexes" being described in China. Since the second quarter in 1999, Confidence indexes similar to China is Texas real estate confidence index (TRECI) compiled by the research centre for real estate at Texas A&M University in US. TRECI adopts a similar method with the index of consumer spirit (ICS) and mainly depends on latent demand expectation from experts and consumers. TRECI ranges from 0 to 1, with .50 being neutral state. Anything which falls above .50 reflects positive feelings about their market, and vice versa. TRECI provides fair and credible reference data for investors.

2.3.2 Domestic Systems

Researches being conducted on the real estate technology systems took part at a later stage in China. These days, the topics of focus remain on price index systems, boom index systems and warning systems. Studies on confidence indexes are being outspreaded in succession in the Mainland China, while some confidence indexes have been compiled in Hong Kong.

(1) Price index systems At present, there are several kinds of real estate price indexes. However, those widely used are China real estate index system and National real estate price index system. "China Real Estate Index" (CREI) is compiled by the China Real Estate Association, Development Research Center of the State Council of PRC, and the China Real Estate Development Groups. It consists of China real estate composite index and China real estate urban index that are also made up of benefit index and price index. The set of indexes reflect upon the changes in trend of real estate market price. The index system began to operate in December 1994 and has provided governmental departments with information on the economy with reference to macro decisions, real estate investors with developmental information, consumers with purchasing data, real estate agents with housing information, and educational and research institutions with theoretical basis. However, the price index for second-hand real estate market was presented to act as a leader in determining the price of commercial housing in 1996 (L. Qu [30]). The method used to calculate China real estate price index was discussed to improve it (Y.J. Jiang and J.H. Xi [31]). In order to completely and accurately represent the change of real estate price in time, certain actions must take place such as strengthening the monitoring system and enhancing governmental macro control of REM will be necessary under the condition of authorization of State Council of the PRC, National Development and Reform Commission and National Bureau of Statistics print and distribute *Notice about Compiling Real Estate Price Index* in 1997 [32]. The index is composed of housing sale price index, land remising price index and housing leasing price index, which branches into many sub-indexes. For example, housing sale price index consists of commercial housing price index, residential properties price index and public housing price index. The index has been released periodically since 1998. In 1999, the model of GM(1,1) was applied to the model of real estate price index, which has been tested against the relative data of Beijing real estate in 1998 (Y.P. Cheng, et al [33]). Literatures [34~38] present the methodology in compilation of real estate price index, analyzing the advantages and disadvantages of Cost, Repeat-sale, Hedonic and Hybrid and investigating some of the existing problems in current methods compiling real estate price index in China. Otherwise, trend extrapolation was applied to real estate price index and the model of quadric multinomial was adopted to simulate Shanghai real estate market in 2004 (N. Yang [39]). Aimed at real estate price index, Some government bodies, scholars, and some enterprises have also established their price index. An example would be the Zhongyuan indexes.

(2) Boom index systems Real estate boom index is known as the "National Real Estate Boom Index" (NREBI). From March 1995 onwards, it is issued on the 15th of every month by the National Bureau of Statistics. The index adopts diagrams, tables, numbers and letters to reflect the status and developmental trend of the REM on a country level. It is a set of composite indexes illustrating the boom condition of the real estate industry. In terms of calculation, NREBI is based on the periodic theory of economic fluctuation and the boom index theory. First, the real estate industry aims at land, capital and market, and then eight representative indexes are selected and calculated. These indexes are weighed to form the composite index. The index system provides the government, developers and consumers with additional supportive information as a point of reference.

(3) Warning systems In the recent years, a warning system for REM have become a focus studied by many scholars and governments. In 1996, a real estate warning system was conceived, and a set of real estate boom indexes were established (Y.B. Liang [40]). Zhao et al [13] compared economic warning methods and selected statistic warning method for REWS (Real Estate Warning System) in 1999. The research explored and determined warning factors and realized that there were limitations of the process of REWS via computers. One year later, information systems was introduced to urban real estate warning and a practical urban REWS was developed (L.Y. Ding and Z.Q. Xu [41]). In 2001, Ye et al [42] adopted the "primary factor analysis" and analysis to set up a suit of indexes through combining qualitative analysis. Li et al [43, 44] analyzed the factors influencing REWS and discovered key determinants in 2003. In May, the Ministry of Construction printed and distributed *Notice of Testing to Run Warning Systems for Urban Real Estate Market in Thirteen Cities Including Shanghai*, which determined fourteen cities (supplement Chengdu) as the first batch of cities targeted for testing and constituted working scheme. The aim of China REWS is to appraise measure, monitor, expect and report the parameters and indexes about REM running. By adopting qualitative and quantitative methods, such as the mathematic simulation, computer process, experts investigation, etc, analysis of the REM status, forecasting future trends of REM, and comparing between residential and real estate industry can be done. The warning system is divided into national REWS and Urban REWS.

(4) Confidence index systems In China, Research Centre for Real Estate in Hong Kong Polytechnic University has compiled their real estate index (BRE Index), and other researchers or institutes have begun doing it in Chinese Mainland. BRE Index is similar to TRECI and it is also based on the ICS. BRE Index has provided a good structure for the Hong Kong real estate market.

(5) System simulation of REM In China, most of researches conducted are based on the System Dynamics (SD) focusing mainly on urban land usage. For example, land usage planning (X.M. Zhao, et al [45]), system dynamic analysis models for urban land usage (N. Hua, et al [46]), dynamic analysis of Shenzhen land usage trend (W.Q. Bai [47]), etc. However, research on SD-based urban housing system is less common, the studies by the following researchers exist. 1) P. Luo, et al [48, 49] constructed the dynamic simulation model for urban housing price systems and the space-time simulation model for the Lanzhou housing price based on SD-GIS. It analyzes both of these models via using SD software. 2) Y.C. Hu and Q.P. Shen [50] roundly discuss the development of Hong Kong housing industry by establishing a SD model. It is a similar case studying the relationship between the single and multiple indicators about real estate economy, but it is regarded to be less of a whole real estate system as the research looks into the relationship of all variables according to the reference to relative literatures.

From the domestic to overseas research status mentioned above, it can be seen that 1) for macro-control systems of REM, economic measures and law measures are core, administrative measures are regarded as an secondary or supportive measure, and information-oriented technology systems are advanced and widely used in the developed Western countries and Hong Kong; however the opposite applies in Chinese Mainland with regards to information-oriented system, which has undergone some research, but further study is required for it to play an effective role; 2) Some of the research based on the information-oriented systems has just started, while RECIs have been introduced into the real estate industry and a relative perfect index system have been established into the developed Western countries and Hong Kong for quite some time; 3) with regards to the research on real estate system simulation, academic discussion about it is often seen and the models of system simulation constructed are still not enough to be put to application.

The systems mentioned above are separate and independent, and not an integrated technology system for macro-control of REM. Thus, the research is to study deep technology support systems for REM macro-control on the basis of Shenzhen REM and reconstruct a technology support system of macro-control that synthesis the warning systems, confidence indexes and system simulation.

2.4 Research Topics

2.4.1 Real Estate Warning Systems

REWS is one of the three sub-systems that constitute the technology support system for Shenzhen REM macro-control. Firstly, its effects on the macro-control system of REM will be analyzed. Secondly, according to the characteristics of real estate industry, appropriate warning methods are to be selected and relevant index system is to be established by using the theories and methods on macro economic warning and real estate warning. Then, by incorporating mathematic statistic methods, the research is to design the Shenzhen REWS, and synthetically apply single indicators and composite indicators to appraise the developmental course of the Shenzhen real estate industry, by monitoring its current status and forecasting its future trends. Lastly, according to the result monitored and warned, the warning system is tested and appraised.

2.4.2 Real Estate Confidence Index

RECIS is another sub-system that constitutes the technology support system for Shenzhen REM macro-control. Based on the overseas and domestic research information, the roles of RECI in macro-control systems are to be analyzed and dissected. The architecture of constructing the RECI is presented and key techniques of constructing RECI are determined. The third one is to compile the composite index (V) and monomial indexes to analyze and issue them on a timely basis via synthetically efficient D&S (V1), latent demand (V2) and latent supply (V3) based on Shenzhen REM. In the conclusion, the application of RECIS is discussed.

2.4.3 System Simulation and Policies Experiment for Real Estate

SS&PE is the third sub-systems that constitute the technology support system for

Shenzhen REM macro-control. Firstly, the research analyzes the significance of system simulation and policies to the real estate industry. Then the SD-based system simulation model of Shenzhen real estate is constructed, and relative policies experiments are studied. The established model will then be analyzed and evaluated based on the Shenzhen REM,.

2.4.4 Applications of the Technology Support System for REM Macro-control

Grounded on Shenzhen REM, an application of the new-type synthesis technology support system for REM macro-control, including warning systems, confidence index systems, system simulation and policies experiments, etc, is analyzed and the relevant effect is appraised.

CHAPTER 3 ESTABLISHMENT OF REAL ESTATE WARNING SYSTEMS

Warning systems have been widely used and applied to economic warning, but it is only in recent years that its application to real estate economy has been studied. The purpose of this chapter is to analyze the effects of the warning systems on the REM macro-control, explore the selection of appropriate warning methods, and determine key warning factors reflecting on the warning signals and limitations based on the characteristics of real estate industry. Based on the investigation data about Shenzhen REM, the application of warning systems are discussed and explained.

3.1 Effects of Warning Systems on REM Macro-control

Real estate warning may be described as that 1) based on scientific theories, some basic rules of real estate economy apply and are summarized by analyzing its historical process and referencing back to the experiences of other relative or similar industries; 2) based on selection and establishment of the index system, the delicate relationship between indicators and the general situation and part characteristics of the real estate industry are recognized and disclosed; and 3) through the continuation of monitoring relative indicators, government departments are able to forecast the general situation and anticipate any changes on characteristics and detect future trends. Therefore proper measures can be taken in advance to keep the real estate economy in a healthy and prosperous and avoid the occurrence of bad situation.

Real estate warning systems is an important component of the technology support system for REM macro-control. Not only does it play an important role in warning manner, but it serves its purpose in an information oriented role in real estate market, which is the development trend of the future macro-control mechanism. Its main functions are 1) to aid the government be knowledgeable in current status of the REM, 2) to assist governments in making informative decisions and 3) to lead developers and housing buyers to make wise investment decisions in a consumer stand point.

First, REWS reflects the discrepancy between the boom and whole trends of REM. Through the use of REWS, real estate administrative departments gain valuable knowledge about the situation and structure of the real estate industry and the harmonious ratio relation between the industry and macro economy. To control the industry structure of national economy and ensure healthy development of the real estate industry, effective allocation of rare resource in the whole society is needed. Otherwise, without the real estate warning report, the central and local government will encounter difficulties when analyzing and comparing the developmental status of real estate industry in different areas to adjust the area structure of real estate industry.

Second, investors may know in time about the whole status and structure of real estate industry through REWS, which supports investors in saving on investment time and structure. For example, relative REWS report can present the supply and demand situation of REM in different ways through the available information on the selection of investment time and property structure. In turn, potential investors are discerned on the developmental trend of REM, and grasp the investment opportunity and evading investment risk.

Third, a warning report may provide real estate agency with the optimal consultation service, which is to enhance the accuracy of consultants judging the developmental trend of REM and benefit from the development of real estate agency.

From the above analysis, it is obvious that REWS is a necessary measure in order for the government to strengthen macro control and keep the healthy and steady development of REM. Thus, by constructing the real estate economy warning systems, the trend of economic fluctuation is studied and scientific information is supplied to the government for making policies and to the enterprises for making decisions.

3.2 Select Real Estate Warning Methods

Economic warning methods are commonly divided into Black Warning, Yellow Warning, and Green Warning, whereas White Warning and Red Warning are part of the operational mechanism. However, because White warning and Green warning belong to special methods, they are not to be considered in the course of researching real estate warning methodology. The research is to select an appropriate method which is the right fit for real estate economic warning from Black Warning, Yellow Warning and Red Warning. According to the characteristics of real estate economy and the tenet of the warning system, these three methods are to be compared and contrasted in order to find out the most suitable method for REWS.

3.2.1 Black Warning Methods

The Black warning method does not take into account of warning signs, instead, it focuses on the changing rule of the time series of warning factors, namely loop fluctuation, and based on the periodical ascending and descending principles, it forecasts future trends of warning factors. Thus it is obvious that the method is a wrong fit for REWS.

First of all, REWS is a multi-indicators warning system while Black warning only reflects on warning factors. The objective of the system is to monitor and forecast all indicators which have a direct influence over real estate economy, and not merely a single indicator. Second, due to the short developmental time of real estate market in Shenzhen, there is not an obvious periodic fluctuation about real estate economy. The Black warning method must depend on the time series of warning factors to judge the future development of real estate. However, the development of China real estate is very short in comparison with only more than a 10 year history, and fluctuation is violent with rapid ups and downs, which lacks stability.

Thus the method is not obviously adapted to REWS.

3.2.2 Red Warning Methods

The Red warning method is an alternative way of analyzing environment and society, which emphasizes on qualitative research to comprehensively analyze the advantageous and disadvantageous influencing the warning factors with combining the intuition and experience of predictors and experts. Thereby, it is regarded more as a qualitative warning method.

The principle of REWS is designed to judge and monitor a series of quantitative indicators and forecast future trends in order to facilitate different kinds of people. However, because the Red warning method emphasizes on qualitative analysis, thus it is not a good fit to REWS. But when quantitative analysis is done, qualitative indicators can never be ignored. The warning result should become more accurate.

3.2.3 Yellow Warning Methods

The Yellow warning method is divided into the following three forms.

(1) Index warning method The Index warning method bases its foundation on the synthesized index of warning indicators, including diffusion index and composite index. The diffusion index denotes the ratio of the ascending indicators to all indicators. And the composite index is the weighted average of all warning indicators. The change of the indicators which reflects warning situation can be judged on according to the change of above composite index.

The index warning method is the fundamental method that is applied to the boom prediction of national economy in the world. But it is not suited for REWS. The reasons for this are as follows:

First of all, the model mainly depends on the composite index, ascending or descending, which yields to an incomplete set of information. In fact, the key determinants affecting real estate economy are very complex, so their effect and degree of influence varies. Though the composite index can reflect the general trend, it also easily compensates the abnormal fluctuation of some indicators. If these indicators are very important, information shown by the composite index is insufficient.

Second of all, it is made against monitoring each of the indicators. The index warning method is based upon the composite index, as the result, it lacks the analysis of each indicator, which is not proficient enough for discovering warning sources or controlling for objectiveness.

Given the results of the above analysis, the method is also not fitted to REWS.

(2) Statistic warning method The first one is to find out an indicator which best reflects the composite warning situation, namely a warning factor and selecting the indicators of warning signs. Based on the change of warning signs, the warning levels are determined and the warning degree of all indicators is analyzed. Its advantages are following:

On one hand, it is a type of quantitative method. The warning degree of the whole situation is determined through the synthesizing each indicators of warning signs.

On the other hand, the method monitors every indicator which contributes to finding out warning sources. When a warning situation happens, the reasons for it may be judged according to the degree of the warning sign indicators. Thereby, before the warning situation takes place, the objective and direction of macro control is produced.

(3) Model warning method The Model method may be used to further analyze warning based on the statistic warning method. It is viewed and considered as a regression model.

From the above analysis, the statistic warning method is very logical and makes sensible use of the existing statistic data in the real estate industry. Considering the situation of the Shenzhen real estate market, the research is to apply its findings to the real estate warning system. In addition, due to the difference between the model and reality a qualitative analysis is to be combined.

3.3 Select Real Estate Warning Factors

After selecting the warning method for real estate, the warning situation of real estate economy must be ascertained, viz. warning factors. Warning factors are the basis of warning research. As soon as warning factors are determined, the research object and range of the whole warning system can be confirmed. The selection of the warning sign indicators, warning limits, and the prediction of warning situation, all depend on warning factors.

3.3.1 Definition of Warning Situation

The warning situation of real estate economy may be described as an abnormal status which has a serious influence on real estate development; people’s lives and national economy is dependant upon. Here are its two meanings:

One situation is the overheating of real estate development. In other words, real estate investment increases rapidly and the amount of real estate supply is largely enhanced in the short term. As the result, the housing supply is in excess of the effective demand, leading to a great deal of housing vacancies and a large number of capital and resource depositions. Capital circulation is hindered and real estate development enterprises cannot be operated as normal. The involvement of banks and other finance institutions play an important role. Otherwise, overheating may result in the large-scale increase of housing price, restraining populaces' effective demand and leads to the imbalance between supply and demand. As abnormal phenomenon takes place, namely there is a great deal of vacant commercial housing in REM, while many residents do not possess enough money for purchase.

The other is the overcooling of real estate investment. The development of real estate industry may drive the development of construction material market, finance market, and labor market. Thus it is an important industry stimulating the development of the national economy. However, the stagnant status of REM caused by the reduction of housing investment, the descending of profit margin and the depression of real estate enterprises, leads to the many resources unexploited and left idle, which neither stimulates the internal demand nor pulls the increase of national economy. The overcooling effect is also one of the warning situations of real estate.

The two kinds of warning situation do not benefit to the development of national economy and the former usually leads to a higher price, a great deal of vacant housing, the waste of resources and the dislocation of economic system. On the contrary, the latter sometimes results in the immobilization of assets, the vacancy of resources, a prolonged period of construction, the tardiness of industrial structure reform. Therefore, whichever situation happens, it is regarded as a warning situation.
Both investment overheating and investment overcooling are the phenomenon of abnormal investment, but there are differences. Among the two situations, the investment overheating or the oversupply of real estate is the main problem. Based on investment systems, developmental systems and practices, it has been proven that investment overheating is much easier to take place in China. Investment overcooling usually takes place after investment overheating issue is cotrolled. Thus this

dissertation is to make an emphasis on the research on investment of overheating.

3.3.2 Determine Warning Factors

According to the definition of warning situation, real estate pricing is determined as the warning factor. The reason is that real estate pricing acts as a linkage factor between real estate transaction, the measurement of weighting the ratio of commodities to money, the sensor of market information and the means of adjusting economic benefit and market supply and demand.

Table 3-1 shows the investment structure of Shenzhen real estate. From the table, it is obvious that the 60%-80% of real estate investment is derived from commercial housing. Therefore the price of commercial housing should be closely monitored.

Table 3-1 The constitute of real estate investment of Shenzhen (Unit: 100 million REM)

Year	Investment completed	Thereinto	
		Housing	Percentage (%)
1997	136.65	85.50	62.57
1998	181.01	117.15	64.72
1999	261.45	184.25	70.47
2000	271.02	193.96	71.57
2001	322.85	220.34	68.25
2002	411.12	282.80	68.79
2003	449.05		

From Figure 3-1 shown, the real estate price index of every district of Shenzhen takes on roughly the same fluctuation in percentage. Due to the lack of a composite index in the whole of Shenzhen, and considering Futian district as a typical area of Shenzhen, the main emphasis of this research is to select the price index of the Futian district as the warning factor.

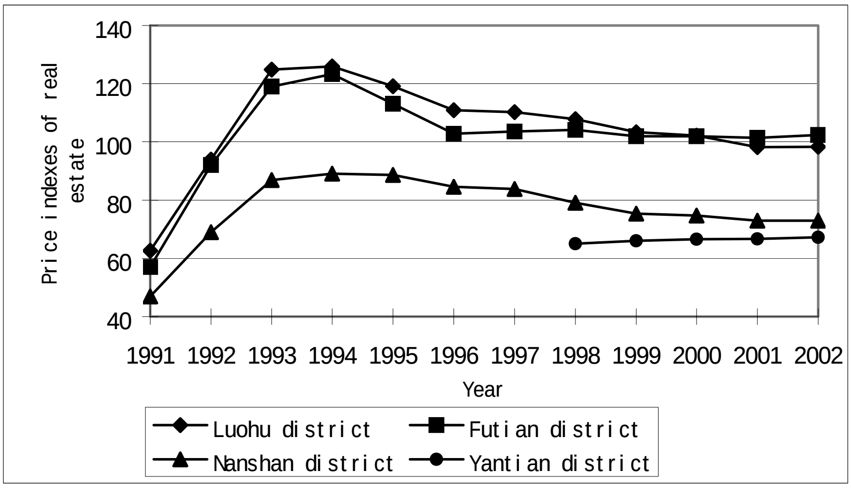


Figure 3-1 The price index of each districts of Shenzhen

3.4 Select the Indicators of Warning Signs

The indicators of warning signs may be described as either the diffusion of warning source or the symbiosis of warning source. It consists of antecedent indicators among warning factors and indicators from warning source. These indicators express the real situation of the economy based on actual change. The indicators of warning signs reflect the change of warning factors, which forecast the change of warning situation.

In selection of the indicators of warning signs, it is important to identify those indicators that can synchronously reflect the changes in the property prices, or predict these changes. Using these indicators of warning signs, the pre-warning system can therefore predict the performance of the REM.

3.4.1 Criteria Selecting the Indicators of Warning Signs

A primary component in the design of warning systems is to select the appropriate indicators of warning signs reflecting the situation of the whole economy. For this, an effective criterion should be determined. According to the definition and function of the indicators of warning signs, the criterion is as following:

(1) The change of indicators must reflect the developmental status of current REM and image the balance condition of real estate supply and demand;

(2) From economic perspective, the change of these indicators must necessary precedes the change of warning situation; and

(3) There should be an obvious cause-and-effect relation or a correlation between these indicators and warning situation, their change should directly or indirectly arouse the modification of the warning situation;

(4) Data related to these indicators must be easily and accurately collected in time.

These indicators in reference to the above criterion are the most ideal indicators of warning signs. In fact, sometimes the indicators of warning signs precede warning factors, but at times it may become parallel or lag warning factors. With the advancement in technology and the rapid development of the economy, the leading period of the indicators of warning signs is becoming shorter. Thus, it is too rigid to realize the indicators of warning signs based solely on the above criterion. Based on the time-series statistic, the research is to focus on these indicators which take on actual meanings or are presented by experts in practice.

3.4.2 Approaches and methods of selecting the indicators of warning signs

According to the economic meaning of the indicators of warning signs and the method in selecting them, while the selection of warning signs indicators, their leading roles and the cause-and-effect relationship between them, should be paid special attention to. Otherwise, the quantitative analysis of data should be combined with qualitative analysis.

3.4.2.1 Approaches

The first approach is to select some economic indicators related to real estate development according to economic meaning and experts' opinions. Based upon the periodic theory of real estate fluctuation, a long series should be selected. The statistic data is taken from the *Yearbook of Shenzhen Real Estate*. Because the statistic data about real estate is not integrated, only the yearly data concerning real estate is analyzed. The following indicators are selected to construct and formulate the time-series analyses: national consumers price index (N-CPI), Shenzhen gross domestic product (S-GDP), Shenzhen fixed assets investment (S-FAI), resident consumption price index (R-CPI), urban and rural residents savings (URRS), permanent population the end of a year (PPY), land development area (LDA), real estate investment amount completed (REIAC), commercial building constructing area (CBCAI), commercial building complete area (CBCAII), commercial building sales area (CBSA), commercial building vacant area (CBVA), commercial housing sales area (CHSA), operating income of real estate enterprises (OIREE), the business tax and additional tax of enterprises (BTATE), the return of real estate enterprises

(RREE), the new projects of commercial building (NPCB), real estate development loans (REDL), individual housing loans (IHL) (shown in Table 3-2).

In the next stage, the warning signs indicators are determined via the economic analysis and statistic analysis. These indicators mentioned above are the basis of selecting the indicators of warning signs. Although they are closely linked with the real estate economy, but a number of them are repeated or in theory some data are not fitted to the indicators of warning signs. Thus the theoretical analysis and quantitative calculation are needed to select economic variables appropriate to the indicators of warning signs.

An impulse-transmission mechanism is the basis of selecting the above indicators. All above indicators are divided into two groups: one reflecting the external impulse; another one imaging the internal fluctuation and the indicators play different roles in real estate economy. Therefore the first one is appropriate economic variables for the indicators of warning signs according to theoretical analyses. These indicators selected initially are analyzed quantitatively to detect the lead indicators of warning signs.

3.4.2.2 Methods

The methods include qualitative methods and quantitative methods. Qualitative methods mainly depend on the opinions of experts and economic theories. The quantitative methods adopt mathematic methods for the calculating and testing the lead of economic variables.

The mathematic methods used to analyzing the indicators and classifying them, mostly include time-difference correlation analysis, K-L information capacity, and clustering analysis, which are developed during the study on the boom of national economy.

(1) The time-difference correlation analysis

The method adopts the correlation coefficients between the variables to judge their lead, consistence or lag time. It is based on an important economic indicator which may sensitively reflect current economic activity and regards it as a comparison indicator. In general, a consistent indicator is taken as the comparing indicator and then the coefficients are calculated through adjusting the lead time or lag time of the comparing indicator.

Suppose $y = \{y_1, y_2, y_3, ..., y_n\}$ as a comparing indicator, $x = \{x_1, x_2, x_3, ..., x_n\}$ as indicators to be selected, *r* as a time-difference correlation coefficient, then:

$$r_l = \frac{\sum_{t=1}^{n}(x_{t-l} - \overline{x})(y_t - \overline{y})}{\sqrt{\sum_{t=1}^{n}(x_{t-l} - \overline{x})^2 \sum_{t=1}^{n}(y_t - \overline{y})^2}}, \quad l = 0, \pm 1, \pm 2, ..., \pm L \qquad (3.1)$$

Thereinto, *l* denotes the lead or lag time. If *l* is negative then it expresses lag; and if *l* is positive then it expresses lead. Thus *l* is called time difference or delay. L denotes the largest delay; and *n* denotes the number of data.

When selecting t indicators, the correlation coefficients of different delay are usually calculated, and then they are compared. Among them the largest efficient r_k is to be considered as the time-difference correlation between an indicator and the comparing indicator, the relevant delay k denotes the lead or lag time.

$$r_k = \max r_l \qquad -L \le l \le L \tag{3.2}$$

(2) K-L information capacity

The method of K-L information capacity was presented by Kullback and Leibler in 1950s in order to judge the adjacent degree of quantitative distribution. In recent years, K-L information capacity is applied to economic analysis.

The application of K-L information capacity to boom analysis is also the basis of a comparing indicator, reflecting the slightest change of economic activity. Suppose $y = \{y_1, y_2, y_3, ..., y_n\}$ as the comparing indicator, after it is normalized, their plus is equal to 1, a series p is derived as follows:

$$p_t = \frac{y_t}{\sum_{j=1}^{n} y_j}, \quad t = 1,2,3,...,n \text{ (thereinto suppose } y_t > 0\text{)} \tag{3.3}$$

Suppose $x = \{x_1, x_2, x_3, ..., x_n\}$ as the indicator to be selected, after normalized q is derived as follows:

$$q_t = \frac{x_t}{\sum_{j=1}^{n} x_j}, \quad t = 1,2,3,...,n \ \text{(thereinto suppose } x_t > 0\text{)} \qquad (3.4)$$

K-L information capacity may be calculated as follows:

$$k_l = \sum p_t \ln(p_t / q_{t+l}), \quad l = 0,\pm1,\pm2,...,\pm L \qquad (3.5)$$

Therefore, *l* denotes the lead or lag time. If *l* is negative then it expresses lag; and if *l* is positive then it expresses lead. *l* is also called time difference or delay. L denotes the largest delay; and *n* denotes the number of data.

After 2*L*+1 information capacities are calculated, a minimum value k_m is chosen from all values of k_l as the K-L information capacity of the indicator *x*.

$$k_m = \min k_l, \quad -L \le l \le L \qquad (3.6)$$

The delay *m* becomes relevant to K-L information capacity as the lead or lag time of the indicator is selected. Otherwise, K-L information capacity would become smaller or close to 0, the indicator *x* is closer to the comparing indicator.

(3) Clustering analysis

The method regards all objects as samples, and views every cluster as a set of some samples which are “all together”. There are two kinds of methods to measure their relations: the first method is the similar coefficient, namely those similar samples are grouped as one species. Another method is distance, viz. each sample is regarded as a point within a multi-dimension space, then the distance between these samples is regulated based on some rules, and those with the closest in proximity are to be regarded as one class.

The precondition of applying clustering analysis to selecting lead, synchronous, lag indicators is that among the total of three indicators, there must be at least one clear indicator. After clustering analysis, all indicators are classified based on respective clear indicators.

3.4.2.3 Determine a Method

It is appropriate to apply the above three methods to the selection of the lead indicators of national economy. However real estate is on a developmental phase, its fluctuation is significant and its regularity is not obvious. Thus quantitative methods should be combined with qualitative methods. After being considered synthetically, the following method is to be adopted to select the indicators of warning signs.

First, it analyzes the economic indicators related to real estate and primarily selects these variables appropriate to warning.

Based on a comparing indicator, the time-difference correlation analysis for these primary indicators is made to analyze the relations between these indicators and the comparing indicator in order to find out synchronous or lead indicators. Due to the abnormal development of real estate, the analysis may lead to a huge problematic error.

The third one is to amend, complement and explain the result calculated above and determine the indicators of warning signs.

Lastly, according to above analysis, these indicators which are synchronous or lead to the comparing indicator or reflect the running status of current economy, are selected.

Table 3-2 Primary indicators of warning signs of Shenzhen real estate

Year	N-CPI (1985=100)	S-GDP Index (1979 =100)	S-FAI (100 million REM)	R-CPI (1979=100)	URRS (100 million RMB	PPY (10 thousand)	REIAC (100 million RMB)	LDA (10 thousand M^2)	NPCB (10 thousand M^2)	CBCAI (10 thousand M^2)	CBCA-II (10 thousand M^2)	CBSA (10 thousand M^2)	CHSA (10 thousand M^2)	CBVA (10 thousand M^2)	OIREE (100 million RMB)	BTDTE (100 million RMB)	RREE (100 million RMB)	REDL (100 million RMB)	IHL (100 million RMB)
1986	106.50	1283.10	24.86	177.40	12.11	93.56	9.71	382.00		503.65	181.27	63.70	45.29	35.40	4.16	0.51	1.88		
1987	114.30	1609.00	28.52	203.00	18.84	115.44	9.02	342.00		331.12	134.37	111.26	73.28	43.69	8.61	0.60	2.16		
1988	135.80	2186.60	43.62	260.00	30.00	153.14	6.80	415.00		345.93	103.90	107.39	68.74	30.70	9.33	0.68	1.84		
1989	160.20	2595.50	49.99	326.00	39.18	191.60	12.16	418.00		392.33	180.29	90.67	50.77	35.40	11.17	0.71	3.58		
1990	165.20	3439.10	57.92	331.20	57.45	201.94	11.12	197.00		304.62	133.41	77.14	56.32	33.56	14.03	0.82	2.95		
1991	170.80	4677.10	79.36	341.20	88.60	238.53	25.56	538.00	251.31	467.82	150.44	112.54	97.13	25.43	22.88	2.87	7.62	0.22	0.05
1992	181.70	6229.90	141.01	366.10	153.95	260.90	71.49	796.00	380.67	950.06	198.40	151.46	96.00	49.85	41.42	8.39	17.88	0.87	0.19
1993	208.40	8098.90	195.05	439.70	175.13	294.99	102.77	424.00	504.49	1396.44	281.46	180.17	140.89	21.87	78.61	10.86	29.69	1.16	0.55
1994	258.60	10536.70	230.96	519.70	290.37	335.51	130.46	526.00	200.06	1298.82	311.10	246.93	183.28	99.69	86.27	8.24	32.34	2.22	4.17
1995	302.80	12960.10	275.82	584.10	466.42	345.12	103.04	351.00	141.30	1371.06	311.58	274.57	209.07	181.22	103.02	6.01	33.63	6.98	7.63
1996	327.90	15085.60	327.53	629.10	582.23	358.48	124.83	193.00	337.43	1495.27	394.32	324.88	261.13	328.68	146.61	8.16	31.00	8.19	22.37
1997	337.10	17499.30	393.07	649.86	707.67	379.64	136.65	994.00	386.35	1454.17	327.04	405.44	336.70	258.69	156.30	8.34	30.18	66.15	57.85
1998	334.40	20036.70	480.39	645.40	861.88	394.96	167.49	255.00	490.17	1646.38	441.97	432.22	372.38	332.38	178.03	8.70	28.89	109.33	125.82
1999	329.70	22861.90	569.59	640.90	951.99	405.13	215.25	316.00	745.15	2142.88	571.46	541.84	492.51	274.81	262.57	13.15	26.13	136.92	245.19
2000	329.83	26108.30	619.70	658.80	1082.64	432.94	271.02	244.00	737.56	2182.66	652.26	611.37	556.82	251.48	314.92	13.79	38.85	82.01	369.55
2001	332.14	29554.60	673.37	644.30	1373.39	468.76	322.85	394.00	884.86	2462.75	770.58	643.47	593.72	228.53	388.69	17.67	43.67	113.60	520.12
2002	331.14	33987.80	747.15	652.00	1756.49	504.25	411.12	348.00	944.54	2672.46	915.30	791.70	724.41	246.84	467.16	21.90	61.98	165.43	697.88

3.4.3 Time-difference Correlation Analysis of the Indicators of Warning Signs

(1) Select a comparing indicator

For a real estate warning system, real estate price should be closely monitored as an indicator of the market. There exist different comparing indicators in different areas, for example sales ratio or vacant ratio. The vacant ratio in China real estate statistics takes on limitation in theory and there is an effective real estate price indexes system in Shenzhen. Thus real estate price index is regarded as the comparing indicator. But because real estate price indexes in Shenzhen had not a longer history and begun in 1991, a short data series is not fitted to a time-series analysis. According to the theoretical analysis, the amount of sales area should be kept ahead price (as shown in Table 3-3), therefore, based on the relation between the amount of sales area and price index, the real estate price indexes are replaced by the amount of sales area to make a time-series analysis. Otherwise consider housing to be dominating in Shenzhen REM and the fluctuation of housing price indexes of all districts are approximately identical according to Shenzhen Real Estate Yearbook, the price index of Futian district is adopted to calculate and select a comparing indicator.

From Table 3-3, it is shown that the lead time of gross sales area to real estate price index is two years, and within that period of time, the absolute value of their correlation coefficient is largest at, 0.8313. In addition, the lead time of the area of new projects is three years, their absolute value is 0.543.

Table 3-3 The time-difference correlation coefficient between price indexes and the main indicators of commercial housing

Delay	Gross sales area of housing		Area of new projects	
	lead	Lag	lead	lag
0	0.212	0.212	0.034	0.034
1	-0.390	0.260	-0.102	-0.221
2	-0.831	0.314	-0.305	0.180
3	0.828	0.333	-0.543	0.330
Max|r|	0.831		0.543	
I	2		3	

(2) Result of time-difference analysis

The time-difference analysis between all indicators and the gross sales area of commercial housing (for short, sales area) is prepared and is shown in Table 3-4.

Table 3-4 The time-difference correlation analysis between all indicators and sales area

Delay	N-CPI		S-GDP		S-FAI	
	lead	lag	Lead	lag	lead	lag
0	0.889	0.889	0.992	0.992	0.995	0.995
1	0.908	0.831	0.968	0.966	0.974	0.962
2	0.914	0.694	0.891	0.864	0.894	0.859
3	0.874	0.447	0.748	0.668	0.733	0.665
4	0.755	0.152	0.528	0.426	0.497	0.426
5	0.529	-0.183	0.238	0.111	0.216	0.113
6	0.201	-0.477	-0.064	-0.171	-0.061	-0.183
Max|r|	0.914		0.992		0.995	
i	2		0		0	

Delay	R-CPI		URRS		PPY	
	lead	lag	Lead	lag	lead	lag
0	0.881	0.881	0.990	0.990	0.911	0.911
1	0.901	0.825	0.963	0.972	0.895	0.868
2	0.903	0.679	0.875	0.880	0.875	0.727
3	0.870	0.416	0.710	0.696	0.824	0.462
4	0.762	0.118	0.458	0.474	0.705	0.169
5	0.551	-0.216	0.148	0.166	0.520	-0.189
6	0.255	-0.509	-0.171	-0.113	0.294	-0.454
Max|r|	0.903		0.990		0.911	
i	2		0		0	

Delay	REIAC		CBCAI		CBCAII	
	lead	lag	lead	lag	lead	lag
0	0.978	0.978	0.952	0.952	0.968	0.968

1	0.946	0.942	0.934	0.909	0.936	0.957
2	0.843	0.846	0.859	0.794	0.804	0.875
3	0.652	0.644	0.715	0.571	0.597	0.670
4	0.432	0.422	0.566	0.332	0.365	0.481
5	0.234	0.124	0.338	-0.005	0.198	0.190
6	0.019	-0.170	0.151	-0.344	-0.105	-0.085
Max|r|	0.978		0.952		0.968	
i	0		0		0	

Delay	CBVA		CHSA		RREE	
	lead	lag	lead	lag	lead	lag
0	0.837	0.837	0.997	0.997	0.835	0.835
1	0.888	0.790	0.961	0.967	0.805	0.776
2	0.873	0.697	0.855	0.880	0.766	0.617
3	0.805	0.513	0.659	0.710	0.778	0.369
4	0.605	0.275	0.407	0.483	0.730	0.091
5	0.338	-0.025	0.087	0.184	0.611	-0.277
6	-0.210	-0.321	-0.188	-0.080	0.421	-0.577
Max|r|	0.888		0.997		0.835	
i	1		0		0	

Delay	OIREE		BTATE		LDA	
	lead	lag	lead	lag	lead	lag
0	0.984	0.984	0.889	0.889	-0.098	-0.098
1	0.948	0.965	0.842	0.834	-0.133	-0.176
2	0.825	0.880	0.753	0.713	0.081	-0.235
3	0.622	0.697	0.614	0.489	0.205	-0.199
4	0.405	0.489	0.518	0.268	0.338	-0.186
5	0.137	0.202	0.380	-0.046	-0.030	-0.280
6	-0.156	-0.066	0.229	-0.354	0.277	-0.253
Max|r|	0.984		0.889		0.338	
i	0		0		0	

Delay	REDL		IHL			
	lead	lag	lead	lag		
0	0.883	0.883	0.903	0.903		
1	0.770	0789	0.705	0.884		
2	0.644	0.633	0.319	0.756		
3	0.271	0.339	-0.124	0.509		
4	-0.197	0.045	-0.386	0.276		
5	-0.539	-0.291	-0.544	-0.040		
6	-0.698	-0.651	-0.707	-0.306		
Max|r|	0.883		0.903			
i	0		0			

(3) Analysis of results

Notice time-difference analysis is consistent with the theoretical analysis, where the impact of macroeconomic variables leads to the fluctuation of real estate economy. In general, macroeconomic indicators lead to real estate economic indicators.

(i) National consumers' price indexes (N-CPI)

When lead(i) is equal to 2, the absolute value of the correlation coefficient between N-CPI and sales area is biggest, equivalent to 0.914, viz. its lead time is about two years. And its lead time to price indexes is about four years.

(ii) Shenzhen gross domestic product (S-GDP)

When lead(i) is equal to 0, the absolute value of the correlation coefficient between S-GDP and sales area is biggest, equivalent to 0.992, viz. it is synchronous to sales area. Thus its lead time to price indexes is about two years.

(iii) Shenzhen fixed assets investment (S-FAI)

The analysis of S-FAI is similar to S-GDP. Thus its lead time to price indexes is about two years.

(iv) Residents consumption price index (R-CPI)

The analysis of R-CPI is similar to N-CPI. Thus its lead time to price indexes is about four years.

(v) Other indicators

According to similar analysis mentioned above, URRS, REIAC, CBCAI, CBCAII, CHSA, OIREE, BTATE, RREE, REDL and IHL, the lead time of these indicators to price indexes is two years; the lead time of CBVA and NPCB is three years; the lead time of PPY is four years; and the lead time of LDA is six years. To illustrate the results, NPCB is depicted in Table 3-3.

(4) Determine the indicators of warning signs

According to the above results, these indicators preceding the warning factors (real estate price index), are selected as the indicators of warning signs. By combining the theoretical analysis with quantitative analysis, where these following indicators are determined, viz. fixed assets investment amount (S-FAI) , real estate investment amount (REIAC), land development area (LDA), the area of new projects of commercial building (NPCB), the complete area of commercial building (CBCAII), the sales area of commercial building (CBSA), real estate development loans (REDL), and individual housing loans (IHL).

Fixed assets investment amount (S-FAI) reflects the rapid development of the macro economy.

Real estate investment amount (REIAC), land development area (LDA), and the area of new projects of commercial building (NPCB) are the main indicators reflecting the supply capacity of REM. Warning situation is often caused by oversupply, and these three indicators obviously show the way in economic meaning. Warning situation of REM often begins with lack of control in investment and sequent investment in a high speed. At first, the increase of investment leads to the increase of land development area and the area of new projects also increases in current year. Thus it is reasonable to select these three indicators as some of the indicators of warning signs.

The three indicators become key determinants in forming the real supply of REM, namely complete area. Therefore, complete area (CBCAII) is also an appropriate indicator of warning signs.

The sales area of commercial building is an important indicator reflecting the demand of REM. One of the main objectives of warning system is to mimic the supply and demand of REM. From the above analysis, the sales area of commercial building (CBSA) is selected as an indicator of warning signs.

The relation between real estate and finance has attracted people's attention. To some extent, real estate development loans (REDL) and individual housing loans (IHL) reflect the scale of investment and consumption. In addition, the time-difference analysis between them and sales area show that they are the lead of the price index. Accordingly, these two indicators are appropriate for the indicators of warning signs.

The ultimate problem concerned by real estate warning systems is the harmonious development of real estate economy and macro economy. The growth rate of practicality or value indicators is limited to just reflecting and displaying the development scale of real estate. In order to better evaluate the harmony between the real estate and macro economy. Several indicators of warning signs which are closely related with macro economy are adjusted. According to the opinions of experts, "fixed assets investment", "real estate development loans" and "individual housing loans" are transferred to "real estate investment growth rate/GDP growth rate", "real estate investment amount/fixed assets investment amount", "real estate development loans/medium or long-term loans balance" and "individual housing loans/real estate development loans".

Because real estate changes due to seasonal fluctuations, in order to avoid seasonal influence, the growth ratio of all indicators is calculated based on a same date, viz. the growth ratio of current value to same-date value last year (shown in Figure 3-2 and Table 3-5).

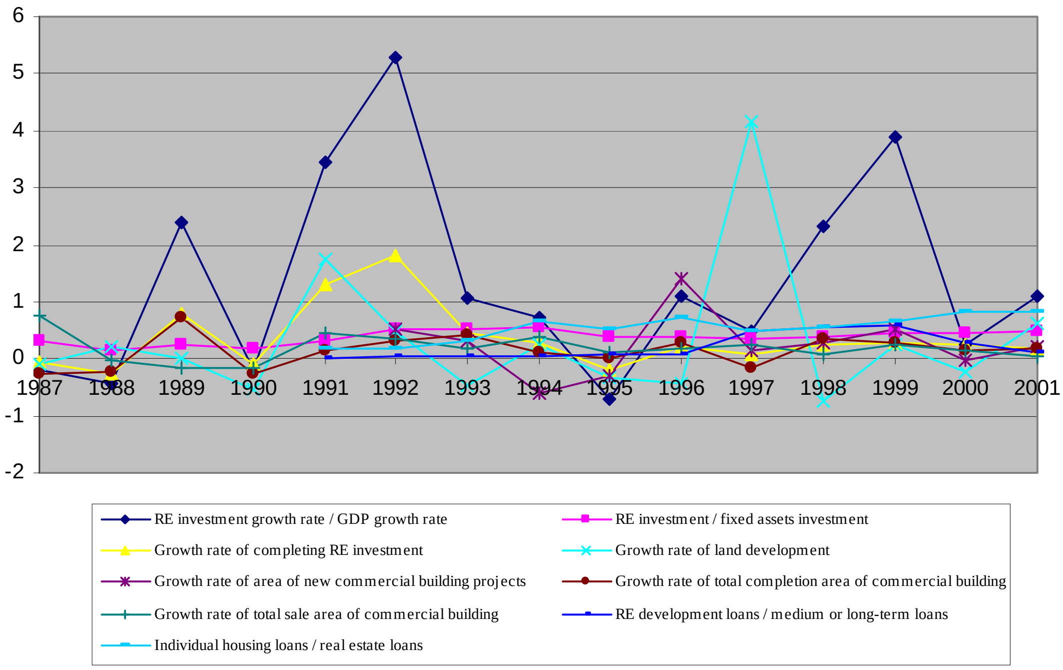


Figure 3-2 The growth rate of the indicators of real estate warning signs

Table 3-5 The indicators of warning signs for Shenzhen real estate

Year	RE investment growth rate/GDP growth rate	RE investment /fixed assets investment	Growth rate of completing RE investment	Growth rate of land development	Growth rate of area of new commercial building projects	Growth rate of total completion area of commercial building	Growth rate of total sale area of commercial building	RE development loans/ medium or long-term loans	Individual housing loans/real estate loans
1987	-0.21	0.32	-0.07	-0.10		-0.26	0.75		

1988	-0.44	0.16	-0.25	0.21		-0.23	-0.03		
1989	2.39	0.24	0.79	0.01		0.74	-0.16		
1990	-0.18	0.19	-0.09	-0.53		-0.26	-0.15		
1991	3.43	0.32	1.30	1.73		0.13	0.46	0.01	0.18
1992	5.27	0.51	1.80	0.48	0.51	0.32	0.35	0.03	0.18
1993	1.05	0.53	0.44	-0.47	0.33	0.42	0.19	0.03	0.32
1994	0.73	0.56	0.27	0.24	-0.60	0.11	0.37	0.04	0.65
1995	-0.72	0.37	-0.21	-0.33	-0.29	0.00	0.11	0.08	0.52
1996	1.09	0.38	0.21	-0.45	1.39	0.27	0.18	0.07	0.73
1997	0.50	0.35	0.09	4.15	0.14	-0.17	0.25	0.47	0.47
1998	2.31	0.38	0.23	-0.74	0.27	0.35	0.07	0.55	0.54
1999	3.90	0.46	0.29	0.24	0.52	0.29	0.25	0.59	0.64
2000	0.23	0.44	0.26	-0.23	-0.01	0.14	0.13	0.27	0.82
2001	1.10	0.48	0.19	0.61	0.20	0.18	0.05	0.12	0.82
2002	1.88	0.55	0.27	-0.12	0.07	0.19	0.23	0.13	0.81

The mean and standard deviation of the proposed nine indicators is shown in Table 3-6.

Table 3-6 The mean and standard deviation of these nine indicators

The indicators of warning signs	RE investment growth rate/GDP growth rate	RE investment /fixed assets investment	Growth rate of completing RE investment	Growth rate of land developme nt	Growth rate of area of new commercia l building projects	Growth rate of total completion area of commercia l building	Growth rate of total sale area of commercia l building	RE developme nt loans/ medium or long-term loans	Individual housing loans/real estate loans
Mean	1.500	0.383	0.345	0.294	0.229	0.138	0.190	0.199	0.557
Standard deviation	1.691	0.119	0.523	1.147	0.484	0.265	0.220	0.209	0.223

3.5 Determine the Warning Limits of Real Estate

3.5.1 Criteria of Determining Warning Limits

The rationality of warning limits is to influence the accuracy of monitoring the change of all economic indicators affecting the judgment of the whole economic situations.

Layout office of Japan uses three numbers to describe the warning limits of boom warning indicators. The limit of red light section and yellow light section is determined based on the mean of the change rate of indicators within a time period of six months before implementing the boom adjustment policy. The limit of blue light section and green light section is determined based on the mean of the change rate of indicators within duration of six months before relieving the boom adjustment policy. The middle value of both the two limits is the restriction of the yellow light section and green light section. This method is flawed as there is a great deal of limitations. First of all, it only depends on the appropriate time of implementing or relieving boom adjustment policies; second, owing to the different roles and particularities of some indicators, those should be taken into account when their limits are determined.

In terms of the limits of warning indicators, one warning system is fitted to a particular method. In China, the limits of the warning indicators of national economy are determined according to past economic change or loop, the roles and properties of all variables, macro-control policies implemented in different periods and the objective of economic development plan.

The determination of warning limits should be combined with the characteristics of design objects. In China, real estate industry is accelerating, but it is still a relatively new industry which takes on short-term development, large fluctuations, follow a set of imperceptible rules and non-complete statistic data. Thus the warning limits of REWS must take into account its characteristics and particularities.

Warning limits depend on the analysis of historic data, namely to find out rules from the developmental course of real estate. In other words, before warning situation happens or during its course of action, the change characteristics of all variables are analyzed and a rational range for warning indicators are determined. However due to the characteristics of China real estate industry analyzed above, it is difficult to determine the rational range of all economic indicators through depending on the historic data analysis. Therefore the warning limits of REWS should be combined with the opinions of experts and qualitative analysis.

3.5.2 Determination and Adjustment for Warning Limits

3.5.2.1 Primary Determination of Warning Limits for the Indicators of Warning Signs

The indicators of warning signs are normalized respectively based on their mean and standard deviation. Value range [-1,1] is the normal running section called “green light section”; range [-1.5,-1) is the cold running section called “azury light section”; range (-∞,-1.5) is the overcooling running section called “blue light section”; range (1,1.5] is the hot running section called “yellow light section”; and range (1.5,+∞) is the overheating running section called “red light section”.

The following are the statistical explanations for determining the warning limits. In terms of standard normal distribution, the probability of standard normal variable on range [-1,1], [-1.5, 1.5] is 68.26%, 86.64% respectively. According to statistical theory and the opinions of experts, it is roughly suitable for the developmental rules of real estate to adopt that the standard deviation and 1.5 times of the standard deviation as the limit of the warning range. In other words, the assumption is that over a considerable long period of time, the probability of a healthy operation in the property market in Shenzhen is approximately 68%, the probability of a hot or cold market is about 19%, and the probability of overheating and overcooling is about 13%.

Then the normalization results of all warning indicators are their warning value.

In terms of the indicator of "the growth rate of real estate investment/GDP growth rate", its warning limit needs adjustment. If the above method is used to determine its limit, exceedingly large results will be generated. According to previous studies, in a rapidly developing phase of any urban economy, the indicator should lie within the range of [1,1.4]. If such a ratio exceeds 2 or becomes less than 0.2, it signifies that the real estate market is overheating or overcooling. Based on these experiential values, the limitation of "the growth rate of real estate development/GDP growth rate" are determined as follows: $(-\infty,0.2)$, $[0.2,1)$, $[1,1.4]$, $(1.4,2]$ and $(2,+\infty)$, corresponding to overcooling, cold, normal, hot and overheating, respectively, which are equal to the normalized value ranges, $(-\infty,-1.5)$, $[-1.5,-1)$, $[-1,1]$, $(1,1.5]$ and $(1.5,+\infty)$.

3.5.2.2 Adjustment of Warning Value with the Effect of Accumulation

The forecast of warning situation is to synthetically appraise the warning degree of warning situation based upon the analysis of section for warning signs. However, during the course of actual operation, the growth rates of the indicators of warning signs cannot be simply compared with warning limits. However, with the exception when the warning value is determined, the effect of accumulation should be taken into account.

Real estate development is a complicated yet systematic project. In its inception stage, it is easy to underestimate the investment budget, leading to an inflated and uncontrollable investment process. When the current value of warning situation is taken into consideration in the warning system, its previous values should also be taken into consideration so that its accumulative effect is thought out. For example, according to above warning limits, the growth rate of commercial building investment amount is lower in 1993, which should belong to a non-warning section. But its growth rate is recorded to have escalated to 180% in 1992 which further exceeds its upper warning limit. Due to its lead and the delay of its role, it is to influence the REM in 1993. Though its growth rate is small in 1993, its absolute amount is larger. Thus it should not be regarded as being non-warning. It is to improve the forecast accuracy of warning situation to consider the effect of accumulation.

Through the usage of the following method, the accumulative effect of a warning indicator in the past two years can be taken into account.

Suppose the growth rate of a warning indicator in period i is x_i, and its upper warning limit is I, and then the changed growth rate of the indicator is x_{ic}.

$$x_{ic} = x_i + f(x_{i-1}) + f(x_{i-2}) \tag{3.7}$$

Thereinto, $f(x_{i-1}) = x_{i-1} - I$, $x_{i-1} > I$, the other is zero;

$f(x_{i-2}) = x_{i-2} - I$, $x_{i-2} > I$, the other is zero.

Based on the characteristics of each indicator of warning signs and the correlation of time-differences with the warning factor, the warning system takes into account the accumulative effect in the past two years of the following seven warning indicators, viz. growth rate of RE investment/GDP growth rate, RE investment amount/fixed assets investment amount, growth rate of complete investment amount of RE, growth rate of land development area, growth rate of new commercial building projects, real estate development loans/medium or long-term loans balance, and individual housing loans/real estate development loans.

3.6 Analysis of Real Estate Warning Situation

3.6.1 Methods of Warning Situation Analysis

The general method of warning situation analysis is as follows: given a corresponding point for each section, generally, e.g. the “green light section” is 3 points, the “yellow light section” is 4 points, the “red light section” is 5 points, the “azury light section” is 2 points and the “blue light section” is 1 point. Suppose *m* warning indicators are chosen, the aggregated point is generated by adding up the signal points which *m* indicators show in each period. When all indicators are displaying red lights, the aggregated point is 5×m being the maximum; when they are exhibiting blue lights, the aggregated point is 1×m in the least. Then it can be synthetically judged that which light should be given to the warning signal in the current period by comparing the composite index with its limits.

The way to determine the limits of the composite index is as follows: regarding 85% (rounding) of the full mark (5xm) as the limit between “red light and yellow light”, and taking 73% and 50% of the full mark as the upper and lower limits of “green light”, and taking 36% of the full mark as the limit between “azury light and blue light”.

The above method is adapted to the warning system for current national economy. However, this method can only show the developing tendency of a warning factor, and it cannot exactly show the warning degree, no matter how much the real estate is overheating or overcooling. This research is to be adjusted as follows:

(1) The normalized result of each indicator is regarded as its warning value;

(2) For the indicator of *growth rate of real estate investment/GDP growth rate*, after its warning section is determined according to experience, its warning value may be derived by using interpolation and extrapolation;

(3) When the composite index is synthesized, the weighting efficient of some indicators need modifying based upon the method of arithmetic mean; and

(4) The mark of light sections of the composite index should be kept consistent with the

each individual indicator.

3.6.2 Warning Analysis of Single Indicator

According to the above analysis, the nine indicators of warning signs should be tested and verified. Hereon *growth rate of real estate investment/GDP growth rate* and *real estate investment amount/fixed assets investment amount* are only chosen to test their practicability and effectiveness based on the investigation data of Shenzhen REM.

(1) The warning analysis of the indicator of *growth rate of real estate investment/GDP growth rate* is shown in Table 3-7, Figure 3-3 and Figure 3-4.

Table 3-7 The warning analysis of *growth rate of real estate investment/GDP growth rate*

Year	Growth rate of real estate investment/ GDP growth rate	Normalizing	Interpolation and extrapolation	Adjustment of accumulation
1987	-0.21	-1.05	-1.80	-1.80
1988	-0.44	-1.29	-2.05	-2.35
1989	2.39	1.61	3.35	2.49
1990	-0.18	-1.04	-1.79	-0.50
1991	3.43	1.25	2.84	4.40
1992	5.27	2.31	4.34	5.39
1993	1.05	-0.02	1.05	5.23
1994	0.73	-0.36	-1.07	1.78
1995	-0.72	-1.43	-2.20	-2.20
1996	1.09	-0.12	0.45	-0.25
1997	0.50	-0.54	-1.26	-1.95
1998	2.31	0.03	1.13	1.13
1999	3.90	0.31	1.52	1.52
2000	0.23	0.19	1.35	1.37
2001	1.10	-0.03	1.04	1.06
2002	1.88	0.19	1.35	1.35

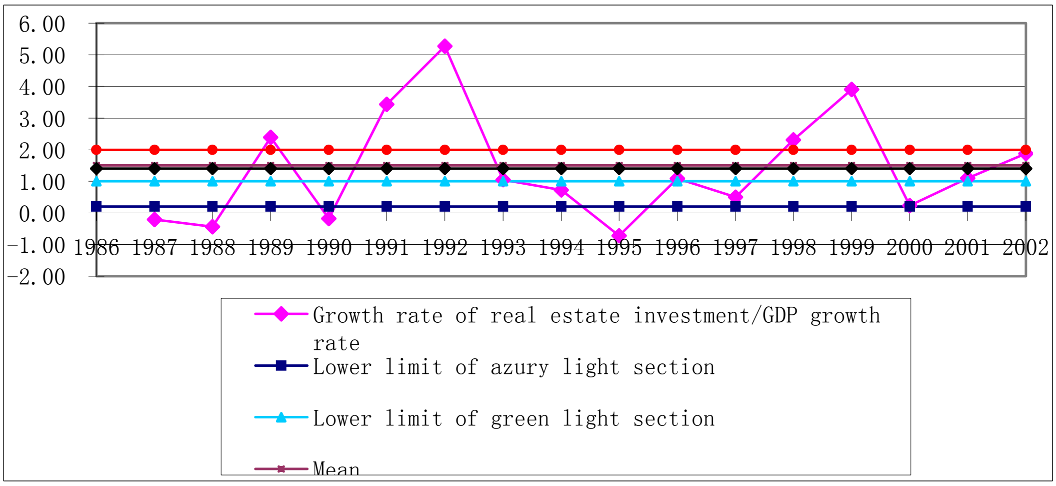


Figure 3-3 The supervising chart of *growth rate of real estate investment/GDP growth rate*

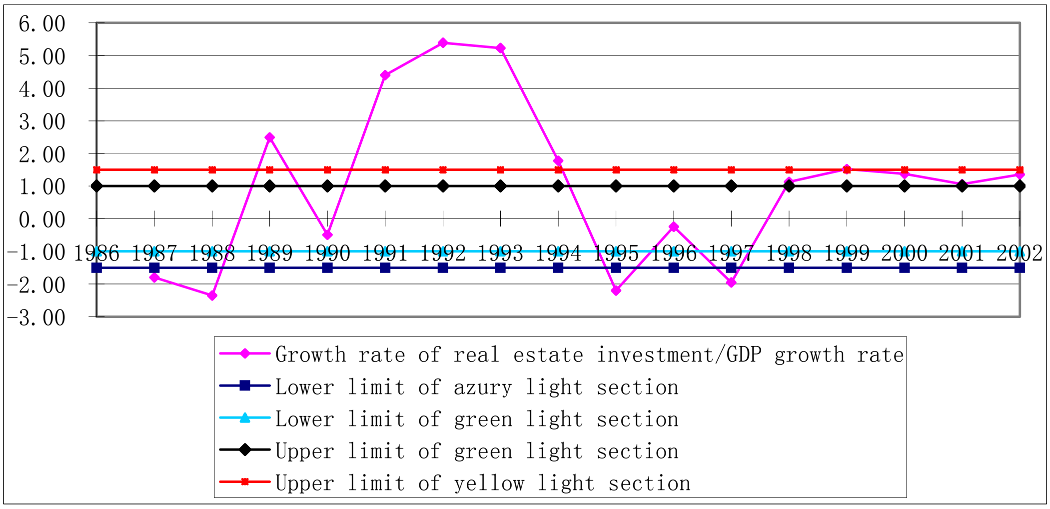


Figure 3-4 The chart of the warning value of *growth rate of real estate investment/GDP growth rate*

Table 3-7 shows the monitoring and warning value of *growth rate of real estate investment/GDP growth rate*, Figure 3-3 and Figure 3-4 show the chart of growth rate and warning value respectively. The warning chart depicts the obvious developmental course and trend of the indicator and its direct effect on warning situation can be evaluated.

(2) The warning analysis of the indicator of *real estate investment amount/fixed assets investment amount* is shown in Table 3-8, Figure 3-5 and Figure 3-6.

Table 3-8 The warning analysis of *real estate investment amount/fixed assets investment amount*

Year	Real estate investment amount/fixed assets investment amount	Normalizing	Adjustment accumulation
1987	0.32	-0.56	-0.56
1988	0.16	-1.90	-1.90
1989	0.24	-1.17	-1.57
1990	0.19	-1.60	-2.00
1991	0.32	-0.51	-0.61
1992	0.51	1.04	0.94
1993	0.53	1.21	1.21
1994	0.56	1.53	1.53
1995	0.37	-0.08	-0.05
1996	0.38	-0.01	0.01
1997	0.35	-0.29	-0.29
1998	0.35	-0.29	-0.29
1999	0.38	-0.04	-0.04
2000	0.44	0.46	0.46
2001	0.48	0.81	0.81
2002	0.55	1.40	1.40

Likewise, Table 3-8 shows the monitoring value and warning value of *real estate investment amount/fixed assets investment amount*, Figure 3-5 and Figure 3-6 show its supervising chart and warning chart respectively.

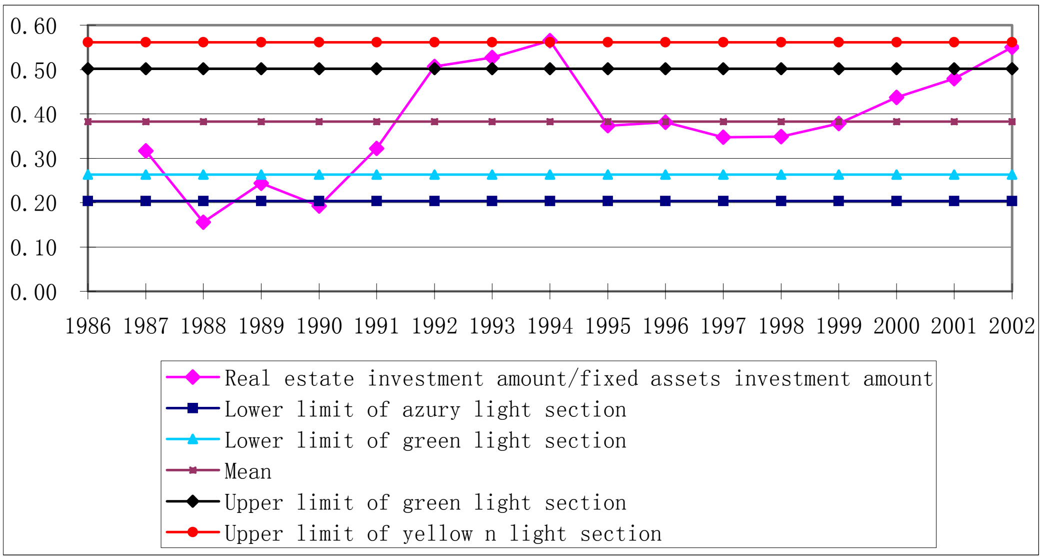


Figure 3-5 The supervising chart of *real estate investment amount/fixed assets investment amount*

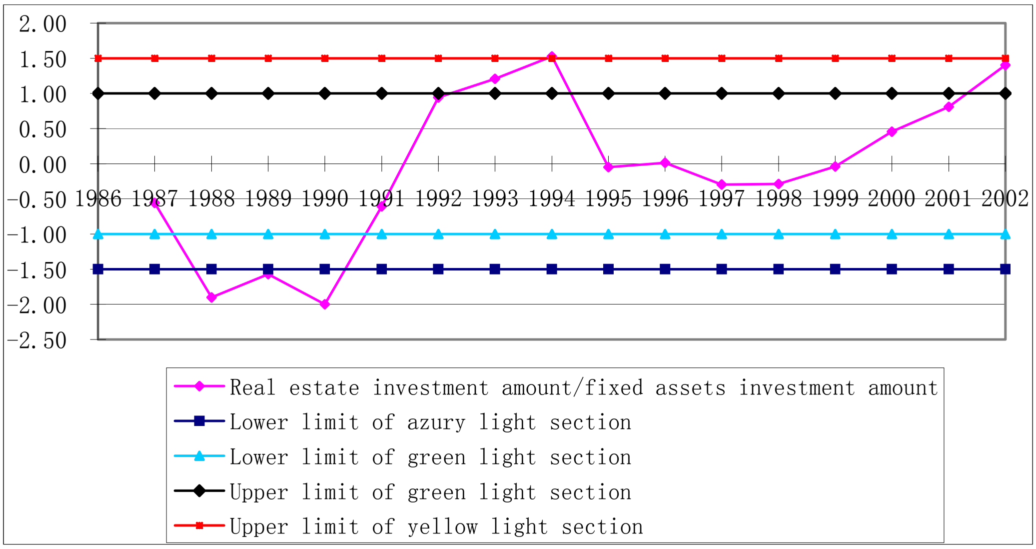


Figure 3-6 The chart of the warning value of *real estate investment amount/fixed assets investment amount*

The warning analysis of other indicators refer to 6.1.1

3.6.3 Warning Analysis of the Composite Index

The composite index is derived from the weighted means of all the single indicators, namely composite warning value is the weighted mean of the warning value of each single indicator. Therefore, the weighting efficient of each single indicator is to be determined via using the Delphi method. The annual composite value is compared with the "real estate price/50-2", through which real estate market may be forecasted.

3.6.4 Forecast Real Estate Warning Situation

By using the warning analysis of single indicators and composite index, the future trend of REM within a period of time can be forecasted. For example the warning value of *growth rate of real estate investment/GDP growth rate* ascends from 1.06 in 2001 to 1.35 in 2002, and the warning value of *real estate investment amount/fixed assets investment amount* increases from 0.81 to 1.40 simultaneously, which demonstrates the rapid development of real estate when compared to the macro economy, viz. the imperfect harmony between them. According to these data, the future development of REM related to this period of time can be judged, e.g. overheating or overcooling. Otherwise, alternative measures have to be taken.

3.6.5 Analysis of Warning Signals

3.6.5.1 Warning Signals

The Warning signals of all indicators of warning signs and the composite index depend on their warning sections respectively. There are a total of five warning sections: green light section, yellow light section, red light section, azury light section, and blue light section, corresponding to normal section, hot section, overheating section, cold section, and overcooling section, respectively.

If the signal exhibits “green light”, it indicates that the current REM is healthy and stable. The government’s measures are to maintain its stable growth.

“Yellow light” signifies that the development of REM is stable and its growth is “hot”. In the short term, it is possible to become overheating or stable. However, when “red light” transform into “yellow light”, it is in an unsuitable to continue deflating the real estate market; when “green light” evolves into “yellow light”, the adopted measures during the “green light” period can be maintained, but the measures of promoting the growth of real estate cannot be adopted. It is necessary to closely monitor the changes in the future in order to avoid an overheating market.

“Red light” denotes that the development of real estate market is overheating. It is necessary for the government, financial organizations to take preventive measures to gradually cool the market back into its normal status.

“Azury light” (cold section) implies that it is possible REM can become stable or in recession. When “azury light” turns into “green light”, it means the developing speed of real estate becomes stable and the measures for promoting growth should be taken; when the “green light” turns to “azury light”, the growth rate becomes negative, measures should be taken to accelerate the property market.

If the signal turns from “azury light” to “blue light”, the real estate market falls down to the bottom of valley, the government should take powerful measures to activate the growth of the real estate market.

3.6.5.2 Analysis of Warning Indexes

Warning indexes denote the degree of deviation to the normal level of economic indicators, e.g. warning indexes of signal indicators and a composite warning index. The analysis and forecast of warning situation mainly depends on the composite warning index.

The results derived from the system are the warning value of warning indicators and composite index.

The normal level of each indicator is standardized as zero. The difference between a warning index and zero is the deviation degree, from which it signifies whether or not the current economy is normal. If a warning index is above zero, this means that the economic development exceeds the normal level; vice versa, if it is under zero, this means the development level of current economy is lower and the economic situation shrinks.

Warning indexes are also divided into five sections. According to the section of warning indexes, the status or future trend of current real estate market may be analyzed.

(1) In “blue light section”

Current status: real estate economy rapidly diminishes, the investment of real estate enterprises descends in a large scale, and real estate products are not salable. The whole industry can be seen as being in the “the foot of valley”.

Future trend: due to the inertia of economy, if great change does not take place real estate will maintain the low level for a prolonged period of time.

Policies: During the period, the government should consider to take precautionary measures, e.g. to ease monetary policy, to reduce interest rate, to activate real estate market and to simulate the investment of real estate enterprises.

(2) In “azury light section”

Current status: real estate market is cold, and both the investment in real estate and the demand of real estate are not deficient.

Future trend: it is possible for real estate to become stable or for trend to become recessionary.

Policies: there are two kinds of conditions. If warning index changes from “blue light section” to “azury light section”, the government should be cautious and strengthen the stimulation degree. Due to the inertia of economy, economic polices implemented to stimulate the development of REM may be a stimulant causing the real estate economy to increase rapidly, which may lead to the overheating economy. On the other hand, if it turns from “green light section” to “azury light section”, some measures should be taken to avoid the over descending economy.

(3) In “green light section”

Current status: the development of real estate market is normal and stable.

Future trend: it is possible to become hot or cold within the short term. Because the situation of REM is good, it is more possible to become hot.

Policies: Governments and enterprises should pay close attention to the factors, e.g. the situation of macro economy, economic policies, etc, which can lead to the imbalance of real estate. Real estate enterprises should improve the quality of real estate products and develop salable products through the investigation of demands at all levels. Governments together with enterprises should also cherish the good situation of real estate and guard against the confusion of current situation, for example a large scale of development which may results in overheating.

(4) In “yellow light section”

Current status: real estate investment is expedited and real estate products increase rapidly.

Future trend: it can possibly become overheating or stable.

Policies: Two conditions exist. If warning index ascends to the section, governments should focus on its trend. Due to its inertia it may increase continuously and certain types of measures should be taken, for example aim to deflate monetary policies and to restrict the continuous expansion of investment. On the contrary, if it descends to the section, deflation policies should not be taken continuously. Based on economic inertial, it may come back to the normal status.

(5) In “red light section”

Current status: real estate market is overheating, namely investment amount is escalating in large scale, the inventory of commercial building increases, and the demand of real estate also goes up. But because the demand augmentation is less than the increase of real estate output, a large amount of buildings are left vacant.

Future trend: the future trend of real estate market depends on warning indexes. If the warning index is very large, maybe it will lead to the overheating of real estate within the upcoming two years. If the warning index just arrives at the lower limit of “red light section”, some measures taken will allow REM be stable within the short term.

Policies: when warning indexes are in “red light section”, governments should take different measures according to different conditions in order to effectively control the overheating of REM. The best way to control the situation of overheating is to detect it as early as possible.

Because the composite index is synthesized with single indexes, the reason causing the change of the composite index can be found easily by analyzing each single index. The relevant method taken is the same as the composite index.

3.6.5.3 Supplementary Explanation

The ultimate aim of REWS is to forecast or analyze warning situation. However, the forecast and analysis not only focuses on real estate, but it also takes into consideration of other industries and the situation of national economy.

Though there are two conditions for the warning situation of real estate, viz. overcooling and overheating, the overheating of real estate market is even more. The reasons for this are not only inaccurate investment decisions caused by the enterprises' error in estimation and judgment of REM, but also the trend of national economy, current investment systems and the process of real estate development. For a long period of time, investors are inconsistent with their risk taking behaviors and make blind investment decisions, resulting in the bad sanction of investment.

Therefore, the forecast and analysis of warning situation not only analyzes the internal factors of real estate industry, but also combine financial policies, the development of national economy, etc, to discover the reasons causing the change of REM and other possibility changes. Finally the warning result should be combined with the experts' judgment of the whole economy to accurately forecast the trend of real estate market.

3.7 Summary

The chapter mainly finishes these following researches:

(1) To analyze the role of warning systems in the macro-control system for REM, and discuss the warning methods of real estate, select a fitted method, viz. the statistic warning method of Yellow warning method through the combination of the real estate industry characteristics.

(2) To describe warning situation, such as analyzing the "overheating" and "overcooling" and determine the warning factor, viz. the price index of Futain housing market, by considering Shenzhen REM;

(3) To establish the criteria of selecting the indicators of warning signs, discuss the approaches and methods of selection, and based on the time-difference correlation analysis, determine nine indicators of warning signs, viz. *growth rate of real estate investment/GDP growth rate*, *real estate investment amount/fixed assets investment amount*, *growth rate of annual real estate investment*, *growth rate of land development area*, *growth rate of the area of new commercial-building projects*, *growth rate of the complete construction area of commercial building*, *growth rate of the sales area of commercial building*, *real estate investment loans/medium or long-term loans balance*,

and *individual housing loans/real estate investment loans*;

(4) To analyze the criteria of determining warning limits, then present the limits of all warning indicators, and otherwise present the method for adjusting the effect of accumulation;

(5) To discuss the methods of the analysis of warning situation, probe into the warning analysis of single indexes and the composite index, analyze the forecast of warning situation, and study the expression of warning signals and the explanation of warning.

CHAPTER 4 ESTABLISHMENT OF REAL ESTATE CONFIDENCE INDEXES

Real estate confidence indexes are effective means of reflecting the running status and future trend of REM. They are also an important component of macro-control systems. Based on the domestic and overseas research status of RECI, this chapter is to analyze its role in the macro-control system, present the architecture of constructing the RECI, probe into the key techniques of constructing indexes, and to compile monomial indexes and composite indexes for Shenzhen REM, consider the efficient demand and supply (D&S), latent demand and latent supply. According to the sets of indexes, the forecast of REM is discussed and application is analyzed through an illustration and depiction of a case study.

4.1 Roles of RECI in Macro-control Systems

Real estate confidence indexes are a set of indexes compiled with market price index. Its core and other main indexes are synthesized under the guidance of scientific theory, reflecting and measuring the running status, booming degree, and equilibrium degree of real estate market held by consumers and investors. By investigating and analyzing indexes imaging REM and economic-social indexes concerned, main factors affecting REM are analyzed qualitatively and quantitatively, then based on the complete and objective market research, they are classified and processed according to their weightiness, and finally these indexes are generated by adopting some of mathematics methods. RECI formula is completed, which is one of the important means of macro control of REM, and is also the main component of technology support systems for real estate macro-control. And more, it not only assists in governmental macro control, but also provides guidance to investment needs and consumption patterns.

First of all, RECI may provide reliable reference data for government to grasp the general idea of market demand and make macro-control policies. The composite index is derived from processing data gained from periodical questionnaires or sampling survey. The index may in time reflect the demand preference of consumers in different area and with various levels of income, their appraisal of real estate price level, their expectation of REM, their intentions of purchasing housing, etc. By analyzing the RECI, the government can forecast the scale and structure of the demand of real estate within a certain time frame and then based on this make necessary policies. By far, there is no any other means to wholly image the demand of REM. And policies are also constituted based on past data, not by consumers' demand preference. Therefore, the research on RECI may be sufficient to fill the vacancy to provide scientific data for governments and constitute policies.

The second one is to assist the government to make scientific plan of land usage. Land supply is the basis of real estate development and the government act as the land provider. It is significant for the government to scientifically and rationally remise land, which is to strengthen governmental macro control and enhance the efficiency of land use. However, there is no scientific reference for government to make land planning, e.g. how much land should be put into the market every year or how land should be used. For example, in the past several years, due to the oversupply of land, a large number of buildings are built in the subsequent several years, which led to supply over demand. In addition, it resulted in a great deal of the vacancy of commercial buildings, which made developers and financial organizations face large risk; on the other hand, it led to the waste of land use. Through constructing RECI, the government may accurately weigh the confidence level of consumers and at their best attempt to forecast the demand in some of areas for a future period of time. Based on this, the government can make rational land planning to improve the efficiency of land utilization.

Third, it may instruct regional planning and the construction of relative infrastructure. Urban planning and regional planning play a leading role in urban construction, and current urban depend upon the result of preceding planning. However, Shenzhen urban planning lags the development of economy, resulting in urban problems, e.g. traffic jam. For example, Shenzhen population forecasted several years ago was about five million, but at present it has reached beyond ten million in population. The forecast of population is the basis of urban planning, due to the lack of reorganization urban planning also suffers relevant problems. The fundamental reason for this is the lack of knowledge and understanding of market development. In terms of current condition, urban planning should base on scientific market research. The RECI to be compiled is on the basis of market research. Thereby, the market condition reflected by the index plays a leading role in constituting planning.

Fourth, it assists governments in the rebuild of old city zone. The rebuild of old city zone involves many aspects of relations and benefit, among which the most important is how city develops after rebuilt, such as the project sites, the project orientation, the project risk, the project return, etc. The correct estimation must depend on knowing about market, which is derived from data gained from the sampling survey of the populaces to get a better understanding of public viewpoints and opinions. RECI is to provide these data.

Finally, it instructs the behaviors of real estate developers and consumers, which impels the healthy development of real estate market. RECI can accurately reflect the condition of supply and demand of real estate, the future trend of price and the trend of market development in every district. By issuing RECI in a timely manner, real estate developers and consumers can correctly judge the market status and then make rational decisions according to these indexes, reducing and avoiding the probability of irrational investment.

4.2 Architecture of Constructing RECI

Based upon the characteristics of Shenzhen REM, the architecture of constructing RECI is presented in Figure 4-1. The architecture takes into account both demand and supply. The composite confidence index (V) is generated with the efficient D&S index ($V1$), the latent demand index ($V2$) and the latent supply ($V3$). These indexes mentioned above and key techniques are analyzed in the following text.

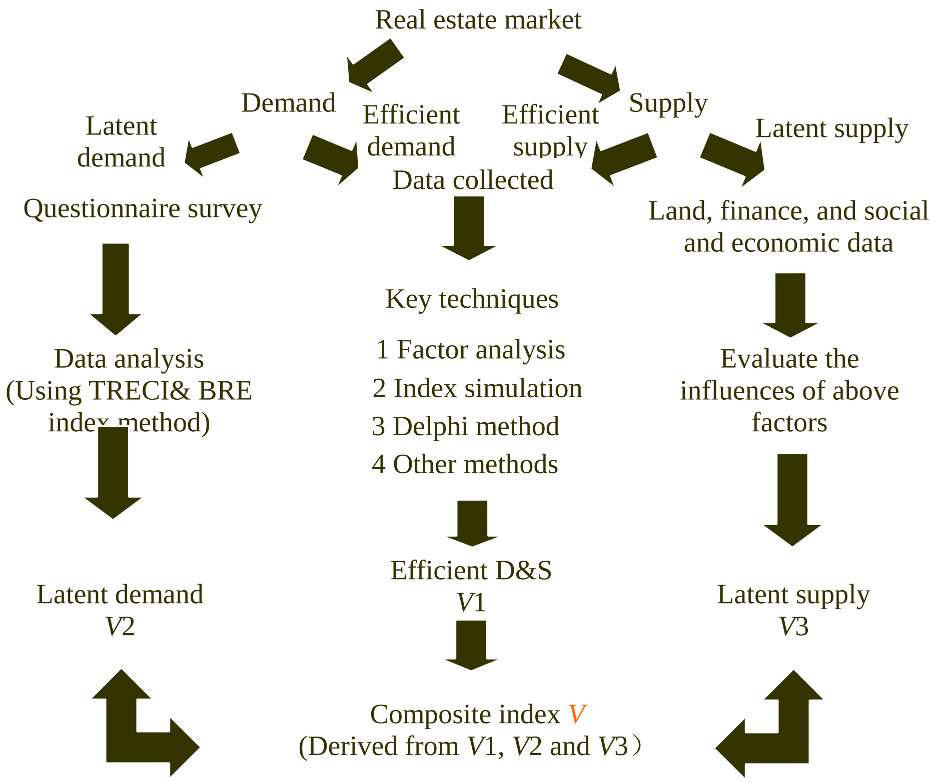


Figure 4-1 The architecture of constructing Shenzhen RECI

4.3 Key Techniques of Real Confidence Indexes

Limited researches on RECI are performed in China; especially it is firstly discussed to synthetically take into account efficient D&S and latent D&S to construct RECI. Therefore, it is necessary to analyze its key techniques in order to amend them according to the characteristics of real estate industry.

4.3.1 Factor Analysis

4.3.1.1 Introduction of Factor Analysis

Factor analysis was invented nearly 100 years ago by psychologist Charles Spearman (R. L. Gorsuch, 1983) [51], who hypothesized that the enormous variety of tests of mental ability--measures of mathematical skill, vocabulary, other verbal skills, artistic skills, logical reasoning ability, etc.--could all be explained by one underlying “factor” of general intelligence that he called *g*. He hypothesized that if *g* could be measured and if a subpopulation of people with the same score on *g* is selected, you will find no correlations among any tests of mental ability. In other words, he hypothesized that *g* was the only factor common to all those measures. Factor analysis is a mathematical tool which can be used to examine a wide range of data sets. It has been used in disciplines as diverse as chemistry, sociology, economics, psychology and the analysis of the performance of race horses (C. E. Reese and C. H. Lochmuller, 1993) [52]. Many statistical methods are used to study the relationship between independent and dependent variables. Factor analysis is different; it is used to study the patterns of relationship among many dependent variables, with the goal of discovering something about the nature of the independent variables. The independent variables were not measured directly. When independent variables are observed directly, the answers obtained by factor analysis are in fact more hypothetical and tentative. The inferred independent variables are called factors. A typical factor analysis suggests answers to four major questions: 1) How many different factors are needed to explain the pattern of relationships among these variables; 2) What is the nature of the selected factors; 3) How well do the hypothesized factors explain the observed data; 4) How much purely random or unique variance does each observed variable include (A. S. Rubenstein, 1986) [53].

Generally, one complete factor analysis includes the following approaches:

(1) Confirm the type of factoring It includes the definition of the type of factor analysis and the selection of the variables of factor analysis.

(2) Calculate and test correlation matrices It must be assured that all variables are correlated, which may be judged by directly observing them or objectively testing them, e.g. Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's Test.

(3) Establish the factor analytic data modes There are two data modes which have been often used, viz. Principal Component Analysis (PCA) and Principal Factor Analysis (PFA). The PCA is an effective and constructive method used widely.

(4) Determine the number of factors The number of factors from PCA is the same as the original variables. However, the aim of factor analysis is to replace all original variables with a few principal factors. Besides experiences, characteristic roots is a method often used, which only reserves these factors which eigenvalues (characteristic roots) are larger than 1. The variance-ratio method is also a common method, which is on the basis of the variance of factors reserved. Generally, it is at least 60%. Scree plot (A scree plot is a two dimensional graph with factors on the x-axis and eigenvalues on the y-axis and shows the sorted eigenvalues, from large to small, as a function of the eigenvalue index) and statistic test are also useful methods in order to determine the number of factors.

(5) Rotation of factors The factor loadings, also called component loadings in PCA, which is the correlation coefficients between the variables (rows) and factors (columns). This means that the effect of variable with a large loading on the factor is large. But sometimes the loadings of all factors focus on a factor, which makes it is also possible to use a factor to explain all variables. The aim of the rotation of factor is to solve the problem. Both orthogonal rotation and oblique rotation are two kinds of rotation methods. If there is obvious correlation between all factors, the oblique rotation is a more appropriate choice of method.

(6) Explanation of Factors It is important for this approach to reasonably explain principal factors. The explanation of factors usually depends on the variables with high loading. The factor loading matrix after rotation may greatly improve the explanation of the factor. Note that after being rotated, maybe all loadings of a factor are high, and this kind of factor is usually called a common or basic factor. A reasonable explanation is that it depends on the commonness of problems researched. Otherwise, for a factor with low loading, if its variance of explanation is too insignificant and, it may be abandoned.

(7) Factor scores Factor scores also called component scores in PCA, factor scores are the scores of each case (row) on each factor (column). To compute the factor score for a given factor in a single case, one takes the case's standardized score on each variable, multiplies it by the corresponding factor loading of the variable for the given factor, and sums up these products. The SPSS FACTOR procedure saves standardized factor scores as variables in the working data file. By default it will name them as FAC1_1,FAC2_1, FAC3_1, etc., for the corresponding factors (factor 1, 2 and 3) of analysis 1; and FAC1_2, FAC2_2, FAC3_2 for a second set of factor scores, within the same procedure, and so on. Although SPSS adds these variables to the right of your working data set automatically, however, they will be lost when you close the dataset without-saving your data.

4.3.1.2 Factor Analysis and RECI

In the period of research and analysis of real estate confidence index, we need to establish the index system, confirm the correlative index, such as index affecting the demand and supply, etc. for predigesting the process of calculation, we must describe and analyze the problems with the index as little as possible; otherwise, in the period of establishing index, there would be correlation between some of them and the index with bigger correlation must be deleted. Subject to the above reasons, we can see that factor analysis can't be neglected in the period of establishing real estate confidence index. Factor analysis will be used to establish effective index.

4.3.2 Statistical Package for Social Science

As the earliest statistical analysis software, Statistical Package for Social Science (SPSS) has been used widely in communication, medication, bank, stock market, insurance, etc. there is an unwritten rule in international academy that all calculation and analysis by SPSS can be without explanation. Generally, all factor analysis is finished by SPSS. The application of SPSS in real state confidence index is as follows:

(1) To Stat survey result, factor analyzing; and

(2) To analyze and outlook price index, population index, purchase index and market index with MA, MACD and BIAS.

4.3.3 Delphi Method

The Delphi method was developed by the RAND Corporation in the late 1960's as a forecasting methodology. Later, the U.S. government enhanced it as a group decision-making tool with the results of Project HINDSIGHT (Robins, 1986), which established a factual basis for the workability of Delphi. That project produced a tool in which a group of experts could come to some consensus of opinion when the decisive factors were subjective, and not knowledge-based. Delphi is a particularly appropriate tool when decision-making is mandatory in a political or emotional environment, or when decisions affect strong factions with opposing preferences. The tool works formally or informally, in large or small contexts, and reaps the benefits of group decision making while insulating the process from the limitations of group decision-making (Morrison, Donald F.1990) [54]; e.g., over-dominant group members, political lobbying, or "bandwagonism". The process of Delphi method is shown in Figure 4-2.

The application of Delphi Method in real estate confidence index is to confirm the factors which affect the real estate market.

Figure 4-2 The process of Delphi method

4.3.4 Index Simulation Method

4.3.4.1 Introduction of the Index Simulation Method

The background of index simulation technology is derived from the stock markets. The stock theory is divided into two branches: the random walk theory and the technical analysis theory. The viewpoint of the random walk theory is that the fluctuation of stock price is uncontrollable and cannot be forecasted at all; however the one of the technical analysis theory suggests that the fluctuation is characterized by regularity and predictability [55]. Though both of the two branches are often used in stock market [56], there are limitations is the two theories. In 1938, Albert established the wave theory which combines the random walk theory with the technical analysis theory skillfully.

The index system of stock market is very complex and consists of many indicators, but most of technical indicators are derived from the following three key indicators:

(1) Moving Average (MA) As a technical analysis indicator, MA is adopted widely in stock markets. In 1939 an American analyst of investment analyzed MA for the first time (G.W Gau and D.B. Kohlhepp, 1978) [57]. MA is a valid tool for tracing the trend of market and its main objective is to identify the end point of an old trend and the beginning point of a new trend. Its procedures are the calculation of the average price, joint with lines and the observation of stock trend. The periods of time commonly used are 3 days, 6 days, 10 days, 12 days, 24 days, 30 days, 72 days, 200 days, 288 days, 13 weeks, 26 weeks, 52 weeks, etc. and by selecting different periods it analyzes the change of stock price by comparing MA with closing price daily. Therefore, the MAs of different periods are characterized as different sensitivities; in general, when the period is shorter, its sensitivity becomes higher. The model of MA is follows:

$$MA = (P_1 + \ldots + P_n)/n$$

P denotes the daily price of stock; *n* denotes the number of days.

(2) Moving Average Convergence and Divergence (MACD) MACD is created by C. Arbii [58] and is a tool for judging the time of stock deal. It is based on the average theory and is an indicator of trends. However, this model has its disadvantages. One is, it is difficult to get rid of the false signal sent by MA; another one is the inability to reserve the effect of MA. Thus it is characterized as trend, stability, etc. The procedures of MACD are to analyze the trend of stock price via analyzing the relationship among EMA, DIF and DEA (or MACD, DEM), among which DIF is the core and DEA acts as an assistant. DIF is the difference between the short-term EMA1 and long-term EMA2 and a BAR chart can be drawn based upon the difference between DIF and DEA. The EMA of DIF for period N is DEA.

Suppose the period of EMA1 is 12 days, the one of EMA2 is 26 days; the one of DIF is 9 days, the procedures of calculating MACD is clearly illustrated below:

① Calculate EMA

EMA1: EMA(12)=Yesterday EMA(12)×11/13＋Today closing price×2/13

EMA2: EMA(26)=Yesterday EMA(26)×25/27＋Today closing price×2/27

② Calculate DIF

DIF=Today EMA(12)－EMA(26)

③ Determine MACD

(3) BIAS BIAS is also an effective method forecasting index, which can be used as a supplementary tool to support the forecasting the development trends of index. Its model is as follows:

$$BIAS = (A - B)/B \times 100\%$$

A denotes today average; B denotes the average based on some period.

In general, the range of BIAS ranges from 15% to -15%, namely when it is from 0 to 15%, stock price maybe descend; vice versa.

4.3.4.2 Index Simulation Method and RECI

As we know, the index system of a stock market is matured and perfected. The accuracy of forecasting the trend of stock price using quantitative methods has been admitted. These methods have also been applied to a future and money market. But those are seldom applied to a real estate market. Thus the difference and relative means between REM and stock market should be analyzed in order to adjust to these methods.

Their relationship includes: both of them are closely linked with the macroeconomy, the positive correlation and there exists information asymmetry.

And their differences are presented as follows:

In terms of the attributes and status of assets, stocks are dummy economy and real property can be taken as a pillar industry; real property is characterized as stability and uniqueness and stocks are not; real property is difficult to modify and amend into money and stocks like quick assets.

Regarding the means of gaining returns, there are two means for stocks, namely price difference and bonus and three means for real property, viz. price difference, rent and self-residing.

From the viewpoint of the period theory, the period of real estate is longer than the one of stock market. Otherwise, their running is also different.

By comparing real estate market with stock market, it is obvious that the index simulation method is not applied to REM directly. There exist the following problems.

(1) The accuracy and updating of data collected. For stocks market, the data is accurate and in time; with respect to real estate market, the quality of data cannot be assured;

(2) The selection of indicators. Stocks market has a unique indicator, namely price; however there are many factors or indicators in real estate market.

(3) The continuity of objects for index systems. Almost all of the stock deals are not halted and but real property is entirely different.

In summary, the index simulation method cannot be directly applied to REM. Based upon the characteristics of REM, the method needs to be customized and amended to an appropriate methods.

4.3.5 TRECI&BRE Index

A well established survey that spans a time period of more than 50 years is the University of Michigan Index of Consumer Sentiment (ICS) (Curtin, 2000) [59]. The methodology of the ICS is described in detail by its Director, Richard Curtin (2002a) [60]. In essence, there are monthly surveys based on "approximately 500 telephone interviews with adult men and women living in households in the coterminous United States (48 States plus the District of Columbia)". The Index of Consumer Sentiments is derived from 5 questions. According to Curtin (2002b) [61], "two questions focus on how the personal financial situation of the household has recently changed and how it is expected to change during the year ahead, two questions focus on the outlook for the economy over in the near to long run terms, the one question focuses on the buying conditions for household durables".

This methodology in particular has been replicated to produce a confidence index in the real estate sector. In the USA, the real estate center at the Texas A&M University has been compiling their Texas Real Estate Confidence Index (TRECI) since the second quarter of 1999. The Texas Survey adopts in principle the same methodology of the ICS. However, there are 5 panels of specialists chosen randomly for participation: builders' commercial realtors, residential realtors, mortgage lenders and commercial lenders. The panels thus cover the property development, construction and the financial sectors. Each specialist is asked to answer 6 questions: "the first three questions involve their evaluations about the preceding quarter and the final three questions focus on their expectations for the coming quarter".

Concurrently, in Hong Kong, the real estate center at the Hong Kong Polytechnic University also establishes the BRE Index for the Hong Kong Residential Property Market. We called it BRE Index. It addresses three terms of references:

(1) To establish time-series BRE Indices for different groups of homeowners and non-home owners;

(2) To explore changes in price expectations and confidence of housing consumers through time in the performance of the local residential property market; and

(3) To develop trends of housing demand, decision and preferences of homeowners and potential buyers.

The application approaches of simulating TRECI&BRE Index in real estate confidence index are as follows:

(1) Questionnaire design and survey;

(2) Analyze the survey results, and establish the potential demand index of each

target population; and

(3) Create and integrate each index by the weighted average method, and establish the total potential demand index.

4.3.6 Composite Index Method

Composite index method is a useful appraisal or analysis method which is also an asset for typical quantitative-analysis. Its intention is to generate the statistic value of all indicators with weighted average method in order to gain a composite value. The advantages of this method are obvious; it is a simple operation, comprehensive value, etc. But most importantly is its ability to determine the weighting coefficients of all indicators.

During the course of constructing RECI, the method is to be applied widely, e.g. the composition of price indexes, the index of efficient D&S, the index of latent supply, and the composite index of real estate.

4.4 Analysis of the Efficient D&S of REM (V1)

The efficient D&S of market is the demand with payment ability or purchasing power and the relevant supply (P.F. Colwell, R.E. Cannaday and C. Wu, 1983) [58]. As such, the efficient D&S of REM refers the demand for buildings and land with payment ability and the supply related. Because there are many factors which affect the efficient D&S of REM, it is difficult to analyze the D&S both qualitatively and quantitatively. In order to find the monomial indicator V_1 reflecting the efficient D&S

of REM, first the efficient factors of market have to be determined which allows it to be calculated [62]. The research is to determine these factors and their weighting coefficients by using the Delphi method and factor analysis method. Subject to the survey data, indicator simulation method and others are adopted to calculate the value of these factors and forecast their trend.

4.4.1 Questionnaires

4.4.1.1 Design of Questionnaires

According to the opinions of experts, 25 factors, which may influence the efficient D&S of REM, are presented by the group of experts. They follow: the distribution and density of population (X_1), GDP (X_2), governable income (X_3), housing mortgage loans (X_4), real estate investment amount (X_5), capital (X_6), land development (X_7), the area of new projects (X_8), construction area (X_9), complete area (X_{10}), sales amount (X_{11}), sales area (X_{12}), sales price (X_{13}), vacant area (X_{14}), usable floor area (X_{15}), leasing area (X_{16}), leasing price (X_{17}), construction cost (X_{18}), the bargain area of old housing (X_{19}), the bargain price of old housing (X_{20}), property management (X_{21}), price (X_{22}), the interest rate of loan (X_{23}), employment rate (X_{24}), and stock market (X_{25}). These factors are incorporated into a 25 questionnaire with answers and relative scores, as shown in Appendix 1.

4.4.1.2 Area and Objectives of Investigation

The questionnaire mainly focuses on Hong Kong. The objectives of investigation are the professionals and scholars belonging to the real estate industry. All of them are undergraduates or above and have abundant experiences of real estate with three to ten years industry experience. Thus, their opinion is valuable and it is a good representation of the majority of real estate professionals.

4.4.1.3 Process of the Investigation

Under the help of professionals and experts of the real estate industry, the investigation has been very successful. From July 2004 to December 2004, 50 questionnaires were sent, and 48 questionnaires are fulfilled and returned, among which the number of valid questionnaires is 34, with the valid ratio of 68%, as shown in Table 4-1. These questionnaires are processed to gain the original data for Factor Analysis Method.

Table 4-1 The condition of questionnaires investigation

Total number of Qs	Number of valid Qs	Number of invalid Qs	Number of blank Qs
50	34	14	2

4.4.2 Factor Analysis for 25 Factors

4.4.2.1 Results of Factor Analysis

The above original data is calculated through by using SPSS, as shown in Appendix 2. The KMO of all variables is 0.621, which expresses the acceptability of the result. According to the extraction rule, namely characteristic roots are larger than 1 (R. B. Darlington, et al, 1973 [63]), four primary factors are chosen from these 25 random variables, their accumulated contribution rate is up to 68.906%.

4.4.2.2 Explanation of Results

By analyzing the loading matrix between all variables and four primary factors, the explanation of these four primary factors are shown below:

- The first primary factor $F1$ has a bigger loading factor for variable $X1$, denoting the effect of population on real estate market, including population distribution and density. Thus the first primary factor reflects the influence of population on REM and is called population factor.

- The second primary factor $F2$ takes on bigger factor loadings for variables $X3$, $X4$, $X23$ and $X24$, among which variables $X3$ and $X24$ reflect the status of social macro economy and $X4$ and $X23$ reveal the condition of housing loans. By formulating these four variables, it is obvious that the second factor reflects the purchasing power of consumers and thus it is commonly called as today's PP factor.

- The third primary factor $F3$ takes on bigger factor loadings for variables X13 and X14, representing price and vacancy respectively and are important indicators weighting housing price. Thus it is called price factor.

- The fourth primary factor $F4$ takes on bigger factor loadings for variables $X7$, $X10$ and $X11$, among which variables $X7$ and $X10$ reflect the status of REM development and $X11$ indicate the status of sale. Thus exhibiting the status of real estate market and is called market factor.

The explanation of results and the classification of variables are shown in Table 4-2.

4.4.2.3 Scores of Factors

In practicality, factors scores are the weighting coefficients of factors, namely the weighting coefficients of influencing efficient D&S can be determined. These coefficients are the ratio of each contribution rate to accumulated contribution rate, as calculated in Table 4-2.

Table 4-2 The explanation and scores of all primary factors

Factor	F1	F2	F3	F4
Variables explained	X_1	X_3, X_4, X_{23}, X_{24}	X_{13}, X_{14}	X_7, X_{10}, X_{11}
Factor name	Population factor	PP factor	Price factor	Market factor
Factor score	0.338	0.243	0.224	0.195

4.4.3 Analysis and Prediction of Factors

According to relevant data for Shenzhen REM, the four factors shown above can be analyzed and predicted by the adoption of the composite index method, index simulation method, etc. The details of methods forecasting the trend of each factor are shown in Table 4-3.

4.4.3.1 Analysis and Prediction of the Price Factor

When real estate market is analyzed by way of using the above methods, it is to be divided into four parts, first-hand residential housing (Fir-RH) market, second-hand residential housing (Sec-RH) market, commercial building market, and office building market.

Table 4-3 The methods for analyzing these four factors

Factor	Source of data	Method
Population	Departments concerned	Ratio, index simulation
Purchasing power	Departments concerned	PPP, ratio method
Price	Departments concerned	Ratio method, index simulation
Market	Departments concerned	Ratio method, weighted average, etc.

(1) Fir-or-Sec-RH market

Because housing price is partially influenced by many non-market factors, such as view, location, storey, etc., the market price should be adjusted before constructing price index in order to make it comparable in the market. The weighted average method and ratio method are then utilized to attain the models of price index for the Fir-or-Sec-RH market. The modeling process in detail is as follows.

- **Corrected characteristic price** Characteristic price method is also commonly labeled as the Hedonic method, separating the price of attributes from total price by adopting regression analysis and the standard price of real estate, which is only influenced by market. Then by using the ratio method their index may be calculated. But the transaction data of Shenzhen REM does not involve the characteristics of view, direction, property management level, etc, thus the following characteristics are only corrected, including location, storey, area, fitment, etc.), namely what is called corrected characteristic price method. Its advantage is that it controls the non-market factors influencing real estate price and allows price comparison to be unbiased and comparable. However, these factors may arouse big fluctuation.

- **Corrected characteristic price adjusted** Because these factors are not controlled by the corrected characteristic price method it may arouse a big fluctuation of average price for the same area at different times, moving average method can be used to modify the effect on indexes. The method reduces obvious fluctuation and substitutes the disadvantages of corrected characteristic price. But it may result in a linear change for real estate price, which would not reflect the true effect of REM in reality

- **Flat model price** The procedure of the method is as follows. First, residential sections in the districts of Shenzhen are divided into several areas and the houses of each area are divided into several flat models, such as one room, two rooms, three rooms and so on; the average price of each flat model, the housing average price of each area, and the housing average price of a district are constructed one at a time; and by adopting the above price, indexes are constructed. The method takes into account location and flat model, but it does not consider other remaining factors.

- **Composite method** It adopts the advantages of the above three methods and attempts its best to correct these non-market factors. The real estate price index is established.

The detail procedure is following:

First, all districts of Shenzhen are divided into different areas. The underlying principle for it is:

1) Consider the aggregation of residential housing;

2) Considering the homogeneity of areas, viz. location, environment, etc, in order to assure the representative and comparability of samples;

3) Determining the borderline of areas through using geographical coordinates and ensuring that more than 90% of transaction data can be put into areas according to the coordinates of land; the areas plotted are shown in Table 4-4 and Table 4-5.

Table 4-4 The areas for Fir-RH Market

Order	Futian	Nanshan	Luohu	Yantian	Longgang	Baoan
1	Bagua	Huaqiao city	Buxin	Shatoujiao	Henggang	Longguan
2	Futian center	Keji garden	Caiwuwei	Yuantian	Longgang center	Shafu
3	Huaqiang	Nantou	Cuizhu		Pingbu	Shiyan
4	Huanggang	Nanyou	Dongmen		Pingyong	Songming
5	Jingtian	Shekou	Liantang			Xinxi
6	Meilin	Xili	Xungang			
7	Shixia		Wenjin			
8	Xiangmi lake					
9	Xinzhou					
10	Yuanling					

Table 4-5 The areas for Sec-RH Market

Order	Futian	Nanshan	Luohu	Yantian	Longgang	Baoan
1	Bagua	Huaqiao city	Buxin	Shatoujiao	Henggang	Longguan
2	Futian bonded area	Keji garden	Caiwuwei	Yuantian	Kengping	Shafu
3	Futian center	Nantou	Cuizhu		Longgang center	Shiyan
4	Huaqiang	Nanyou	Dongmen		Peng'ao	Songming
5	Huanggang	Shekou	Huangbei		Pingbu	Xinxi
6	Jingtian	Xili	Liantang		Pingyong	
7	Hailin	Yueliangwan	Shuiku			
8	Shangbu		Xungang			
9	Shixia		Wenjin			
10	Xiangmi lake					
11	Xinzhou					
12	Yuanling					

Second, it is crucial to divide the residential property of each area into five kinds of flat models.

According to the area and characteristics of residential property, flat models are classified as one room (including similar one room), two rooms, three rooms, four rooms and above. For Fir-RH market, there is a record of flat models when the house is transacted in net. But with respect to Sec-RH market, there doesn't exist a record of flat models when house is registered, thus relative flat models are classified by the building area of each residential property. The kinds of flat model are shown in Table 4-6.

Table 4-6 The kinds of flat model

Flat model	Structure of flat model (Fir-RH)	Building area concerned (Sec-RH)
A	One room or single flat	Below $48m^2$
B	Two rooms	$[48m^2,78m^2]$
C	Three rooms	$[78m^2,110m^2]$
D	Four rooms	$[110m^2,155m^2]$
E	Above four rooms	Above $155m^2$

Third, correct original price.

① **Estimate the corrected parameters of price** Due to the limitation of the current sample data, the research only corrects location, building area, total height, storey, building age, etc. In addition, because samples are selected according to districts, areas, types of flat models, this may assure that the location and kinds of building are comparable. As a result, only building area, storey, decoration and building age are corrected. For Fir-RH market, storey, building area and decoration are corrected, With regards to the Sec-RH market, storey, building area and building age are prepared.

. Their models are as follows:

For Fir-RH,

$$P_{ikj} = \alpha + \beta_3 X3_{ikj} + \beta_4 X4_{ikj} + \beta_5 X5_{ikj} + \gamma_{i1} D_{i1} + \cdots + \gamma_{is} D_{is} + u$$

And for Sec-RH,

$$P_{ikj} = \alpha + \beta_3 X3_{ikj} + \beta_4 X4_{ikj} + \beta_6 X6_{ikj} + \gamma_{i1} D_{i1} + \cdots + \gamma_{is} D_{is} + u$$

P_{ijk} denotes the post-adjusted price for sample point *j* of area *k* and in district *i*; α denotes asked price; $X3_{ikj}$, $X4_{ikj}$, $X5_{ikj}$, $X6_{ikj}$ are the attributes of a sample point *j*, such as storey, building area, decoration, age; β_3, β_4, β_5, β_6 are respectively the correction coefficients of each of the attributes; D_{i1}, D_{i2}, …, D_{is} are dummy variables; γ_{i1}, γ_{i2}, …, γ_{is} are the coefficients respectively of each of the dummy variables; and *u* denotes chance error variable. These correction coefficients estimated are shown in Table 4-7 and Table 4-8.

Table 4-7 The correction coefficients of Fir-RH price

	Storey	Area (Yuan/sq.m.)	Decoration	Source of data
Inside of special zone	62.6425	6.3675	309.52	Data from net
	60.39	6.946		Data registered
Outside of special zone	60.135	2.295	277.38	Data from net

Table 4-8 The correction coefficients of Sec-RH price

	Storey	Area (Yuan/sq.m.)	Building age
Inside of special zone	28.04	7.806	192.9
Outside of special zone	19.48	2.755	171.89

② The equations of correcting price

The Fir-RH market in special zone:

$P_T = P_A + |4 - S| \times 62.6 + (100 - A) \times 6.37 - D \times 309.52$

$$P_H=P_A+(10-S)\times 62.6+(100-A)\times 6.37-D\times 309.52$$

P_T denotes the Post-corrected price for tier housing; P_A denotes the asking price; P_H denotes the Post-corrected price for high-rise housing; S denotes the storey of house; A denotes the building area; D denotes the decoration level.

The Fir-RH market out of special zone:

$$P_T=P_A+|4-S|\times 60.1+(100-A)\times 2.3-D\times 277.38$$

$$P_H=P_A+(10-S)\times 60.1+(100-A)\times 2.3-D\times 277.38$$

The Sec-RH market in special zone:

$$P_T=P_A+|4-S|\times 28+(100-A)\times 7.8-(A_B\text{-}5)\times 192.9$$

$$P_H=P_A+(10-S)\times 28+(100-A)\times 7.8-(A_B\text{-}5)\times 192.9$$

A_B denotes the age of the building.

The Sec-RH market out of special zone:

$$P_T=P_A+|4-S|\times 19.48+(100-A)\times 2.7-(A_B\text{-}5)\times 171.89$$

$$P_H=P_A+(10-S)\times 19.48+(100-A)\times 2.7-(A_B\text{-}5)\times 171.89$$

Fourth, calculation of the average price and price indexes are as follows:

(1) Construct the average price model of each flat model

$$p_{ijkl}^{t} = \frac{\sum p_{ijkls}^{t} q_{ijkls}^{t}}{\sum q_{ijkls}^{t}}$$

According to the above formula, p^{t}_{ijkl} denotes the average price of flat model l in report date; p^{t}_{ijkls} denotes the price of sample point s in report data; q^{t}_{ijkls} denotes the area of sample point s in report data; i denotes the district; j denotes the type of residential property; k denotes area k; l denotes flat model.

(2) Construct the housing average price model of each area

$$p_{ijk}^{t} = \sum w_{ijkl} \, p_{ijkl}^{t}$$

$$w_{ijkl} = \frac{q_{ijkl}^{0}}{\sum q_{ijkl}^{0}}$$

p^{t}_{ijk} denotes the average price of area k in report date; q^{0}_{ijkl} denotes the area of flat model l as a function of area k in comparing date; w_{ijkl} is the weighted coefficient of flat model l; and other parameters are dittos.

(3) Construct the housing average price model of a district

$$p_{ij}^{t} = \frac{\sum p_{ijk}^{t} q_{ijk}^{0}}{\sum q_{ijk}^{0}} = \sum w_{ijk} \, p_{ijk}^{t}$$

In this formulation, p^{t}_{ij} denotes the average price of district i; q^{0}_{i} denotes the area of area k in comparing date; w_{ijk} denotes the weighted coefficient of area k; and other parameters are dittos.

(4) Construct the housing price index model of a district

$$I_{ij} = \frac{p_{ij}^{t}}{p_{ij}^{0}} = \frac{\sum p_{ijk}^{t} q_{ijk}^{0}}{\sum p_{ijk}^{0} q_{ijk}^{0}}$$

$$k_{ij} = \frac{p_{ij}^{0}}{6300}$$

In order to make the indexes of all districts comparable, a representing average price (the average price in Jan 1st, 2001) is selected for the purpose of adjusting these indexes. Tab.4-9and Tab.4-10 are the calculated the Fir-RH price index and the Sec-RH price index of all districts.

Table 4-9 The Fir-RH price index of all districts

District	2001/1	2001/2	2001/3	2001/4	2002/1	2002/2	2002/3	2002/4	2003/1	2003/2
Futian	106.254	103.665	104.124	109.572	116.471	115.685	115.306	111.224	109.617	114.68
Luohu	93.389	94.199	94.312	93.542	92.967	94.977		101.62	99.08	99.708
Nanshan	84.737	83.878	82.448	83.878	86.395	90.951	91.769	90.661	88.882	91.408
Yantian	80.254	81.452	75.535	72.738	73.898	78.994		78.963	86.768	91.683
Baoan	54.294	54.357	56.11	52.643	55.107	58.515	62.13	61.912	61.064	61.181
Longgang	49.822	50.973	55.171	55.697	54.058	55.171	55.065	53.887	54.33	56.236

Table 4-10 The Sec-RH price index of all districts

District	2001/1	2001/2	2001/3	2001/4	2002/1	2002/2	2002/3	2002/4	2003/1	2003/2
Futian	78.005	77.372	77.037	78.813	79.969	80.925	81.402	80.354	81.867	82.974
Luohu	72.881	72.222	70.625	69.214	71.463	72.399	71.044	71.841	74.312	74.954
Nanshan	59.555	59.202	60.599	61.231	62.12	61.986	61.292	60.9	64.964	66.551
Yantian	58.091	54.86	53.354	50.04	53.87	57.622	56.316	53.123	57.909	60.252
Baoan	35.081	35.709	36.865	35.282	37.139	36.715	37.587	35.853	38.422	40.009
Longgang	37.081	36.695	35.305	36.903	38.956	36.918	37.417	37.77	40.086	40.716

Similarly, Shenzhen price index is also calculated using the methods.

Note that the weighting coefficients of flat models and area are determined by the total sale area of each flat model or area.

(2) Commercial building

The frequency chart of commercial building price can be drawn based on historical data. In fact, commercial buildings are classified into four grading systems, viz. high, medium-high, medium, and low. By the chart and the limitations between grades, sampling proportion and the weighting coefficients of all grades can also be determined. The relative average price and indexes are calculated.

Futian district is taken as an example. First, the frequency chart for Futian district is drawn from 2001 to 2002 (see Figure 4-3), from the chart it is obvious that the limitation of grades are RMB14000, 22000, 42000 and the frequency of each grade is 21.71%, 38.16%, 35.09% and 5.04% respectively, which are the sampling ratio of each grade. Through calculating the ratio of the sale area of each grade to total sale area, the weighting coefficients are derived as a percentage to be 50.08%, 29.19%, 17.51%, and 3.22%.

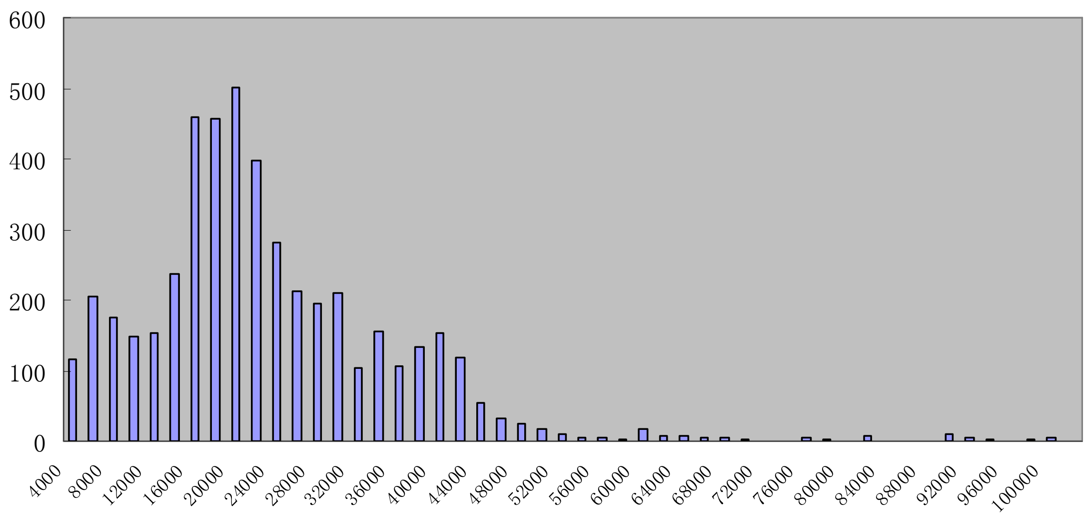


Figure 4-3 The frequency chart of commercial building in Futian District from 2001 to 2002

Then, actual transaction data is classified against the grades and based on the lowest grade transaction amount the deal amount of other grades is calculated. For Futian district in the second quarter of 2002 (see Table 4-11), the total number of deals are 375 among which low, medium, medium-high and high grades occupy 89, 86, 169 and 31 respectively, namely 23.7%, 22.9%, 45.1% and 8.2%. According to the above sampling proportion, the transaction amount of medium-grade building, 86, should be used as the basis of calculating the sampling amount of other grades, as shown in Table 4-11. The process of the computation is done in the following method:

Total sampling size needed=86/(38%)=225

Low-grade sampling size=21.7%×225=49

Medium-high-grade sampling size=35.09%×225=79

High-grade sampling size=5.04%×225=11

Namely the sampling size of each grade is respectively 49, 86, 79, 11.

Table 4-11 The process of calculating the average price of commercial building of Futian District in the second quarter of 2002 (Yuans/sq.m.)

Grade	Low	Medium	Medium-high	High
	Below 14000	14000-22000	22000-42000	Above 42000
Frequency	0.217	0.382	0.351	0.050
Area proportion	50.1%	29.2%	17.5%	3.2%
No. of actual deal	89	86	169	31
Ratio of actual deal	23.7%	22.9%	45.1%	8.3%
Sampling size	49	86	79	11
Average price of all grades	8621	17216	29673	51657
Total average price	16203			

Third, the average price of the total four grades is calculated as follows:

$$p_i = \frac{\sum_{j=1}^{n_i} p_{ij}}{n_i}$$

p_i denotes the average price of grade i; n_i is the sampling size; p_{ij} signifies the price of sample point j among grade i.

For example, the average price for Futian District is represented by the following:

$$p_1=8621;\ \ p_2=17216;\ \ p_3=29673;\ \ p_4=51657$$

As the result, the total average price is derived as follows:

$$\begin{aligned}\overline{p} &= \frac{\sum_{i=1}^{4} f_i * p_i}{\sum_{i=1}^{4} f_i} \\ &= 50.08\% * 8621 + 29.19\% * 17216 + 17.51\% * 29673 + 3.22\% * 51657 \\ &= 16203\end{aligned}$$

The price index of commercial building is calculated:

$$I_{ij} = \frac{\overline{p}}{p_0}$$

If the price in comparing date turns out to be 6300, then the price index is: 16203/6300=2570.

The estimation and calculation of the price index of commercial building of all districts, is shown in Table 4-12

Table 4-12 The price index of commercial building of all districts

Time / District	0101	0102	0103	0104	0201	0202	0203	0204	0301	0302
Futian	250.8	258.1	251.6	255.1	259.4	257.2	263.6	264.2	268.7	267.6
Luohu	298.4	294.8	299.5	296.0	298.9	302.2	297.5	292.0	295.7	303.2
Nanshan	165.1	164.6	172.0	173.9	173.2	177.3	173.4	174.5	174.9	172.3
Yantian	105.3	113.5	109.9	110.8	105.2	105.2	93.3	104.2	103.4	97.2
Baoan	99.9	99.8	96.0	101.6	109.1	108.1	106.5	101.8	100.8	99.0
Longgang	145.0	139.2	143.0	141.0	147.1	154.8	157.5	154.4	151.6	153.0

(3) Office building

In comparison with commercial building, the deal data of office building is limited. For example, from the first quarter of 2001 to the second quarter of 2003, the deal data of office building for Longguang District is 31 whereas Yantian District and Baoan District is 79 and 198 respectively. As a result of the limited available data, it is almost impossible to find an appropriate method to establish their indexes. Thereby, the research is to adopt various different methods to construct the price indexes for each of the districts. With respect to Futian, Nanshan and Luohu, relevant data is relatively more available than others and their indexes of office building are constructed like the index of commercial building, but in this case only divided into three grades: low, medium, and high. For Yantian, Baoan and Longgang, because of the lack of data, norm data is constructed based on total transaction data and the norm data is used to establish the index.

The evaluation of the price index of office building is shown in Table 4-13 and Tab.4-14).

Table 4-13 The grades and corresponding sampling proportion and weighting coefficients for office buildings of Futian district

Futian district			
Grade	Low	Medium	High
	Below 7000	7000-12000	Above 12000

Proportion	40%	51%	9%
Weighting coefficient	0.51	0.38	0.12

Table 4-14 The price index of office building of all districts

Time / District	0101	0102	0103	0104	0201	0202	0203	0204	0301	0302
Futian	123.7	129.2	129.9	128.6	116.4	119.5	111.4	122.6	116.0	120.0
Luohu	108.6	104.2	107.1	115.0	105.6	114.2	124.1	94.9	95.1	107.5
Nanshan	72.9	72.9	73.3	74.3	73.6	74.6	73.9	73.3	74.7	73.6
Yantian	102.7	102.7	102.7	102.7	106.6	105.8	107.2	108.2	106.2	108.2
Baoan	61.7	58.6	58.1	60.2	62.9	60.7	58.9	56.2	59.8	57.3
Longgang	29.6	32.0	30.6	31.0	30.6	31.6	29.5	31.2	30.5	30.6

(4) Prediction of price indexes

The simulation stock method is applied to the prediction of price indexes by using the data corrected and its process is as follows:

① Based upon a month and quarter, both EMA_1 and EMA_2 are calculated and their moving coefficients are determined:

$$e_1=2/(30+1)=0.0645$$

$$e_2=2/(90+1)=0.0219$$

And then,

$$EMA = e\times(TA - YA) + YA$$

TA and *YA* denote today’s and yesterday’s average price respectively.

② DIF is calculated as:

$$DIF = EMA_1 - EMA_2$$

③ MACD is calculated as:

$$MACD = E \times (DIF_1 - DIF_2) + DIF_2$$

E denotes the moving coefficient of $MACD$; DIF_1 and DIF_2 denote today's and yesterday's DIF respectively.

④ Calculate deviation column (BAR) is shown below:

$$BAR = DIF - MACD$$

The Shenzhen REM data retrieved from 2001 to 2003 is used to forecast the above four price indexes and the results are presented with by the following MACD charts (see Figure 4-4 to Figure 4-7).

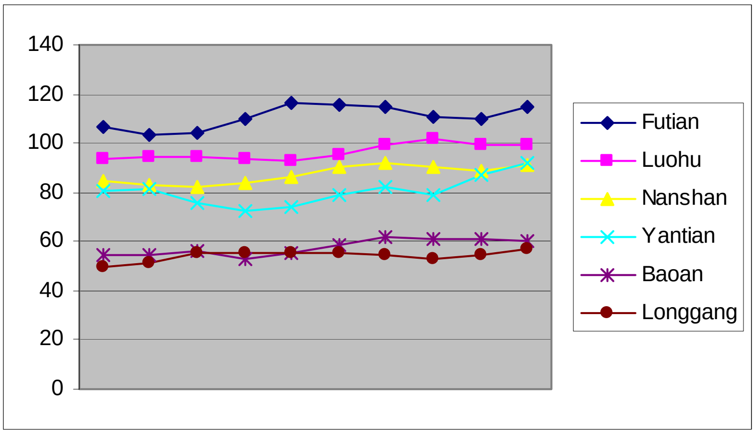


Figure 4-4 The MACD chart of Fir-RH price index for all districts of Shenzhen

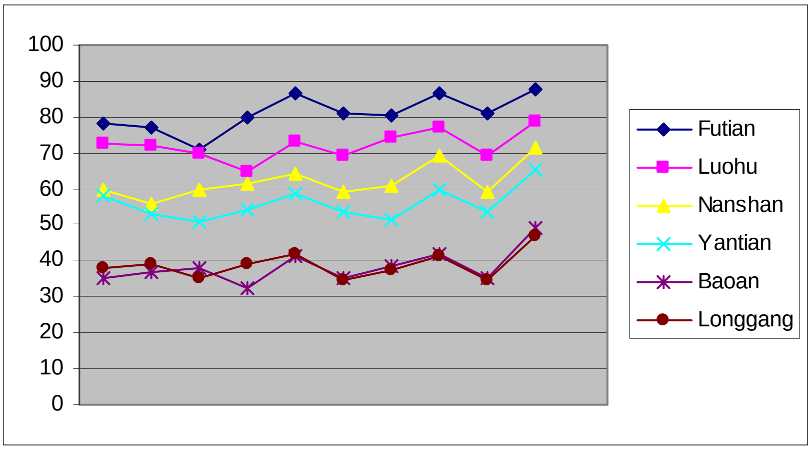


Figure 4-5 The MACD chart of Sec-RH price index for all districts of Shenzhen

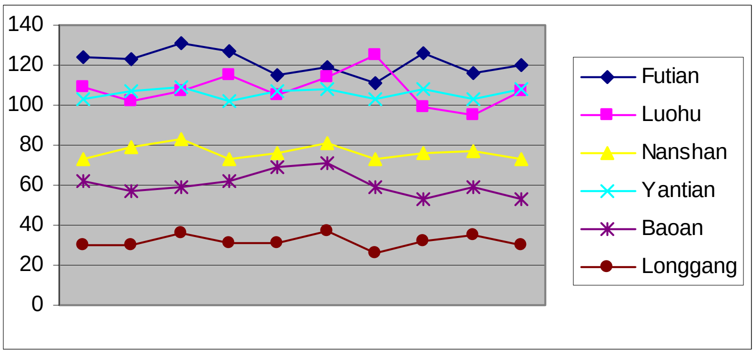


Figure 4-6 The MACD chart of commercial building price index for all districts of Shenzhen

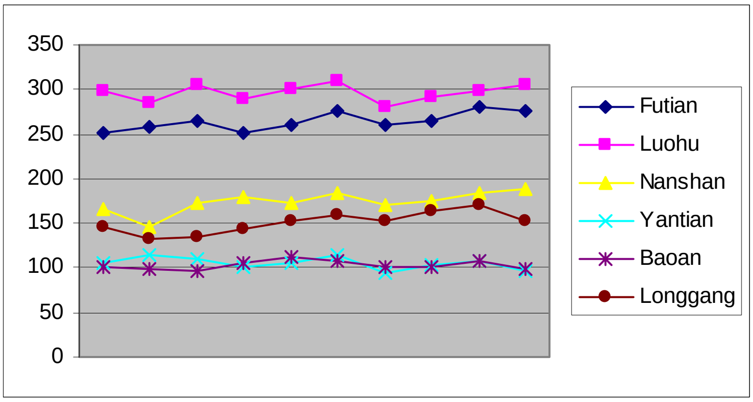


Figure 4-7 The MACD chart of office building price index for all districts of Shenzhen

When the price indexes fall in the first quarter of 2003 and need to be forecasted, the outcome will depend on the BIAS of all price indexes compiled in December 2002. Their BIAS is presented from Table 4-15 to Table 4-18.

Table 4-15 The BIAS of Fir-RH price index

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
BIAS	0.13%	0.03%	0.03%	-0.09%	-0.08%	0.009%

Table 4-16 The BIAS of Sec-RH price index

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
BIAS	-0.01%	-0.03%	-0.06%	-0.08%	-0.07%	-0.06%

Table 4-17 The BIAS of commercial building price index

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
BIAS	0.095%	-0.002%	-0.01%	0.99%	-0.05%	-0.981%

Table 4-18 The BIAS of office building price index

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
BIAS	-0.02%	-0.98%	-0.001%	0.953%	0.009%	-0.01%

Through comparing the BIAS, their trends can be contrasted and judged; their largest value in the next period may be calculated. As an example, the DIF of Fir-RH price index of Futian is 0.0135 last period and under the condition of determining its descending trend its growth scale may be estimated at about 0.0135, or 1.35%. Thus it should be equal to 109.5 in the first quarter of 2003, a numerical representation which is close to the real value of 109.617. The similar method is used to calculate the forecast value of other price indexes and the results are presented. (see Table 4-19).

Table 4-19 The forecasting value of basic price indexes

Index / District	Fir-RH index	Sec-RH index	Comm index	Office index
Futian	109.5	81.0	269.0	115.3
Luohu	99.1	74.5	295.1	95.6
Nanshan	88.81	64.7	173.9	74.1
Yantian	86.3	57.6	103.0	106.0
Baoan	61.1	38.3	100.3	59.0
Longgang	54.1	40.2	151.9	30.1

(5) Composing of four indexes

In the end, the price index needs to be constructed with the price indexes of Fir-RH, Sec-RH, Commercial building and Office building by adopting weighted average methods. Their weighting coefficients are determined based on their proportion.

Likewise, based on the forecasting value of the basic price indexes of the first quarter of 2003, the price index is derived (see Table 4-20). Note that the weighting coefficients of Fir-RH index, Sec-RH index, Comm index and Office index are 57.7%, 35.3%, 5% and 2% respectively.

Table 4-20 The forecasting value of composite price index in the first quarter of 2003

District	Price index
Futian	107.53
Luohu	100.14
Nanshan	84.26
Yantian	77.40
Baoan	54.97
Longgang	53.61

4.4.3.2 Analysis and Prediction of Population Factor

The distribution and density of population are important factors which plays a key role in influencing the real estate market. Shenzhen for example, is a new and typical city of choice for immigration, thus comparing with other cities in China, it is characterized as follows [64]:

- No registered population is estimated to be more than registered population. Based on the fifth census of 2000, the percentage of no registered population is at about 83.45%, an increase of about 22.11% from the fourth census.

- The density of population is greatest among all medium or big cities in China. In the fifth census, it has escalated to 3597 from 825 per sq.km. in the fourth census, namely it increases 3.46 times and the annual increase percentage of 15.32%. However, according to the yearbooks of other cities, in 2003 those of Shanghai, Guangzhou and Beijing are only 2902, 975 and 881 per sq.km.

- The growth rate of population is largest. The annual growth rate is at 14.91% from the fourth census to the fifth census. It is noticeable that less than 1% is due to natural growth and it is estimated that nearly 14% is a result of immigration.

- The average age of population is smallest. Similarly based on the fifth census, the average age is 25.37 in 2000 and the percentage of population from 20 to 39 has increased to 66.38%.

- The average cultural level of labor population is at lowest level. Among all labor resources, the population with a secondary school or above education only occupies 15.21% and the population with elementary school or below qualification is at a staggering 66.52%.

- The no registered population is biggest. In 2000, the in flow of population into Shenzhen is up to 677.21 ten thousand.

It is obvious from above characteristics that as a result of the small proportion of natural growth rate to the total growth rate of the population; the population index is constructed mainly based on immigration population.

The population of 1999 is regarded as the value in comparing date, and the population index may be established. The status of Shenzhen population is shown in Table 4-21 and Table 4-22.

Table 4-21 The status of Shenzhen population in 1999 (Unit: Ten thousand)

Population types	Permanent population	Registered population	No registered population
Shenzhen	394.96	114.60	280.36
Luohu	60.03	28.62	31.42
Futian	70.67	27.48	43.19
Nanshan	42.87	12.79	30.08
Yantian	11.05	2.59	8.45
Baoan	121.26	24.92	96.34
Longgang	89.08	18.20	70.88

Table 4-22 The density of Shenzhen population in 1999 (Unit: Persons/sq.km.)

Shenzhen	2074
Inside special zone	4815
Luohu	7742
Futian	9356
Nanshan	2649
Yantian	1606
Outside special zone	1381
Baoan	1746
Longgang	1072

Taking the population data of the city in 1991 as comparing data, and representive index is 1000, the population index of each district from 1991 to 2003 are calculated (see Tab.4-23)

Tab.4-23 The population index of Shenznen

District/year	1999	2000	2001	2002	2003
Luohu	151.9	172.2	189.7	270.1	330.6
Futain	178.9	199.9	216.6	297.7	361.1
Nanshan	108.5	109.6	115.6	138.2	149.9
Yantain	27.9	33.5	38.9	67.1	86.3
Baoan	307.0	310.1	313.7	355.6	391.1
Longgang	225.6	228.6	235.1	266.1	300.6

Similarly，Based on the population index above, with use of index simulation method, the population index can be forecasted. First, draw the MACD chart of Shenzhen population index, as shown in Fig.4-8;

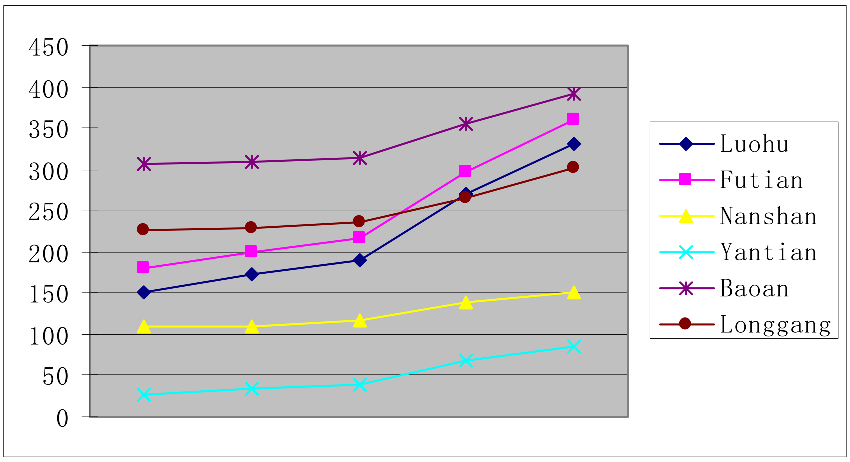


Fig.4-8 The MACD chart of Shenzhen population index

and then calculated its BIAS， as shown in Tab.4-24。

Tab.4-24 The BIAS of Shenzhen Population index

BIAS/year	1999	2000	2001	2002	2003
Luohu	-0.53%	-0.41%	-0.21%	-0.11%	-0.19%
Futain	-0.13%	-0.11%	-0.71%	-0.19%	-0.37%
Nanshan	-0.63%	-0.09%	-0.27%	-0.31%	-0.09%
Yantain	-0.03%	-0.53%	-0.20%	-0.19%	-0.71%
Baoan	-0.17%	-0.01%	-0.17%	-0.30%	-0.09%
Longgang	-0.32%	-0.45%	-0.15%	-0.22%	-0.36%

Finally determine the change scale of population.

For example, we want to predict the population index of Luohu district in 2003. From the above table, the BIAS of Luohu in 2003 is negative, it means the population will increase, and through the calculation, the DIF of Luohu in 2003 is 0.223, so the population index of Luohu in 2003 should be 270.1*1.223=330.33. This result is nearly the same as the real data (330.6). From this way, the predicted population index of Shenzhen in 2003 is calculated as shown in Tab.4-25.

Tab.4-25 The predicted population index of Shenzhen in 2003

district/predicted index	2003
Luohu	330.33
Futain	360.9
Nanshan	149.3
Yantain	86.1
Baoan	390.9
Longgang	300.31

4.4.3.3 Analysis of Purchasing Power Factor

The purchasing power of residents is a kind of inventory and is also the accumulation of usable economic resources of a family at a time. Only the increase of income and purchasing power may satisfy the continuous increase of consumers' demand of housing.

From the1990s onwards, the income level of Shenzhen has expanded to three or four times of the average level of income of the whole country. It is certain that the housing price of Shenzhen is very high, but the purchasing power factor of Shenzhen residents is also strong. Table 4-26 shows that the annual income of family of Shenzhen and China.

Table 4-26 The annual income of family of Shenzhen and China

Year	1997	1998	1999	2000	2001	2002	2003
Annual income per family of Shenzhen (Yuans)	15725	39367	47142	58547	65985	69203	73741
Annual income per family of China (Yuans)	5285	11487	13834	15484	16141	17400	18293

The ratio of housing price to income is also a useful indicator of analyzing the purchasing power of residents. From Table 4-27, the ratio declines year after year and is close to international ratio, viz. 3:1 to 6:1.

Table 4-27 The ratio of housing price to income of Shenzhen

Year	Annual income per family (ten-thousand Yuans)	Price per flat (ten-thousand Yuans)	Housing price/Income
1998	3.94	44.3	11.2:1
1999	4.71	45.6	9.7:1
2000	5.85	41.5	7.1:1
2001	6.60	46.5	7.0:1
2002	6.92	44.1	6.4:1
2003	7.37	44.4	6.3:1

Note that the purchasing power factor refers to the actual PP of urban residents for housing. Therefore, when analyzing this factor, the composite PP of residents needs to be analyzed by generating the ratio of housing payout and the actual PP is derived. In 2003, national GDP per capita is equal to $1087 and Shenzhen GDP per captia is $6590; with the latter being far higher than the former. But the number is only a mean which cannot truly reflect the real living conditions of residents. International organizations usually adopt Purchasing-Power Parity (PPP) exchange rates to calculate the GDP per captia in order to evaluate the residents' living conditions of a country. During the course of calculating GDP per captia based on PPP exchange rates, the price level needs synthesizing in order to calculate the real consumption, such as dress, food or rent, etc. which amounts to a certain level of GNP. Most of the international organizations usually apply PPP [65] to the composite comparison between many countries.

PPP refers to the ratio of the real purchasing power of two or more kinds of currencies, meaning the ratio of the amount of two kinds of currencies which are used to purchase the same amount of commodities or labor services in respective countries (Castle.1999) [66]. Note that according to the 93SNA the price of the commodities or labor services of every country must be marked by using their currencies.

In 1968, *International Comparison Program* (ICP), a project started by the UN as an attempt to try and compare the purchasing power levels of different countries. The research reevaluates same goods and services with same price and calculates GDP per capita using the exchange rates and not the nominal exchange rates in order to try and reflect the real income level of a country [67]. The ICP has six steps: first GDP is divided into resident consumption, governmental consumption, capital and net export;

they are then subdivided into many basic sorts, about 150-250 in ICP; thirdly, one or more representative goods or services are selected from each of basic sorts; fourth, based on these items the parity of each basic sort is determined; fifth, by using these parity, the output of every country can be converted into the amount of international currency; last, the composite price ratio, viz. the PPP of GDP, is calculated by transforming these amounts of international currency [68]. As a consequence of China entering ICP from 1999 on [69], Shenzhen PPP can be estimated by using China PPP.

- The detail of constructing Shenzhen PPP is show in Figure 4-9.

China PPP of RMB to Dollar in 1999   Difference between China and Shenzhen in 1999

Shenzhen PPP of RMB to Dollar in 1999

Figure 4-9 The flowing chart of calculating Shenzhen PPP in 1999

First, the calculation of the difference between Shenzhen and China must be completed. Given that there is no difference between Shenzhen and China before 1979 and based on the *China Statistics Yearbook 2001* and *Shenzhen Statistics Yearbook 2001*, the reduction index of China and Shenzhen GDP in 1999 are 259.74 and 279.63 (100 in 1978) respectively. The ratio of Shenzhen PP to China PP is derived, 1.076:1, namely 1 Yuan in China is equal to 1.076 Yuans in Shenzhen in 1999. The PPP of RMB to Dollar is 4.57, then Shenzhen PPP is derived, namely 4.25. Via using same method, Shenzhen PPP for other years can be calculated (see Tab.4-28).

Table 4-28 The PPP of Shenzhen REM to Dollar

Year	1999	2000	2001	2002	2003
PPP	4.25	4.01	4.13	3.79	3.21

Because PPP reflects the direct PP of currency, by using Shenzhen GDP and exchange rates, the direct PP of Shenzhen residents can be formulated, (see Tab.4-29).

Table 4-29 The direct PP of Shenzhen urban residents

Year	1999	2000	2001	2002	2003
Direct PP (Yuans)	34912.1	38365.5	42628.4	47897.1	54428.6

Then based on the ratio of payout for housing, the housing PP can also be calculated, (see Tab.4-30).

Table 4-30 The housing PP of Shenzhen urban residents

Year	1999	2000	2001	2002	2003
Housing PP (Yuans)	3490	4000.6	6394.6	7184.3	8273.1

Finally, based on the housing PP of 1999, the PP index can be constructed (see Tab.4-31).

Tab.4-31 The housing PP index of Shenzhen urban residents

year	1999	2000	2001	2002	2003
index	1000	1146.3	1832.2	2058.5	2370.5

4.4.3.4 Analysis of Real Estate Market Factor

The market factor is composed of market development and market transaction.

(1) Real estate development

From the 1990s onward, due to the influence of domestic macro-economic policies in Shenzhen and its special location, Shenzhen real estate development increases year after year and many indicators about development rapidly rise in a large scale. Therefore, the amount and source of development capital, the area of new projects and construction area change obviously which reflects that real estate market is becoming better. Table 4-32 to Table 4-35 show the development conditions of Shenzhen REM from 1999 to 2003.

Table 4-32 The structure of investment amount completed on Shenzhen REM

Year	Investment amount completed this year (100 million Yuans)	Subdivisions				
		Investment on housing	Investment on land	Cost for purchasing land	Cost for purchasing old buildings	Others
1999	181.02	125.40	18.68	34.10		2.84
2000	261.45	198.95	16.11	42.46		3.93
2001	271.02	196.54	25.24	47.57		1.67
2002	322.85	217.57	25.07	80.21		
2003	411.12	304.00	26.25	72.42	1.02	7.43

Table 4-33 The structure of source of capital of Shenzhen real estate development (100 million)

Capital / Year	Total	Balance of last year	Total capital this year	Domestic loans	Foreign capital	Capital in budget	Bonds	Self-financing
1999	309.21	59.43	249.78	60.20	12.50			103.69
2000	391.66	62.22	329.44	85.65	13.91			95.94
2001	472.68	85.16	387.52	84.09	15.40			125.91
2002	638.43	127.16	511.27	129.04	9.99			177.42
2003	737.97	141.87	596.10	152.99	8.62	6.96		165.23

Table 4-34 The construction area and the area of new projects of Shenzhen (Ten-thousand m^2)

Area / Year	Construction area					Area of new projects				
	Total	Housing	Office	Commer-cial	Others	Total	Housing	Office	Commer-cial	Others
1999	1646.38	1218.86	130.58	180.07	116.87	490.17	393.52	17.86	39.46	39.33
2000	2142.88	1629.11	140.44	245.46	127.87	745.15	620.05	13.44	56.49	55.17
2001	2182.66	1661.57	111.56	230.30	179.23	737.56	577.62	26.05	68.83	65.06
2002	2462.75	1916.02	97.26	240.43	209.04	884.86	712.40	22.88	69.52	80.06
2003	2672.60	2100.82	100.54	251.47	219.63	944.54	730.94	44.13	104.85	64.62

Table 4-35 The housing area completed for Shenzhen (Ten-thousand m^2)

Year	Total area	Subdivisions			
		Housing	Office	Commercial	Others
1999	441.97	353.29	24.86	39.79	24.03
2000	571.46	467.36	20.03	59.16	24.91
2001	652.26	551.59	13.54	49.01	39.12
2002	770.58	621.91	24.06	68.65	55.96
2003	915.30	763.64	13.16	65.70	72.80

From above data, it reveals that Shenzhen real estate development ascends year after year and development capital, construction area, the area of new projects and area completed appear to rise in large scale. Amongst the three kinds of buildings, housing building remains to have a large scale increment which positively correlates with the growth of population. Office building shows the change again and again and takes on diminishing position as a whole, caused by the macro-control policies.

(2) Real estate transaction

Real estate transaction corresponds with real estate development. Table 4-36 shows the condition of real estate transaction of Shenzhen.

Table 4-36 The sale of buildings in Shenzhen (Ten-thousand m^2)

Year	Total area	Subdivisions			
		Housing	Office	Commercial	Others
1999	432.22	372.38	22.06	19.85	17.93
2000	541.84	492.51	15.02	26.20	8.11
2001	611.37	556.82	12.19	26.32	16.04
2002	643.47	593.72	11.01	27.40	11.34
2003	791.70	724.41	17.94	46.36	2.99

(3) The indicators for market factor

According to the above analysis, development capital, development area and transaction area are used to establish the indicators for market factor and they are then weighted and applied to the construction of the market index. Developmental area and transaction area depend on housing, office and commercial buildings and their weighting coefficients, which are in turn based on their area (see Tab.4-37 to Tab.4-40). Note that H denotes Housing; O denotes Office building; and C denotes Commercial building.

Table 4-37 The development capital index of Shenzhen REM

Year	1999	2000	2001	2002	2003
Index	1000	1444.3	1497.1	1783.5	2271.1

Table 4-38 The development area index of Shenzhen REM

Year	1999			2000			2001			2002			2003		
Sort	H	O	C	H	O	C	H	O	C	H	O	C	H	O	C
Index	728	106	166	891	90	191	956	87	199	1067	103	213	1279	89	257

Table 4-39 The transaction area index of Shenzhen REM

Year	1999			2000			2001		
Sort	H	O	C	H	O	C	H	O	C
Index	861.5	51.00	87.40	1139.4	34.72	115.65	1288.17	28.17	132.17
Year	2002			2003					
Sort	H	O	C	H	O	C			
Index	1373.29	25.44	120.64	25.44	1373.29	25.44			

Tab. 4-40 The market factor index of Shenzhen

year	1999	2000	2001	2002	2003
index	1000	1302.2	1395.87	1572.37	1930.43

4.4.4 Select the Comparing Date and Base

Considering the trends of Shenzhen real estate market and consistency, the comparing date for indicator V1 is determined as 1999 and the corresponding base is 1000 points. The four indicators for V1 are identical. (See Tab.4-41)

Tab. 4-41 The sub-index of the efficient D&S factors

year/factor	1999	2000	2001	2002	2003
Price factor	1000	1066.1	1049.7	1070.1	1073.2
Population factor	1000	1054.1	1069.7	1121.3	1209.1
Purchasing power factor	1000	1146.3	1832.2	2058.5	2370.5
Market factor	1000	1302.2	1395.87	1572.37	1930.42

4.4.5 Composition of Indexes

After the value and weighting coefficients of the four indexes, the efficient D&S index can be derived by calculating the four indexes. The equation is constructed as following:

$$V_1=w_1*F_1+w_2*F_2+w_3*F_3+w_4*F_4$$

w_1, w_2, w_3 and w_4 are the weighting coefficients of four factors; F_1, F_2, F_3 and F_4 indicating the value of the four indicators; V_1 is the value of the efficient D&S index, (see Tab.4-42).

Tab.4-42 The efficient D&S index (V1)

year	1999	2000	2001	2002	2003
index	1000	1145.82	1290.11	1370.21	1460.76

4.5 Analysis of the Latent Demand of REM (V2)

The latent demand of REM is a main indicator reflecting the future demand of real estate. By collecting the opinions and viewpoints of real estate consumers through telephone interviews and questionnaire results, their expectations and confidence for Shenzhen REM can be analyzed and the latent demand indicator V2 is also constructed. Thereby based upon the indicator, the change of the confidence of participants of REM is expected to be discussed.

4.5.1 Questionnaires Investigation

4.5.1.1 Design of Questionnaires

For collecting individual behaviors, questionnaire is an efficient method. The principle of designing it is that the questionnaire can describe the changing mode of expectation of people to REM in the past time and determine the changing trend of correlation between the expectations to market with regards to the whole economy.

Interviewees are to be asked the following questions, such as their opinions for present and future market, their scruple to investment, these factors influencing their purchasing real estate or housing, etc. Otherwise, interviewees should be classified and questions should be precise and perspicuous. In order to simulate the activity of respondents, some presents can be awarded. Investigation should be characterized as periodicity, for example monthly or quarterly and every round investigation should be kept consistent in order to avoid big errors. Different answers are to be used to appraise the opinions and behaviors of different respondents and the order of questions should be written in the order from economy to population. The difference between the various rounds is attributed to the change of interviewees' ideas, including the change of purchasing behaviors, the confidence and expectation of investors, economy and population. Wording should also be kept consistent [70].

4.5.1.2 Objectives of Investigation

The target respondents of the survey are the non-expert populace in the local residential property sector. There are two kinds of samples: a sample composed of homeowners, and a sample composed of potential home buyers, target sample to be in the age group of 18 and above in Shenzhen.

Respondents are specifically "branched" into six groups and sampled in each survey, as follows:

(1) Group A – Homeowner (HO)

a. Group A1 – Homeowner in the market considering another purchase (HOCPI)

b. Group A2 – Homeowner and conditional purchaser (HOCPII)

c. Group A3 – Homeowner and non-buyer (HON)

(2). Group B – Non-homeowner (NHO)

a. Group B1 – Non-homeowner in the market considering new purchase (NHOCPI)

b. Group B2 – Non-homeowner and conditional purchaser (NHOCPII)

c. Group B3 – Non-homeowner and non-buyer (NHON)

4.5.1.3 Range and Means of Sending Questionnaires

Questionnaire would be sent in Shenzhen, distributed to six districts, viz. Futian, Luohu, Nanshan, Yantian, Baoan and Longgang, and at the same time in Hong Kong Special Administrative Region near Shenzhen. The questionnaires are randomly and intentionally sent.

4.5.2 Telephone Survey

Due to the accessibility of telephones in Shenzhen, almost all populace can also be interviewed through telephone. Survey is usually conducted on the weekends by investigators trained specially to speak in Mandarin or Cantonese. The survey takes about five minutes to complete over the telephone. The Computer-Assisted Telephone Interviewing (CATI) software may be used in conducting surveys. In general, CATI offers the benefits of automatic dials, reduced data cleaning, instant data updating, automatic data recording, and more importantly, prevention of human errors.

4.5.2.1 Sampling Procedures

Shenzhen residential telephone directories are used as the sampling frame. Computer-generated random sampling procedures are employed to ensure random homeowners and potential home buyers are selected. First, telephone numbers are drawn from six residential telephone directories of six districts of Shenzhen. Second, from these "number seeds" another set of numbers are generated by changing the last four digits randomly to include the unlisted or new numbers. Finally, the CATI system chooses respondents randomly for interview. Adult respondents, who are unable to be contacted to conduct the interview in the first round, are called back five times to complete the interview later.

4.5.2.2 Sample Survey Procedures

The result of small range survey conducted in Hong Kong in Nov. 2004 would be regarded as the basis of improving questionnaires, and similarly the respondents for the survey also provided with a chance for training. After that, a large-scale survey would be conducted, and sample size can include up to 15000 to 20000, among which valid samples are up to 12000 to 18000. The procedure can be conducted in Shenzhen.

4.5.3 Statistics of Results

The statistics of survey results is mainly based on TRECI&BRE index method. The positive result indicates the response of approval and the negative result imply for the response of disapproval. The scoring range of every question is from +4 to -4 and these scores are weighted after eliminating the highest score and the lowest score. The questionnaire and corresponding scores are designed (see Appendix 3).

4.5.4 Index Construction

Therefore, the potential range of total score of the questionnaire is from -32 to +32. Based on the TRECI&BRE index method, the index ranges between 0 (the lowest confidence) and 1000 (the highest confidence), with the median 500 being neutral. Numbers that fall above 500 indicate positive confidence; and numbers that fall below 500 indicate negative confidence. The equation is as follows:

$$\frac{(Total \quad score + 32)}{64} \times 1000 = Value \quad of \quad the \quad index$$

The above model may be used to determine respectively HOCPI index, HOCPII index, NHOCPI index and NHOCPII index and then the latent index V_2 is derived through comparison of the four indexes.

4.5.5 Example

The sample data was collected from a small scale survey in Hong Kong utilized to establish the latent demand index. The result of the questionnaires sent or returned is present in Table 4-43 and Table 4-44. Note that the detail and outcome of the survey is shown in Appendix 5.

Table 4-43 Questionnaires sent and returned

Sent	Returned	Valid	Invalid	Valid ratio
63	63	54	9	85.7%

Table 4-44 The detail of respondents

Sorts of groups	Number	Proportion
Group A1	15	27.8%
Group A2	7	12.9%
Group A3	5	9.2%
Group B1	14	25.9%
Group B2	12	22.3%
Group B3	1	1.9%

Both group A3 and group B3 are not interested in real estate or do not possess the ability to purchase real estate property. In other words, they have no intentions of purchasing real property or have no confidence in REM. Thus their opinions can be ignored. As a result, the total number of correspondents is 46, when the highest and lowest scores are eliminated. Finally the latent demand index is derived as 621.1, which indicates positive opinion of REM.

Note that when the composite confidence index is constructed, the comparing date and value of the index V_2 need adjustment.

4.6 Analysis of the Latent Supply of REM (V3)

The latent supply ability of REM mainly depends on the amount of land to be developed [71]. Due to the limitation of land sources, the government strictly controls the annual amount of land development and its sorts. In general, the government creates new policies annually for land development to ensure reasonable and scientific use of land sources. Otherwise, the latent supply is also influenced by capacity rates. It is because capacity rates will directly affect the development amount of residential building per-unit land area.

4.6.1 Models of the Land Supply Index

4.6.1.1 Models of the Land Inventory Index

The land inventory of this year refers to the land non-utilized among the total amount of land supply last year, including land stored by developers, land needing reissue remised procedures, etc. In Shenzhen there is a great amount of inventory land entering REM and the randomness of inventory land entering the market has a big impact on land market, which influences direct governmental macro control of REM. Therefore, when the latent supply index is constructed, land inventory should be regarded as an important factor. The models of the land inventory index are illustrated as follows.

(1) Construct the model of land inventory index for each of districts

$$I_{ci}^{t} = \frac{L_{ci}^{t}}{L_{ci}^{0}} \times 1000$$

L_{ci}^{0} denotes the land inventory of district *i* in comparing date; L_{ci}^{t} denotes the land inventory of district *i* in report date; I_{ci}^{t} denotes the land inventory index of district *i*.

Table 4-45. is the land inventory index for all districts of Shenzhen.

Table 4-45 The land inventory index for all districts of Shenzhen

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
Index	2266.7	1540.5	2656.7	561.8	1095.9	772.9

(2) To construct the models of land inventory index for Shenzhen

$$I_c^t = \sum w_{ci}^t I_{ci}^t$$

$$w_{ci}^t = \frac{L_{ci}^t}{\sum L_{ci}^t} \times 100\%$$

I_c^t denotes the land inventory index of Shenzhen; w_{ci}^t denotes corresponding weighting coefficients; other parameters are ditto.

The estimation of the land inventory index of Shenzhen is commutated and the result is 1012.7.

Due to the large randomness of land inventory, it is difficult to forecast its change. The prediction may be conducted on the basis of the present status and future trend of REM and the macro economy.

4.6.1.2 Models of the Land Increment Index

Land increment is an important part of land supply and has an absolute effect on real estate supply. Both the construction of the models of land increment index and prediction are subject to the real data of land planning (for instance the data related to land contracts). The models of land increment index are similar to those of land inventory index:

(1) Construct the model of land increment index for each of districts

$$I_{zi}^{t} = \frac{L_{zi}^{t}}{L_{zi}^{0}} \times 1000$$

L_{zi}^{0} denotes the land increment of district *i* in comparing date; L_{zi}^{t} denotes the land increment of district *i* in report date; I_{zi}^{t} denotes the land increment index of district *i*.

The calculation of the land increment index for all districts is shown (see Table 4-46).

Table 4-46 The land increment index for all districts of Shenzhen

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
Index	1108.3	1003.1	1007.2	1017.7	1006.1	1007.3

(2) Construct the models of land increment index for Shenzhen

$$I_{z}^{t} = \sum w_{zi}^{t} I_{zi}^{t}$$

$$w_{zi}^{t} = \frac{L_{zi}^{t}}{\sum L_{zi}^{t}} \times 100\%$$

I_{z}^{t} denotes the land increment index of Shenzhen; w_{zi}^{t} denotes corresponding weighting coefficients; other parameters are ditto.

The index of the land increment of Shenzhen is determined at 1018.6.

4.6.2 Models of the Land Capacity Rate Index

The capacity rate can be determined as the ratio of total construction area to land area for some parcel of land within an urban planning zone. It is then classified into two kinds: actual capacity rate and planning capacity rate. The so-called capacity rate usually refers to the planning capacity rate (i.e. land capacity rate), the ratio of the total construction area permitted to an area of the parcel of land [72]. A capacity rate reflects the intensity and effect of land utilization, which influences the amount of real estate development. Thus it is an important indicator of urban land planning. The land capacity rate index depends mainly on the data associated with land planning. The models of land capacity rate index are shown below:

(1) Construct the model of average capacity rate of land supply of each district

$$\overline{I_{ri}} = \frac{\sum R_{ij} S_{ij}}{\sum S_{ij}}$$

$\overline{I_{ri}}$ denotes the average capacity rate of land supply of district *i*; R_{ij} denotes the capacity rate of land *j* of district *i*; S_{ij} denotes the area of land *j* of district *i*.

The calculation of the average capacity rates of all districts based upon the land supply in 2002 is created (see Table 4-47). The result is presented in Table 4-48.

Table 4-47 The status of land supply of all districts of Shenzhen in 2002

District	Luohu		Futian		Nanshan		Yantian		Baoan		Longgang	
	Parcel	Area (hm^2)	Parcel	Area (hm^2)	Parcel	Area (hm^2)	Parcel	Area (hm^2)	Parcel	Area (hm^2)	Parcel	Area (hm^2)
Housing	0	0	0	0	2	2.59	3	8.02	12	61.48	8	23.35
Comm common facility	0	0	2	1.30	0	0	4	4.32	1	0.80	1	0.40
Government	4	2.36	8	8.61	5	15.47	1	0.13	29	41.55	26	38.86
Industrial warehouse	0	0	0	0	19	118.93	3	3.60	82	296.25	112	383.92
Communication	0	0	0	0	0	0	3	107.93	0	0	4	110.62
Municipal facility	0	0	13	23.46	2	2.31	3	2.26	17	18.98	35	76.77
Others	1	0.08	0	0	0	0	2	0.70	1	1.88	0	0

Table 4-48 The average capacity rate of all districts of Shenzhen in 2002

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
Average rate	1.31	1.76	1.19	1.06	1.17	1.13

(2) Construct the model of average capacity rate of land supply of Shenzhen (idem)

$$\overline{I_r} = \frac{\sum \overline{I_{ri}} S_i}{\sum S_i}$$

$\overline{I_r}$ denotes the average capacity rate of total land supply of Shenzhen; S_i denotes the total area of land supply (including inventory and increment) of district *i*; other parameters are ditto.

The average capacity rate of land supply of Shenzhen in 2002 is computed. The result is 1.21.

(3) Construct the model of the land capacity rate index for each district

$$I_{ri} = \frac{\overline{I_{ri}^{t}}}{\overline{I_{ri}^{o}}} \times 1000$$

I_{ri} denotes the land capacity rate index of district *i*; $\overline{I_{ri}^{o}}$ denotes the average capacity rate of land supply of district *i* in comparing date; $\overline{I_{ri}^{t}}$ denotes the average capacity rate of land supply of district *i* in report date.

Based upon the above model and average capacity rates, the capacity rate indexes can be constructed for all districts (see Table 4-49)

Table 4-49 The capacity rate index for all districts of Shenzhen in 2002

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
Index	1103.1	1198.3	1116.7	1417.1	1231.3	1197.4

(4) Construct the model of the land capacity rate index for Shenzhen

$$I_r = \frac{\overline{I_r^t}}{\overline{I_r^o}} \times 1000$$

I_r denotes the land capacity rate index for Shenzhen; $\overline{I_r^o}$ denotes the average capacity rate of land supply of Shenzhen in comparing date; $\overline{I_r^t}$ denotes the average capacity rate of land supply of Shenzhen in report date.

From the model, the result of the land capacity rate index for Shenzhen in 2002 is 1019.0.

The forecast and future land capacity rate index should be a dependable indicator on urban land planning.

4.6.3 Models of the Latent Supply Index for REM

4.6.3.1 Determine the Weighting Coefficients Concerned

The latent supply index mainly depends on the land inventory index, the land increment index and the capacity rate index and their weighting coefficients are determined as follows:

The capacity rate index adopts an average capacity rate, thus the influence of the index on real estate development is about n ($n=\overline{I_r^t}$) times the effect of land supply index. Thereby, the weighting coefficients of land supply index and capacity index are respectively determined as w_1 and w_2.

$$w_1 = \frac{1}{n+1} = \frac{1}{\overline{I_r^t}+1}$$

$$w_2 = \frac{\overline{I_r^t}}{n+1} = \frac{\overline{I_r^t}}{\overline{I_r^t}+1}$$

For w_1, it involves the weighting coefficients of land inventory index and land increment index, namely w_{11} and w_{12}, which are subject to the proportion.

$$w_{11} = \frac{L_c^t}{L_c^t + L_z^t} \times w_1 = \frac{L_c^t}{(L_c^t + L_z^t)(\overline{I_r^t}+1)}$$

$$w_{12} = \frac{L_z^t}{L_c^t + L_z^t} \times w_1 = \frac{L_z^t}{(L_c^t + L_z^t)(\overline{I_r^t}+1)}$$

Thereinto parameters are ditto.

4.6.3.2 Construction of the Latent Supply Index

The latent supply index for REM is derived from the accumulation of land inventory index, land increment index and capacity rate index, as follows:

$$V_3 = w_{11} \times I_c + w_{12} \times I_z + w_2 \times I_r$$

Thereinto, V_3 denotes the latent supply index; and other parameters are ditto.

The prediction of the latent supply index is calculated based on the above three indexes.

Otherwise, for different kinds of real estate products (such as housing, commercial or office building), their latent supply indexes are calculated respectively.

The latent supply index of each district in 2002 is constructed and shown (see Table 4-50).

Table 4-50 The latent supply index for each district of Shenzhen in 2002

District	Futian	Luohu	Nanshan	Yantian	Baoan	Longgang
Index	1546.2	1295.2	1683.3	1024.2	1141.6	1003.8

And the computation of the latent supply index of Shenzhen in 2002 is established at 1016.6.

4.7 Construction of RECI (V)

According as above description of RECI, RECI is not a single index but a suit of an index system. Through establishing and issuing RECI, REM can be compared, analyzed and predicted lengthwise and breadth wise from many viewpoints and over multi-time dimensions. The composition index is derived through the accumulating all monomial indexes.

4.7.1 RECI Systems

4.7.1.1 Establishment of RECI Systems

First, from the viewpoint of the index, RECI system can be divided into four levels, as shown in Figure 4-10. The first level is synthesized index level, which reflects the developmental status and REM trend of a selected region. The second one is monomial index level, involving efficient D&S index, latent demand index, and latent supply index, which indicates the status of REM through a variety of viewpoints. The third one is sub-index level, which constructs all sub-indexes imaging efficient D&S index, latent demand index, and latent supply index. The fourth one is basic index level, which further analyzes all the above sub-indexes, and these indexes usually engage the attentions of experts and the public.

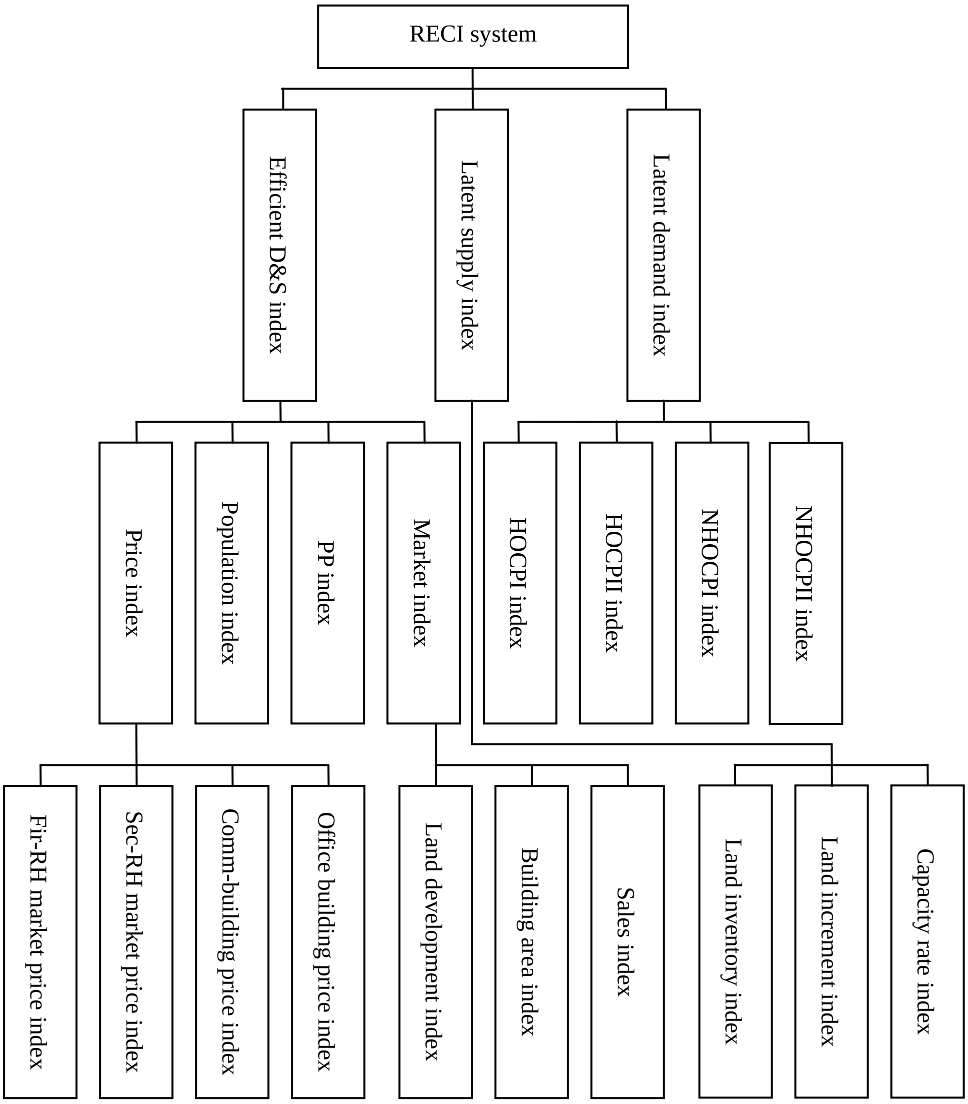


Figure 4-10 The framework of real estate confidence index system (1)

Based on the region, whether synthesized index, or other indexes can be used for analyzing the REM of a district or an area as well as a whole city or country. Figure 4-11 shows its architecture.

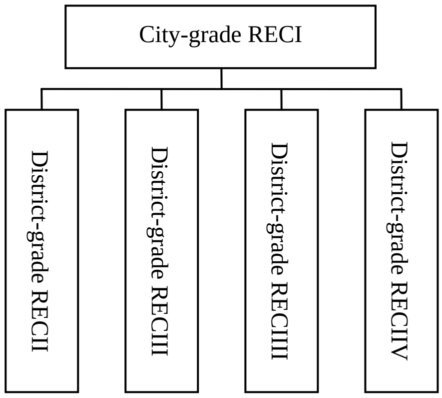


Figure 4-11 The framework of real estate confidence index system (2)

4.7.1.2 Functions of RECI

RECI can be used as a tool of guidance to developers’ investment, and consumers’ consumption, and assist in governmental macro control of REM, which ensures the healthy development of the market.

(1) Synthesized confidence index

It is a integrated index, which synthetically takes into account four factors, namely efficient D&S, latent demand, and latent supply, and entirely reflects the developmental status and trends of REM of a certain region; it is an important mean of weighing the healthy development and optimistic trends of REM in the area. Government, investors, and consumers are able to grasp the trends of REM through the index when it is necessary to make an educated macro control and investment decision better. It plays a leading role in the whole RECI system.

(2) Efficient D&S index

It images the real D&S status of REM through mostly analyzing a selection of factors, such as price, population, etc., influencing the present D&S. Thereby, government, investors, and consumer may know about the D&S status of RE product based upon the index to make decisions. Otherwise, the index can also provide the synthesized index with data concerned.

(3) Latent demand index

It mirrors the social demand for RE product by analyzing the responses of real estate industry expert panelists and populaces in an area to a series of questions about what their opinions are about their market area in the near future. The index not only provides RE developers with knowledgeable information, but also supplies house-purchasers with valuable data and government constituting land planning and construction programming with beneficial information. In addition, it is also the basis of the synthesized index.

(4) Latent supply index

It is an index constructed through analyzing the data about urban planning and industrial programming in order to image the supply level of RE product in the near future. The supply level of RE not only affects the decision making of RE developers, but also influences consumers' purchasing plan. In addition, the index also represents RE development capacity to keep a sustained growth level, which has an important influence on the increment and inventory of RE product and the governmental macro-control trends of REM. Likewise, it also supply relevant data to the synthesized index.

(5) Other indexes

With regards to other applicable indexes, such as the price index, HOCPI index, capacity rate index, Fir-RH market price index, etc., reflect the developmental status of REM from a more microcosmic viewpoint. For instance, Fir-RH market price index images the price status and trends of newly-developed residential housing market, supplying important information to potential house-buyer. Concurrently, they also provide superior indexes for basic data.

4.7.2 Construction of the Models of the Composite Confidence Index

4.7.2.1 Model of the Composite Confidence Index

The composite index is the weighted average of monomial indexes. The model is presented as follows:

$$V = \sum_{i=1}^{3} W_i V_i$$

V denotes the composite index; V_i denotes the monomial index; W_i denotes the weighting coefficient of monomial index i.

Note: The neutral value of the latent demand index is 500 and the bases of both the efficient D&S index and the latent supply index are 1000, the latent demand index needs adjusting when completed.

4.7.2.2 Determination of the Weighting Coefficients of Monomial Indexes

It is important for the composite index method to determine the respective weighting coefficients. Hereon, the research adopts Delphi method to determine the results. The procedures are as follows:

(1) Select experts. Due to the RECI, these experts should be selected in the fields of real estate and macroeconomy.

(2) Introduce and send data related to these experts, answer their problems.

(3) Constitute and send evaluation tables as shown in Table 4-51. Total score is 100 and the scores of all monomial indexes should be positive and within 100.

Table 4-51 The evaluation table of experts

Composite index	Real estate composite confidence index (%)		
Factors	Efficient D&S index	Latent demand index	Latent supply index
Scores	P_{1j}	P_{2j}	P_{3j}

(4) Collect and analyze the opinions of these experts. The result is fed back to these experts which allows for them to rethink their evaluation.

(5) By three or four rounds of evaluation, a reasonable result is derived:

$$W_i = \frac{\sum_{j=1}^{n} P_{ij}}{n} \quad i=1，2，3$$

P_{ij} denotes the score of expert j for index i; n denotes the total number of experts; and W_i is ditto.

Based on the method, the weighting coefficients of all monomial indexes are determined as shown in Table 4-52.

Table 4-52 The weighting coefficients of Shenzhen RECIs

Composite index	Shenzhen real estate composite confidence index (%)		
Monomial indexes	Efficient D&S index	Latent demand index	Latent supply index
Weighting coefficients	30	40	30

4.7.3 Prediction of RECI

The forecast of RECI is an important component of the research on RECI and it may lead or guide government towards better macro control, the investment decision of developers and the purchasing decision of consumers. Furthermore, it also assists in REWS. The forecast not only includes the prediction of composite index but also involves monomial indexes, sub-indexes and basic indexes. The forecast of basic indexes and sub-indexes is the basis of the prediction of other indexes. The forecast of basic indexes has been analyzed above. The following will explore the prediction of other indexes.

4.7.3.1 Prediction of Sub-indexes

From above RECI system, some sub-indexes have basic indexes, such as price index and market index. For these sub-indexes, their forecast is based upon the preceding forecast of basic indexes through utilizing other models. However, other sub-indexes have no basic indexes and their forecast is analyzed as follows. First, the population index and the PP index can be predicted by the index simulation method, such as the MACD; second, the sub-indexes of the latent demand index may be predicted with index simulation method and other related methods, similar to the regression analysis; third, the sub-indexes of the latent supply index, such as land inventory index, land increment index, etc. may be predicted by adopting the data from the urban planning department and industry programming departments. The models have been presented in the above Sections.

4.7.3.2 Prediction of Monomial Indexes and Composite Index

The monomial indexes are based on their sub-indexes, therefore, their prediction is to utilize the forecast results of predetermined sub-indexes. Similarly, the forecast of the composite index is founded on monomial indexes.

4.8 Summary

The main findings of the researches established in this chapter are:

(1) The roles of RECI in macro-control systems are analyzed, the key technologies of constructing RECI are presented and improved, such as facto analysis, Delphi method, composite index method, SPSS software, index simulation, TRECI&BRE index method and so on, according to the characteristics of real estate industry;

(2) Aiming at these 25 factors influencing the efficient D&S of real property, questionnaires are designed, the objectives of investigation are determined, returned questionnaires established the important factors and corresponding weighting

coefficients. By using factor analysis method and SPSS, the analysis of the 25 factors and their index models and forecasting models are established, namely the models of sub-indexes and monomial indexes;

(3) Based on the answers to the questionnaires, such as the opinions of consumers on the status and trend of REM, their scruple to investment, other factors influencing their purchasing real estate or housing, etc, designed the questionnaire and determined the survey methods. Telephone survey, and then constructed the model of the latent demand index via using the TRECI&BRE index method;

(4) Considered the land supply and capacity rate of Shenzhen, the ratio method was applied to the construction of the models of land inventory index, land increment index and capacity rate index for each districts or Shenzhen. The composite index method was adapted to the construction of the composite latent demand index;

(5) Constructed the four-level RECI system, the composite index, monomial indexes, sub-indexes and basic indexes, analyzed the functions of these indexes, the weighting coefficients of all monomial indexes are determined by using the Delphi method and the model of the composite confidence index are established and analyzed the forecast models;

(6) Discovered the data regarding REM in recent years, analyzed the procedures of their models.

CHAPTER 5 SYSTEM SIMULATION AND POLICIES EXPERIMENTS OF REAL ESTATE

5.1 Significance of System Simulation and Policies Experiments in Real Estate Macro-control

The significance of system simulation and policies experiments in real estate macro-control is to help the government departments to know what the situation of REM will be if the government implementing macro-control to the REM. The system simulation and policies experiments of real estate is to emulate the main indicators of Shenzhen commercial housing system and forecast the status value of each indicator through a simulation system; otherwise it can simulate the effect of each of policies via adjusting the parameters of these policies in order to analyze and experiment on these policies and assist in decisions making.

First of all, as to its functions, the research can dynamically emulates real estate system, simulates the evolution trends of multi-indicators, experiments on the policies for real estate and assists in making decisions and real estate dynamic warning.

Then, in terms of theory, the research on real estate system based on SD is a new project in China, and the SD-based real estate dynamic warning system is also a new breakthrough. There are many researches on urban land use based upon SD in China, however it is few to study on real estate system based on SD. The SD-based simulation models for real estate system are not complete about structure, feedback relations and the quantitative description of main indicators. The research is to further discuss these.

Otherwise, with regard to application, it is a new idea to adopt SD to study the real estate system of a city and to apply this to the macro control of REM. At present, there are only some academic discussions in China, and no any applications about this. The research is to deep study Shenzhen real estate system and establishes the policies experiments laboratory for it.

5.2 Establish the Simulation Models for Real Estate System

5.2.1 Theoretical Models of System Simulation

The commercial housing system takes on the typical characteristics of complex systems, i.e. intuition and non-sensitivity for parameters. According to system decomposition principle, the commercial housing system may be divided into four sub-systems: land for housing, housing demand, housing supply, and housing price. These four sub-systems are related each other through production flow, production cost theory and commodities value theory. According to the theory of price fluctuation around value, the research thinks that the price of commercial housing consists of cost (including land cost, construction cost, interest rate, administrative cost and others) and value (maybe negative, called “S&D risk return” in models) formed by the S&D fluctuation of housing market. The S&D risk return involves profits and tax. Based on current profits, real estate developers estimate the expected profits for next a period of time in order to determine whether they try to gain the use right of land or carry out land development. If the S&D risk profit is not enough to pay for the expected profit and governmental tax, the developer is not to develop real estate, namely their developmental aspiration is zero; and on the contrary, it is 1. The main cause-and-effect relation is shown in Figure 5-1. There are eight main feedback loops:

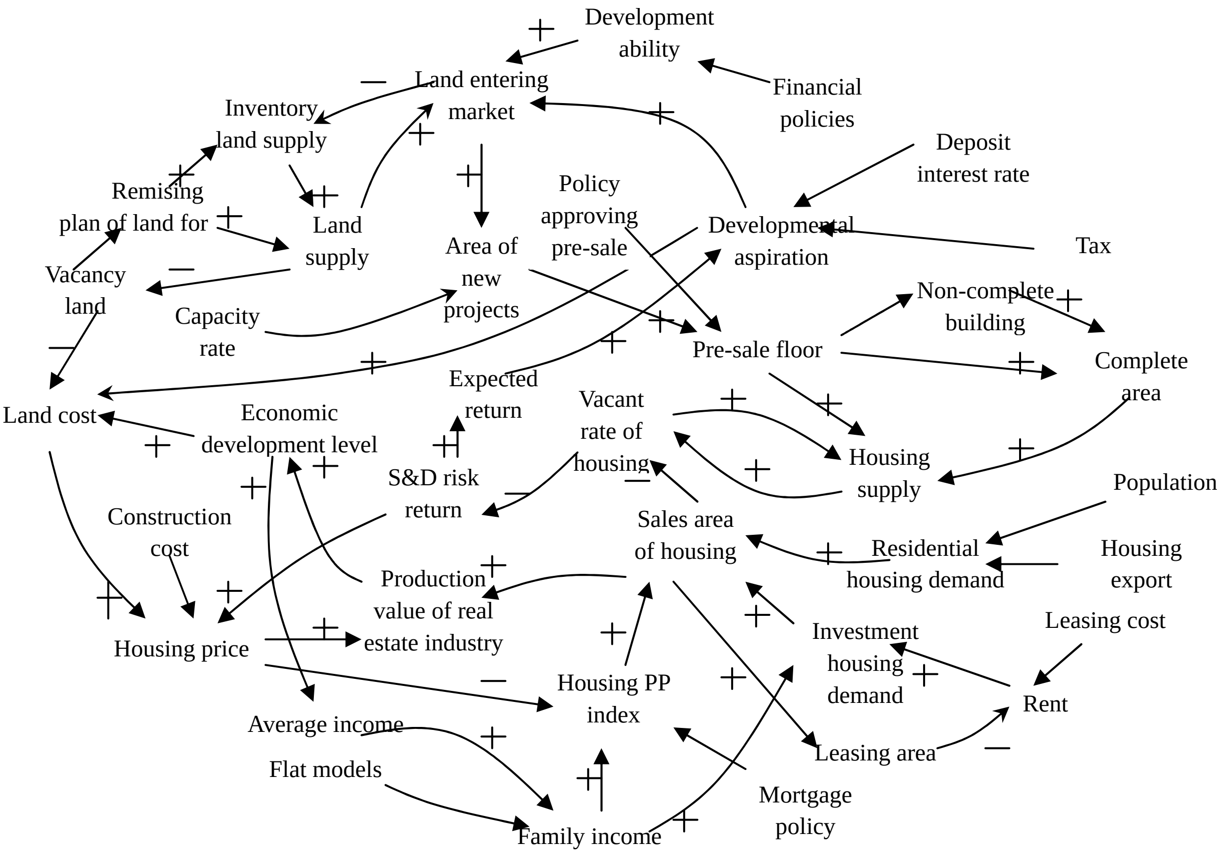


Figure 5-1 The SD-based theoretical model of the system simulation for real estate

(1) Land supply → -Vacant land → +Land supply

The negative feedback loop means that the larger the amount of annual land supply is, the faster the reduction of vacant land is, which makes the annual speed of land supply small.

(2) Housing supply → +The vacant rate of housing → +Housing supply

The positive feedback loop shows that the more housing supply is, the larger housing inventory is, which makes housing supply much more than before.

(3) The sales area of housing → +The production value of real estate industry → +Economic development level → +Average income → +Housing Purchasing Power (PP) index → +Housing sales

The positive feedback loop indicates that housing demand may bring along the development of urban economy which is to enhance the level of average income that will further stimulate the demand of housing.

(4) Housing supply → +The vacant rate of housing→-S&D risk return → +Expected return → +Development aspiration → +Housing supply

The negative feedback loop shows that the oversupply of housing results in a low return which depresses developers’ investment and it further influences housing supply.

(5) The sales area of housing → -The vacant rate of housing → -S&D risk return → +Housing price → -Housing PP index → +Housing demand

The negative feedback loop means that a great deal of housing demand may increase the development return, namely a ascending housing price, which reduces the purchasing power of housing and also reduces the efficient demand of housing.

(6) Land cost → +Housing price → -Housing PP index → +Housing demand → +The efficient ratio of demand to supply → +The benefit of S&D → +Risk profits → +Development aspiration → +Land cost

The negative feedback indicates that an over high land price reduces the residential PP of housing and the demand of housing market which depresses the developers' aspiration that affects land value.

(7) Economic development level → +Land cost → +Housing price → +The production value of real estate industry→+ Economic development level

The positive feedback loop shows that the development of urban economy will accelerate the demand of land for industry, commerce and communication which enhances the price of housing land and housing price; then this also increases the production value of real estate industry and impels the development of urban economy.

(8) Housing rent → +Investment housing demand → +Housing sales → +Leasing area→-Hosing rent

The positive feedback loop means that there is a large correlation between housing leasing and housing sales, namely rent is higher, the aspiration of purchasing housing is stronger, which stimulates the ascend of housing sale and impels the leasing market of housing; and leasing area also influence the rent level.

5.2.2 System Simulation Models of Shenzhen Real Estate

5.2.2.1 Structure of the Model

Based on the theoretical study of the model of real estate system, according to the aims of the research and the situation of Shenzhen REM, the system simulation model of Shenzhen REM selects over 40 variables, which embodies five main feedback loops (see Figure 5-2).

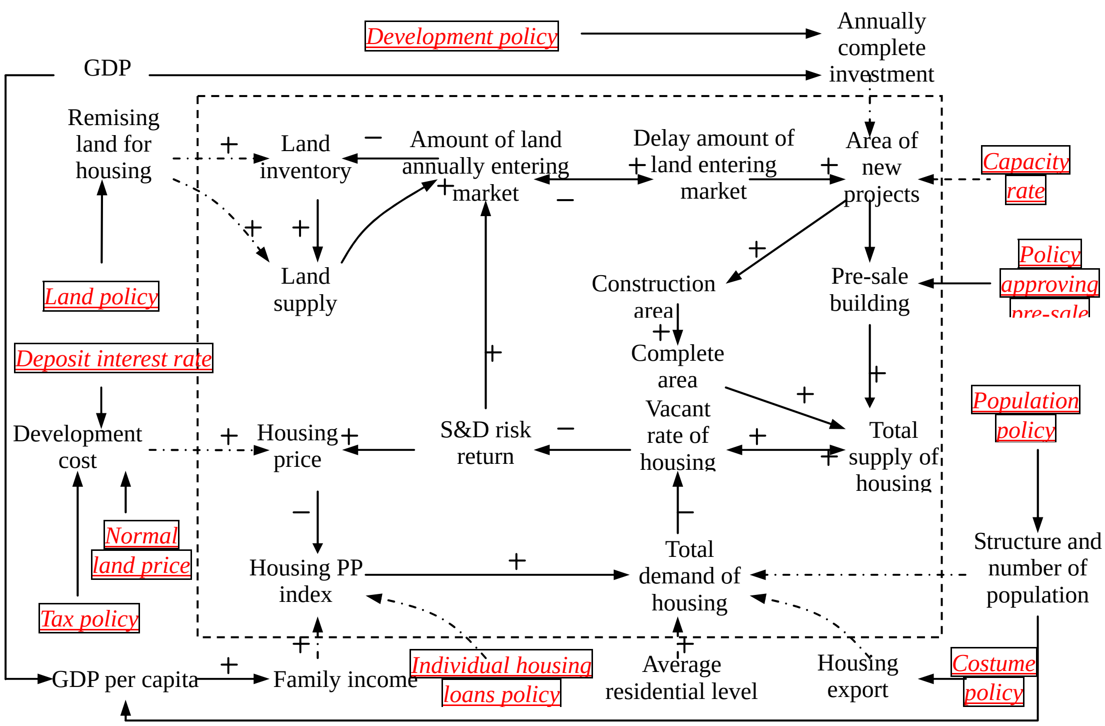


Figure 5-2 The system simulation model of Shenzhen real estate

(1) Housing supply → +The vacant rate of housing → + Housing supply

The positive feedback loop shows that the larger the amount of housing supply is, the more housing inventory is, which leads to much more housing supply.

(2) Housing supply → +The vacant rate of housing → -S&D risk return → +Annual land area entering market → +The area of new project s→ +Housing supply

The negative feedback loop indicates that the oversupply of housing may reduce the investment return and it is to depress the development aspiration of developers which further influence the supply of housing.

(3) Housing demand → -The vacant rate of housing → -S&D risk return → +Housing price → -Housing demand

The negative feedback loop shows that a great deal of housing demand may increase the development return, namely a ascending housing price, which reduces the purchasing power of housing and also reduces the efficient demand of housing.

(4) The amount of land annually entering market → +The delay amount of land entering market → -The amount of land annually entering market

The negative feedback loop means that the large the amount of land annually entering market is, the larger the delay amount of land entering market is, which will restrain the land from entering the market.

(5) Land inventory → +Land supply → +The amount of land annually entering market → -Land inventory

The negative feedback loop shows that with the increase of the amount of land annually entering market, land inventory will reduce gradually.

5.2.2.2 Illumination of Main variables

Owing to the requirement of modeling, several variables, which are seldom involved in traditional researches on real estate, are to be introduced into the model. Otherwise, the definitions and calculation of some main variables are different from those of traditional researches.

(1) Land inventory is described as the land which is left behind and can legally enter into REM at any time.

(2) The amount of land supply is the land which can be provided, including the remising land for housing and land inventory.

(3) The amount of land annually entering market is the area of land annually put into real estate market; and the delay amount of land entering market is the area of land which has been put into market and has not been developed.

(4) The total amount of housing supply is the total area of commercial housing which can be sold.

(5) Housing inventory is the rest of the total amount of housing supply subtracted the total sales area of housing.

(6) The total demand of housing is the real sales area of commercial housing.

(7) Purchasing Power index is usually used to measure the possibility of the change from the theoretical demand of housing to the actual demand of it, and the index is influenced by price, average income, loans policy, etc.

5.2.3 Sub-modules and Relevant DYNAMO Equations

5.2.3.1 Land for Housing

The sub-module of land for housing is involved with the following variables, viz. land supply (GYLAND), the amount of land annually entering the market (RSLAND), and the delay amount of land entering the market (RSNOKF).

- Land supply consists of the remising land for housing (PDPLAN) and land inventory (RESERV). Its equation is following:

A GYLAND.K=PDPLAN.K + RESERV.K

PDPLAN is determined by land administrative department according to urban land planning and it is presented as a table function as follows:

A PDPLAN.K=TABLE(PIDI,TIME.K,1997,2010,1)

RESERV is a state variable and its speed (DRRES) is the difference between PDPLAN and RSLAND. Their DYNAMO equations are following:

L RESERV.K=RESERV.J+DT*DRRES.JK

R DRRES.KL=PDPLAN.K-RSLAND.K

- RSLAND is synthetically influenced by GYLAND, housing demand (DEMAND) and the delay amount of land entering market (RSNOKF). Its equation is derived from multivariable linear recession as follows.

RSLAN1.K=-5.28+0.12*GYLAND.K+0.9*((DEMAND.K/CRPOLI.K)+CJIJ)-0.25*RSNOKF.K

Thereinto, CRPOLI.K is the average capacity rate of housing; RSLAN1 is the forecasting value of RSLAND after 2002.

- RSNOKF is a state variable. DRNOKF denotes its speed and KAIGON denotes the area of new projects. Its equation is following:

L RSNOKF.K=RSNOKF.J+DT*DRNOKF.JK

R DRNOKF.KL=RSLAND.K-KAIGON.K/2.5

Otherwise, the module needs the parameter of land policy (viz. the table function of PDPLAN), land inventory and the delay amount of land entering market in the comparing date. And then it puts out the amount of annually entering market and the delay amount of land entering market. Its structure is shown in Figure 5-3.

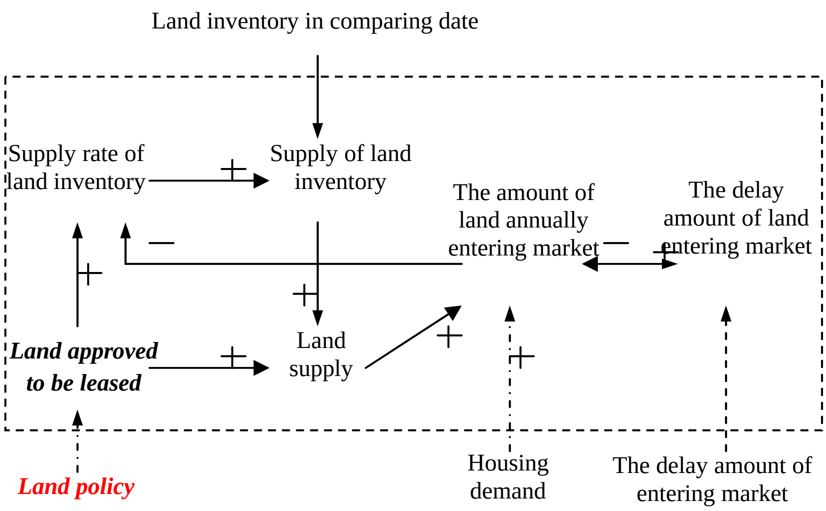


Figure 5-3 The structure of the sub-system of land for housing and its feedback loop

5.2.3.2 Housing Supply

The module of housing supply (SUPPLY) includes the following variables: housing inventory (EMP), pre-sale area approved (PZYUSO) and the area completed but not sold (JUNNYU) and its equation is following:

A SUPPLY.K=EMP.K+PZYUSO.K+JUNNYU.K

- EMP is the difference between the supply amount of housing and the demand amount of housing last year. Its equation is a state equation, thereinto its change rate (DREMP) is the difference between PZYUSO and the demand of housing (DEMAND) at the same year, as follows.

L EMP.K=EMP.J+DT*DREMP.JK

R DREMP.KL=PZYUSO.K-DEMAND.K

- PZYUSO is highly correlated with the area of new projects (KAIGON), as follows:

A PZYUS1.K=YUSOPO*XKAIYU*KAIGON.K

Thereinto, YUSOPO denotes the pre-sale policy; XKAIYU is the ratio of the pre-sale area to the area of new projects.

KAIGON is mainly affected by RSNOKF and annual investment amount completed (NTOUZI), its equation is following:

A KAIGO1.K=151.51+0.44*RSNOKF.K+0.22*NTOUZI.K。

- The DYNAMO equation of JUNNYU is following:

A JUNNYU.K=JUNGON.K*KJUNYU

Thereinto, KJUNYU is a coefficient; and the DYNAMO equation of complete area (JUNNYU) is following:

A JUNGON.K=(1/SGQI.K)*SHIGON.K

And thereinto, SGQI denotes the construction period of commercial housing; SHIGON denotes construction area and is a state variable; DRSGON is a change rate. Equations concerned are following:

L SHIGON.K=SHIGON.J+DT*DRSGON.JK

R DRSGON.KL=KAIGON.K-JUNGON.K

The module needs four parameters of policies, viz. the policy approving to pre-sell, average capacity rate of housing, domestic loan proportion and advance payment policy, and basic parameters, namely GDP growth rate, the construction period of housing, pre-sale proportion and land inventory in comparing date. Finally, its output is mainly the total amount of housing supply. All of these are shown in Figure 5-4.

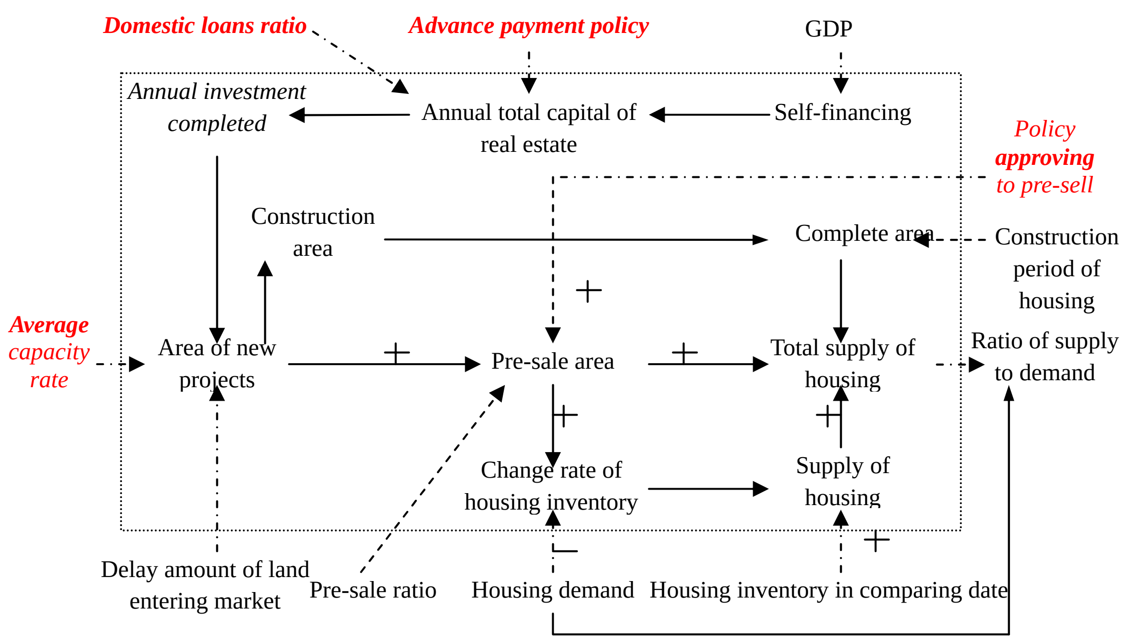


Figure 5-4 The structure of the sub-system of housing supply and its feedback loop

5.2.3.3 Housing Demand

According to total population and the area per capita, urban housing demand may be estimated. However the ratio of the theoretical demand (XUQIU) changed into efficient demand (DEMAND) usually depends on the ratio of housing price to family income. In order to study the influence of price and income on actual demand, the model presents the housing purchasing power (PP) index (GML). The DYNAMO equation of DEMAND is following:

A DEMAND.K=XUQPOL*XUQIU.K*(1+ZUSOUB)*GML.K+WAIXI O.K

Thereinto, XUQPOL denotes the parameter of demand policy; ZUSOUB denotes the ratio of housing lease to sales; and WAIXIO denotes the amount of housing export.

- According to the conditions of Shenzhen, its population is divided registered permanent population and no-registered permanent population and their relevant theoretical demands of housing are HJXUQ and ZZXUQ, as follows.

A XUQIU.K=HJXUQ.K+ZZXUQ.K

The housing demand equation is: housing demand = the increment of population * average area per capita + total population * the increment of the area per capita.

With regard to HJXUQ,

A HJXUQ.K=DRHJPO.KL*HJAVH.K+HJPOP.K*DRHJAV.KL

Thereinto, HJPOP is total registered permanent population; DRHJPO is the increment of registered permanent population; HJAVH is the area per capita of registered permanent population; DRHJAV is the increment of the area per capita of registered permanent population.

HJPOP is a state variable and its change rate is DRHJPO, which consists of the natural growth amount (HJPZR) and the plan growth amount (HJPJX). Their equations are following:

L HJPOP.K=HJPOP.J+DT*DRHJPO.JK

R DRHJPO.KL=HJPZR.K+HJPJX.K

A HJPZR.K=HJPOP.K*CHJPZR

A HJPJX.K=TABLE(HJJXPO,TIME.K,1997,2010,1)

Thereinto, CHJPZR is the natural growth rate of registered permanent population; HJJXPO is a population parameter.

HJAVH is also a state variable and its change rate is DRHJAV, as follows:

L HJAVH.K=HJAVH.J+DT*DRHJAV.JK

R DRHJAV.KL=HJJUZHU

Thereinto, HJJUZHU is the growth rate of per capita residential area.

In terms of ZZXUQ,

A ZZXUQ.K=DRZZPO.K*ZZAVH.K+ZZPOP.K*DRZZAV.KL

Thereinto, ZZPOP denotes total no-registered permanent population; DRZZPO denotes its increment; ZZAVH is the per capita residential area of no-registered permanent population; DRZZAV is its increment.

ZZPOP is an assistant variable and its equation is following:

A ZZPOP.K=POP.K-HJPOP.K

Thereinto, POP is the total population of Shenzhen.

In the model, POP is given actual value from 1997 to 2001, viz. POP2 and forecasting value from 2002 to 2010, viz. POP1 and it can be described with CLIP function, as follows:

A POP.K=CLIP(POP1.K,POP2.K,TIME.K,2002)

L POP1.K=POP1.J+DT*DRPOP1.JK

R DRPOP1.KL=POP.K*DRPO1.K

A DRPO1.K=TABLE(DRP1,TIME.K,1997,2010,1)

Thereinto, DRPOP1 is the change rate of POP1.

The equation of DRZZPO is following:

A DRZZPO.K=DRPOP.K-DRHJPO.KL

Thereinto DRPOP is the increment of total population.

Both ZZAVH and DRZZAV are described with table function, as follows.

A ZZAVH.K=TABLE(ZZAV,TIME.K,1997,2010,1)

R DRZZAV.KL=CLIP(DRZAV1.K,DRZAV2.K,TIME.K,2001)

- Housing PP index GML principally reflects the influence of housing price and family income on the ratio of the theoretical demand changed into the actual demand of housing, and its equation is following:

A GML.K=JIQGML.K*INCOME.K*JIAGE.K

Thereinto, JIQGML is a basic PP index; INCOME is the factor of income; and JIAGE is the factor of price.

JIQGML is calculated with the ratio of housing price to income in 1997 as the comparing index, as follows.

JIQGML.K=YX*(20467*HUXP.K*(1+IN)**(1-XI.K)*(1-(1+IN)**XI.K)/(-IN))/(6250*85)

Thereinto, YX denotes the correction coefficient considering hidden income; HUXP is the average population of each family; IN denotes the growth coefficient of income in comparing date; and XI denotes the reasonable ratio of price to income.

INCOME is involved with the growth rate of income and the flexibility coefficient of income (SRTANX), and the growth rate of income is influenced by the actual growth rate of income (GZSORU) and the growth rate of mortgage loans (AJSORU). Their equations are following:

A INCOME.K=1+(GZSORU.K+AJSORU.K)*SRTANX

A GZSORU.K=(INCOM.K/1597)-1

A AJSORU.K=AJK*(ANJIE.K/AJ1997.K)

Thereinto, AJK is the coefficient of mortgage loans changed into actual loans; ANJIE is the annual mortgage loans; AJ1997 is mortgage loans in comparing date. And the equation of ANJIE is following:

ANJIE.K=(AJY1.K*(1-Q.K**N.K)/(1-Q.K))/(SOUQI.K*HOUSEP.K*MJ.K*(1+AJLIXI.K)**N.K)

In fact, ANJIE is an index in the model, namely a ratio of capital used to pay for housing to total mortgage loans, which is under the condition of no effect on the common life of residents. Thereinto, AJK1 and Q can be calculated as follows:

A AJY1.K=GFZICU*INCOM.K*HUXP.K*(1+IN.K)*(1+AJLIXI.K)** (N.K-

1)

A　Q.K=(1+IN.K)/(1+AJLIXI.K)

Thereinto, GFZICU is the ratio of payment to income; AJLIXI is the interest rate of mortgage loans; N is the period of loans; INCOM is the per capita income; HUXP is the average population of each family; and others are ditto.

IN is the rate of income increment, affected by the GDP per capita, as follows:

A　IN.K=GDPZLV.K*0.48

The factor of flat housing price (JIAGE) is calculated as follows:

A　JIAGE.K=1-JGK*(HOUSEP.K*MJ.K-6280*85)/(6250*85)

Thereinto, JGK is the flexibility coefficient of flat price; and MJ is the area of a flat, a state variable, and DRMJ is its change rate as follows.

L　MJ.K=MJ.J+DT*DRMJ.JK

R　DRMJ.KL=CDRMJ*MJ.K

- WAIXIAO is a table function in the model, as follows:

A　WAIXIAO.K=TABLE(WAIXIA,TIME.K,2002,2010,1)

And ZUSOUB in the model is the ratio of lease to sale, is a parameter.

In the module, the following parameters should be input, namely population policy, custom policy and mortgage loans policy (including down-payment, period and interest rate); and the following value should be input, viz. the natural growth rate of registered permanent population, registered permanent population in comparing date, the ratio of lease to sales, the ratio of housing export, the flexibility coefficient of price, the flexibility coefficient of income, the flat area in comparing date, the growth rate of flat area, per capita income, the average population of each family, the growth rate of per capita income, the per capita residential area of registered permanent population in comparing date, the growth rate of the per capita residential area of registered permanent population, the per capita residential area of no-registered permanent population in comparing date, the growth rate of the per capita residential area of no-registered permanent population, total population in comparing date, and the growth rate of total population. And this module educes the demand of housing in the end (see Figure 5-5).

5.2.3.4 Housing price

The price of commercial housing (HOUSEP) is a state variable, and its change rate is DRHP. Its equation is following:

L HOUSEP.K=HOUSEP.J+DT*DRHP.JK

R DRHP.KL=COST.K*(1+RETURN.K)-HOUSEP.K

Thereinto, COST is the cost of housing; RETURN is the rate of return.

- Cost (COST) includes the land price (LANDP), development cost (KAIFCB) and other cost (QITA), and its equation is following:

A COST.K=(LANDP.K+KAIFCB.K+QITA.K)*(1+LXPOLI.K)**PERI O1

Thereinto, LXPOLI is the interest rate of development loans; PERIO1 is the period of loan.

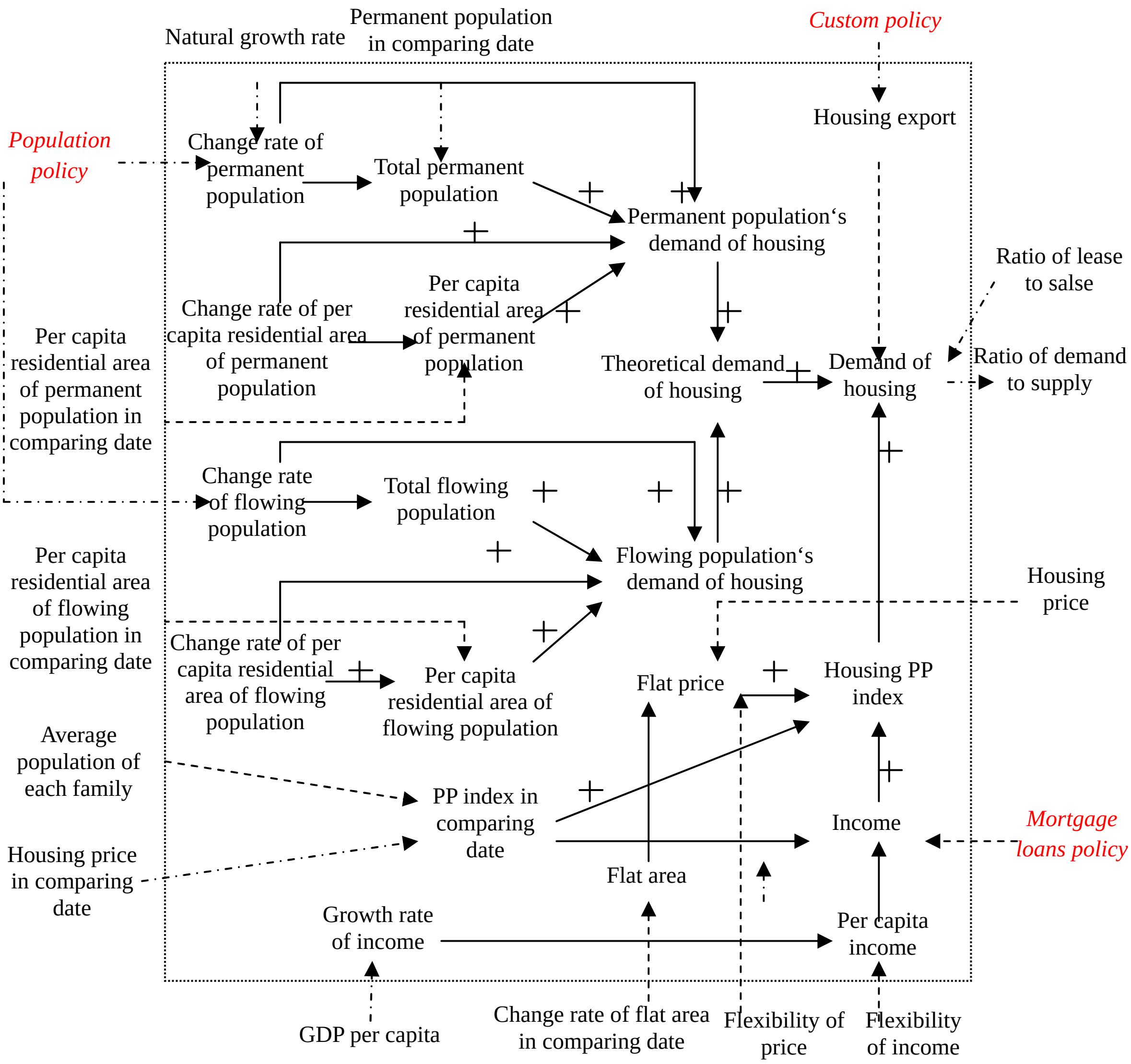


Figure 5-5 The structure of the sub-system of housing demand and its feedback loop

LANDP is a state variable and its change rate is DRLANP, calculated as follows:

L LANDP.K=LANDP.J+DT*DRLANP.JK

R DRLANP.KL=LANDP.K*CLANDP

KAIFCB is an assistant variable, as follows:

A KAIFCB.K=JIANAN.K/CJIAN

Thereinto, JIANAN is construction cost, a state variable, and its change rate is DRJIAN; CJLAN is the ratio of construction cost to development cost.

The equation of JIANAN is following:

L JIANAN.K=JIANAN.J+DT*DRJIAN.JK

R DRJIAN.KL=JIANAN.K*CCJIAN

And QITA involves administrative cost, advertisement cost, and others, as follows:

A QITA.K=HOUSEP.K*QT

- RETURN is the function of the ratio of demand to supply (RATE), as follows:

A RETURN.K=B1.K*RATE.K**NUM+B2.K

A B2.K=-(2LXPOLI.K+J)

A B1.K=(2LXPOLI.K+J)**(1-NUM)*(P1+2LXPOLI.K+J)**NUM

Thereinto, B1 and B2 are parameters; J is the coefficient of housing depreciation; P1 is the average return rate, and NUM is a coefficient

In the module, some parameters of policies, viz. the interest rate of development loans, land price, and tax, are needed. And some variables are required, such as construction cost and its growth rate in comparing date, the ratio of construction cost to development cost, the period of loan to sales, price in comparing date, land price in comparing date, depreciation efficient; the ratio of other cost to price. The result simulated is Housing PP index. The structure and feedback loop of the module is shown in Figure 5-6.

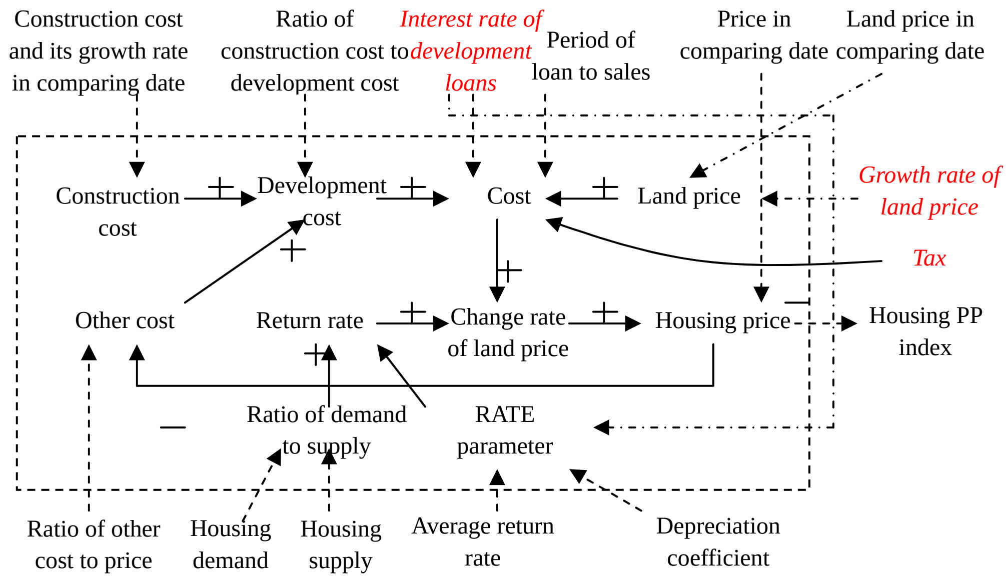


Figure 5-6 The structure of the sub-system of housing price and its feedback loop

All DYNAMO equations are shown in Appendix 7.

5.2.4 Main Equations and Parameters

According to above DYNMO equations, some parameters among them are to be presented via depending on Shenzhen real estate market as follows.

5.2.4.1 Land for Housing

(1) The annual planned area of remising land for housing (PIDI) is a table function. The data of land planning from 1999 to 2010 is derived from *Developmental Strategy for Shenzhen Real Estate Market* [73] as shown in Table 5-1.

Table 5-1 Shenzhen planned land for commercial housing from 1999 to 2010

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	合计
215	218	212	200	190	182	173	165	157	150	150	150	2162

(unit: ten-thousand square meters)

(2) The supply of land inventory in comparing date (1997), RESERV is equal to 716 ten-thousand square meters. It is derived from historic data (397+7+180+132=716), viz. *Developmental Report about Shenzhen Real Estate 2002~2003* [74].

(3) Annual amount of land entering market for housing (RSLAND.K). Via multivariable regression analysis, the equation is determined as follows:

$$RSLAN1.K=-5.28+0.12*GYLAND.K+0.9*((DEMAND.K/CRPOLI.K)+CJIJ)-0.25*RSNOKF.K$$

(4) Calculate the area of land for housing (JIJLAN.K) (including new housing and housing rebuilt). Based on *Yearbook of Shenzhen Real Estate*, JIJLAN fluctuates around 120 ten-thousand square meters since 1993. Considering the continuous ascend of capacity rate from 1993 on, JIJLAN is estimated as 60 ten-thousand square meters.

(5) Development aspiration (POPULA), its value is 0 or 1. Suppose

A=Housing value – Cost – Tax – Expected return

In theory, if A>0, then POPULA=1; if A<0, then POPULA=0.

However, in fact the cost and return of all enterprises is different. Some enterprises think that the investment is losing and their aspiration is zero; but some others think that the investment is profitable and their aspiration is 1. If the profitability of an enterprise is measured with its livingness, all livingness value of all enterprises takes on normal distribution in a city or an area, namely the number of enterprises with weak or strong livingness is less. Considering the reality of Shenzhen real estate market, POPULA is given 1 in the model.

(6) The delay amount of land entering market (RSNOKF.K) is calculated as follows.

L RSNOKF.K=RSNOKF.J+DT*DRNOKF.JK

R DRNOKF.KL=RSLAND.K-KAIGON.K/2.5

N RSNOKF=418

Thereinto, RSNOKF in comparing date is 418 ten-thousand square meters, which is calculated according to the data from 1991 to 1997 and capacity rate, “2.5”.

5.2.4.2 Housing Supply

(1) Constructing area (SHIGON). Its value in comparing date is 966.19 ten-thousand square meters according to *Yearbook of Shenzhen Real Estate 1997*.

L SHIGON.K=SHIGON.J+DT*DRSGON.JK

R DRSGON.KL=KAIGON.K-JUNGON.K

N SHIGON=966.19

(2) The average capacity rate of housing (CRPOLI.K) is described with a table function. In view of the reduction of land of Shenzhen, the capacity rate will ascend. (Source of data: Sampling investigation and *Developmental Strategy for Shenzhen Real Estate Market* [73]).

CRPOLI.K=TABLE(CR,TIME.K,1997, 2010,1)

CR=1.98/2.05/2.3/2.4/2.5/2.68/2.5/2.5/2.6/2.7/2.8/2.8/2.9/2.9

(3) The parameter of policy approving pre-sale (YUSOPO) describes the ratio of presale area to total area of new projects, 0.9 in the model.

(4) The presale area approved from 1997 to 2001 is following: (Source of data:

Yearbook of Shenzhen Real Estate 2002 [75]).

PZYUS2.K=TABLE(PZYS,TIME.K,1997,2001,1)

T PZYS=349.54/498.60/538.77/597.90/607.14

(5) Construction period of commercial housing is given one year.

(6) Housing inventory (EMP.K) is a state variable. According to *Yearbook of Shenzhen Real Estate* [76], it is given 270 ten-thousand square meters (619.54-349.54=270) as its basic value. The equations are following:

L EMP.K=EMP.J+DT*DREMP.JK

N EMP=270

R DREMP.KL=PZYUSO.K-DEMAND.K

(7) Housing supply (SUPPLY.K) in comparing date (1997) is given 619.54 ten-thousand square meters (349.54+191.94+(305.63-110.48)*0.4=619.54), and relevant equations are following:

L SUPPLY.K=SUPPLY.J+DT*DRSUPP.JK

N SUPPLY=619.54

R DRSUPP.KL=(EMP.K+PZYUSO.K)-SUPPLY.K

(8) The area of new projects (KAIGON.K). Based upon the analysis of statistic data, the correlation coefficients between it and RSLAND.K and TOUZI.K are 0.8657 and

0.9069 respectively. Via a regression analysis, the regression equation is derived as follows:

A KAIGON.K=-3.67+0.65*RSLAND.K+1.72*TOUZI.K

5.2.4.3 Housing Demand

(1) The demand of housing (DEMAND.K) is influenced by the theoretical demand of housing (XUQIU.K) and PP index (GML.K) which not only takes into account the residents' ability to purchasing house but also involves the residents' demand of investment. Otherwise, the demand of housing is also affected by mortgage patterns or preferential policy for purchasing housing, viz. the parameters of policies (XUQPOL). Its equation is following:

A DEMAND.K=XUQ.K*XUQIU.K*(1+ZUSOUB)*GML.K+WAIX IO.K

Thereinto, XUQ.K is the table function of XUQPOL.

(2) For XUQPOL is mainly affected by mortgage patterns or preferential policy for purchasing housing, due to the effect of Asian Finance Crisis on Shenzhen, the demand in 2000 ascends a little, XUQPOL is given 1.05; and others are given 1, as follows.

A XUQ.K=TABLE(XUQPOL,TIME.K,1997,2010,1)

T XUQPOL=1/1/1/1.05/1/1/1/1/1/1/1/1/1/1

(3) PP index (GML.K) mainly reflects the residents' ability to purchase house. According to the experiences of experts, first the research determines the reasonable ratio of price to income (MINDEX), then calculates total income during a reasonable period of time and compares the total income with flat value. Otherwise, the change of income (INCOME) and the change of flat value (JIAGE) should be considered. It may be calculated as follows.

A GML.K=JIQGML.K*INCOME.K*JIAGE.K

Thereinto, PP index in comparing (JIQGML) is presented in Section 5.2.3.3.

(4) Income factor (INCOME), the increment of wage (GZSORU), the increment of mortgage (AJSORU) and mortgage loans (ANJIE) are calculated as Section 5.2.3.3.

(5) The growth rate of per capita income (IN.K) is mainly affected by GDP per capita, as follows:

A IN.K=GDPZLV.K*0.48

Thereinto, GDPZLV is the growth rate of GDP per capita; 0.48 means that if GDP increase 1%, IN will increase 0.48% which is derived from statistic data from 1991 to 2002.

(6) YINXIN is the correction efficient of income (hidden income), and is given 1.35.

SOUR.K is the total family income within a reasonable period of time.

(7) The average population of family (CHUXP) is given 3.41 gained from *Yearbook of Shenzhen Real Estate*.

(8) Housing export (WAIXIO.K) is given real value from 1997 to 2001 and is presented estimated value from 2002 on, which is derived from *Yearbook of Shenzhen Real* Estate [75] and *Developmental Strategy for Shenzhen Real Estate Market* [76].

A WAIXIO.K=CLIP(WAIX1.K,WAIX2.K,TIME.K,2002)

A WAIX1.K=TABLE(WAIXIA,TIME.K,2002,2010,1)

T WAIXIA=50/50/50/50/50/50/50/50/50

A WAIX2.K=TABLE(WAIX,TIME.K,1997,2001,1)

T WAIX=23.06/28.95/48.33/58.48/52.01

(9) Total population (POP) from 1997 to 2001 is presented as a table function POP2.K in the model; and from 2002 to 2010, it is evaluated as a state variable POP1.K which regards 2001 as the comparing date, and its change rate is given 0.048 according to the *Research Report for Population*.

A POP.K=CLIP(POP1.K,POP2.K,TIME.K,2002)

A POP2.K=TABLE(POP20,TIME.K,1997,2001,1)

T POP20=379.6/395/405.1/430.9/468.8

L POP1.K=POP1.J+DT*DRPOP1.JK

N POP1=468.8

R DRPOP1.KL=POP10.K*POP1.K

A POP10.K=POP1PO*(-(TIME.K-1996)**3+3600)/3601

C POP1PO=0.048

(10) The registered permanent population (HJPOP.K) of 1997 is given 109.46, and its change rate includes planned increment (HJPJX.K) and natural increment (HJPZR.K), as follows.

L HJPOP.K=HJPOP.J+DT*DRHJPO.JK

N HJPOP=109.46

R DRHJPO.KL=HJPZR.K+HJPJX.K

A HJPZR.K=HJPOP.K*CHJPZR

C CHJPZR=0.01

A HJPJX.K=TABLE(HJJXPO,TIME.K,1997,2010,1)

T HJJXPO=4/4/4.06/4.5/6/5.5/5.5/5.5/5.5/5.5/5.5/5.5/5.5/5.5

Thereinto, CHJPZR is natural growth rate; HJJXPO is planned growth rate.

(11) No-registered permanent population (ZZPOP.K) and its increment (DRZZPO.K) are calculated as follows.

A ZZPOP.K=POP.K-HJPOP.K

A DRZZPO.K=DRPOP1.KL-DRHJPO.KL

(12) Per capita residential area of registered permanent population (HJAVH.K).

According to *Developmental Strategy for Shenzhen Real Estate Market* [73], it has been up to 30.6 square meters in 1998. Based on the experience of overseas city, its growth would be limited, thus its growth rate from 1999 to 2010 is given 1/3.41 sqm/year and the growth rate before 1999 is 1 sqm/year in the model.

A HJAVH.K=CLIP(30.6,HJAVH1.K,HJAVH1.K,30.6)

L HJAVH1.K=HJAVH1.J+DT*DRHJA1.JK

N HJAVH1=28.6

R DRHJAV.KL=1/3.41

R DRHJA1.KL=CLIP(0,1,TIME.K,1999)

(13) Per capita residential area of no-registered permanent population (ZZAVH.K). In the model, ZZAVH.K from 1997 to 2001 can be derived from the total population, per capita residential area, the per capita residential area of registered permanent population, registered permanent population and no-registered permanent population, as a table function ZZAVH2.K. ZZAVH.K from 2002 to 2010 is determined as a state variable ZZAVH1.K, whose rate is 0.489, the average calculated from the actual data since 1991.

A ZZAVH.K=CLIP(ZZAVH1.K,ZZAVH2.K,TIME.K,2002)

A ZZAVH2.K=TABLE(ZZAVH0,TIME.K,1997,2001,1)

T ZZAVH0=7.997/9.046/11/12.047/12.224

L ZZAVH1.K=ZZAVH1.J+DT*DRZZAV.JK

N ZZAVH1=12.224

R DRZZAV.KL=ZZAVPO

C ZZAVPO=0.489

(14) The ratio of lease to sales (ZUSOUB) is given 0.03 based upon the *Developmental Strategy for Shenzhen Real Estate Market*.

(15) The calculation of the theoretical demand of housing (XUQIU.K), the registered permanent population's demand of housing (HJXUQ.K) and the no-registered permanent population's demand of housing (ZZXUQ.K) is the same as those in Section 5.2.3.3.

(16) Influence efficient of per capita income on PP (SRTANX) is presented 0.585, based upon the *Developmental Strategy for Shenzhen Real Estate Market*.

(17) Influence efficient of flat price change on PP (JGK) is given 0.7, gained from *Yearbook of Shenzhen Real Estate*.

(18) The ratio of residents' payment for housing (GFZICU) is given 20%. In USA, the research on "acceptant housing policy" shows that it is unacceptant that per capita income is below the medium income of a whole country or state, and more than 25%-30% of annual family income needs paying for housing. Based on the data of 2002, per capita income is 2714.77 Yuan monthly for a medium-income family in Shenzhen and the deposit end of a month is 1079.88 Yuan. Considering current payment for education, medical treatment, etc, under the condition of not influencing basic life, the ratio should be 20% ((1079.88/2)/2714.77).

(19) The period of mortgage loan can be gained from sampling investigation, as follows:

A N.K=TABLE(YEARPO,TIME.K,1997,2010,1)

T YEARPO=7.14/18.3/19/19.2/20.8/24.9/25/25/25/25/25/25/25/25

(20) The down-payment of mortgage loan (SOUQI) is derived from *Yearbook of Shenzhen Real Estate*.

A SOUQI.K=TABLE(SOQIPO,TIME.K,1997,2010,1)

T SOQIPO=.642/.681/.676/.69/.71/.75/.78/.8/.8/.8/.8/.8/.8/.8

(21) The interest rate of mortgage loan (AJLIXI) is also gained from *Yearbook of Shenzhen Real Estate*.

A AJLIXI.K=TABLE(AJLXPO,TIME.K,1997,2010,1)

T JLXPO=.088/.076/.053/.053/.053/.042/.042/.042/0.04/.04/.04/.04/.04/.04

5.2.4.4 Housing price

(1) Housing price (HOUSEP.K) is a state variable and its value in comparing date (1997) is given 6250 Yuan (Source of data: *Developmental Report about Shenzhen Real Estate 2002~2003* [74]), as follows.

L HOUSEP.K=HOUSEP.J+DT*DRHP.JK

N HOUSEP=6250

R DRHP.KL=COST.K*(1+RETURN.K)-HOUSEP.K

(2) Cost (COST.K) is presented in Section 5.2.3.4, as follows.

A COST.K=(LANDP.K+KAIFCB.K+QITA.K)*(1+LXPOLI.K)**PERI O1

(3) The time from gaining the land use right to presale is 1.7 years, and considering other delay factors, the time for interest rate (PERIO1) is 2 years.

(4) The tax rate of commercial housing (SUIPOL) is given 0.061.

(5) The interest rate of real estate development loans (LXPOLI.K) is described with a table function as follows. (Source of data: *Yearbook of Shenzhen Real Estate 2002* [75])

A LXPOLI.K=TABLE(LX,TIME.K,1997,2010,1)

T LX=.1/.08/.0594/.0594/.0594/.0594/.0594/.0594/.0594/.0594/.0594
/.0594/.0594/.0594

(6) Development cost (KAIFCB.A) consists of construction cost, infrastructure cost, etc, as follows. In general, construction cost is about 65%, namely CJIAN is equal to 0.65.

A KAIFCB.K=JIANAN.K/CJIAN

(7) Construction cost (JIANAN.K) is a state variable; its value in comparing date (1997) is given 1450 Yuan (Derived from *Yearbook of Shenzhen Real Estate 2002* [75]) and its change rate is 0.01.

L JIANAN.K=JIANAN.J+DT*DRJIAN.JK

R DRJIAN.KL=JIANAN.K*CCJIAN

C CCJIAN=0.01

N JIANAN=1450

(8) Land price (LANDP.K) is a state variable; its value in comparing date (1997) is evaluated as 1320 Yuan (*Yearbook of Shenzhen Real Estate 2002* [75]) and its growth rate is given 0.005.

L LANDP.K=LANDP.J+DT*DRLANP.JK

R DRLANP.KL=LANDP.K*CLANDP

C CLANDP=0.005

N LANDP=1320

(9) The relation between the return rate of commercial housing (RETURN.K) and the ratio of demand to supply (RATE.K). Due to the positive direct ratio between RETUEN.K and RATE.K, their relation may be described as the function:

$$RETURN.K=a*RATE.K^{n}+b$$

The analysis about this is following:

$$SUPPLY(1+LXPOLI+RETURN)=DEMAND(1+LXPOLI+P1)+(SUPPLY-DEMAND)(1-J-LXPOLI)$$

Thereinto, P1 is the average return rate of housing sold; LXPOLI is the interest rate of development loans; and J is the annual depreciation rate.

Then,

$$RETURN=RATE*(P1+2R+J)-2R-J$$

If RATE=0, namely efficient demand is equal to zero, then RETURN=-(2R+J); and if RETURN=0, RATE=(2R+J)/(P1+2R+J). Thus,

$$a=(2R+J)^{(1-N)}*(P1+2R+J)^{N}; \qquad b=-(2R+J)。$$

A RETURN.K=B1.K*RATE.K**NUM+B2.K

A B2.K=-(2LXPOLI.K+J)

A B1.K=(2LXPOLI.K+J)**(1-NUM)*(P1+2LXPOLI.K+J)**NUM

Thereinto, J=0.0143 (70 years depreciation) ; P1=0.208 (Gained from *Yearbook of Shenzhen Real Estate 2002* [75]); NUM=2.4 (Derived from historic data via simulation).

5.3 Test of the Simulation Model

5.3.1 Results of Running

The simulation model established above totally consists of 12 indicators, viz. sales area, land supply, complete area, the area of new projects, presale area approved, the ratio of supply to demand, housing supply, housing inventory, housing price, land inventory, the delay amount of land entering market, and the amount of land entering market. According to the analysis of some parameters mentioned above, these 12 indicators are simulated based on the comparing date 1997, shown in Table 5-2. Thereinto, the unit of housing price is Yuan/sqm; the ratio of supply to demand has no unit; and the units of other indicators are ten-thousand square meters. Otherwise, complete area, the area of new projects and presale area approved presented in the table are real value from 1997 to 2001 and forecast value from 2002 to 2010; and other indicators is forecast value from 1998 to 2010 based on their value in 1997. Hereon, sales area, the area of new projects and housing price are to be regarded as examples to test the model.

Table 5-2 The system simulation of Shenzhen commercial housing from 1997 to 2010

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sales area	340.8	379.8	489.0	548.6	576.4	641.2	646.8	659.7	635.6	606.7	581.1	555.6	522.1	509.7
Land supply	1062	1197	1095	976.3	863.3	511.3	568.3	573.8	551.0	519.8	484.1	445.4	411.8	386.4
Complete area	***243.3***	***353***	***467***	***552***	***622***	575.8	635.5	662.9	670.1	669.1	664	656.2	646.8	635.2
Area of new projects	***300***	***393***	***620***	***578***	***712***	755	717.8	684.5	667.2	653.6	640.8	627.9	612.1	591.6
Pre-sale area approved	***349.5***	***498.6***	***538.7***	***577.9***	***647.1***	679.5	646.1	616.1	600.4	588.2	576.7	565.1	550.9	532.5
Ratio of supply to demand	1.888	2.124	1.979	1.954	2.037	2.002	2.001	1.920	1.901	1.913	1.945	2.004	2.122	2.191
Housing supply	643.8	806.8	968.3	1072.	1174	1284	1295	1267	1208.	1160.	1130.	1113	1108	1117.
Housing inventory	270	278.6	397.3	447.0	476.3	547.0	585.3	584.5	540.8	505.8	487.2	482.8	492.3	521.1
Housing price	6250	5986.	5648.	6012.	6161.	6058.	6153.	6205.	6435.	6560.	6594.	6570.	6481.	6293.
Land inventory	716	814	900	720.6	526.3	361.3	378.3	391.8	378.0	354.8	327.1	295.4	261.8	236.4
Delay amount of land entering market	418	546	685.8	812.8	1031.	1248.	1079.	969.1	891.0	820.4	751.6	684.0	616.4	547
Amount of land annually entering market	248	297	375	450	502	133	176.6	195.7	196.3	192.7	188.7	183.6	175.4	175.2

From Figure 5-7, Shenzhen demand of commercial housing from 1997 to 2004 ascends splendidly; the sale from 2002 to 2006 is in the bloom, over 600 ten-thousand square meters; and the demand of housing after 2006 descends obviously, but above 500 ten-thousand square meters.

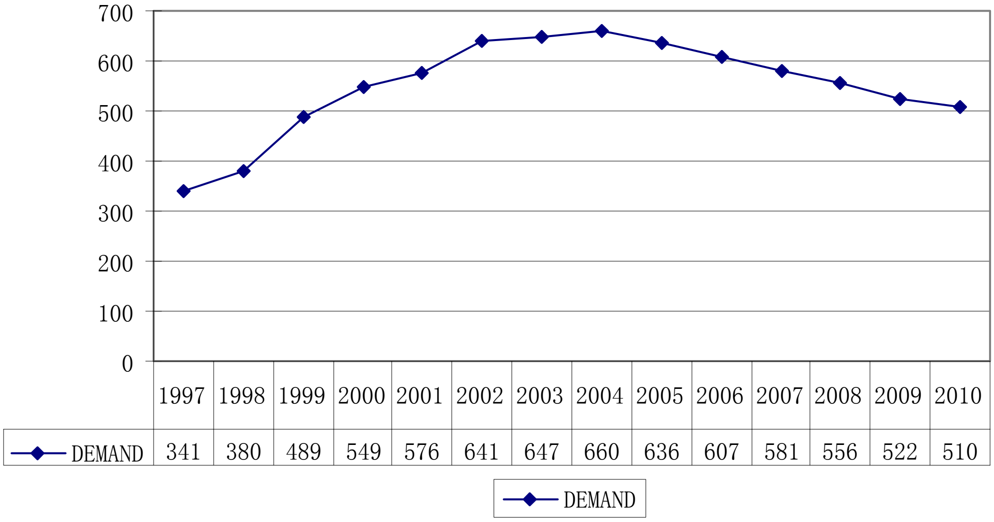


Figure 5-7 The simulation of sales area from 1997 to 2010

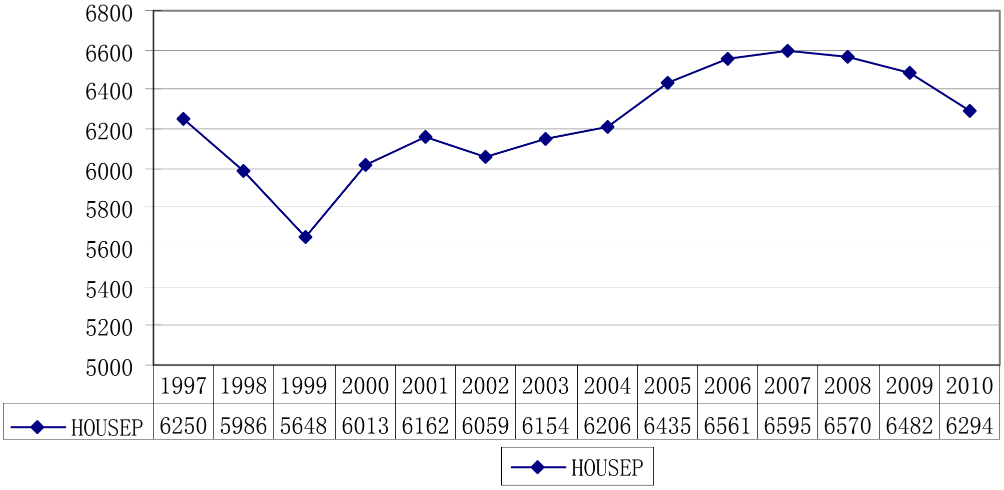


Figure 5-8 The simulation of *housing price* from 1997 to 2010

Figure 5-8 shows that housing price generally fluctuates around 6100 yuan/sq.m. from 1997 to 2010 in Shenzhen and is stable. However, its change is different in short term. From 1997 to 2004, the price fluctuates around 6000 yuan/sq.m. After 2004, it ascends slowly and until 2008, it also descends. The reasons for these is following: one is that with the maturation of REM, the relation of supply and demand will become more and more reasonable and purchasing action and development action will become more rational; the second one is that due to the large-scale increase of land entering market, housing supply is to ascend in the recent three years, which leads to the descend of housing price; the third one is that there is usually a low demand period after the price ascends, which will make the price down.

And Figure 5-9 indicates that the area of new projects ascends stably from 1997 to 2002. Especially in 2002 it was up to 755 ten-thousand square meters and then descended. It maintains 600-700 ten-thousand square meters from 2004 to 2010.

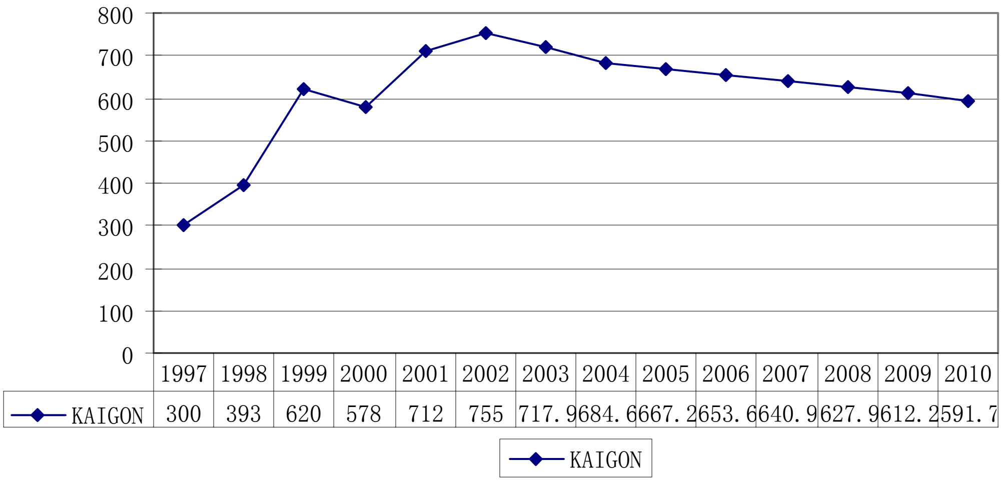


Figure 5-9 The simulation of *area of new projects* from 1997 to 2010

5.3.2 Analysis of Trends

According to the simulation of Shenzhen commercial housing system, from 1997 to 2010 housing price fluctuates around 6100 Yuan and the ratio of supply to demand is 1.9 to 2.2. In general, Shenzhen commercial housing system is much more stable and reasonable. But owing to a great deal of land entering market from 1999 to 2001, the supply of following 2-3 years would be over. The details are as follows:

(1) Land for housing

Land for housing involves land supply, land inventory, the amount of land entering market and the delay amount of land entering market. The amount of land supply descends rapidly from 1998 to 2001, and until 2002 it is stable, 500 ten-thousand square meters. The amount of land inventory descends rapidly from 1999 to 2002, and is table gradually from 2003 to 2007, 300 ten-thousand square meters. The amount of land annually entering market reaches a peak from 1999 to 2001 and is stable from 2002 to 2004, about 200 ten-thousand square meters. The delay amount of land entering market reaches a peak in 2002, and then declines little by little. The result shows that from 1999 to 2001, due to the stimulation of the demand of housing, the amount of land entering market increases a great deal, which uses up a large amount of land inventory and leads to the reduction of land supply and the increase of land of entering market. And with the increase in governmental control of remising land, the remising land for housing reduces gradually; otherwise, the government also adjusts the relation between supply and demand of housing. All of these make land market stable gradually.

(2) Housing supply

Housing supply involves the area of new projects, constructing area, complete area, the pre-sale area approved, housing inventory, housing supply, etc, among which the area of new projects, housing inventory and housing supply are analyzed as three key indicators. From 1997 to 2002, owing to the influence of the increase of demand, land supply and investment, the area of new projects ascends obviously and reaches a peak.

Then it descends gradually and maintains 600-700 ten-thousand square meters. The supply of commercial housing reaches a peak from 2002 to 2004, nearly 1300 ten-thousand square meters, and then is down to about 1100 ten-thousand square meters. Housing inventory reaches a peak from 2002 to 2005, up to 550 ten-thousand square meters and then declines to 500 ten-thousand square meters. The result shows that the supply of commercial housing will face huge pressure in the future 2-3 years.

(3) Housing demand

The demand of housing would maintain a high level in the future 2-3 years. However, from a long-term view it generally descends little by little. The simulation result indicates that due to the rapid development of Shenzhen economy and the improvement of urban environment, the demand of housing increases with a large scale from 1997 to 2002; from 2002 to 2005 it is a peak of demand, up to 650 ten-thousand square meters, especially a new peak in 2004, namely 660 ten-thousand square meters; and from 2005 to 2010, the demand falls slowly, about 5%.

(4) Housing price

Housing price involves two core indicators, viz. the ratio of supply to demand and price. The simulation result shows that the ratio is stable from 1998 to 2000; form 2001 to 2004, owing to the influence of the bloom of market and land inventory entering market, the ratio becomes large obviously. From 1998 to 2003, housing price is stable, about 6000 Yuan/sqm, or even descends a lit. However, after 2004 the price began to rise to 6400 Yuan/sqm and then falls. Because a large amount of land enters market in recent years, housing price would declines. But due to the low price, the amount of land entering market would reduce which leads to ascending price.

5.4 Experiments of Policies

Above simulation results are on the basis of current policies. Via using SD and adjusting the parameters of important policies, some experiments can be made on the policies of Shenzhen commercial housing system in order to determine reasonable policies.

According to the structure of above model, five kinds of policies are selected as follows: land policy, population policy, financial policy, policy approving pre-sale, and other policies, which include in all 13 parameters. Thereinto, the parameter of land policy is mainly the table function of “the plan of the remising land for housing” PIDI; the one of population policy is the table function of “the plan growth of registered permanent population” HJPJXP; the one of policy approving pre-sale is ZJYSPO; and those of other policies include the table function of “average capacity rate” CRPOLI, the parameter of custom policy WXPOLI and the tax rate of commercial housing SUIPOL. In consideration of the significance of finance policy to REM, the parameters of finance policy in the model consist of the interest rate of real estate development loans (LXPOLI), the ratio of real estate loans to total capital for real estate (DAIKBL), the period of personal mortgage loans (N), the interest rate of mortgage loans (AJLIXI) and the down-payment of mortgage loans (SOUQI). Herein, the amount of remising land is to be taken as an example for the experiments of policies in order to analyze the influence of land policy on sales area, housing supply and housing price.

According to above simulation models, if land is stopped remising from 2003 to 2004, namely the amount of remising land in 2003 and 2004 is to become 0, not original 190 and 182 ten-thousand square meters, then the parameters related are changed as follows.

The original table function of remising land:

PIDI=346/383/195.68/255.65/337/238.62/190/182/173/165/157/150/150/150

And the current function after changed:

PIDI=346/383/195.68/255.65/337/238.62*/0/0/*173/165/157/150/150/150

Thus the simulation result is shown in Table 5-3 and Figure 5-10 to Figure 5-12, in which small-letter titles represent original simulation value and capital-letter titles denote experiment value.

Table 5-3 The experiment on the policy remising land 2003~2004

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.8	379.8	489.0	548.6	576.4	641.2	646.8	659.7	630.0	588.5	554.7	520.3	488.4	467.1
demand	340.8	379.8	489.0	548.6	576.4	641.2	646.8	659.7	635.6	606.7	581.1	555.6	522.1	509.7
Change rate	0	0	0	0	0	0	0	0	*-0.008*	*-0.0299*	*-0.045*	*-0.063*	*-0.064*	*-0.083*
SUPPLY	643.8	806.8	968.3	1072.	1174.	1284.	1295	1257.	1176.	1102.	1051.	1019.	1005.	1004.
supply	643.8	806.8	968.3	1072.	1174.	1284.	1295	1267	1208.	1160.	1130.	1113.	1108	1117.
Change rate	0	0	0	0	0	0	0	*-0.0071*	*-0.026*	*-0.0506*	*-0.069*	*-0.084*	*-0.092*	*-0.100*
HOUSEP	6250	5986.	5648.	6012.	6161.	6058.	6153.	6205.	6467.	6652.	6711.	6706.	6598.	6426.
housep	6250	5986.	5648.	6012.	6161.	6058.	6153.	6205.	6435.	6560.	6594.	6570.	6481.	6293.
Change rate	0	0	0	0	0	0	0	0	*0.0050*	*0.01402*	*0.0176*	*0.0207*	*0.0179*	*0.0211*

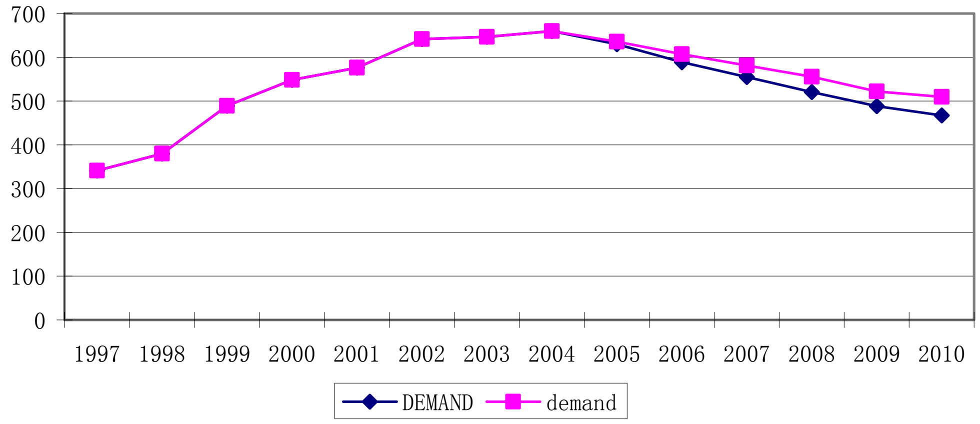


Figure 5-10 The influence of land policy on DEMAND

From the experiment on land policy, the halt or reduction of remising land for housing may reduce sales area and housing supply in the following years and make housing price ascending in the future. At the same time, due to the effect between the ratio of supply to demand and price, the price fluctuates. Via these kinds of experiments on policies, an appropriate policy may be selected to manage housing market.

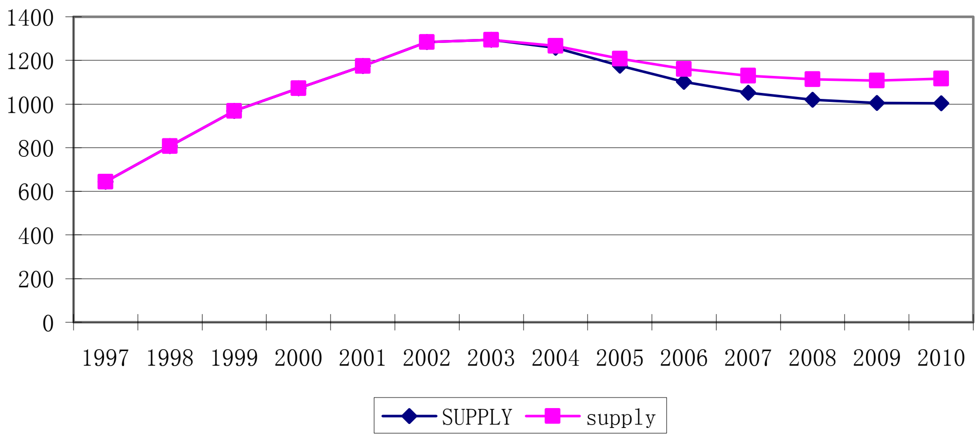


Figure 5-11 The influence of land policy on SUPPLY

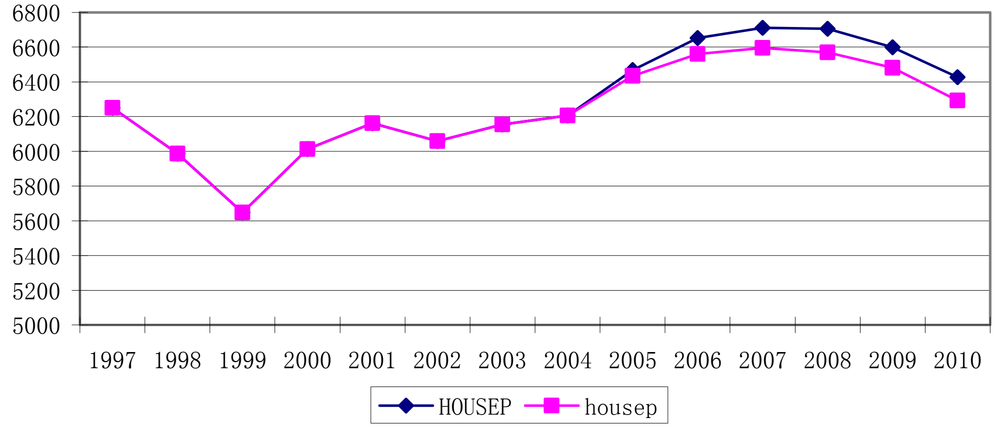


Figure 5-12 The influence of land policy on HOUSEP

5.5 Summary

The chapter mainly finishes these following researches:

(1) Analyzed the significance of the system simulation and policies experiments of real estate, constructed the theoretical model of system simulation and the system simulation model of Shenzhen real estate, studied the four sub-modules of the system, viz. land for housing, housing supply, housing demand and housing price, and presented the DYNANO equations of all modules and relevant parameters;

(2) Tested the application of the system simulation model of real estate via a demonstration, and analyzed the results of running.

(3) Based on the system simulation model established, studied the policies experiments of real estate, presented the approach of doing it, and performed an experiment on land policy.

CHAPTER 6 APPLICATION AND APPRAISAL OF MACRO-CONTROL SYSTEM FOR REM

This chapter's focus is to take example of the Shenzhen real estate market to analyze the application of technological support system for macro-control constructed above by using actual investigation data. Otherwise, based on the real condition, the effect of the technological support system is to be appraised and to be applied to REM.

6.1 Application of the Technological Support System For Macro Control of Real Estate

6.1.1 Application of REWS

With respect to REWS, this dissertation is to apply the indicators of warning signs, namely the nine monomial indicators and a composite indicator, to formulate a warning analysis based on the data of Shenzhen REM from 1986 to 2002.

6.1.1.1 Warning Analysis of Single Indicator

(1) The warning analysis of the indicator of *growth rate of real estate investment/GDP growth rate* is shown in Table 3-7, Figure 3-3 and Figure 3-4.

(2) The warning analysis of the indicator of *real estate investment amount/fixed assets investment amount* is depicted in Table 3-8, Figure 3-5 and Figure 3-6.

(3) The warning analysis of the indicator of *growth rate of annual real estate investment amount* is shown in Table 6-1 and Figure 6-1.

Table 6-1 The warning analysis of *growth rate of annual real estate investment*

Year	Real estate investment completed annually (100 million RMB)	Growth rate	Normalizing	Adjustment of accumulation
1986	9.71			
1987	9.02	-0.07	-0.80	-0.80
1988	6.80	-0.25	-1.13	-1.13
1989	12.16	0.79	0.85	0.85
1990	11.12	-0.09	-0.82	-0.82
1991	25.56	1.30	1.82	1.82
1992	71.49	1.80	2.78	3.10
1993	102.77	0.44	0.18	1.78
1994	130.46	0.27	-0.14	1.13
1995	103.04	-0.21	-1.06	-1.06
1996	124.83	0.21	-0.26	-0.26
1997	136.65	0.09	-0.48	-0.48
1998	181.01	0.23	-0.23	-0.23
1999	261.45	0.29	-0.11	-0.11
2000	271.01	0.26	-0.16	-0.16
2001	322.85	0.19	-0.29	-0.29
2002	411.12	0.27	-0.14	-0.14

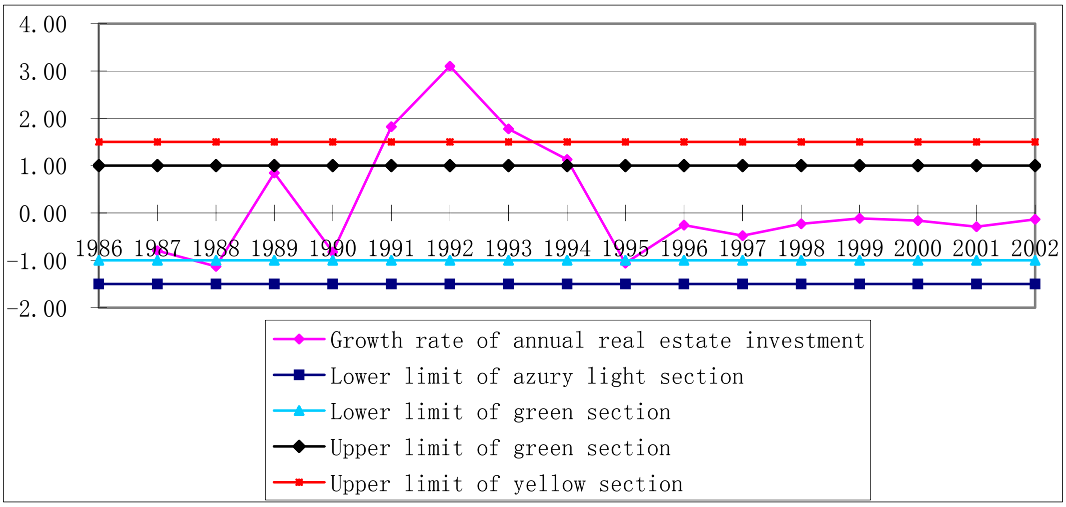


Figure 6-1 The chart of the warning value of *growth rate of annual real estate investment*

(4) The warning analysis of the indicator of *growth rate of land development area* is shown in Table 6-2 and Figure 6-2.

Table 6-2 The warning analysis of *growth rate of land development area*

Year	Land development area (ten-thousand sqm)	Growth rate	Normalizing	Adjustment of accumulation
1986	382.00			
1987	342.00	-0.10	-0.35	-0.35
1988	415.00	0.21	-0.07	-0.07
1989	418.00	0.01	-0.25	-0.25
1990	197.00	-0.53	-0.72	-0.72
1991	538.00	1.73	1.25	1.25
1992	796.00	0.48	0.16	0.16
1993	424.00	-0.47	-0.66	-0.66
1994	526.00	0.24	-0.05	-0.05
1995	351.00	-0.33	-0.55	-0.55
1996	193.00	-0.45	-0.65	-0.65
1997	994.00	4.15	3.36	3.36
1998	255.00	-0.74	-0.90	0.96
1999	316.00	0.24	-0.05	1.81
2000	244.00	-0.23	-0.46	-0.46
2001	394.00	0.61	0.28	0.28
2002	348.00	-0.12	-0.36	-0.36

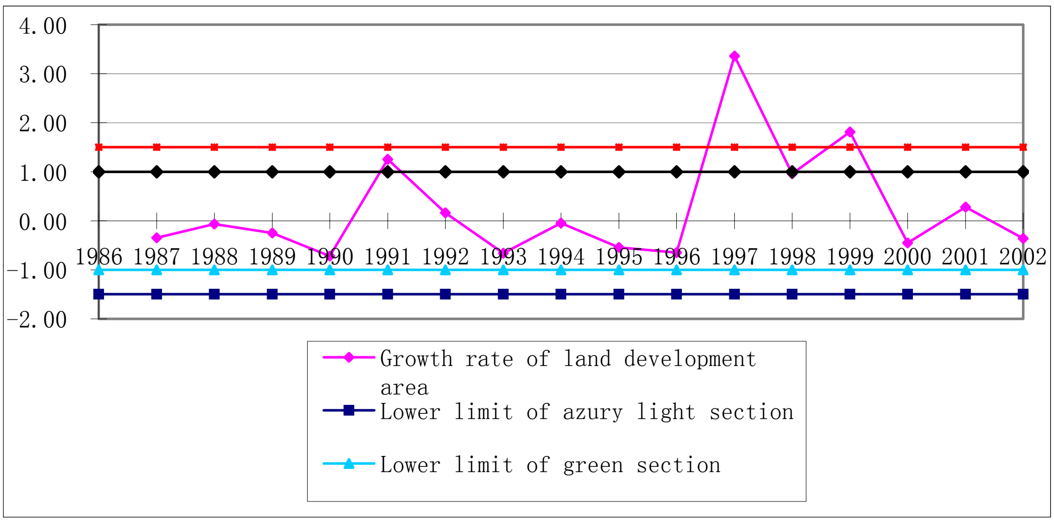


Figure 6-2 The chart of the warning value of *growth rate of land development area*

(5) The warning analysis of the indicator of *growth rate of the area of new commercial-building projects* is shown in Table 6-3 and Figure 6-3.

Table 6-3 The warning analysis of *growth rate of the area of new commercial-building projects*

Year	Area of new commercial-building projects (ten-thousand sqm)	Growth rate	Normalizing	Adjustment of accumulation
1991	251.31			
1992	380.67	0.51	0.59	0.59
1993	504.49	0.33	0.20	0.20
1994	200.06	-0.60	-1.72	-1.72
1995	141.30	-0.29	-1.08	-1.30
1996	337.43	1.39	2.39	2.17
1997	386.35	0.14	-0.17	0.72
1998	490.17	0.27	0.08	0.97
1999	745.15	0.52	0.60	0.60
2000	737.56	-0.01	-0.49	-0.49
2001	884.86	0.20	-0.06	-0.06
2002	944.54	0.07	-0.33	-0.33

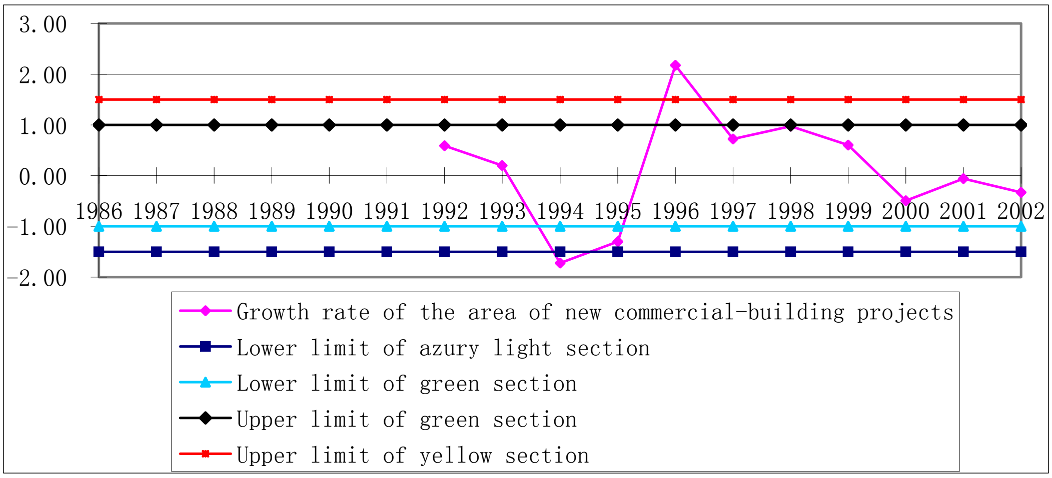


Figure 6-3 The chart of the warning value of *growth rate of the area of new commercial-building projects*

(6) The warning analysis of the *growth rate of the complete construction area of commercial building* indicator is shown in Table 6-4 and Figure 6-4.

Table 6-4 The warning analysis of *growth rate of the complete construction area of commercial building*

Year	Complete construction area of commercial building (ten-thousand sqm)	Growth rate	Normalizing
1986	181.27		
1987	134.37	-0.26	-1.50
1988	103.90	-0.23	-1.38
1989	180.29	0.74	2.25
1990	133.41	-0.26	-1.50
1991	150.44	0.13	-0.04
1992	198.40	0.32	0.68
1993	281.46	0.42	1.06
1994	311.10	0.11	-0.12
1995	311.58	0.00	-0.52
1996	394.32	0.27	0.48
1997	327.04	-0.17	-1.17
1998	441.97	0.35	0.81
1999	571.46	0.29	0.58
2000	652.26	0.14	0.01
2001	770.58	0.18	0.16
2002	915.30	0.19	0.19

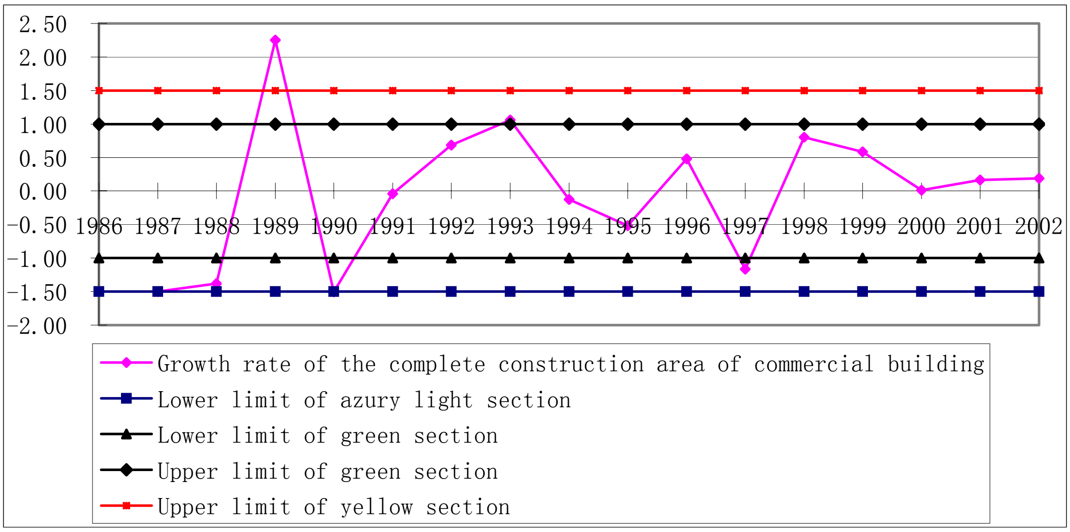


Figure 6-4 The chart of the warning value of *growth rate of the complete construction area of commercial building*

(7) The warning analysis of the *growth rate of the sales area of commercial building*

indicator is shown in Table 6-5 and Figure 6-5.

Table 6-5 The warning analysis of *growth rate of the sales area of commercial building*

Year	Sales area of commercial building (ten-thousand sqm)	Growth rate	Normalizing
1986	63.70		
1987	111.26	0.75	2.52
1988	107.39	-0.03	-1.02
1989	90.67	-0.16	-1.57
1990	77.14	-0.15	-1.54
1991	112.54	0.46	1.22
1992	151.46	0.35	0.71
1993	180.17	0.19	0.00
1994	246.93	0.37	0.82
1995	274.57	0.11	-0.36
1996	324.88	0.18	-0.03
1997	405.44	0.25	0.26
1998	432.22	0.07	-0.56
1999	541.84	0.25	0.29
2000	611.37	0.13	-0.28
2001	643.47	0.05	-0.63
2002	791.70	0.23	0.18

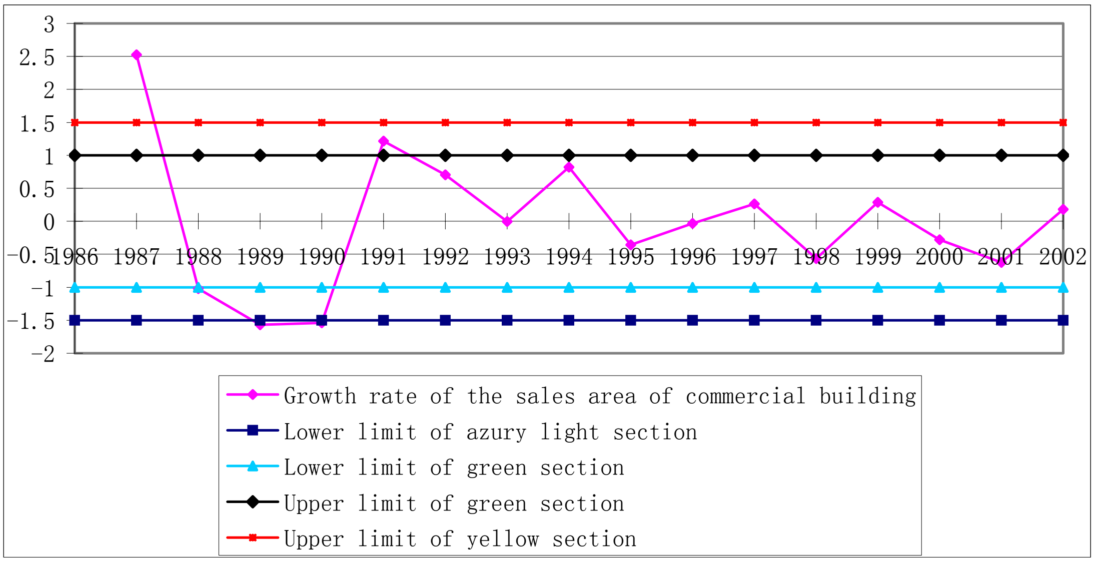


Figure 6-5 The chart of the warning value of *growth rate of the sales area of commercial building*

(8) The warning analysis of the *real estate investment loans/medium or long-term*

loans balance indicator is shown in Table 6-6 and Figure 6-6.

Table 6-6 The warning analysis of *real estate investment loans/medium or long-term loans balance*

Year	Real estate investment loans/medium or long-term loans balance	Normalizing	Adjustment of accumulation
1991	0.01	-0.92	-0.92
1992	0.03	-0.83	-0.83
1993	0.03	-0.81	-0.81
1994	0.04	-0.76	-0.76
1995	0.08	-0.59	-0.59
1996	0.07	-0.62	-0.62
1997	0.47	1.32	1.32
1998	0.55	1.69	1.69
1999	0.59	1.88	2.08
2000	0.27	0.32	0.89
2001	0.12	-0.36	0.03
2002	0.13	-0.32	-0.32

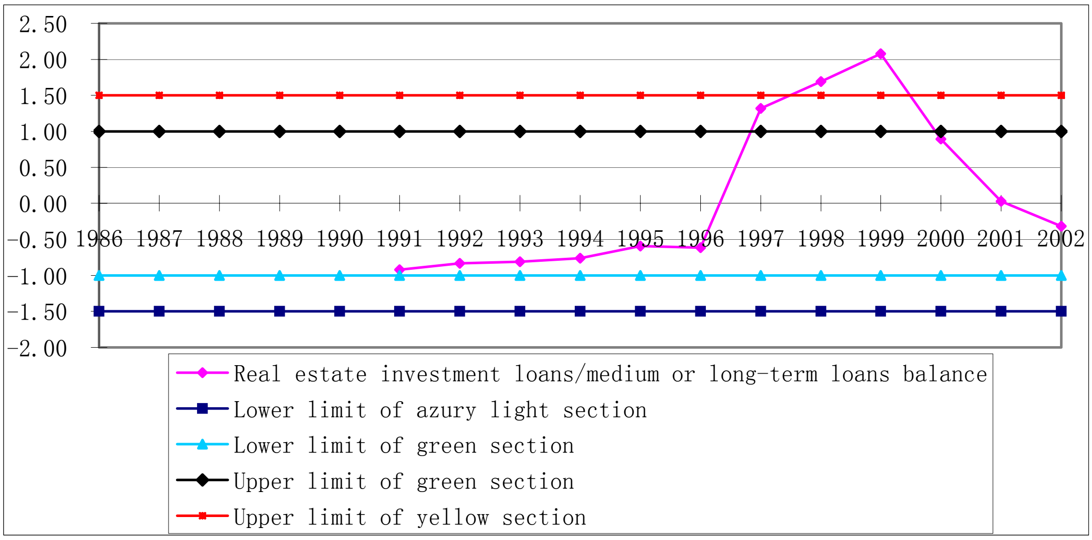


Figure 6-6 This chart shows the warning value of *real estate investment loans/medium or long-term loans balance*

(9) The warning analysis of the *individual housing loans/real estate investment loans* indicator is shown in Table 6-7 and Figure 6-7.

Table 6-7 The warning analysis of *individual housing loans/real estate investment loans*

Year	Individual housing loans/real estate investment loans	Normalizing	Adjustment of accumulation
1991	0.18	-1.68	-1.68
1992	0.18	-1.69	-1.87
1993	0.32	-1.06	-1.43
1994	0.65	0.43	0.24
1995	0.52	-0.16	-0.16
1996	0.73	0.79	0.79
1997	0.47	-0.41	-0.41
1998	0.54	-0.10	-0.10
1999	0.64	0.38	0.38
2000	0.82	1.17	1.17
2001	0.82	1.19	1.19
2002	0.81	1.13	1.13

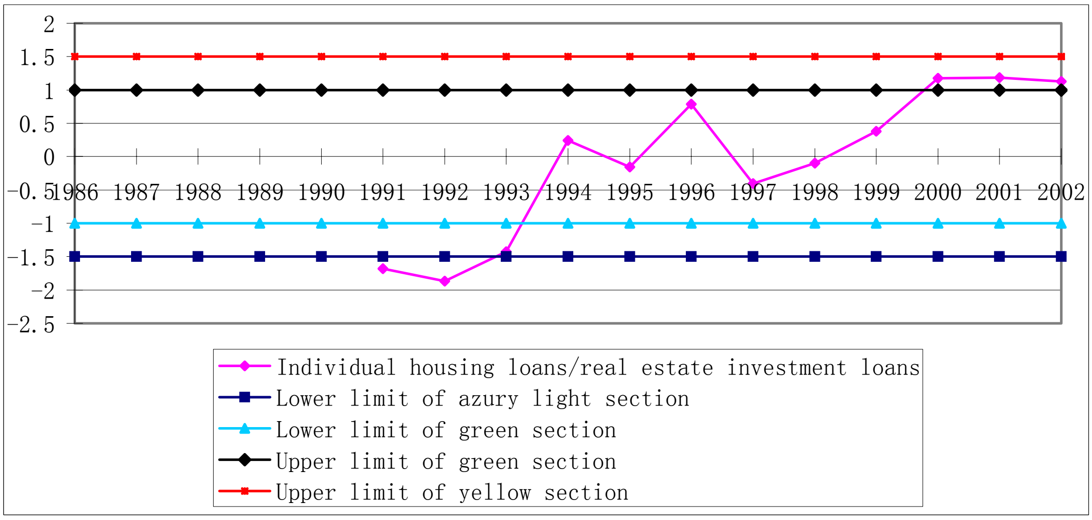


Figure 6-7 This chart shows the warning value of *individual housing loans/real estate investment loans*

6.1.1.2 Warning Analysis of Composite Index

Considering the significance of the *growth rate of real estate investment/GDP growth rate* indicator, its weighting coefficient is determined as 0.3 by experts; and others are identical to each other. Thus the composite warning value is derived from the weighted average of the total value of all monomial indicators. Table 6-8 shows the warning value of single indicator and the composite warning value.

Table 6-8 The warning value of each of monomial indicators and the composite indicator

Year	Warning value of *growth rate of real estate investment /GDP growth rate*	Warning value of *real estate investment /fixed assets investment*	Warning value of *growth rate of completion real estate investment*	Warning value of *growth rate of land development*	Warning value of *growth rate of new commercial housing projects*	Warning value of *growth rate of total completion area of commercial housing*	Warning value of *growth rate of total sale area of commercial housing*	Warning value of *real estate development loans /medium or long-term loans*	Warning value of *personal housing loans/real estate development loans*	Composite warning value
1987	-1.80	-0.56	-0.80	-0.35		-1.50	2.52			-0.60
1988	-2.35	-1.90	-1.13	-0.07		-1.38	-1.02			-1.19
1989	2.49	-1.57	0.85	-0.25		2.25	-1.57			0.72
1990	-0.50	-2.00	-0.82	-0.72		-1.50	-1.54			-0.73
1991	4.40	-0.61	1.82	1.25		-0.04	1.22	-0.92	-1.68	1.41
1992	5.39	0.94	3.10	0.16	0.59	0.68	0.71	-0.83	-1.87	1.92
1993	5.23	1.21	1.78	-0.66	0.20	1.06	0.00	-0.81	-1.43	1.69
1994	1.78	1.53	1.13	-0.05	-1.72	-0.12	0.82	-0.76	0.24	0.63
1995	-2.20	-0.05	-1.06	-0.55	-1.30	-0.52	-0.36	-0.59	-0.16	-1.06
1996	-0.25	0.01	-0.26	-0.65	2.17	0.48	-0.03	-0.62	0.79	0.09
1997	-1.95	-0.29	-0.48	3.36	0.72	-1.17	0.26	1.32	-0.41	-0.30
1998	1.13	-0.29	-0.23	0.96	0.98	0.81	-0.56	1.69	-0.10	0.62
1999	1.52	-0.04	-0.11	1.81	0.60	0.58	0.29	2.08	0.38	0.94
2000	1.37	0.46	-0.16	-0.46	-0.49	0.01	-0.28	0.89	1.17	0.51
2001	1.06	0.81	-0.29	0.28	-0.06	0.16	-0.63	0.03	1.19	0.45
2002	1.35	1.40	-0.14	-0.36	-0.33	0.19	0.18	-0.32	1.13	0.56

The composite warning value is used to compare with the “real estate price index/50-2” (see Figure 6-8) in order to analyze the relation between the warning value and the price index. From Figure 6-8, it is shown that the composite warning value leads real estate price index one year and their changing trends remain the same. Otherwise, by referencing back to the time-difference correlation analysis, their correlation coefficient is highest under the condition of leading one year. Therefore, the composite warning may warn and forecast the future trend and situation of real estate market.

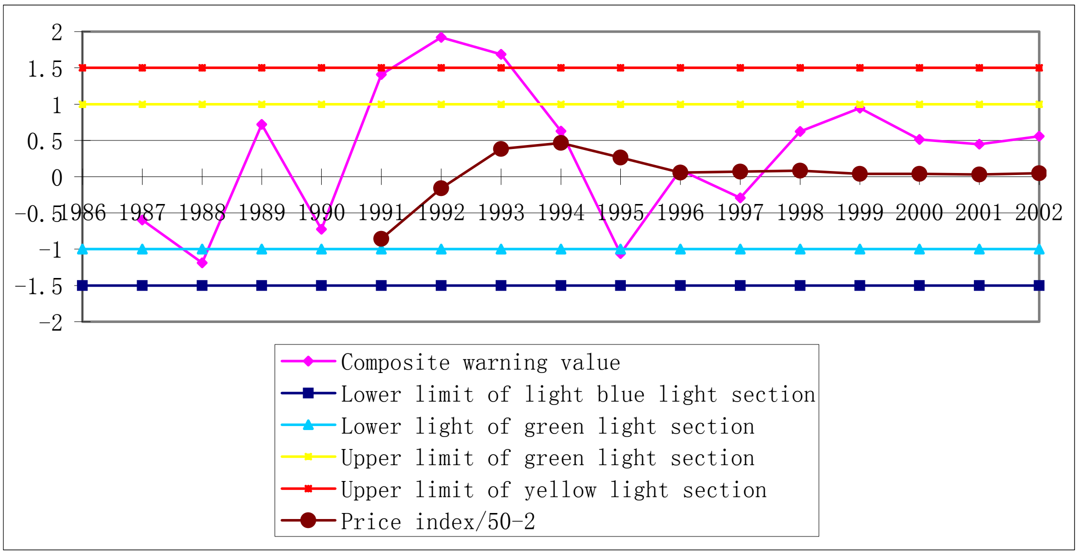


Figure 6-8 The chart of the composite warning value of Shenzhen real estate market

6.1.2 Application of RECIs

6.1.2.1 Investigation of Shenzhen Real Estate Market

(1) Survey data about Shenzhen REM

According to the needs of confidence indexes, the survey is constructed. Based on the *Yearbook of Shenzhen Real Estate* 2000~2004 [75, 77~80], the data relevant on land, house property and sales is extracted and analyzed.

① Land supply. Table 6-9 denotes land supply of Shenzhen from 1999 to 2003.

Table 6-9 The composition of land use of Shenzhen

Year	Total area (km^2)	Details							
		Tillage	Gard-en plot	Wood-land	Grass-land	Land for residen-tial and factory	Land for comm-unica-tion	Water area	Virgin land
1999	1948.69	64.43	218.53	713.22	3.91	505.06	46.81	238.09	158.65
2000	1952.84	64.16	217.48	706.92	3.89	515.57	47.00	237.81	155.86
2001	1952.84	63.72	275.61	644.78	0.66	559.32	60.77	226.05	121.94
2002	1952.84	61.47	281.57	615.76	1.91	597.88	64.21	215.34	114.71
2003	1952.84	60.14	302.62	605.10	0.74	624.37	76.79	209.56	73.51

② Sales of house property. Appendix 7 shows the sales of house property from 1999 to 2003.

③ Development of real estate. The development status from 1999 to 2003 is shown in Table 4-14 to Table 4-17, including the constitution of developmental capital, its origin, construction area, area of new projects, and complete area.

(2) The status of Shenzhen population

From 1999 onwards, the population of Shenzhen continuously increases. Appendix 8 illustrates the level of population density, population distribution and composition, natural growth rate, mortality rate and the growth rate of permanent population from 1999 to 2003.

(3) The status of Shenzhen purchasing power

According to the *Yearbook of China Statistic* and *Yearbook of Shenzhen Statistic*, the data about purchasing power is derived and shown in Table 6-10 and Table 6-11.

Table 6-10 The direct purchasing power of Shenzhen residents

Year	1999	2000	2001	2002	2003
Direct purchasing power (unit: Yuan)	34912.1	38365.5	42628.4	47897.1	54428.6

Table 6-11 The ratio of housing payout to total income for Shenzhen residents

Year	1999	2000	2001	2002	2003
Ratio	9.91%	10.40%	15.01%	14.99%	15.19%

(4) Survey of latent demand

The index of latent demand is based on questionnaires; by far the research carries on twice, once in 2003 and 2004. Due to the research range from 1999 to 2003, only the survey of 2003 is presented, and it is shown in Table 6-12 and Table 6-13.

Table 6-12 The handout and withdrawal of questionnaires

Handout	Withdrawal	Valid	Invalid	Valid rate
1260	1150	1130	20	89.6%

Table 6-13 The condition of respondents

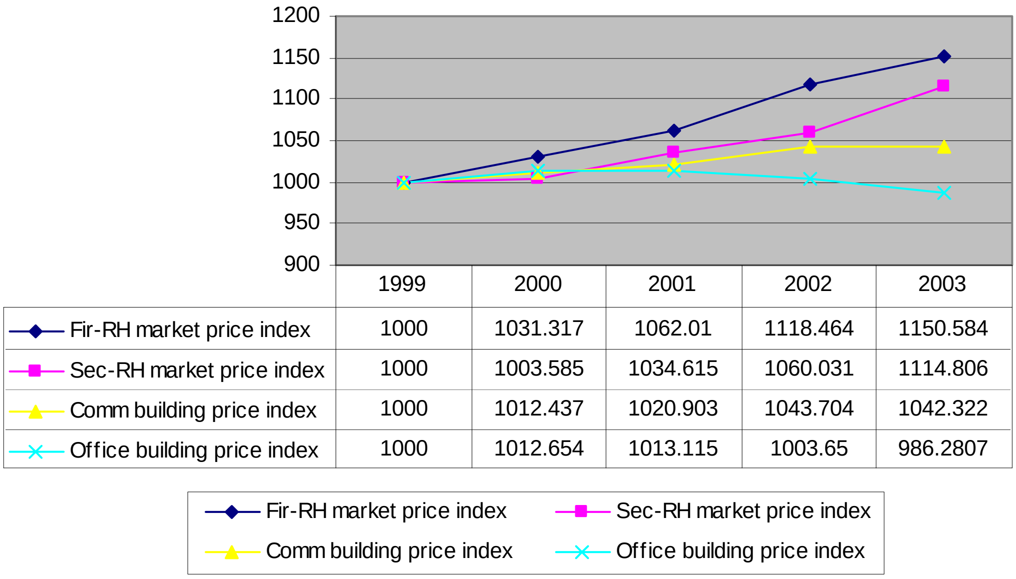
Groups	Number	Rate
Group A1	239	21.1%
Group A2	220	19.4%
Group A3	29	2.5%
Group B1	371	32.8%
Group B2	230	20.3%
Group B3	41	3.9%

6.1.2.2 Analysis of Basic Indexes

Based on the above survey data, basic confidence indexes for Shenzhen REM from 1999 to 2003 are constructed as follows.

(1) Basic indexes for price index

Basic indexes for price index include the price indexes for Fir-or-Sec-RH, the price index of commercial building and the price index of office building is shown in Figure 6-9. Note that these indexes are related to the indexes constructed above; only they are based on their respective average price in 1999.



	1999	2000	2001	2002	2003
Fir-RH market price index	1000	1031.317	1062.01	1118.464	1150.584
Sec-RH market price index	1000	1003.585	1034.615	1060.031	1114.806
Comm building price index	1000	1012.437	1020.903	1043.704	1042.322
Office building price index	1000	1012.654	1013.115	1003.65	986.2807

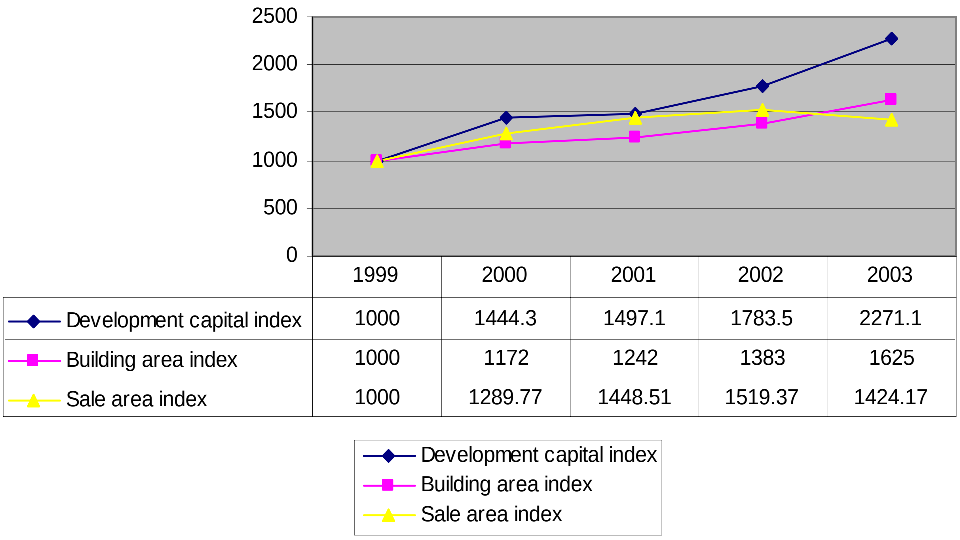
Figure 6-9 The basic indexes for the price index of Shenzhen REM

Figure 6-9 shows that the housing price of Fir-RH market and Sec-RH market is consistently fluctuating, especially the bigger amplitude from 2001 to 2002; and relatively, the price of commercial building and office building increases less, or even decreases to a degree. For example, the price index of office building. All of these have a close relation with the development of Shenzhen real estate market in recent years.

(2) Basic indexes for market index

Basic indexes for market index involve development capital index, building area index and sale area index, which will be analyzed in Figure 6-10.

From Figure 6-10, from 1999 to 2003, it is obvious that real estate investment and complete area ascend stably, especially from 2002 to 2003, there is a sudden spike where there is a large scale increase; and sale area is stable only declines slightly in 2003 due to the intervention of governmental control.



	1999	2000	2001	2002	2003
Development capital index	1000	1444.3	1497.1	1783.5	2271.1
Building area index	1000	1172	1242	1383	1625
Sale area index	1000	1289.77	1448.51	1519.37	1424.17

Figure 6-10 The basic indexes for Shenzhen REM index

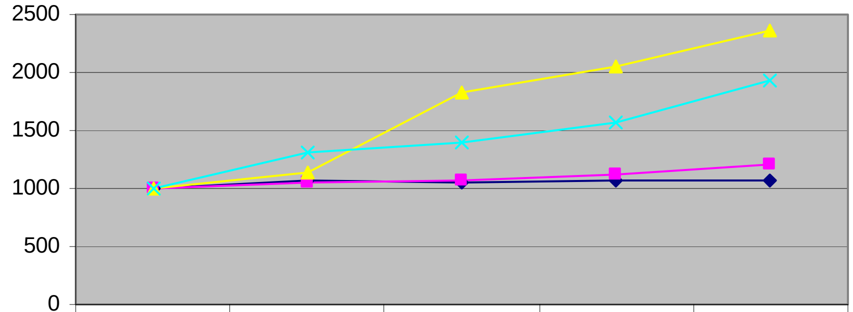
6.1.2.3 Analysis of Sub-indexes

According to above basic indexes and survey data, the sub-indexes from 1999 to 2003 are established as follows.

(1) Sub-indexes for efficient D&S index

The sub-indexes for efficient D&S index include price index, population index, PP index and market index, among which price index and market index are composed with their basic index respectively and the remaining two indexes are calculated directly. The results are shown in Figure 6-11.

From Figure 6-11, all of these four indexes show positive increase from 1999 to 2003; the increase is especially obvious with PP index and market index.



	1999	2000	2001	2002	2003
Price index	1000	1066.1	1049.7	1070.1	1073.2
Population index	1000	1054.1	1069.7	1121.3	1209.1
PP index	1000	1146.3	1832.2	2058.5	2370.5
Market index	1000	1302.2	1395.87	1572.37	1930.42

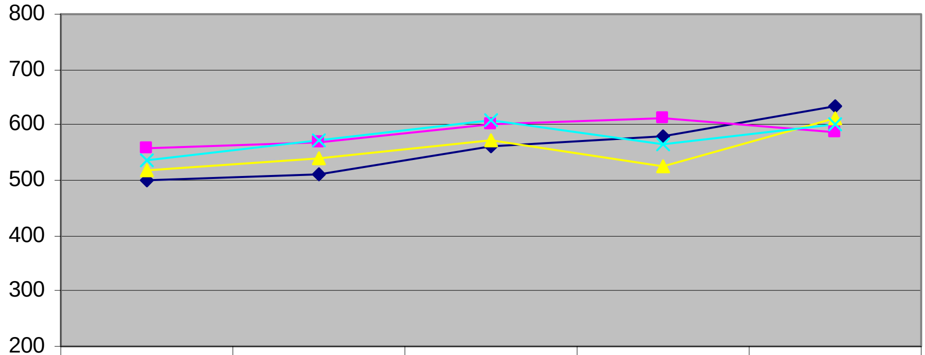
Price index   Population index
PP index   Market index

Figure 6-11 The sub-indexes for the efficient D&S index of Shenzhen REM

(2) Sub-indexes for latent demand index

The sub-indexes for latent demand index involve HOCPI index, HOCPII index, NHOCPI index and NHOCPII index. All of them are constructed based on questionnaires, as show in Figure 6-12. Because only the questionnaires of 2003 are utilized, the indexes of other years are calculated by estimation method.

It is shown from Figure 6-12 that in recent years the confidence of non-homeowners is higher than the one of homeowners, namely non-homeowners are more confident of REM. But the confidence of homeowners is higher in 2003, which is fit to reality.

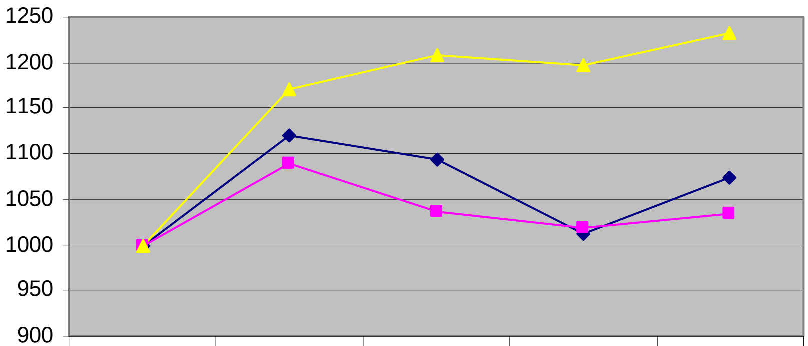


	1999	2000	2001	2002	2003
HOCPI index	500.3	511.2	561.2	578.7	634.3
HOCPII index	557.9	567.3	600.3	613.2	587.2
NHOCPI index	517.1	538.5	571.3	527.1	613.1
NHOCPII index	537.6	571.7	608.4	566.5	600.4

Figure 6-12 The sub-indexes for the latent demand index of Shenzhen REM

(3) Sub-indexes for latent supply index

The sub-indexes for latent supply index include land inventory index, land increment index and capacity rate index, as analyzed in Figure 6-13.



	1999	2000	2001	2002	2003
Land inventory index	1000	1120.1	1093.1	1012.7	1073.1
Land increment index	1000	1090.1	1037.2	1018.6	1033.3
Capacity rate index	1000	1171.3	1207.5	1197.4	1231.9

Figure 6-13 The sub-indexes for the latent supply index of Shenzhen REM

By referring to Figure 6-13, land supply increases in a large scale from 1999 to 2000, including land inventory and land increment, and the capacity rate also increases rapidly. After 2000, land supply is controlled effectively and fluctuation normalizes. However, capacity rate remains high, which is also an important reason of resulting in the high capacity rate at present.

6.1.2.4 Analysis of Monomial Indexes

Monomial indexes involve efficient D&S index, latent demand index and latent supply index, forming the basis of sub-indexes mentioned above.

(1) Efficient D&S index

First, the weighting coefficients of its sub-indexes are to be determined. According to Section 4.4, these weighting coefficients for price index, population index, PP index and market index have been calculated as follows: 0.224, 0.338, 0.243 and 0.195. Then the efficient D&S index from 1999 to 2003 is calculated and shown in Figure 6-14.

(2) Latent demand index

Likewise, the Latent Demand Index requires the weighting coefficients of its sub-indexes. According to Section 4.5, the coefficients of HOCPI index, HOCPII index, NHOCPI index and NHOCPII index are calculated based on the number of respondents. These coefficients are classified into two levels: one is Homeowner and the other classified as Non-homeowner (sum 100%); another is HOCPI index and HOCPII index (sum 100%) and NHOCPI index and NHOCPII index (sum 100%). The index is calculated as follows (see Figure 6-21).

(3) Latent supply index

Based on Section 4.6, the weighting coefficients of its sub-indexes are presented and shown in Table 6-14. The index is determined (see Figure 6-14).

Table 6-14 The weighting coefficients of all sub-indexes of latent supply index from 1999 to 2003

Year	1999	2000	2001	2002	2003
Land inventory index	0.59	0.31	0.29	0.38	0.41
Land increment index	0.04	0.47	0.39	0.17	0.20
Average capacity rate index	0.37	0.22	0.32	0.45	0.39

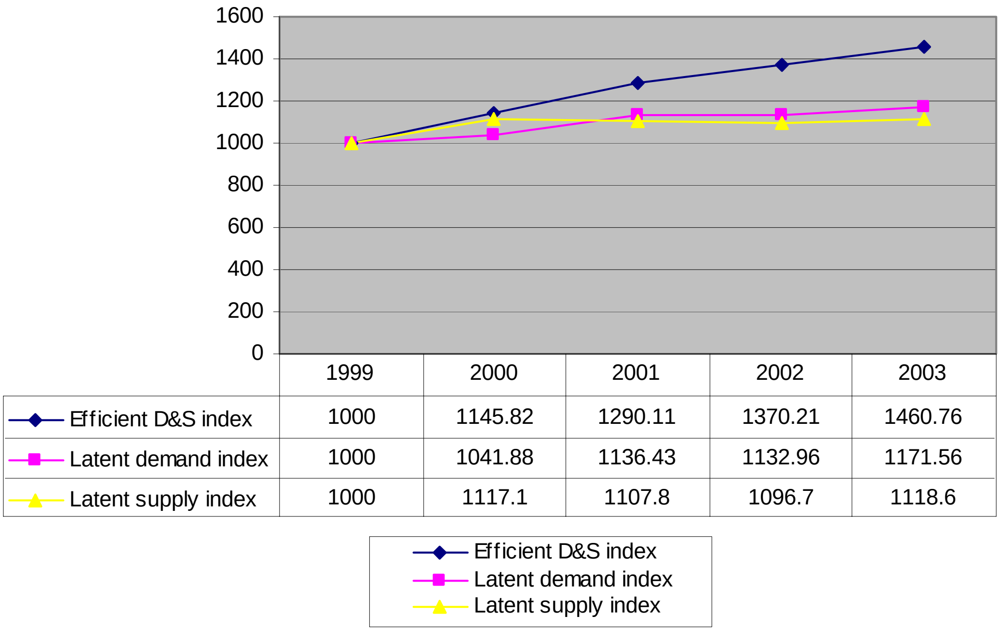


Figure 6-14 The monomial confidence indexes of Shenzhen REM

From Figure 6-14, the three indexes indicate positive trends from 1999 to 2003. Especially, the efficient D&S index increases with a large scale, showing that as a result of the rise in population, the development of economy and the increase of income in recent years, are causing the demand of real estate to grow rapidly.

6.1.2.5 Analysis of Composite Index

Real estate composite confidence index is constructed based on the above analysis and it is synthesized by the efficient D&S index, the latent demand index and the latent supply index. Their weighting coefficients are determined in Section 4.7, respectively 0.3, 0.4 and 0.3. The index is shown in Figure 6-15.

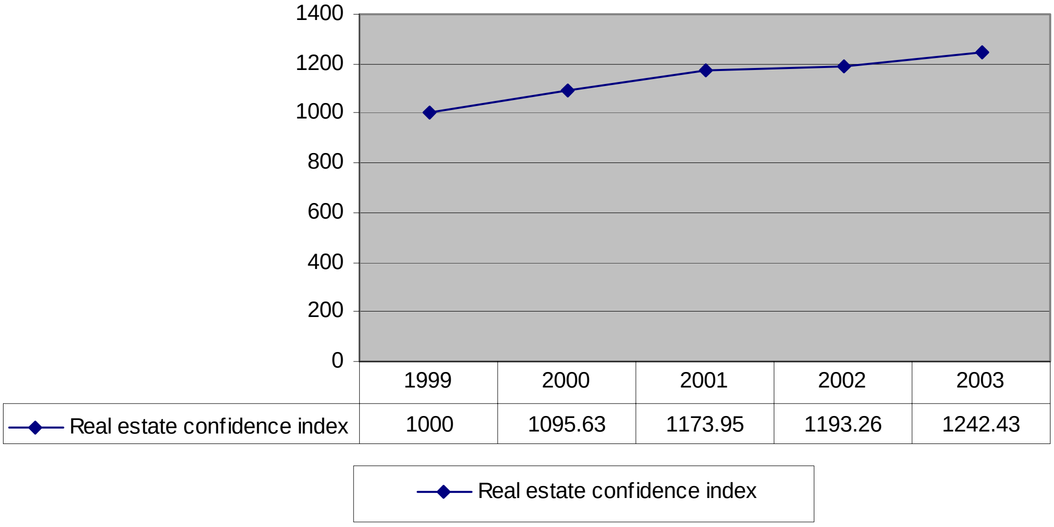


Figure 6-15 The composite confidence index of Shenzhen REM

It is shown from Figure 6-15 that Shenzhen real estate market keeps ascending in recent years. Though it goes through the SARS of 2001 and the policies change of 2003 it remains to be stable and healthy.

6.1.2.6 Prediction Analysis of Indexes

The prediction of indexes involves the composite index, monomial indexes, sub-indexes and basic indexes and its period may range from a month to a quarter. Thus the research only takes a sample of the composite index from the first quarter of 2001 to the first quarter of 2003.

The prediction analysis of the composite index is based on the forecast of sublevel indexes and then its MACD chart is established by utilizing the index simulation method, as shown in Figure 6-16.

From Figure 6-16, it is shown that the MACD of the composite index begins descending after surpassing the growth in the fourth quarter of 2001 and it doesn't rise again until the third quarter of 2002. This also shows that after the first quarter of 2003, the index may continue to keep rising. With regards to the growth range, it can be predicted by comparing DIF.

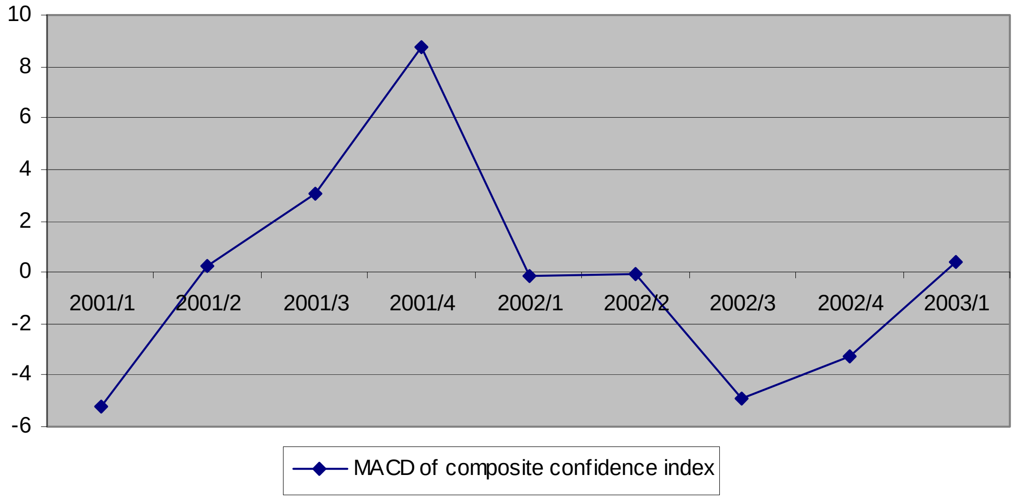


Figure 6-16 The MACD chart of Shenzhen real estate composite confidence index

6.1.2.7 Explanations

Aimed at the above demonstration, the research presents an explanation of constructing and applying the index system as follows:

First, the above analysis is on the basis of a one-year period, not a quarter or a month. However, provided that the data is sufficient, these indexes may be constructed and issued based on a quarter or even a month by adopting the same methods. For example, Figure 6-17 shows the price index of commercial building of Shenzhen based upon a quarter.

Second, in terms of these indexes constructed based on population, land supply, purchasing power and market, it is difficult to consider their change for a short term, these indexes may be calculated within a one-year period and then to be adjusted if necessary.

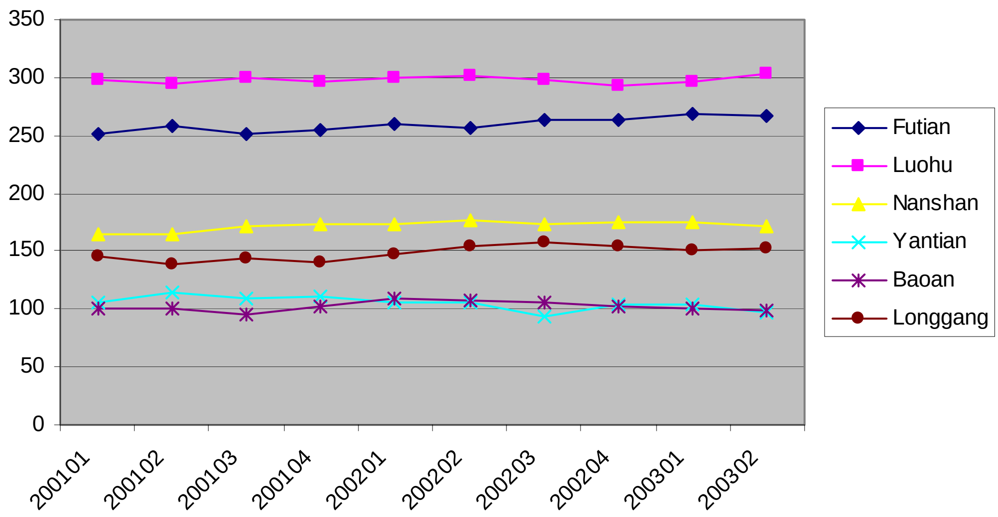


Figure 6-17 The price index of commercial building of Shenzhen

Third, these indexes about latent demand can be fine tuned according to needs. For instance, when the latent demand index is calculated, it is adjusted in order to conveniently compute the composite index.

Fourth, the above analysis presents only the indexes of Shenzhen REM and neglects the indexes of each district, for example Figure 6-17; in fact these whole indexes are based on the indexes of all districts.

Fifth, with respect to the prediction of indexes, only MACD method is adopted in the demonstration. In practice, the BIAS method is also used in combination to forecast their trends.

Sixth, during the course of establishing the indexes, their weighting coefficients are not absolute but relative. In order to assure the optimal effect takes place, these coefficients should be adjusted in relation to the different regions and periods.

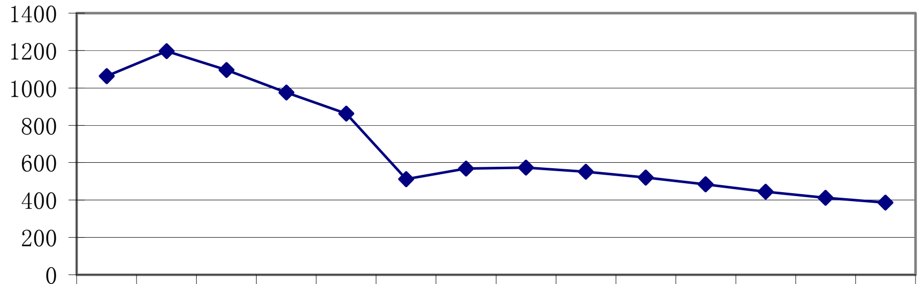
Seventh, under the condition of the above problems, these established models may be applied to other cities or regions.

6.1.3 Application of System Simulation and Policies Experiments of Real Estate

6.1.3.1 Application of System Simulation of Real Estate

The application of system simulation and policies experiments of real estate is to be analyzed based on the simulation results of Shenzhen commercial housing system from 1997 to 2010 in Chapter 5 (See Table 5-2). There are a total of 12 indicators in all, among which sales area, the area of new projects and housing price have been analyzed in Chapter 5. The remaining indicators are analyzed as follows.

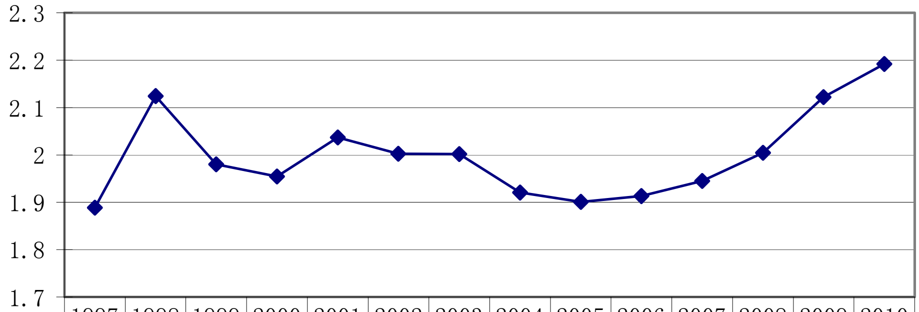
The simulation of land supply (see Figure 6-18) shows that the amount of the land supply of Shenzhen is most abundant in 1998, up to 1197 ten-thousand square meters, and then it reduces gradually per annum, after 2002 the amount left is 400-600 ten-thousand square meters. The reasons for this are following: one is that the government pays close attention to the control of land for housing; another one is that under the condition of stable demand, housing supply becomes stable only after 2000 and 2001.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GYLAND	1062	1197	1096	976	863	511	568	574	551	520	484	445	412	386

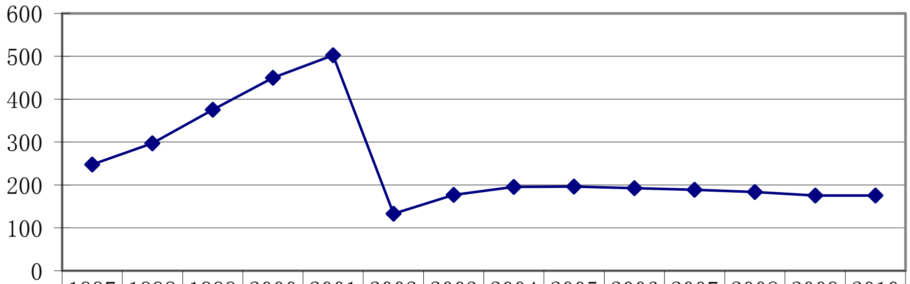
Figure 6-18 The simulation of land supply from 1997 to 2010

The simulation of the ratio of supply to demand (see Figure 6-19) shows that the ratio from 1997 to 2010 is generally stable, from 1.9 to 2.2, which indicates that Shenzhen real estate market is by and large in a healthy condition. In detail, from 1999 to 2008 the ratio becomes lower; the reason for this is the large demand of housing. Otherwise, the ratio between 2001 and 2003 is higher, about 2-2.05; this is due to the large amount of land entering market in 2000 and 2001.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
RATEO	1.89	2.12	1.98	1.95	2.04	2	2	1.92	1.9	1.91	1.95	2	2.12	2.19

Figure 6-19 The simulation of the ratio of supply to demand of housing from 1997 to 2010



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
RSLAND	248	297	375	450	502	133	177	196	196	193	189	184	175	175

Figure 6-20 The simulation of land annually entering market from 1997 to 2010

The simulation of land annually entering market is shown in Figure 6-20, which indicates that the amount of land entering market from 1999 to 2001 is larger than those in other years. From 1997 to 2001, the amount of land entering market ascended abruptly; due to the reduction of remising land for housing and the effect of the amount of land supply in the past three years, the amount of land entering market decreased slightly in 2002; and the amount of land remains to be stable from 2003 to 2010, between 150 and 200 ten-thousand square meters. In the model, the amount of land entering market is heavily influenced by the amount of land for housing, housing demand and the delay amount of land entering market. From 1997 to 2001, the amount of land entering market increased with the bloom of housing market and reached a peak in 2000 or 2001. When the amount of remising land is not sufficient, the land inventory would be used. Due to the decline of land supply and housing demand, the amount of land entering market will become stable.

Figure 6-21 is the simulation chart of housing supply. The result shows that the amount of housing supply takes on a clear course of fluctuation, viz. ascending—peak —descending from 1997 to 2010. The peak happens from 2002 to 2005, over 1200 ten-thousand square meters. From 2005 to 2010, it falls steadily. The reasons for this is following: one is that the increase of land entering market from 1998 causing an increase of new projects in comparison to the ascending of the demand of housing, and leading to the increase of housing inventory; another one is both from gaining land to approving pre-sale and from ground breaking to complete need a period, and the delay function will play a role in the future three years.

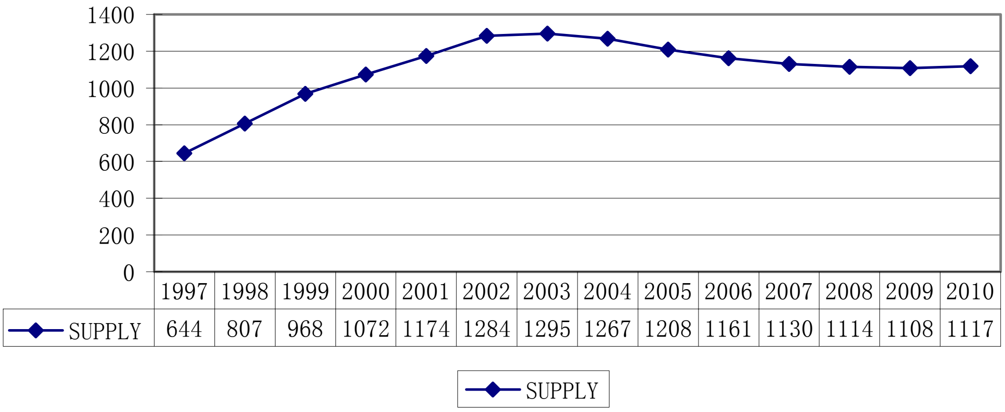


Figure 6-21 The simulation of housing supply from 1997 to 2010

The simulation of land inventory is shown in Figure 6-22, which clearly addresses the fact that after land inventory reaches a peak in 1999, due to the large-scale increase of land entering the market from 1999 to 2001, the amount of remising land for housing reduces; and land inventory also shows a decline, the level dropped down to about 300 ten-thousand square meters after 2003.

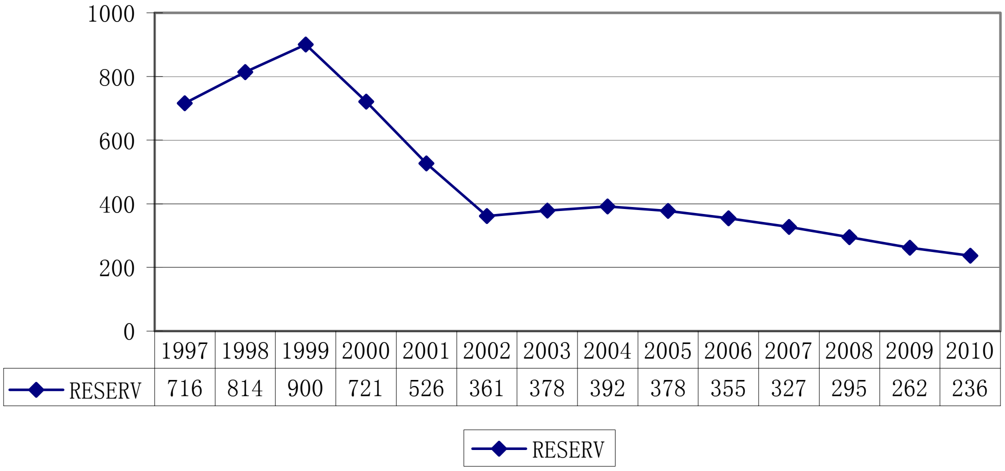


Figure 6-22 The simulation of land inventory from 1997 to 2010

The simulation result of housing inventory (see Figure 6-23) shows that Shenzhen housing inventory has reached its peak at about 585 ten-thousand square meters, in 2003 and 2004; because of the large-scale increase of land entering market from 1997 to 2004, housing inventory ascends continuously until 2004 to 2008 where it begins to decline and ascends slowly until 2009.

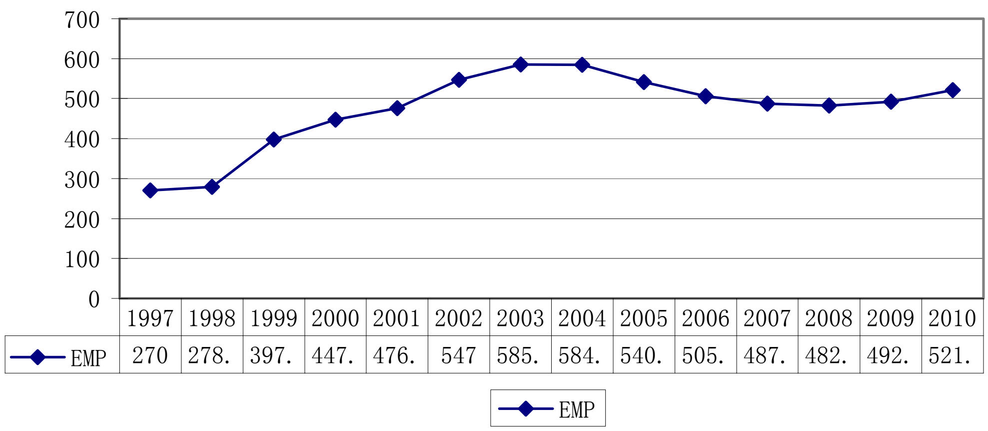
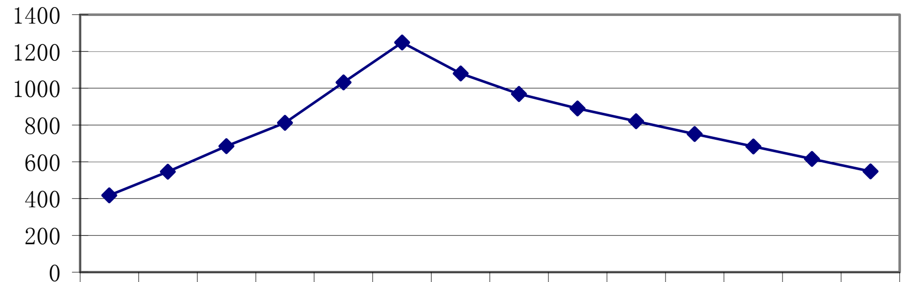


Figure 6-23 The simulation of housing inventory from 1997 to 2010

Figure 6-24 shows the simulation result of the delay amount of land entering market. It is clear from the figure that the variable reaches an all time high in 2002, which is directly related to the large amount of land entering into the market from 1999 to 2001.

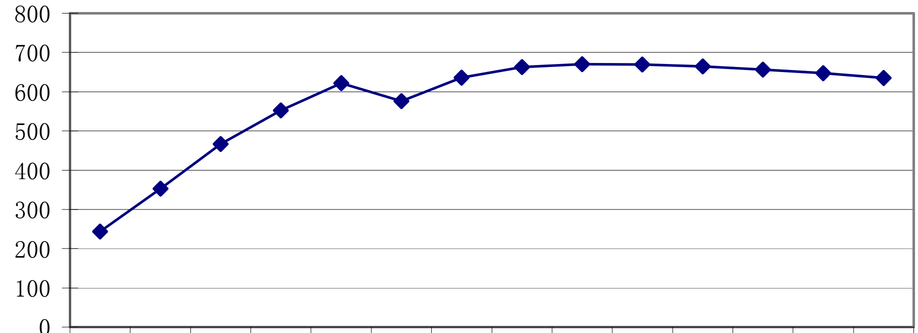


	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
RSNOKF	418	546	686	813	1032	1249	1080	969	891	820	752	684	616	547

RSNOKF

Figure 6-24 The simulation of the delay amount of land entering market from 1997 to 2010

The simulation result of complete area (see Figure 6-25) indicates that the complete area of commercial housing in Shenzhen from 2003 to 2010 shows a relatively stable trend, about 650 ten-thousand square meters.

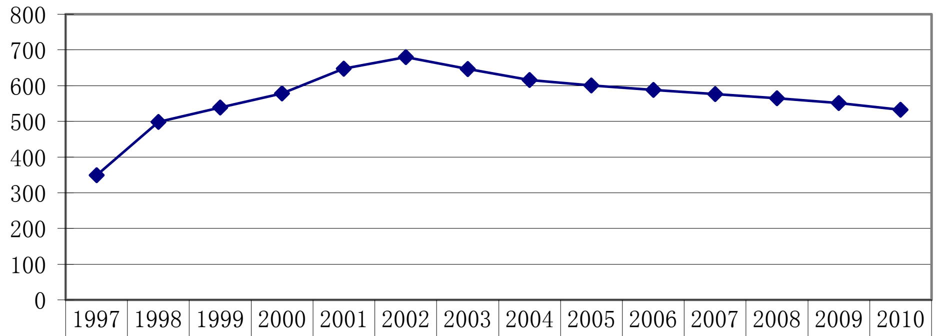


	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
JUNGON	243	353	467	552	622	576	636	663	670	669	664	656	647	635

JUNGON

Figure 6-25 The simulation of complete area from 1997 to 2010

From Figure 6-26, the simulation of pre-sale area approved shows that the pre-sale area slowly declines over the years and maintains at about 600 ten-thousand square meters form 2002 to 2010.



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PZYUS0	349.	498.	538.	577.	647.	679.	646.	616.	600.	588.	576.	565.	551	532.

PZYUS0

Figure 6-26 The simulation of pre-sale area approved from 1997 to 2010

6.1.3.2 Application of Policies Experiments of Real Estate

Focused at the five policies mentioned in Chapter 5, viz. land policy, population policy, finance policy, policy approving to pre-sell, and other policies, and taken into consideration the 13 parameters, some experiments are to be performed and the results are analyzed.

(1) Experiments on land policies

(i) The experiment on “stop remising land for housing from 2003 to 2004”—land policy I is presented in Section 5.4.

(ii) Experiment on “return land within following three years”—land policy II

In other words, the land has stopped remising in 2003 and 2004 and the amount of land remised is annually added 100 ten-thousand square meters from 2005 to 2007. Then the functions are constructed in the following method:

The original table function of land remised:

PIDI=346/383/195.68/255.65/337.01/238.62/190/182/173/165/157/150/150/150

The table function after changed:

PIDI=346/383/195.68/255.65/337.01/238.62/***0/0/273/265/257/***150/150/150

Thus the simulation result is shown in Table 6-15 and Figure 6-27 to Figure 6-29, in which “small-letter” titles represent original simulation value and “capital-letter” titles denote experiment value (Similarly hereinafter).

Table 6-15 The experiment on “return land within following three years”

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.8	379.8	489.0	548.6	576.4	641.2	646.8	659.7	630.0	588.5	559.4	530.5	507.6	485.8
demand	340.8	379.8	489.0	548.6	576.4	641.2	646.8	659.7	635.6	606.7	581.1	555.6	522.1	509.7
Change rate	0	0	0	0	0	0	0	0	*-0.008*	*-0.029*	*-0.037*	*-0.045*	*-0.027*	*-0.046*
SUPPLY	643.8	806.8	968.3	1072.	1174.	1284.	1295	1257.	1176.	1106.	1069	1054.	1058.	1070.
supply	643.8	806.8	968.3	1072.	1174.	1284.	1295	1267	1208.	1160.	1130.	1113.	1108	1117.
Change rate	0	0	0	0	0	0	0	*-0.007*	*-0.026*	*-0.046*	*-0.054*	*-0.053*	*-0.044*	*-0.041*
HOUSEP	6250	5986.	5648.	6012.	6161.	6058.	6153.	6205.	6467.	6652.	6690.	6666.	6531.	6368.
housep	6250	5986.	5648.	6012.	6161.	6058.	6153.	6205.	6435.	6560.	6594.	6570.	6481.	6293.
Change rate	0	0	0	0	0	0	0	0	*0.0050*	*0.0140*	*0.0144*	*0.0147*	*0.0076*	*0.0118*

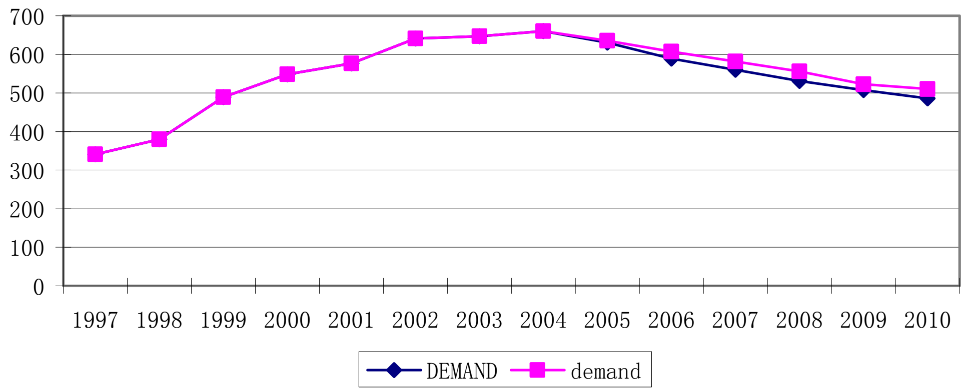


Figure 6-27 The influence of land policy II on DEMAND

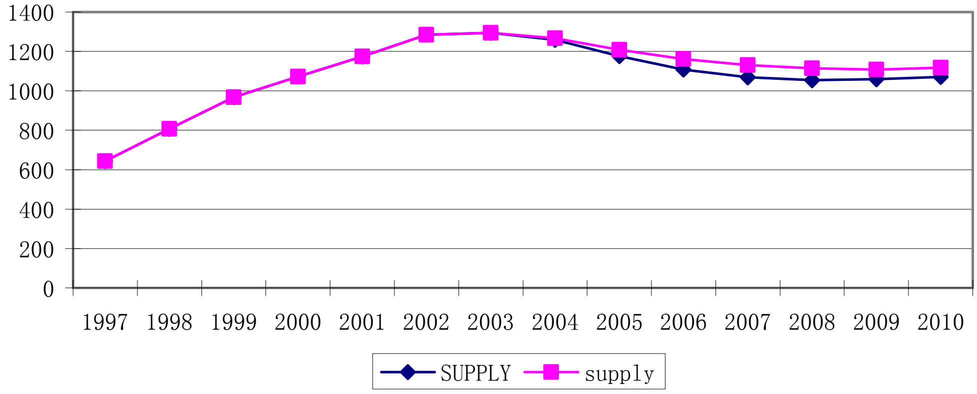


Figure 6-28 The influence of land policy II on SUPPLY

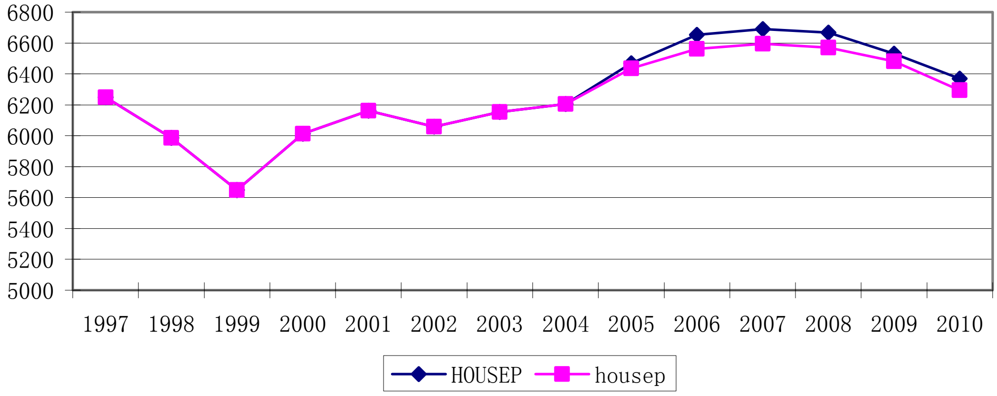


Figure 6-29 The influence of land policy II on HOUSEP

(iii) Experiment on “reduce half land remised for housing in 2003 and 2004”—land policy III

The original table function is constructed in the following method:

PIDI=346/383/195.68/255.65/337.01/238.62/190/182/173/165/157/150/150/150

The table function after changed:

PIDI=346/383/195.68/255.65/337.01/238.62/***95/91***/173/165/157/150/150/150

And the simulation result is shown in Table 6-16 and Figure 6-30 to Figure 6-32.

Table 6-16 The experiment on “reduce half land remised for housing 2003~2004”

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	632.87	597.77	568.06	538.27	505.12	489.41
demand	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	635.66	606.71	581.13	555.66	522.13	509.79
Change rate	0	0	0	0	0	0	0	0	*-0.00439*	*-0.01474*	*-0.02249*	*-0.0313*	*-0.03258*	*-0.03998*
SUPPLY	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1262.4	1192.2	1131.5	1090.9	1066.5	1056.3	1060.6
supply	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1267	1208.4	1160.9	1130.4	1113.6	1108	1117.2
Change rate	0	0	0	0	0	0	0	*-0.00363*	*-0.01341*	*-0.02533*	*-0.03494*	*-0.0423*	*-0.04666*	*-0.05066*
HOUSEP	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6451.5	6606.1	6652.6	6637.2	6540.6	6357.2
housep	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6435.3	6560.9	6594.9	6570.2	6481.8	6293.6
Change rate	0	0	0	0	0	0	0	0	*0.002517*	*0.006889*	*0.008749*	*0.010198*	*0.009072*	*0.010106*

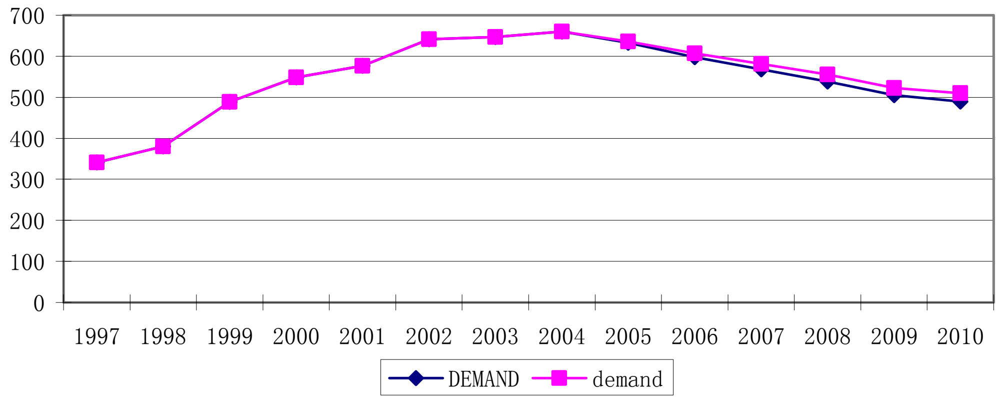


Figure 6-30 The influence of land policy III on DEMAND

(iv) Experiment on “control of land entering market”—land policy IV

In additional to the control of land remised, the government also plays a key role in controlling the amount of land entering into the market. The experiment mainly focuses on the limitation of land entering into the mainstream market. In detail, the amount of land entering market in 2004 is reduced one square KMs. The simulation result is shown in Table 6-17 and Figure 6-33 to Figure 6-35.

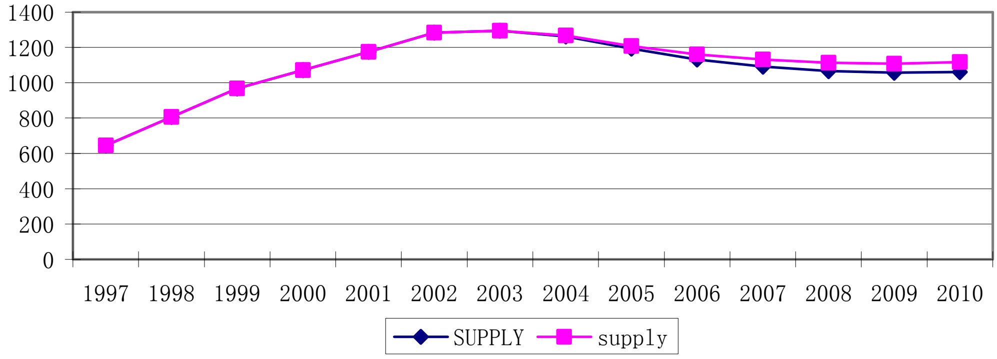


Figure 6-31 The influence of land policy III on SUPPLY

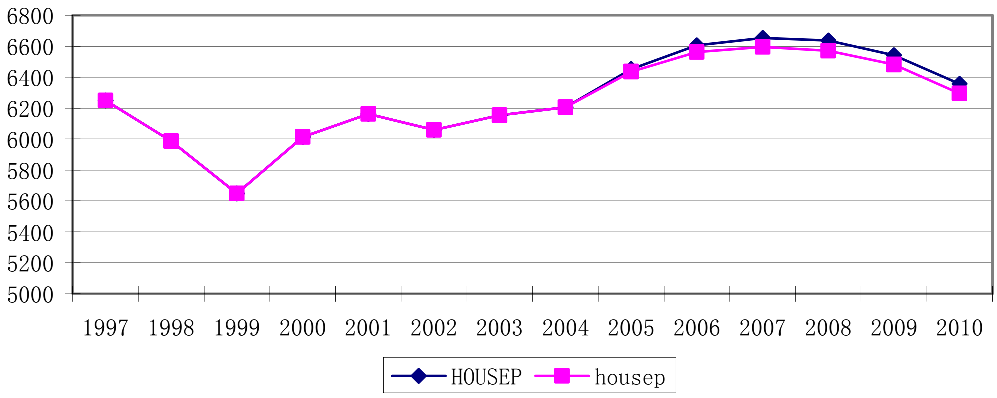


Figure 6-32 The influence of land policy III on HOUSEP

Table 6-17 The experiment on “reduce one-sq.km. land entering market 2004”

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	646.86	640.42	614.74	587.13	568.18	544.6	519.36	502
demand	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	635.66	606.71	581.13	555.66	522.13	509.79
Change rate	0	0	0	0	0	0	0	*-0.02936*	*-0.03291*	*-0.03227*	*-0.02228*	*-0.0199*	*-0.00531*	*-0.01528*
SUPPLY	643.88	806.89	968.31	1072.2	1174.3	1284.1	1255.4	1203	1149	1113.3	1096.9	1090.6	1095.4	1108.9
supply	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1267	1208.4	1160.9	1130.4	1113.6	1108	1117.2
Change rate	0	0	0	0	0	0	*-0.03058*	*-0.05051*	*-0.04916*	*-0.041*	*-0.02964*	*-0.02065*	*-0.01137*	*-0.00743*
HOUSEP	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6336.1	6556.9	6660.1	6652	6612.8	6491.4	6317.9
housep	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6435.3	6560.9	6594.9	6570.2	6481.8	6293.6
Change rate	0	0	0	0	0	0	0	*0.021046*	*0.018896*	*0.01512*	*0.008658*	*0.006484*	*0.001481*	*0.003861*

From the above table and figures, it shows that the price of housing has increased by 2.1% subsequent to restricting one-sq.km. of land entering into the market.

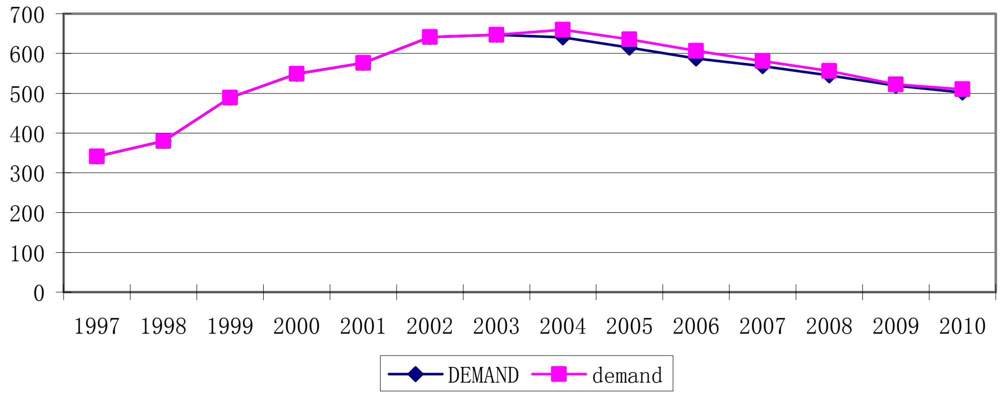


Figure 6-33 The influence of land policy IV on DEMAND

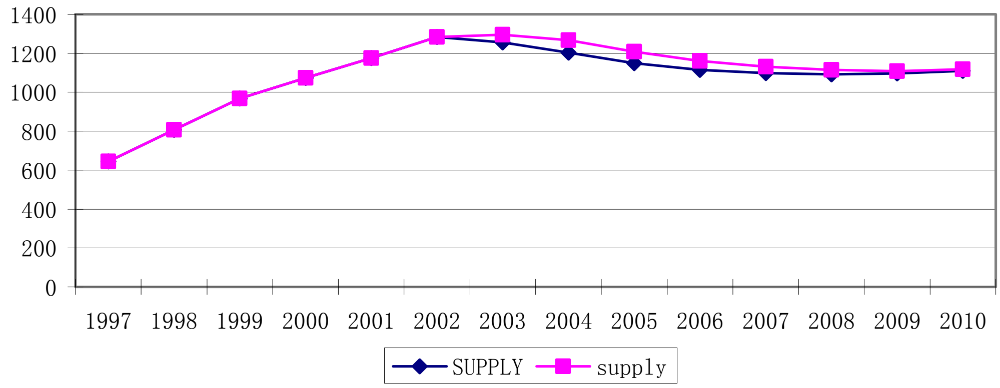


Figure 6-34 The influence of land policy IV on SUPPLY

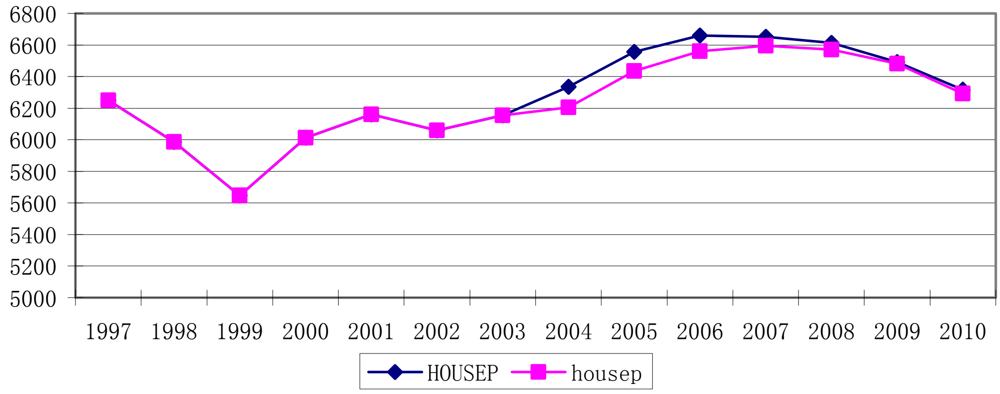


Figure 6-35 The influence of land policy IV on HOUSEP

(v) Analysis of the experiments on land policies

From the above experiments, based on the four kinds of land policies, the comparative results are shown as follows. 1) For DEMAND, with the decline of land remised for housing, the DEMAND reduces within the following years, but the reduction scale differs compared with the different policies, descending from policy I to policy III. Though policy II adds the amount of land remised in the following three years, due to the delay influence on DEMAND, it is not obvious to increase DEMAND. 2) Considering housing supply, it is obvious for SUPPY to decline, to a larger extent compared to DEMAND, after the amount of land remised for housing is reduced. Thus it is important for the oversupply of housing to reduce to the amount of land remised for housing. Otherwise, the effect of policy I has a higher impact than the one of policy III and the supply of housing obviously increases after policy II tally up the amount of land remised. 3) With respect to HOUSEP, it would rise a lit after reducing the amount of land remised. Because of the larger influence of the ratio of supply to demand, it also has an impact on the demand of housing. Therefore the price is self-regulated. Based on these results, policy I is definitely more intensive and policy III is comparatively milder. According to the analysis, policy III is feasible.

The sensitivity analysis of housing price to land policy shows that if the amount of land remised for housing reduces by 100 ten-thousand sq.m.s, the housing price will in turn ascend by 0.5%. Thus it is clear that given the current condition, the direct influence of stopping or reducing land for housing on housing supply, housing demand and housing price is less. The reasons for this are as follows: one is that the inventory amount of land approved to randomly enter into the market is more than the amount of land controlled; another factor is the delay of construction.

Comparing with the first three policies, land policy IV has a much more influential effect on the real estate market. The sensitivity of housing price to land policy IV is 4.2 times higher than the one of the three land policies respectively. Therefore, it can be concluded that the most efficient land policy controlling housing supply is to control the amount of land entering into the market.

(2) Experiments on policies approving to pre-sell

In the simulation model, the policies approving to pre-sell are implemented by controlling the structure of total real estate investment.

(i) Experiment on “canceling the pre-sale of housing 2004”—pre-sale policy I

When the pre-sale of housing 2004 is cancelled, the ratio of deposit or pre-receipt to total real estate investment becomes zero. The results are then translated to the simulation model shown in Table 6-18 and Figure 6-36 to Figure 6-38.

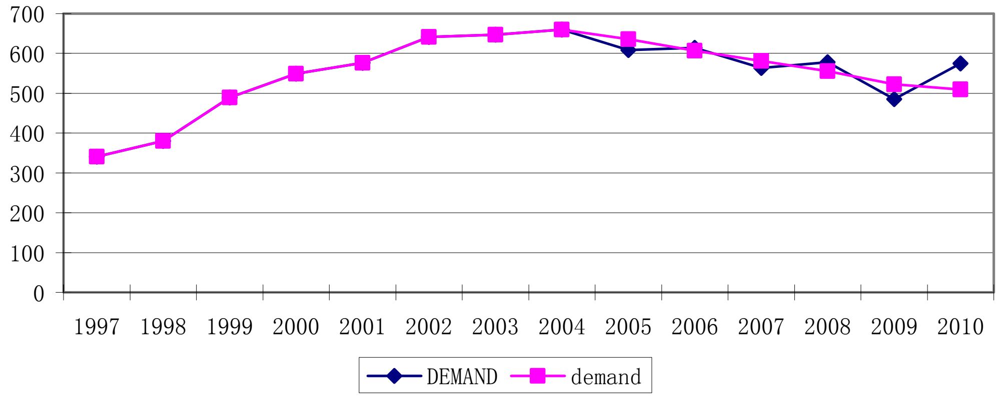


Figure 6-36 The influence of pre-sale policy I on DEMAND

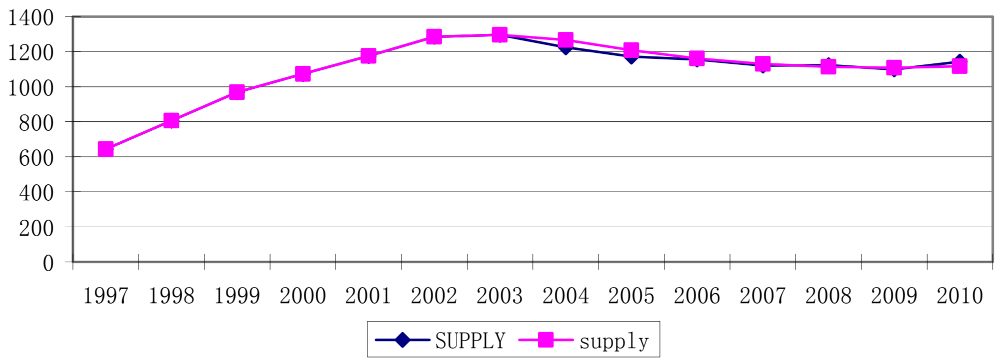


Figure 6-37 The influence of pre-sale policy I on SUPPLY

Table 6-18 The experiment on "canceling pre-sale"

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	608.5	614.31	563.46	577.77	485.42	574.78
demand	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	635.66	606.71	581.13	555.66	522.13	509.79
Change rate	0	0	0	0	0	0	0	0	*-0.04273*	*0.012527*	*-0.03041*	*0.039791*	*-0.07031*	*0.127484*
SUPPLY	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1225.1	1172.3	1154.9	1120.3	1121.8	1097.8	1141.7
supply	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1267	1208.4	1160.9	1130.4	1113.6	1108	1117.2
Change rate	0	0	0	0	0	0	0	*-0.03307*	*-0.02987*	*-0.00517*	*-0.00893*	*0.007364*	*-0.00921*	*0.02193*
HOUSEP	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6593.2	6522.4	6672.9	6485.1	6608.7	6090.9
housep	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6435.3	6560.9	6594.9	6570.2	6481.8	6293.6
Change rate	0	0	0	0	0	0	0	0	*0.024537*	*-0.00587*	*0.011827*	*-0.01295*	*0.019578*	*-0.03221*

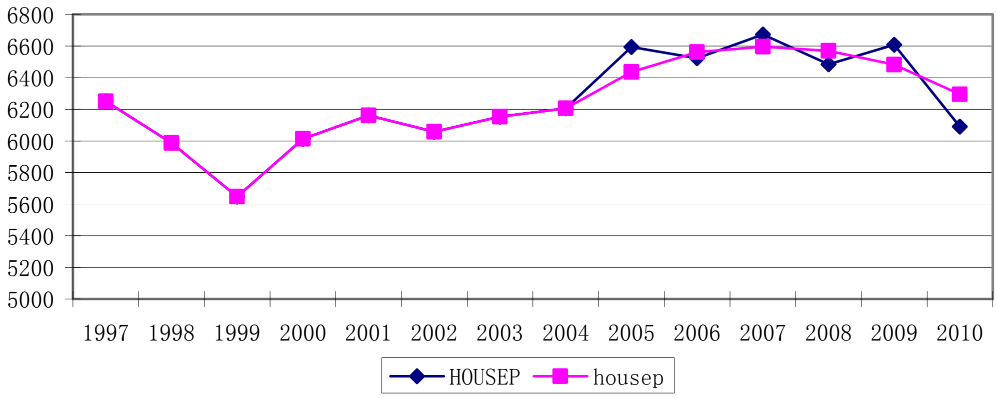


Figure 6-38 The influence of pre-sale policy I on HOUSEP

(ii) Experiment on "pre-sell only after sealing roof"—pre-sale policy II

In this experiment, the policy is implemented only in 2004, causing the above ratio to change to 16.7%. The difference is shown in the simulation model in Table 6-19 and Figure 6-39 to Figure 6-41.

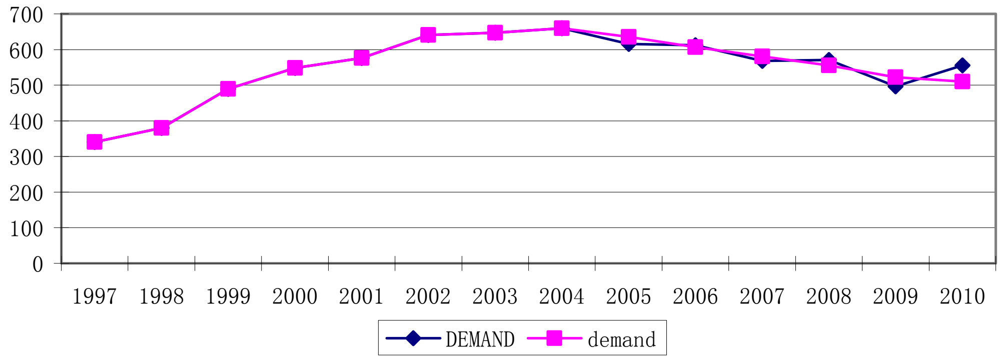


Figure 6-39 The influence of pre-sale policy II on DEMAND

Table 6-19 The experiment on “presell only after sealing roof”

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	615.95	611.86	568.65	571.15	496.47	555.7
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	635.66	606.71	581.13	555.66	522.13	509.79
demand	0	0	0	0	0	0	0	0	*-0.03101*	*0.008488*	*-0.02148*	*0.027877*	*-0.04914*	*0.090057*
Change rate	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1236.1	1181.8	1156.2	1123.1	1119.3	1100.9	1134.4
SUPPLY	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1267	1208.4	1160.9	1130.4	1113.6	1108	1117.2
supply	0	0	0	0	0	0	0	*-0.02439*	*-0.02201*	*-0.00405*	*-0.00646*	*0.005119*	*-0.00641*	*0.015396*
Change rate	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6549.9	6534.8	6650	6510.6	6570.5	6150.4
HOUSEP	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6435.3	6560.9	6594.9	6570.2	6481.8	6293.6
housep	0	0	0	0	0	0	0	0	*0.017808*	*-0.00398*	*0.008355*	*-0.00907*	*0.013684*	*-0.02275*

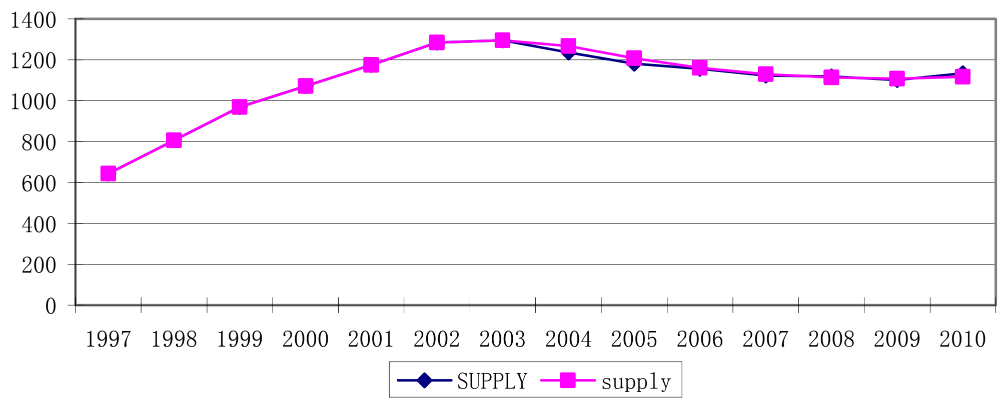


Figure 6-40 The influence of pre-sale policy II on SUPPLY

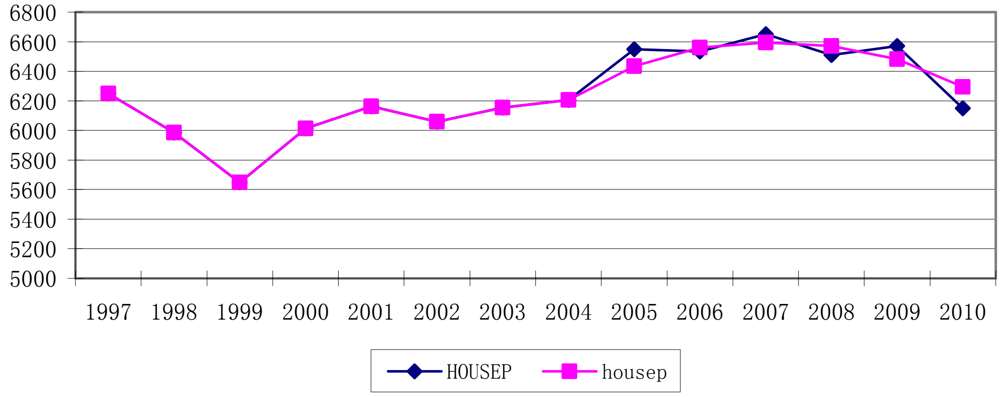


Figure 6-41 The influence of pre-sale policy II on HOUSEP

(iii) Experiment on “pre-sale as long as gaining land”—pre-sale policy III

Likewise, only in 2004, the ratio becomes 67% and the simulation result is shown in Table 6-20 and Figure 6-42 to Figure 6-44.

Table 6-20 The experiment on “pre-sale as long as gaining land”

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	673.19	602.88	599.79	534.92	556.12	445.04
demand	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	635.66	606.71	581.13	555.66	522.13	509.79
Change rate	0	0	0	0	0	0	0	0	*0.059041*	*-0.00631*	*0.03211*	*-0.03732*	*0.065099*	*-0.12701*
SUPPLY	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1333.7	1265.8	1175.3	1143.7	1106.5	1116.9	1092.9
supply	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1267	1208.4	1160.9	1130.4	1113.6	1108	1117.2
Change rate	0	0	0	0	0	0	0	*0.052644*	*0.047501*	*0.012404*	*0.011766*	*-0.00638*	*0.008032*	*-0.02175*
HOUSEP	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6217.4	6580.3	6512.5	6650.1	6364.3	6495.8
housep	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6435.3	6560.9	6594.9	6570.2	6481.8	6293.6
Change rate	0	0	0	0	0	0	0	0	*-0.03386*	*0.002957*	*-0.01249*	*0.012161*	*-0.01813*	*0.032128*

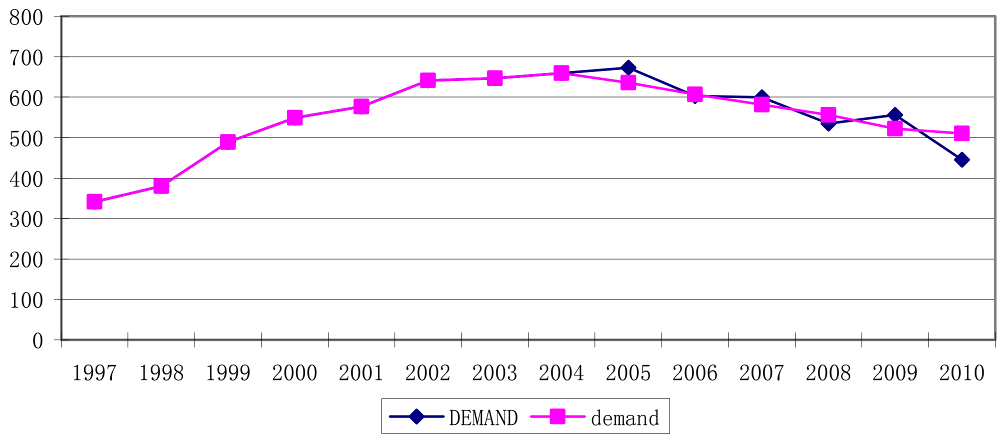


Figure 6-42 The influence of pre-sale policy III on DEMAND

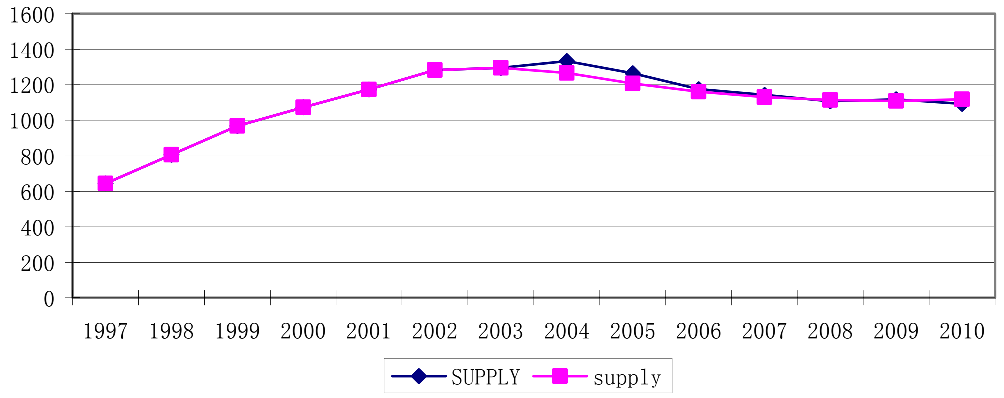


Figure 6-43 The influence of pre-sale policy III on SUPPLY

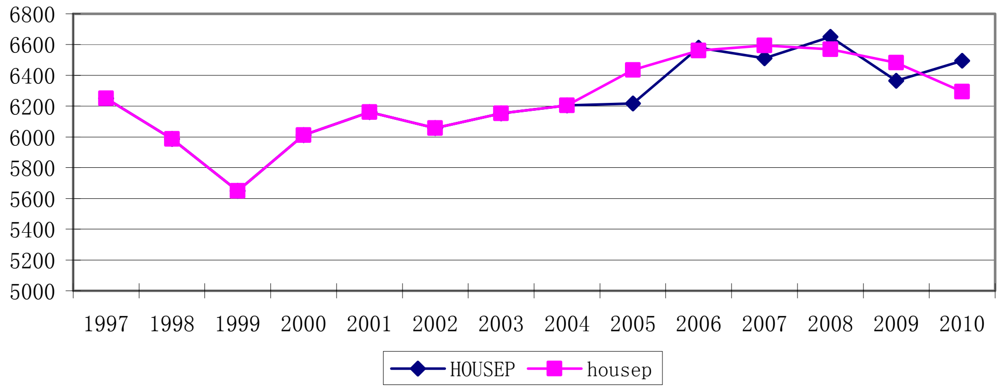


Figure 6-44 The influence of pre-sale policy III on HOUSEP

(iv) Analysis of policies approving to pre-sell

From the above experiments on pre-sale policies, it can be concluded that policies concerned directly affect housing supply, and the ratio of supply to demand leads to a change in the pricing structure, influencing the demand of housing. However, by comparing these policies with the current policy, namely policy I and policy II which are categorized as strict policies cause supply to descend and price to ascend. On the contrary, policy III is a loose policy leading to high supply, low price and high demand.

(3) Experiments on other policies

Other policies include population policy, financial policy, capacity rate, tax, custom, etc; herein custom policy is mainly analyzed. In the simulation with current policies, the annual area of housing export after 2002 (including 2002) is 50 ten-thousand square meters. According to the opinions of experts, if Luohu port and Huanggang port are opened simultaneously, the area may experience an increase of about 60%. For the experiment, in order to test the influence of custom policy on real estate, the parameter of housing export becomes 1.6. The simulation result is shown in Table 6-21 and Figure 6-45 to Figure 6-47.

Table 6-21 The experiment on “custom policy”

TIME	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
DEMAND	340.89	379.87	489.07	548.63	576.45	641.24	671.86	635.94	646.64	593.79	593.76	535.65	553.41	451.95
demand	340.89	379.87	489.07	548.63	576.45	641.24	646.86	659.79	635.66	606.71	581.13	555.66	522.13	509.79
Change rate	0	0	0	0	0	0	*0.038648*	*-0.03615*	*0.017273*	*-0.0213*	*0.021734*	*-0.03601*	*0.059908*	*-0.11346*
SUPPLY	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1245.5	1210.1	1152.5	1133.8	1105.3	1117.5	1098.3
supply	643.88	806.89	968.31	1072.2	1174.3	1284.1	1295	1267	1208.4	1160.9	1130.4	1113.6	1108	1117.2
Change rate	0	0	0	0	0	0	0	*-0.01697*	*0.001407*	*-0.00724*	*0.003008*	*-0.00745*	*0.008574*	*-0.01692*
HOUSEP	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6366.3	6371.5	6626.3	6539.2	6647.3	6373.7	6474.2
housep	6250	5986.1	5648.1	6012.9	6161.6	6058.6	6153.8	6205.5	6435.3	6560.9	6594.9	6570.2	6481.8	6293.6
Change rate	0	0	0	0	0	0	0	*0.025912*	*-0.00991*	*0.009968*	*-0.00845*	*0.011735*	*-0.01668*	*0.028696*

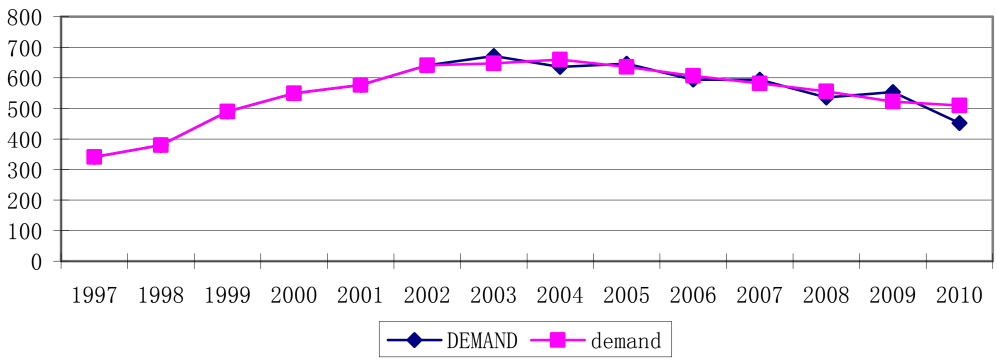


Figure 6-45 The influence of custom policy on DEMAND

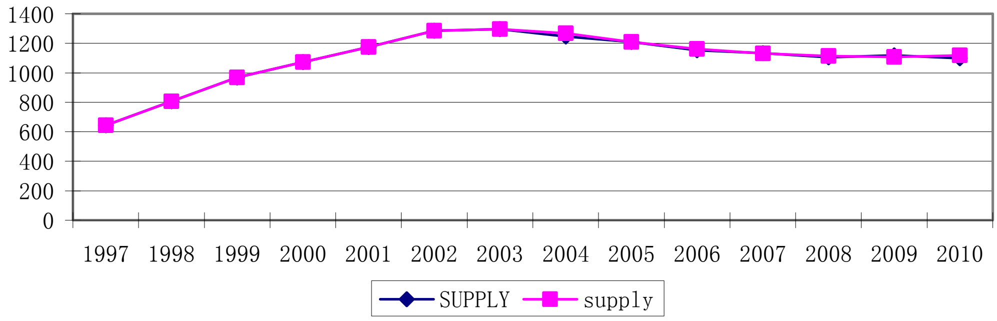


Figure 6-46 The influence of custom policy on SUPPLY

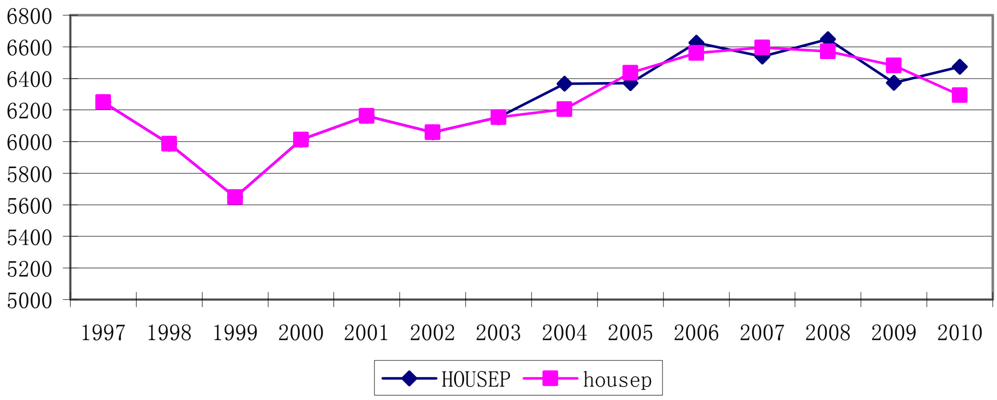


Figure 6-47 The influence of custom policy on HOUSEP

The conclusion from Table 6-21 is that by implementing the policy, the housing export increases tremendously and the demand of housing also increases. For example, the change of demand is much more obvious from 2003 to 2005, and it is close to the original simulation from 2006 to 2007. From the viewpoint of development, custom policy cannot sustain the demand of housing increase in the long run.

6.2 Appraisal of Effect

6.2.1 Test and Appraisal of REWS

Based on the research of the project team of *Developmental Strategy for Shenzhen Real Estate Market*, this dissertation is to adopt the eight indicators for synthetically evaluation of the Shenzhen REM, viz. *real estate investment/GDP, ratio of land for real estate, sale rate of commercial housing, ratio of new projects, sales of housing inventory/sales of housing increment, amount of vacant housing/sales of housing, ratio of lease to sale of housing*, and *ratio of supply to demand of housing*, which are constructed by the project team, in order to test the REWS. However, one of them is adjusted, namely *pre-sale rate of housing* changed to *sale rate of housing*. The results are calculated and analyzed (see Table 6-22). The normal fluctuation range of each indicator is adjusted through by analyzing their mean and standard deviation. Based on the outcome, the qualitative appraisal of Shenzhen REM is established in a given period of time; likewise, the appraisal is done on the basis of the warning analysis of single indicator or composite indicator to test or appraise the REWS as follows.

(1) The status of Shenzhen REM in 1992

From Table 6-22, there are three indicators which are normal and five indicators which are abnormal indicators taken from the year 1992. As a result, *sale rate of commercial housing* and *ratio of new projects* are high, meaning that the boom of real estate is high; and *real estate investment/GDP* is large and *ratio of land for real* *estate* is small, showing an imbalance between real estate development and macro-economy. In addition, *amount of vacant housing/sales of housing* is reasonable, indicating the equilibrium of demand and supply; however *ratio of lease to sale of housing* and *ratio of supply to demand of housing* are abnormal, indicating the disequilibrium in the structure of REM.

From REWS mentioned in Section 5.1.1, the composite warning value in 1992 is 1.92, in the red light section, and the one in 1991 is 1.41. With respect to the warning of single indicator, *growth rate of real estate investment/GDP growth rate* and *growth rate of real estate investment* lie within the red light section and their warning value is high, showing an obvious trend that investment increases rapidly.

In other words, real estate market ascends continuously in 1992. But the over-investment leads to a bad harmony between real estate and the national economy and the imbalance of the structure of real estate market.

(2) The status of Shenzhen REM in 1993

From Table 6-22, there are three normal indicators and five abnormal indicators in 1993. Therefore, *sale rate of commercial housing*, *ratio of new projects* and *ratio of supply to demand of housing* indicate normal behaviors; and the other indicators show abnormal activities.

Table 6-22 Appraisal of Shenzhen REM from 1992 to 2002 based on these eight indicators

Indicators	Value of indicators and Appraisal results											Normal fluctuation range	
	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Lower limit	Upper limit
Real estate investment/GDP	0.225	0.229	0.212	0.129	0.131	0.121	0.14	0.149	0.157	0.172	0.184	0.131	0.206
	×	×	×	×	√	×	√	√	√	√	√		
Ratio of land for real estate	0.287	0.504	0.36	0.351	0.435	0.38	0.301	0.311	0.27	0.319	0.237	0.268	0.415
	√	×	√	√	×	√	√	√	√	√	×		
Sale rate of commercial housing	1.13	0.824	0.581	0.828	0.701	0.944	0.716	0.878	0.926	0.891	0.748	0.693	0.974
	×	√	×	√	√	√	√	√	√	√	√		
Ratio of new projects	0.401	0.361	0.154	0.164	0.226	0.266	0.298	0.348	0.338	0.359	0.353	0.217	0.377
	×	√	×	×	√	√	√	√	√	√	√		
Sales of housing inventory /sales of housing increment	0.095	0.059	0.072	0.058	0.125	0.136	0.232	0.276	0.353	0.388	0.43	0.069	1.000
	√	×	√	×	√	√	√	√	√	√	√		
Amount of vacant housing/sales of housing	0.32	0.12	0.4	0.66	1.01	0.63	0.76	0.51	0.452	0.222	0.218	0.200	0.340
	√	×	×	×	×	×	×	×	×	√	√		
Ratio of lease to sale of housing	0.367	0.39	0.507	0.485	0.44	0.409	0.47	0.51	0.434	0.463	0.543	0.404	0.508
	×	×	√	√	√	√	√	×	√	√	×		
Ratio of supply to demand of housing	0.83	1.07	1.17	1.16	1.83	2	2	1.1	1.46	1.05	1.08	0.944	1.737
	×	√	√	√	×	×	×	√	√	√	√		

(Note: "√" denotes an indicator in normal fluctuation range; "×" denotes an indicator in abnormal one.)

From REWS mentioned in Section 5.1.1, the composite warning value is 1.69, in red light section, in 1993. For the warning analysis of monomial indicators, *growth rate of real estate investment/GDP growth rate* and *growth rate of real estate investment* are in red light section; *real estate investment/fixed assets investment* and *growth rate of complete area* are in the yellow light section.

All these results indicate that Shenzhen real estate market is not balanced in 1993.

(3) The status of Shenzhen REM in 1994

From Table 6-22, there are half indicators which are normal and the rest are abnormal in 1994. There are two normal indicators which respectively reflect the harmony between real estate industry and national economy and the boom of real estate industry. In addition, the two normal indicators show the equilibrium of demand and supply.

From REWS mentioned in Section 5.1.1, the composite warning value is 0.63, in green light section, in 1994. Among the warning analysis of monomial indicators, there are two indicators in red light section, an indicator in yellow light section and an indicator in blue light section.

The above analysis shows that the Shenzhen real estate market is in a period of adjustment in 1993.

(4) The status of Shenzhen REM in 1995

From Table 6-22, there are four normal indicators and four abnormal indicators in 1995. There are two normal indicators which respectively reflect the harmony between real estate industry and national economy and the boom of real estate industry, and two normal indicators which indicate the equilibrium of demand and supply.

From REWS mentioned in Section 5.1.1, the composite warning value is -1.06, in azury light section, in 1995. Among monomial indicators, there is an indicator in blue light section, and two indicators in azury light section, meaning that the overheating of REM has been controlled.

The above analysis shows that the boom and balance of Shenzhen real estate market is still in a bad situation in 1995, however after one-year of adjustment, it begins to turnaround and become stable.

(5) The status of Shenzhen REM in 1996

From Table 6-22, there are five normal indicators and three abnormal ones in 1996. There are two normal indicators which respectively reflect the harmony between real estate industry and national economy and the equilibrium of demand and supply, and three normal indicators which image the boom of real estate industry.

From REWS mentioned in Section 5.1.1, the composite warning value in 1996 is 0.09, in green light section. Among monomial indicators, there is an indicator in red light section. These mean that REM is stable and more active compared to the results in 1995.

The above analysis shows that the equilibrium of demand and supply is in distress in 1996, especially when vacancy rate is high. However, due to the activity of investment, the sale of new or old house increases, showing that real estate industry has risen and developed rapidly.

(6) The status of Shenzhen REM in 1997

From Table 6-22, there are five normal indicators and three abnormal ones in 1997. There are two normal indicators which respectively reflect the harmony between real estate industry and national economy and the equilibrium of demand and supply, although vacant rate is still high, and three indicators images the boom of real estate industry, are all normal.

From REWS mentioned in Section 5.1.1, the composite warning value in 1997 is -0.30, in green light section. Among monomial indicators, there is an indicator in red light section, yellow one, azury one and blue one respectively.

The above analysis shows that although the equilibrium of demand and supply is in mishap in 1997, the whole real estate economy develops rapidly and is in harmony with the national economy. Thus real estate market is normal as a whole.

(7) The status of Shenzhen REM in 1998

From Table 6-22, there are six normal indicators and two abnormal ones in 1998. These indicators reflect the harmony between real estate industry and national economy and the boom of real estate industry are normal, but these indicators imaging the equilibrium of demand and supply are bad.

From REWS mentioned in Section 5.1.1, the composite warning value in 1998 is 0.62, in green light section. Among those monomial indicators, there are seven indicators in green light section and two indicators in yellow one.

Both of them show that real estate industry develops rapidly and real estate market performs normally as a whole in 1998.

(8) The status of Shenzhen REM in 1999

From Table 6-22, there are also six normal indicators and two abnormal ones in 1999. Except for *amount of vacant housing/sales of housing* and *ratio of lease to sale of housing*, other indicators are normal. In fact, the *amount of vacant housing/sales of housing* also declines from 1.01 in 1996 to 0.51 in 1999.

From REWS mentioned in Section 5.1.1, the composite warning value in 1999 is 0.94, in green light section. Among these monomial indicators, there are three indicators in red light section and other indicators are in green light section.

Both of them indicate that Shenzhen real estate industry is in harmony with the national economy and is still booming, the total amount of demand and supply and its structure are in equilibrium, and real estate market is healthy and stable in 1999.

(9) The status of Shenzhen REM in 2000

From Table 6-22, there are also seven normal indicators and only an abnormal one, viz. *amount of vacant housing/sales of housing* in 2000.

From REWS mentioned in Section 5.1.1, the composite warning value in 2000 is 0.51, in green light section. Among these monomial indicators, there are two indicators in yellow light section and other seven indicators are in green light section. Both of them indicate that in 2000 Shenzhen real estate market is booming and is in harmony with national economy and real estate market is stable.

(10) The status of Shenzhen REM in 2001

From Table 6-22, all of eight indicators are normal in 2000; from REWS mentioned in Section 5.1.1, the composite warning value is 0.45, in green light section. Among these monomial indicators, there are two indicators in yellow light section and other seven indicators are in green light section.

Both of them show the same reaction in 2001 Shenzhen real estate market is booming and is in harmony with the national economy and the real estate market remains stable.

(11) The status of Shenzhen REM in 2002

From Table 6-22, there are also six normal indicators and two abnormal ones in 2002. Except for *ratio of land for housing* and *ratio of lease to sale of housing*, other indicators are normal.

From REWS mentioned in Section 5.1.1, the composite warning value in 2002 is 0.56, in green light section. Among these monomial indicators, there are six indicators in green light section and three indicators in yellow light section.

Both of them indicate that Shenzhen real estate market is escalating, its structure is in equilibrium in general, and the real estate market is stable; but it is not enough harmony with national economy in 2002.

According to the above analysis, the warning results from REWS is basically constituent with the appraisal results from above eight indicators, showing that Shenzhen REWS can accurately reflect the characteristics of Shenzhen REM. It may forecast the developmental trend of real estate market in the near or far future, as well as appraise its past or current status.

6.2.2 Test and Appraisal of RECIs

The appraisal of RECIs is done by comparing the application of RECIs mentioned above given the eight indicators established by the project team of the *Developmental Strategy of Shenzhen Real Estate Market*. According to the indexes from 1999 to 2003, it is obvious that whether it is basic indexes, sub-indexes and monomial indexes or composite indexes, they are consistent with these eight indicators in general. Therefore, RECIs may effectively instruct the investment and consumption of real estate. The detail of appraisal is very similar to REWS, hereon it is not to be presented.

6.2.3 Test and Appraisal of System Simulation and Policies Experiments of Real Estate

6.2.3.1 Appraisal of System Simulation Model

The appraisal of the simulation model mainly includes two aspects: practicability and effectiveness.

For the appraisal of the practicability of the model, the aim of modeling should be taken into account; on the other hand the consistency of the model with the urban commercial housing system should be analyzed. From the structure of the model and the derived results, the model can better solve the problems and realize its objective. As for the consistency, the best measure for testing is to compare simulation results with actual data. The reason is because it is important for SD to test the consistency between models and actual data.

In the research, sales area, area of new projects and housing price are only analyzed to test their consistency, as shown as Table 6-23. From the table, the simulation results and actual data are consistent as a whole and their relative error is small. From 1997 to 2002, the average error of housing price is 3.139%, the one of sales area is 3.54%, and the one of area of new projects is 10%. Thus the model can be considered to be reliable. Its effectiveness is determined by relevant policies, and whether the real effect of policies is consistent with simulation results.

Table 6-23 The comparison between simulation data and actual data 1997~2002

TIME	1997	1998	1999	2000	2001	2002
Sales area of simulation	340.89	379.87	489.07	548.63	576.45	641.24
Actual sales area	336.7	372.38	492.51	556.82	593.72	724
Relative error	-0.01229	-0.01972	0.007034	0.014928	0.029959	0.129062
Simulation area of new projects	300	393	620	578	712	755
Actual area of new projects	365.5	429.63	508.4	566.44	675.09	788.95
Relative error	0.218333	0.093206	-0.18	-0.02	-0.05184	0.044967
Housing price of simulation	6250	5986.1	5648.1	6012.9	6161.6	6058.6
Actual housing price	6250	6052.8	5872.5	5825	5938	5825
Relative error	0	0.011142	0.03973	-0.03125	-0.03629	-0.03856

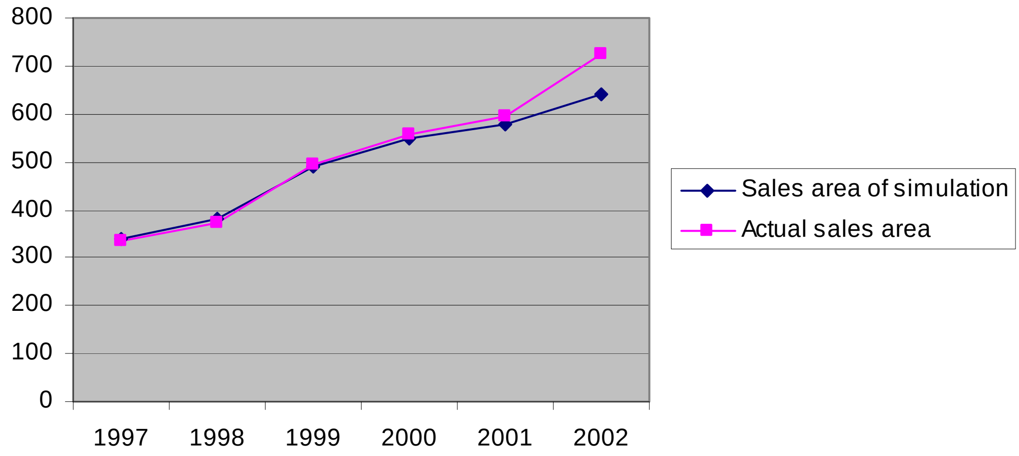


Figure 6-48 The comparison between the simulation results and actual data of sales area 1997~2002

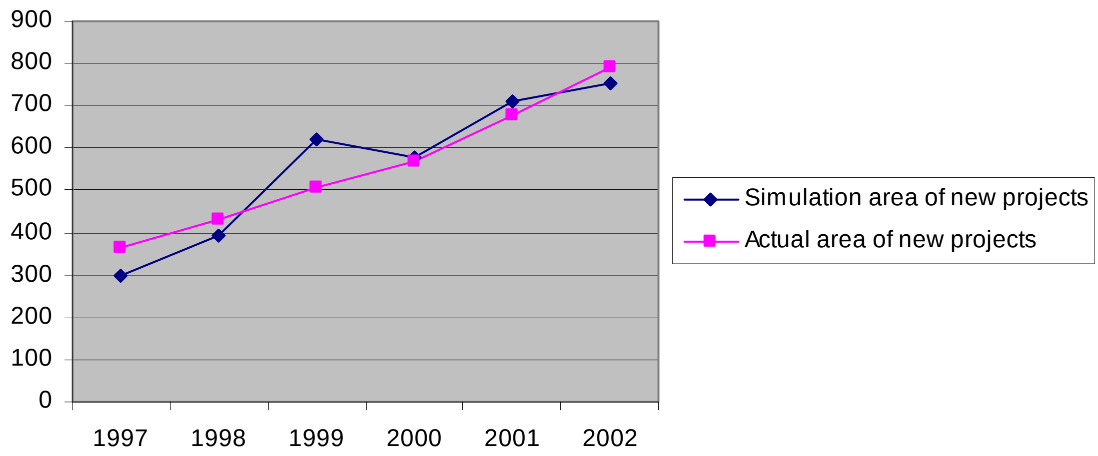


Figure 6-49 The comparison between the simulation results and actual data of area of new projects 1997~2002

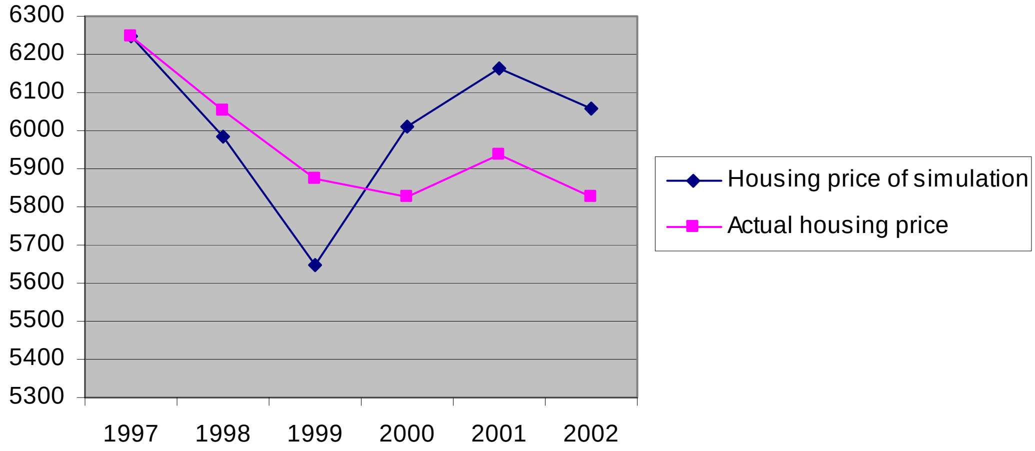


Figure 6-50 The comparison between the simulation results and actual data of housing price 1997~2002

6.2.3.2 Appraisal of Policies Experiments

By testing these parameters of policies mentioned above again, it is found that land policy, policy approving to pre-sell and custom policy can all play an influential factor in the running of the real estate market. It is apparent that for a long term real estate system would become stable after governments change any policy. Thus the Shenzhen real estate system takes on the typical characteristics of complex systems, namely strong self-organization ability. The underlying reason for this is that the Shenzhen real estate market has saturated and reached maturity and its running is restricted by market rules. In theory, it is feasible for Shenzhen REM to adopt self-adjustment policies. In the short term, due to the difference of sensitivity and different influences on demand and supply, all kinds of parameters of policies would affect the state of real estate system with different degree or modes. In fact, the above fpolicies are all important macro-control measures.

6.2.4 Composite Appraisal of the Control System for Real Estate

Based on the above application and appraisal of REWS, RECIs and system simulation and policies experiments, it is shown that the systems may reflect the status and trend of real estate market through different emphasis and can provide reliable technological support for the government to apply macro-control policies, and may offer different users with relevant information.

(1) REWS may determine the current status of REM, namely “overcooling”, “overheating” or “normal”, by analyzing these leading indicators and the composite indicator, to provide governments and investors with important information for decision making processes.

(2) RECIs synthetically take into account current efficient D&S, latent demand, and latent supply, and reflect the confidence and expectation of the public and experts for REM in the future through a suit of perfect index system. Thus RECI system may effectively provide investors and consumers with data, lead the investment and consumption and assist governments in managing REM.

(3) “System simulation and policies experiments of real estate” dynamically simulates the running of real estate market. It either simulates the developmental trend of REM under the condition of some policies or provides dynamic data for the warning system, or tests different policies, which is either the foundation of dynamic warning or the measure of testing and selecting polices.

Therefore, the new macro-control system can play an information-oriented and warning role that effectively reflect the status and development trends of REM, and can provide the important technology tool to assist governments in managing REM and testing the macro-control policies, and can lead investors to make important investment decisions and consumers to make purchasing decisions, leading the real estate market to become stable and healthy.

6.3 Summary and Conclusions

The chapter mainly finishes these following researches:

(1) Based on the relative investigation data about Shenzhen real estate market, REWS, RECI and “system simulation and experiments on policies” they are analyzed by using their models constructed from the above chapters;

(2) According to the analysis, the effect of the new macro-control system is evaluated, assuring its practicability and effectiveness.

With the continuous increase of marketization and normalization degree of China real estate market, the market mechanism has played an important role in the market regulation. And the existing macro-control system of real estate market appears to lack of ability to regulate the market. Especially in Shenzhen, its marketization and normalization degree is quite high, which needs even more an effective and efficient information-oriented tool to guide the healthy development of real estate market. And with the rapid development of modern information and computer technology, the governments need the technology support system to conduct the macro control policies. The research reconstructed a technological support of macro-control for

Shenzhen real estate market, namely constructed real estate warning systems, real estate confidence index systems, and system simulation and policies experiment. The details of achievements obtained are following:

(1) Compared the gap between domestic and overseas research on macro-control systems based on information-oriented and warning systems;

(2) Constructed the REWS. Selected appropriate warning methods according to the characteristics of real estate industry and determined the warning factors via considering the real situation of Shenzhen REM; presented the criteria, procedure and methods to select indicators reflecting warning signs and selected 9 indicators; determined their warning limits based upon relevant methods and at the same time presented the methods adjusting warning accumulation; probed into the methods of warning analysis based on which the warning analysis of single indicator and composite indicator is done; researched the expression and analysis of warning signals and put forward relative questions needed paying attention to.

(3) Established the RECIS. Discussed the key techniques of constructing the system; through questionnaires investigation, discussed how to establish monomial indexes and composite index, which reflect efficient D&S, latent demand and latent supply; established a four-level RECIS, viz. a composite index, monomial indexes, sub-indexes and basic indexes and analyzed their functions; constructed the model of the composite index via using the composite index method.

(4) Constructed the system simulation and policy experiments of real estate. Constructed the theoretical model of system simulation and the conceptual model of

system simulation of Shenzhen real estate, divided residential housing systems into four modules, namely land for housing, housing demand, housing supply, and housing price, and presented the main DYNAMO equations for each of modules, in which relevant calculation and parameters were determined; based upon the model of system simulation constructed, made some experiments on relative real estate policies and analyzed the approach for study on policies.

(5) Based on the investigation data for Shenzhen REM, an application of the new-type macro-control system was done via adopting the relative models. The performance of the system is analyzed and measured, which make sure the practicability and effectiveness of the macro-control system based on information-oriented and modern technology.

From the case study, it is shown that the macro-control system constructed based on information-oriented and modern technology may assist governments in the macro control for REM, lead developers to make investment decisions and instruct consumers in making consumption decisions efficiently and effectively. Additionally, with the continuous mature of REM, it is strived to spread the macro-control system to other cities of China. Therefore, it takes on a good application prospect in the whole country.

Otherwise, the system has some disadvantages, such as sampling reasonability, the reliability of questionnaires, the selection of forecast methods, the lack of data, etc. All of these are not still processed automatically and need studying further.

CHAPTER 7: CONCLUSIONS

This study has investigated three technological support systems that can be used to assist the decision making process of macro-control measures of the Shen Zhen government in the REM. Specifically, the REWS may help the government to understand what is happening in the REM, to master the recent trends of the REM, and to judge the situation of REM. A RECIS is to measure consumers' confidence level in the REM. A RECIS provides a reliable reference for the government to predict future market demand. With this reference, rational plans for issuing macro-control policies can be made. The SS&PE can be used as a simulation tool to experiment the effect of various policies and decisions to the REM.

In other words, the REWS is the basis of decision making, the RECIS is the guide and indicator of the REM, and the SS&PE are the measuring tools to predict the possible effect of any macro-control policies to be issued by the government. The integration of all these provides a reliable ground for the government to make sound decisions for regulating and controlling of the REM.

7.1 Contributions

With the increasing marketization of China's real estate market, the information-oriented mechanism has played an important role in the market regulation. This needs a set of technological supporting to guide the healthy development of real estate market. This study compiles a set of real estate confidence indices on the basis of the domestic and overseas research status and establishes mathematic models concerned at all levels. Proved by the case study, the RECI is rather practical and valid, which can provide effective information for governmental macro control. In addition, the REWS evaluates the REM at the macro-economical level. The REWS can also help the government understand the general trend of the market. The SS&PE can simulate the possible effects of implementing a particular macro-control measure.

Specially, the study has made the following contributions.

(1) In this study, a set of Real Estate Warning Systems (REWS) are established. The role of warning systems in the macro-control system for REM is analyzed, and methods for selecting appropriate warning methods of real estate are discussed. In addition, criteria of selecting the indicators of warning signs are determined. Nine indicators of warning signs are selected, namely these indicators are *growth rate of real estate investment/GDP growth rate*, *real estate investment amount/fixed assets investment amount*, *growth rate of annual real estate investment*, *growth rate of land development area*, *growth rate of the area of new commercial-building projects*, *growth rate of the complete construction area of commercial building*, *growth rate of the sales area of commercial building*, *real estate investment loans/medium or long-term loans balance,* and *individual housing loans/real estate investment loans*.

(2) The roles of RECI in macro-control systems are analyzed, the key techniques of constructing RECI are presented and improved. These techniques include factor analysis, Delphi method, composite index method, SPSS software, index simulation, TRECI&BRE index method. In order to measure the efficient demand and supply of the REM, a set of questionnaires are designed. Returned questionnaires establish the important factors and corresponding weighting coefficients. By using factor analysis

method and SPSS, the analysis of the 25 factors and their index models and forecasting models are established, namely the models of sub-indexes and monomial indexes.

Considering the characteristics of land supply and capacity rate of Shenzhen, the ratio method is applied to the construction of the models of land inventory index, land increment index and capacity rate index for each districts or Shenzhen. The composite index method is adapted to the construction of the composite latent demand index.

A four-level RECI system is constructed, and it includes the composite index, monomial indexes, sub-indexes and basic indexes. The weighting coefficients of all monomial indexes are determined by using the Delphi method and the model of the composite confidence index are established and analyzed the forecast models.

(3) In order to estimate the effect of new policies on the REM,, a model, constructed based on system dynamics, is constructed to simulate how new policies would affect the REM.

In summary, the study has investigated the role of three sets of technological supporting tools in assisting decision making process of macro-control measure of the Shen Zhen REM. The three tools are REWS, the RECI and SS&PE. The integration of these tools provides a comprehensive environment for the government to implement effective and efficient macro-control measures.

7.2 limitations of the study

Although the technological supporting tools are useful to statuary bodies in formulating macro-control measures to regulate the Shen Zhen REM, the study itself can be further improved in the following aspects. First, the three components of the RECI, i.e. V1, V2 and V3, were linearly summed to generate the confidence index. Further research is needed to verify that linear aggregation is appropriate in reflecting the true confidence level of the demand and supply aspects of the REM. In addition, as both REWS and RECI are used to examine the current status of the REM, it is necessary to integrate them to a single measure so that it becomes more convenient for application. Moreover, although a framework has been proposed to implement the technological tools into a GIS based computer system, there is a need to implement the computer system so that the validity of the technological tools can be further evaluated.

In summary, this study has proposed and formulated a set of technological tools for Shen Zhen government to investigate the current trend of REM, and to prepare effective and efficient macro-control measures to regulate the market. The proposed technological tools are expected to be generally useful in other cities in China.

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APPENDIX 1 DESIGN OF THE EFFICIENT D&S QUESTIONNAIRE

Table A1-1 The design of questions

Q1: Do you think the distribution and density of population is important to REM?
Q2: Do you think total GDP and GDP per capita are important to REM?
Q3: Do you think per capita income controlled is important to REM?
Q4: Do you think housing mortgage loans are important to REM?
Q5: Do you think the amount of real estate investment is important to REM?
Q6: Do you think the source of real estate capital is important to REM?
Q7: Do you think the degree of land development is important to REM?
Q8: Do you think the area of new projects is important to REM?
Q9: Do you think construction area is important to REM?
Q10: Do you think complete area is important to REM?
Q11: Do you think the total sale amount of commercial house is important to REM?
Q12: Do you think the sale area of commercial house is important to REM?
Q13: Do you think the price of commercial house is important to REM?
Q14: Do you think the vacant area of commercial house is important to REM?
Q15: Do you think per captia housing area is important to REM?
Q16: Do you think leased area is important to REM?
Q17: Do you think the leased price of house is important to REM?
Q18: Do you think the construction cost of house is important to REM?
Q19: Do you think the transaction area of third-class market is important to REM?
Q20: Do you think the transaction price of third-class market is important to REM?
Q21: Do you think the structure and type of real property are important to REM?
Q22: Do you think price index and inflation rate are important to REM?
Q23: Do you think the interest of medium and long term loans and the interest of housing mortgage loans are important to REM?
Q24: Do you think the employment rate is important to REM?
Q25: Do you think the stock market is important to REM?

Table A1-2 The design of answers and corresponding scores

Answer	Corresponding score
A Very important	2
B Important	1
C No opinion	0
D Not important	-1
E Not very important	-2

APPENDIX 2 CONTRIBUTION RATE AND LOADING MATRIX OF FACTORS

Table A2-1 The characteristic roots and contribution rates of factors

Factor	Characteristic root	Contribution rate	Accumulated contribution rate
1	**3.612**	**23.279**	**23.279**
2	**2.709**	**16.761**	**40.040**
3	**2.036**	**15.414**	**55.454**
4	**1.863**	**13.452**	**68.906**
5	0.211	2.283	71.189
6	0.199	1.952	73.141
7	0.191	1.911	75.052
8	0.186	1.876	76.928
9	0.180	1.831	78.759
10	0.176	1.702	80.461
11	0.168	1.651	82.112
12	0.153	1.497	83.609
13	0.149	1.460	85.069
14	0.139	1.380	86.449
15	0.121	1.296	87.745
16	0.120	1.211	88.956
17	0.170	1.159	90.115
18	0.161	1.127	91.242
19	0.130	1.150	92.742
20	0.121	1.090	94.832
21	0.161	1.062	96.894
22	0.101	1.056	97.950
23	0.097	0.887	98.837
24	0.079	0.776	99.613
25	0.049	0.387	100

Table A2-2 The loading matrix of factors

Factor / Variable	F1	F2	F3	F4
X_1	**0.89**	0.13	0.01	0.21
X_2	-0.03	0.09	0.10	0.11
X_3	0.21	**0.69**	0.19	0.31
X_4	0.05	**0.77**	0.12	0.07
X_5	0.03	0.11	0.22	0.18
X_6	0.02	0.23	0.03	0.21
X_7	0.11	0.31	-0.17	**0.69**
X_8	0.10	0.03	0.01	0.20
X_9	0.09	0.10	0.07	0.07

X_{10}	-0.12	0.11	0.01	**0.77**
X_{11}	0.21	0.07	0.02	**0.67**
X_{12}	0.08	0.09	0.01	-0.22
X_{13}	0.09	0.03	**0.77**	0.05
X_{14}	0.02	0.17	**0.69**	0.11
X_{15}	0.10	0.29	0.21	0.12
X_{16}	0.33	0.15	0.27	0.02
X_{17}	0.21	0.02	0.20	0.03
X_{18}	0.76	0.12	0.18	0.11
X_{19}	0.05	0.21	0.01	0.07
X_{20}	0.10	0.01	0.07	0.13
X_{21}	0.06	0.03	0.21	0.05
X_{22}	0.21	0.02	0.07	0.19
X_{23}	0.16	**0.71**	0.33	0.01
X_{24}	0.03	**0.80**	0.08	0.11
X_{25}	0.11	0.21	0.39	0.33

APPENDIX 3 DESIGN OF LATENT DEMAND QUESTIONNAIRE

Table A3 The design of questions and corresponding scores

Question	Answer	Score
Q2: How do you rate buying a property in Shenzhen as an investment?	A: Very good	+2
	B: Good	+1
	C: Neutral	0
	D: Bad	-1
	E: Very bad	-2
Q6: Is it a good or bad time to buy a house now?	A: Very good	+2
	B: Somewhat good	+1
	C: Somewhat bad	-1
	D: Very bad	-2
Q7: Do you expect that overall economic conditions in Shenzhen will be better or worse than they are at present, or just about the same during the next 3 months, 1 year or 3 years?	A: Much better	+2
	B: Better	+1
	C: Stay the same	0
	D: Worse	-1
	E: Much worse	-2
Q8: Do you think your opportunities to advance in your present job, or your job will get better or worse in the coming year or 3 years?	A: Much better	+2
	B: Better	+1
	C: Stay the same	0
	D: Worse	-1
	E: Much worse	-2
Q9: On average, do you consider current housing prices in Shenzhen are:	A: Extremely high	-2
	B: Somewhat too high	-1
	C: About right	0
	D: Somewhat too low	+1
	E: Extremely low	+2
Q11: When the relation of supply and demand changes, do you think housing prices will rise or fall in 3 months, 1 year or 3 years and what do you expect?	A: Above 20%	+4
	B From 11% to 20%	+3
	C: From 6% to 10%	+2
	D: From 1% to 5%	+1
	E: No change	0
	F: From -1% to -5%	-1
	G: From -5% to -10%	-2
	H: From -11% to -20%	-3
	I: Above -20%	-4
Q13: To what extent do you think the government's restrictions on selling land for new flats will affect prices upwards or downwards?	A: Greatly upwards	+2
	B: Somewhat upwards	+1
	C: Somewhat downwards	-1
	D: Greatly downwards	-2
	E: Neither change	0
Q14: Do you expect your family income to increase, or decrease, or stay where they	A: Greatly increase	+2
	B: Increase somewhat	+1
	C: Stay the same	0

are now during the next 3 months, 1 year or 3 years?	D: Decrease somewhat	-1
	E: Greatly decrease	-2
Q15: Do you think your ability to pay for a home or property purchase will get better or worse in the coming year or 3 years？	A: Much better	+2
	B: Better	+1
	C: Stay the same	0
	D: Worse	-1
	E: Much worse	-2

APPENDIX 4 WEIGHTING COEFFICIENTS OF EACH AREA AND FLAT MODEL

Table A4-1 The weighting coefficients of flat models of Futian Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Bagua	0.57732	0.10465	0.01859	0.15039	0.14906	1
Futian center	0.00336	0.10826	0.45322	0.31147	0.12368	1
Huaqiang	0.13909	0.41260	0.25487	0.14053	0.05292	1
Huanggang	0.04235	0.52999	0.31227	0.09129	0.02410	1
Jingtian	0.05777	0.09366	0.49514	0.24586	0.10758	1
Meilin	0.09142	0.21784	0.51300	0.15740	0.02034	1
Shixia	0.15837	0.24271	0.31702	0.23608	0.04582	1
Xiangmihu	0.06527	0.06932	0.34425	0.23151	0.28965	1
Xinzhou	0.07969	0.13289	0.39112	0.29990	0.09641	1
Yuanling	0.10277	0.36584	0.39597	0.08513	0.05030	1

Table A4-2 The weighting coefficients of flat models of Nanshan Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Huaqiaocheng	0.01804	0.07230	0.27191	0.47293	0.16483	1
Kejiyuan	0	0.07138	0.53449	0.16265	0.23149	1
Nantou	0.01823	0.18747	0.50382	0.19211	0.09837	1
Nanyou	0.05946	0.19328	0.47722	0.19188	0.07815	1
Shekou	0.01954	0.22265	0.28578	0.31452	0.15751	1
Xili	0.10687	0.25308	0.53011	0.08796	0.02198	1

Table A4-3 The weighting coefficients of flat models of Luohu Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Buxin	0.02617	0.37621	0.56806	0.01683	0.01272	1
Caiwuwei	0.09686	0.47048	0.39579	0.02922	0.00766	1
Cuizhu	0.16089	0.33333	0.27874	0.14604	0.08100	1
Dongmen	0.12172	0.35233	0.31864	0.17263	0.03468	1
Liantang	0.04749	0.26566	0.49857	0.08642	0.10186	1
Xungang	0.12063	0.30440	0.47507	0.06888	0.03102	1
Wenjin	0.38337	0.43674	0.14224	0.02547	0.01219	

Table A4-4The weighting coefficients of flat models of Yantian Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	

Shatoujiao	0.06982	0.24535	0.40884	0.16795	0.10804	1
Yantian	0.19489	0.23400	0.30362	0.05882	0.20867	1

Table A4-5 The weighting coefficients of flat models of Baoan Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Longguan	0.03268	0.20561	0.55446	0.13144	0.07582	1
Shafu	0.00077	0.47308	0.47987	0.02167	0.02461	1
Shiyan	0	0.03340	0.96660	0	0	1
Songming	0.01862	0.26669	0.71469	0	0	1
Xinxi	0.01018	0.22709	0.55471	0.13405	0.07396	1

Table A4-6 The weighting coefficients of flat models of Longgang Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Henggang	0.01820	0.16279	0.53608	0.16435	0.11858	1
Longgang center	0.01127	0.15688	0.51411	0.23254	0.08521	1
Peng’ao	0	0.41953	0.37008	0.21038	0	1
Pingbu	0.02943	0.35944	0.48944	0.07338	0.04831	1
Pingyong	0	0	0.85004	0	0.14996	1

Table A4-7 The weighting coefficients of flat models of Futian Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Bagua	0.10348	0.12974	0.34678	0.22827	0.19173	1
Futian bonded area	0.05229	0.40156	0.49427	0.05189	0.00000	1
Futian center	0.00000	0.06853	0.45341	0.28271	0.19535	1
Huaqiang	0.02615	0.10707	0.70304	0.12498	0.03875	1
Huanggang	0.03474	0.24785	0.55993	0.12847	0.02900	1
Jingtian	0.01571	0.09431	0.55140	0.20387	0.13471	1
Hailin	0.02517	0.22910	0.59200	0.11521	0.03853	1
Shangbu	0.00970	0.22659	0.47891	0.22791	0.05689	1
Shixia	0.00693	0.08782	0.38866	0.27365	0.24294	1
Xiangmi lake	0.00072	0.04535	0.29395	0.45756	0.20241	1
Xinzhou	0.02739	0.06215	0.45699	0.15840	0.29507	1
Yuanling	0.00254	0.02724	0.72491	0.21827	0.02704	1

Table A4-8 The weighting coefficients of flat models of Nanshan Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Huaqiao city	0.00703	0.04488	0.31160	0.39832	0.23816	1
Keji garden	0.01858	0.16104	0.65726	0.12130	0.04182	1
Nantou	0.01598	0.20275	0.49095	0.22712	0.06319	1
Nanyou	0.07214	0.21497	0.46505	0.18672	0.06113	1
Shekou	0.14505	0.11419	0.36054	0.25670	0.12351	1
Xili	0.00300	0.75010	0.16829	0.05808	0.02053	1
Yueliangwan	0	0.02408	0.71832	0.01539	0.24221	1

Table A4-9 The weighting coefficients of flat models of Luohu Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Buxin	0.02861	0.37720	0.52807	0.03489	0.03123	1
Caiwuwei	0.05276	0.22552	0.54438	0.13718	0.04017	1
Cuizhu	0.04564	0.18626	0.45444	0.22104	0.09262	1
Dongmen	0.18028	0.31843	0.39423	0.07128	0.03579	1
Huangbei	0	0.12946	0.49550	0.26374	0.11130	1
Liantang	0.03943	0.28816	0.52205	0.11640	0.03397	1
Shuiku	0	0.25217	0.57943	0.16840	0	1
Xungang	0.03839	0.19188	0.60852	0.09968	0.06154	1
Wenjin	0.04096	0.16670	0.58546	0.08363	0.12325	1

Table A4-10 The weighting coefficients of flat models of Yantian Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Shatoujiao	0.03846	0.20464	0.61531	0.10688	0.03471	1
Yuantian	0	0	0	0	0	1

Table A4-11 The weighting coefficients of flat models of Baoan Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Longguan	0.01775	0.38580	0.49651	0.09393	0.00602	1
Shafu	0	0.37657	0.45401	0.16942	0	1
Shiyan	0	0	1	0	0	1
Songming	0.08504	0.13470	0.70473	0.02646	0.04907	1
Xinxi	0.02214	0.25450	0.60906	0.09740	0.01690	1

Table A4-12 The weighting coefficients of flat models of Longgang Sec-RH Market

Area	Flat model					Total
	A	B	C	D	E	
Henggang	0.01436	0.08919	0.49797	0.24888	0.14961	1
Kengping	0	0.26329	0.73671	0	0	1
Longgang center	0.00338	0.13455	0.63946	0.20812	0.01449	1
Peng’ao	0	0	0.77441	0.22559	0	1
Pingbu	0.04105	0.37696	0.51638	0.04738	0.01824	1
Pingyong	0	0.07204	0.09670	0.83126	0	1

Table A4-13 The weighting coefficients of these two markets for each area

Futian district

Area	Sec-RH	Sec-RH
Bagua	0.015537	0.011938
Futian bonded area		0.001752
Futian center	0.138278	0.039068
Huaqiang	0.161425	0.20408
Huanggang	0.09979	0.093224
Jingtian	0.149695	0.173917
Hailin	0.029096	0.097684

Luohu district

Area	Sec-RH	Sec-RH
Buxin	0.383426	0.090172
Caiwuwei	0.052805	0.100087
Cuizhu	0.24651	0.314269
Dongmen	0.100427	0.111376
Huangbei		0.039522
Liantang	0.145035	0.111625
Shuiku		0.011044

Shangbu		0.043781
Shixia	0.090863	0.071178
Xiangmi lake	0.080716	0.084121
Xinzhou	0.183961	0.052911
Yuanling	0.050639	0.126346

Xungang	0.034248	0.121886
Wenjin	0.037549	0.100018

Nanshan district

Area	Sec-RH	Sec-RH
Huaqiao city	0.208608	0.257589
Keji garden	0.021138	0.036983
Nantou	0.24304	0.241019
Nanyou	0.451176	0.292779
Shekou	0.035334	0.086501
Xili	0.040704	0.047181
Yueliangwan		0.037949

Yantian district

Area	Sec-RH	Sec-RH
Shatoujiao	0.86662	0.996253
Yuantian	0.133382	0.003747

Longgang district

Area	Sec-RH	Sec-RH
Henggang	0.064328	0.099236
Kengping	0	0.006114
Longgang center	0.43586	0.129322
Peng’ao	0.000535	0.003557
Pingbu	0.477273	0.75497
Pingyong	0.022003	0.006801

Baoan district

Area	Sec-RH	Sec-RH
Longguan	0.400596	0.18356
Shafu	0.049294	0.017309
Shiyan	0.003384	0.003085
Songming	0.002897	0.017416
Xinxi	0.543828	0.778108

APPENDIX 5 2004 SURVEY OF LATENT DEMAND

Table A5-1 Question 1

Q1: In deciding to buy a property in Shenzhen, do you think of the purchase mainly as an investment or as a primary residence?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Mainly investment	6	3	6	4	19	36.5%
Mainly residence	3	2	4	3	12	23.1%
Partly investment and partly residence	6	2	4	5	21	40.4%
Neither	0	0	0	0	0	0

Table A5-2 Question 2

Q2: How do you rate buying a property in Shenzhen as an investment?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Very good	1	0	2	0	3	6.2%
Good	5	3	2	3	13	27.1%
Neutral	6	1	3	2	12	25%
Bad	2	1	1	2	6	12.5%
Very bad	0	0	0	1	1	2.1%
Don't know / no opinion	2	1	6	4	13	27.1%

Table A5-3 Question 3

Q3: When are you planning to buy a property?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Within 3 months	3	2	2	1	8	16.7%
Within 6 months	2	1	1	3	7	14.6%
Within 1 year	3	1	2	2	8	16.7%
Within 3 years	4	2	7	3	16	33.4%
Don't know	3	1	2	3	9	18.7%

Table A5-4 Question 4

Q4: What size of house / flat you are planning to buy?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
20-40 sq.m.	1	0	0	1	2	4.2%
40-70 sq.m.	2	2	5	3	12	25%
70-100 sq.m.	5	4	6	5	20	41.7%
100-140 sq.m.	4	1	2	2	9	18.7%
Above 140 sq.m.	2	1	1	1	5	10.4%

Table A5-5 Question 5

Q5: What is the preferred location of the property you are planning to buy?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Futian	5	3	5	6	19	39.6%
Luohu	6	3	5	4	18	37.5%
Nanshan	1	0	1	0	2	4.125%
Yantian	1	0	1	1	3	6.25%
Baoan	2	1	1	1	5	10.5%
Longgang	1	0	1	0	2	4.125%

Table A5-6 Question 6

Q6: Is it a good or bad time to buy a house now?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Very good	1	0	2	2	5	10.4%
Somewhat good	7	4	7	5	23	47.9%
Somewhat bad	1	2	2	1	6	12.5%
Very bad	1	0	1	1	3	6.25%
Don't know / no opinion	4	1	2	3	10	20.9%

Table A5-7 Question 7

Q7: Do you expect that overall economic conditions in Shenzhen will be better or worse than they are at present, or just about the same during the next 3 months, 1 year or 3 years?

Answer		Group				Total	Proportion
		A1	A2	B1	B2		
In 3 months	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%
	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%
In 1 year	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%
	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%
In 3 years	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%
	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%

Table A5-8 Question 8

Q8: Do you think your opportunities to advance in your present job, or your job will get better or worse in the coming year or 3 years?

Answer		Group				Total	Proportion
		A1	A2	B1	B2		
In 1 year	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%

	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%
In 3 years	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%
	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%

Table A5-9 Question 9

Q9: On average, do you consider current housing prices in Shenzhen are:?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Extremely high	3	2	4	3	11	23%
Somewhat too high	7	2	6	5	21	43.7%
About right	3	2	3	3	11	23%
Somewhat too low	1	1	1	1	4	8.4%
Extremely low	1	0	0	0	1	2.1%

Q10: Do you think there will be more buyers than flats for sale and prices will rise or there will be more flats for sale than buyers and prices will fall?

A Prices will rise ----------------- Go to Q11

B Prices will fall ------------------Go to Q12

Q11: What do you expect the percentage of rise to be?

In 3 months, ___________________?

In 1 year, _____________________?

In 3 years, ____________________?

Table A5-10 Question 10 and 11

Answer		Group				Total	Proportion
		A1	A2	B1	B2		
Within 3 months	Above 20%	1	0	0	2	3	6.25%
	From 11% to 20%	6	5	7	4	22	45.8%
	From 6% to 10%	7	1	6	5	19	39.6%
	From 1% to 5%	0	1	0	0	1	2%
	No change	0	0	0	0	0	0
Within 1 year	Above 20%	1	0	1	1	3	6.25%
	From 11% to 20%	1	0	0	2	3	6.25%
	From 6% to 10%	6	5	7	4	22	45.8%
	From 1% to 5%	7	1	6	5	19	39.6%
	No change	0	1	0	0	1	2%
Within 3 years	Above 20%	0	0	0	0	0	0
	From 11% to 20%	1	0	1	1	3	6.25%
	From 6% to 10%	1	0	0	2	3	6.25%
	From 1% to 5%	6	5	7	4	22	45.8%
	No change	7	1	6	5	19	39.6%

Q12: What do you expect the percentage of fall to be?

In 3 months, ___________________?

In 1 year, _____________________?

In 3 years, ____________________?

Table A5-11 Question 12

Answer	Group				Total	Proportion
	A1	A2	B1	B2		

Within 3 months	From -1% to -5%	1	0	0	2	3	6.25%
	From -5% to -10%	6	5	7	4	22	45.8%
	From -11% to -20%	7	1	6	5	19	39.6%
	Above -20%	0	1	0	0	1	2%
Within 1 year	From -1% to -5%	0	0	0	0	0	0
	From -5% to -10%	1	0	1	1	3	6.25%
	From -11% to -20%	1	0	0	2	3	6.25%
	Above -20%	6	5	7	4	22	45.8%
Within 3 years	From -1% to -5%	7	1	6	5	19	39.6%
	From -5% to -10%	0	1	0	0	1	2%
	From -11% to -20%	0	0	0	0	0	0
	Above -20%	1	0	1	1	3	6.25%

Table A5-12 Question 13

Q13: To what extent do you think the government's restrictions on selling land for new flats will affect prices upwards or downwards?

Answer	Group				Total	Proportion
	A1	A2	B1	B2		
Greatly upwards	1	1	1	2	5	10.4%
Somewhat upwards	3	2	2	1	8	16.7%
Somewhat downwards	4	2	2	1	9	18.75%
Greatly downwards	1	1	1	2	5	10.4%
Neither change	7	6	8	6	27	56.25%

Table A5-13 Question 14

Q14: Do you expect your family income to increase, or decrease, or stay where they are now during the next 3 months, 1 year or 3 years?

Answer		Group				Total	Proportion
		A1	A2	B1	B2		
In 3 months	Greatly increase	1	0	0	2	3	6.25%
	Increase somewhat	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Decrease somewhat	0	1	0	0	1	2%
	Greatly decrease	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%
In 1 year	Greatly increase	1	0	0	2	3	6.25%
	Increase somewhat	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Decrease somewhat	0	1	0	0	1	2%
	Greatly decrease	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%
In 3 years	Greatly increase	1	0	0	2	3	6.25%
	Increase somewhat	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Decrease somewhat	0	1	0	0	1	2%

	Greatly decrease	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%

Table A5-14 Question 15

Q15: Do you think your ability to pay for a home or property purchase will get better or worse in the coming year or 3 years?

Answer		Group				Total	Proportion
		A1	A2	B1	B2		
In 1 year	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%
	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%
In 3 years	Much better	1	0	0	2	3	6.25%
	Better	6	5	7	4	22	45.8%
	Stay the same	7	1	6	5	19	39.6%
	Worse	0	1	0	0	1	2%
	Much worse	0	0	0	0	0	0
	Don't know / no opinion	1	0	1	1	3	6.25%

Table A5-15 Question 16 and 17

Q16: Sex?

Q17: How old are you?

Answer		Group						Total	Proportion
		A1	A2	A3	B1	B2	B3		
Sex	Male	10	4	4	12	9	1	40	74%
	Female	5	3	1	2	3	0	14	26%
Age	19-29	3	1	0	1	2	0	7	12.9%
	30-39	7	6	3	6	6	1	29	53.7%
	40-49	3	0	2	7	4	0	16	29.6%
	50-59	2	0	0	0	0	0	2	3.7%
	60-69	0	0	0	0	0	0	0	0
	Above 70	0	0	0	0	0	0	0	0

Table A5-16 Question 18

Q18: What is your education standard?

Answer	Group						Total	Proportion
	A1	A2	A3	B1	B2	B3		
No formal schooling	0	0	0	0	0	0	0	0
Primary or below	0	1	0	0	0	0	1	1.8%
Secondary	0	0	1	0	1	0	2	3.6%
Matriculated	3	2	1	1	2	1	10	18%
Tertiary	10	3	3	12	6	0	34	63.9%
Postgraduate or above	2	1	0	1	3	0	7	13.6%
Refuse to answer	0	0	0	0	0	0	0	0

Table A5-17 Question 19

Q19: What is the type of your living accommodation?

Answer	Group						Total	Proportion
	A1	A2	A3	B1	B2	B3		
Private (own)	5	2	1	0	0	0	8	14.9%
Private (mortgage)	7	5	4	0	0	0	16	29.6%
Rent	0	0	0	9	8	1	18	33.4%
Other	0	0	0	5	4	0	9	16.7%
Refuse to answer	3	0	1	0	0	0	4	7.4%

Table A5-18 Question 20

Q20: What is your monthly family income?

Answer	Group						Total	Proportion
	A1	A2	A3	B1	B2	B3		
Below 6000	0	0	0	0	0	0	0	0
6000-9999	0	0	0	0	0	1	1	1.85%
10000-19999	3	2	3	3	3	0	14	25.9%
20000-29999	5	3	2	5	5	0	20	37.1%
30000-39999	5	2	0	1	1	0	9	16.7%
40000 or above	1	0	0	2	1	0	4	7.4%
Refuse to answer	1	0	0	1	2	0	4	7.4%

Note: due to the difference between Hong Kong and Shenzhen Income, the results need adjusting.

APPENDIX 6 ALL DYNAMO EQUATIONS

```
*  The simulation on Shenzhen's housing system
L      HOUSEP.K=HOUSEP.J+DT*DRHP.JK
N      HOUSEP=6250
R      DRHP.KL=COST.K*(1+RETURN.K)-HOUSEP.K
A      COST.K=(LANDP.K+KAIFCB.K+QITA.K)*(1+LXPOLI.K)**PERIO1
C      PERIO1=2
A      REVENU.K=SUIPOL*HOUSEP.K
C      SUIPOL=0.061
A      LXPOLI.K=TABLE(LX,TIME.K,1997,2010,1)
T      LX=.1/.08/.0594/.0594/.0594/.0594/.06/.06/.06/.06/.06/.06/.0594/.0594
A      KAIFCB.K=JIANAN.K/CJIAN
C      CJIAN=0.65
L      JIANAN.K=JIANAN.J+DT*DRJIAN.JK
R      DRJIAN.KL=JIANAN.K*CCJIAN
C      CCJIAN=0.01
N      JIANAN=1450
L      LANDP.K=LANDP.J+DT*DRLANP.JK
N      LANDP=1320
R      DRLANP.KL=LANDP.K*CLANDP
C      CLANDP=0.005
A      QITA.K=HOUSEP.K*QT
C      QT=0.1
A      LIRUN.K=COST.K*RETURN.K-REVENU.K
```

```
A     NLIRUN.K=LIRUN.K/PERIO1
A     RETURN.K=B1.K*RATE.K**NUM+B2.K
A     B2.K=-(2LXPOLI.K+J)
A     B1.K=(2LXPOLI.K+J)**(1-NUM)*(P1+2LXPOLI.K+J)**NUM
C     NUM=2.4
C     J=0.0143
C     P1=0.208
A     RATE.K=DEMAND.K/SUPPLY.K
A     DEMAND.K=XUQ.K*XUQIU.K*(1+ZUSOUB)*GML.K+WAIXIO.K
A     WAIXIO.K=CLIP(WAIX1.K,WAIX2.K,TIME.K,2002)
A     WAIX1.K=WX*WXPOLI
C     WX=50
C     WXPOLI=1
A     WAIX2.K=TABLE(WAI,TIME.K,1997,2001,1)
T     WAI=23.06/28.95/48.33/58.48/52.01
C     ZUSOUB=0.03
A     XUQ.K=TABLE(XUQPOL,TIME.K,1997,2010,1)
T     XUQPOL=1/1/1/1/1/1/1/1/1/1/1/1/1/1
A     XUQIU.K=HJXUQ.K+ZZXUQ.K
A     HJXUQ.K=DRHJPO.KL*HJAVH.K+HJPOP.K*DRHJAV.KL
L     HJPOP.K=HJPOP.J+DT*DRHJPO.JK
N     HJPOP=109.46
R     DRHJPO.KL=HJPZR.K+HJPJX.K
A     HJPZR.K=HJPOP.K*CHJPZR
C     CHJPZR=0.01
A     HJPJX.K=TABLE(HJJXPO,TIME.K,1997,2010,1)
```

T HJJXPO=4/4/4.06/4.3/5/5.5/5.5/5.5/5.5/5.5/5.5/5.5/5.5/5.5

L HJAVH.K=HJAVH.J+DT*DRHJAV.JK

N HJAVH=30.6

R DRHJAV.KL=1/3.41

A POP.K=CLIP(POP1.K,POP2.K,TIME.K,2002)

L POP1.K=POP1.J+DT*DRPOP1.JK

N POP1=468.8

R DRPOP1.KL=POP.K*DRPO1.K

A DRPO1.K=TABLE(DRP1,TIME.K,1997,2010,1)

T DRP1=0/0/0/0/0/0.048/0.047/0.045/0.043/0.04/0.037/0.034/0.029/0.024

A POP2.K=TABLE(PO2,TIME.K,1997,2001,1)

T PO2=379.6/395/405.1/432.9/468.8

A DRPOP2.K=TABLE(DRP2,TIME.K,1997,2001,1)

T DRP2=21.16/15.32/10.17/27.81/35.82

A DRPOP.K=CLIP(DRPOP1.KL,DRPOP2.K,TIME.K,2002)

A ZZXUQ.K=DRZZPO.K*ZZAVH.K+ZZPOP.K*DRZZAV.KL

A ZZPOP.K=POP.K-HJPOP.K

A DRZZPO.K=DRPOP.K-DRHJPO.KL

A ZZAVH.K=TABLE(ZZAV,TIME.K,1997,2010,1)

T

ZZAV=8.38/8.4/9.06/10.6/11.49/11.69/12.18/12.67/13.16/13.65/14.14/14.63/15.1/15.

6

R DRZZAV.KL=CLIP(DRZAV1.K,DRZAV2.K,TIME.K,2003)

A DRZAV1.K=0.489

A DRZAV2.K=TABLE(DRZZA,TIME.K,1997,2002,1)

T DRZZA=0.1/0.344/0.756/0.297/0.026/0.529

A GML.K=JIQGML.K*INCOME.K*JIAGE.K

A JIQGML.K=YX*(65349*(1+INJ)**(1-XI.K)*(1-(1+INJ)**XI.K)/(-INJ))/(6250*85)

C INJ=0.07

A INCOME.K=1+(GZSORU.K+AJSORU.K)*SRTANX

A GZSORU.K=(INCOM.K/1597)-1

A AJSORU.K=AJK*(ANJIE.K/AJ1997.K)

C AJK=0.1

A AJYINS.K=AJSORU.K*SRTANX

A AJ1997.K=F1.K*F2.K/F3.K

A F1.K=0.2*65349*1.07*1.088**6.14

A F2.K=(1-(1.07/1.088)**7.14)/(1-(1.07/1.088))

A F3.K=0.642*6250*85*(1+0.088)**7.14

A ANJIE.K=(AJY1.K*(1-Q.K**N.K)/(1-Q.K))/(SOUQI.K*HOUSEP.K*MJ.K*(1+AJLIXI.K)**N.K)

A AJY1.K=GFZICU*INCOM.K*HUXP.K*(1+IN.K)*(1+AJLIXI.K)**(N.K-1)

C GFZICU=0.2

A Q.K=(1+IN.K)/(1+AJLIXI.K)

A IN.K=GDPZLV.K*0.48

A N.K=TABLE(YEARPO,TIME.K,1997,2010,1)

T YEARPO=7.14/18.3/19/19.2/20.8/24.9/25/25/25/25/25/25/25/25

A AJLIXI.K=TABLE(AJLXPO,TIME.K,1997,2010,1)

T AJLXPO=.088/.076/.053/.053/.053/.042/.042/.042/0.04/.04/.04/.04/.04/.04

A SOUQI.K=TABLE(SOQIPO,TIME.K,1997,2010,1)

T SOQIPO=.642/.681/.676/.69/.71/.75/.78/.8/.8/.8/.8/.8/.8/.8

C SRTANX=0.585

A JIAGE.K=1-JGK1*(HOUSEP.K*MJ.K-6250*85)/(6250*85)

C JGK1=0.75

C YX=1.4

A XI.K=TABLE(XINLI,TIME.K,1997,2010,1)

T XINLI=6/6/6/6/6/6/6/6/6/6/6/6/6/6

L MJ.K=MJ.J+DT*DRMJ.JK

N MJ=85

R DRMJ.KL=CDRMJ*MJ.K

C CDRMJ=0.05

A INCOM.K=CLIP(INCOM1.K,INCOM2.K,TIME.K,2002)

A INCOM2.K=TABLE(INCO,TIME.K,1997,2001,1)

T INCO=1597/1677/1706/1820/1989

A INCOM1.K=-87.43+0.05*RJGDP.K

A RJGDP.K=GDP.K/POP.K

A HUXP.K=CHUXP

C CHUXP=3.41

A SUPPLY.K=EMP.K+PZYUSO.K+JUNNYU.K

L EMP.K=EMP.J+DT*DREMP.JK

N EMP=270

R DREMP.KL=PZYUSO.K-DEMAND.K

A JUNNYU.K=JUNGON.K*KJUNYU

C KJUNYU=0.1

A JUNGON.K=(1/SGQI.K)*SHIGON.K

A SGQI.K=TABLE(SGQ,TIME.K,1997,2010,1)

T SGQ=3.97/3.45/3.48/3/3/3/3/3/3/3/3/3/3/3

```
L      SHIGON.K=SHIGON.J+DT*DRSGON.JK
R      DRSGON.KL=KAIGON.K-JUNGON.K
N      SHIGON=966.19
A      KAIGON.K=CLIP(KAIGO1.K,KAIGO2.K,TIME.K,2003)
A      KAIGO2.K=TABLE(KAIGO,TIME.K,1997,2002,1)
T      KAIGO=300/393/620/578/712/755
A      KAIGO1.K=151.51+0.44*RSNOKF.K+0.22*NTOUZI.K
A      NTOUZI.K=KTOUZI.K*ZONGZJ.K
A      KTOUZI.K=TABLE(KTZ,TIME.K,1997,2010,1)
T      KTZ=.658/.725/.794/.699/.631/.688/.7/.7/.7/.7/.7/.7/.7/.7
A      ZONGZJ.K=KFDAIK.K+ZICHOU.K+QTZIJ.K
A      KFDAIK.K=KFDKBL.K*ZICHOU.K
A      KFDKBL.K=TABLE(KFDK,TIME.K,1997,2010,1)
T      KFDK=.505/.58/.89/.67/.73/.93/.72/.72/.72/.72/.72/.72/.72/.72
L      ZICHOU.K=ZICHOU.J+DT*DRZICO.JK
N      ZICHOU=61.19
R      DRZICO.KL=ZICHOU.K*DRZC.K
A      DRZC.K=CLIP(DRZC1.K,DRZC2.K,TIME.K,2002)
A      DRZC2.K=TABLE(ZCZLV,TIME.K,1997,2001,1)
T      ZCZLV=0.695/-0.075/0.312/0.409/-0.069
A      DRZC1.K=GDPZLV.K*1.18*SI.K
A      SI.K=TABLE(SS,TIME.K,1997,2010,1)
T      SS=0/0/0/0/0/1/.95/.9/.8/0.7/0.6/0.45/0.3/0.15
L      GDP.K=GDP.J+DT*DRGDP.JK
N      GDP=11300133
R      DRGDP.KL=GDP.K*GDPZLV.K
```

A GDPZLV.K=TABLE(GDPPOL,TIME.K,1997,2010,1)

T GDPPOL=.14/.114/.16/.17/.15/.15/.15/.15/.15/.15/.15/.15/.15/.15

A QTZIJ.K=ZJYSPO.K*ZICHOU.K

A ZJYSPO.K=TABLE(QTZJ,TIME.K,1997,2010,1)

T QTZJ=1.89/0.71/1.4/1.29/1.1/1.59/1.33/1.33/1.33/1.33/1.33/1.33/1.33/1.33

A RSLAND.K=CLIP(RSLAN1.K,RSLAN2.K,TIME.K,2002)

A RSLAN2.K=TABLE(RSLD,TIME.K,1997,2001,1)

T RSLD=248/297/375/450/502

A RSLAN1.K=-5.28+0.12*GYLAND.K+0.9*((DEMAND.K/CRPOLI.K)+CJIJ)-0.125*(RSNOKF.K+EMP.K/2.5)

C CJIJ=50

A CRPOLI.K=TABLE(CR,TIME.K,1997,2010,1)

T CR=1.98/2.05/2.3/2.4/2.5/2.68/2.5/2.5/2.5/2.5/2.5/2.5/2.5/2.5

A GYLAND.K=RESERV.K+PDPLAN.K

L RESERV.K=RESERV.J+DT*DRRES.JK

N RESERV=716

R DRRES.KL=PDPLAN.K-RSLAND.K

A PDPLAN.K=PLANPO*PLAN.K

C PLANPO=1

A PLAN.K=TABLE(PIDI,TIME.K,1997,2010,1)

T PIDI=346/383/195.68/255.65/337.01/150/190/182/173/165/157/150/150/150

L RSNOKF.K=RSNOKF.J+DT*DRNOKF.JK

R DRNOKF.KL=RSLAND.K-KAIGON.K/2.5

N RSNOKF=418

```
A     PZYUSO.K=CLIP(PZYUS1.K,PZYUS2.K,TIME.K,2002)
A     PZYUS2.K=TABLE(PZYS,TIME.K,1997,2001,1)
T     PZYS=349.54/498.60/538.77/577.90/647.14
A     PZYUS1.K=YUSOPO*XKAIYU*KAIGON.K
C     YUSOPO=1
C     XKAIYU=0.9
N     TIME=1997
A     RATE0.K=SUPPLY.K/DEMAND.K
SAVE
HOUSEP,SUPPLY,DEMAND,RATE,EMP,POP,COST,SHIGON,JUNGON,KAIGON
,ZONGZJ
SAVE
RETURN,LIRUN,RESERV,GYLAND,PZYUSO,RSLAN1,ANJIE,JIQGML,INCOM
,AJYINS
SAVE
XUQIU,ZZXUQ,HJXUQ,RSLAND,RATE0,ZICHOU,QTZIJ,KFDAIK,GDP,AJ1997
SAVE
GML,JIQGML,INCOME,JIAGE,REVENU,PZYUS1,RSNOKF,RJGDP,KAIGO1
SPEC                    DT=1/LENGTH=2010/SAVPER=1
```

APPENDIX 7 SALE STATUS OF SHENZHEN REAL ESTATE

Table A7-1 The sale area of commercial house of Shenzhen

Year	Sale area (Ten-thousand m^2)	Subdivision			
		Housing	Office	Commercial	Other
1999	265.34	228.30	11.31	11.25	14.48
2000	213.18	190.37	5.77	14.44	2.60
2001	236.66	205.57	5.18	17.31	8.60
2002	259.87	241.16	3.13	10.02	5.56
2003	308.10	276.74	9.24	20.64	1.48

Table A7-2 The sale area of commercial house being constructed of Shenzhen

Year	Sale area (Ten-thousand m^2)	Subdivision			
		Housing	Office	Commercial	Other
1999	166.88	144.08	10.75	8.60	3.45
2000	328.66	302.14	9.25	11.76	5.51
2001	374.71	351.25	7.01	9.01	7.44
2002	383.60	352.56	7.88	17.38	5.78
2003	483.60	447.67	8.70	25.72	1.51

Table A7-3 The sale area of commercial house of all districts

Year	Sale area (Ten-thousand m^2)	Subdivision					
		Luohu	Futian	Nanshan	Yantian	Baoan	Longgang
1999	432.22	90.89	135.99	75.68	7.69	54.63	67.34
2000	541.84	118.53	162.59	94.89	12.10	71.62	82.01
2001	611.37	86.13	200.59	125.39	7.57	78.65	113.04
2002	643.47	110.75	165.28	140.62	9.01	95.21	122.60
2003	791.70	129.45	206.81	182.60	9.67	127.22	135.95

Table A7-4 The presale area of commercial house of Shenzhen

Year	Presale area (Ten-thousand m^2)	Subdivision			
		Housing	Office	Commercial	Other
1999	603.64	498.60	28.73	70.87	5.44
2000	616.86	538.77	26.54	44.97	6.58
2001	660.45	577.90	12.34	50.45	19.76
2002	722.46	647.14	3.32	65.02	6.98
2003	1058.29	961.42	23.75	71.88	1.24

APPENDIX 8 POPULATION OF SHENZHEN

Table A8-1 The distribution of population of Shenzhen (Persons/KM^2)

Region \ Year	1999	2000	2001	2002	2003
Shenzhen	2074	2222	2405	2582	3596
Inside special zone	4815	5214	5659	5867	7007
Luohu	7742	8123	10818	9102	9821
Futian	9356	10050	8704	11352	11652
Nanshan	2649	3072	3352	3448	4395
Yantian	1606	1748	1917	1978	2162
Outside special zone	1381	1462	1587	1747	2934
Baoan	1746	1848	2021	2253	3836
Longgang	1072	1136	1220	1320	2032

Table A8-2 The structure of population of Shenzhen in 1999 (Ten-thousand persons)

Sort	1999		
	Permanent population	Population registered	Flowing population
Shenzhen	405.14	119.85	285.29
Luohu	61.08	28.78	32.30
Futian	73.02	29.29	43.73
Nanshan	44.77	14.15	30.62
Yantian	11.32	2.59	8.73
Baoan	124.46	25.92	98.54
Longgang	90.49	19.12	71.37

Table A8-3 The structure of population of Shenzhen in 2000 (Ten-thousand persons)

Sort	2000		
	Permanent population	Population registered	Flowing population
Shenzhen	432.94	124.92	308.02
Luohu	64.09	28.56	35.53
Futian	78.43	31.46	46.97
Nanshan	50.46	15.66	34.80
Yantian	12.33	2.64	9.69
Baoan	131.72	26.58	105.14
Longgang	95.91	20.02	75.89

Table A8-4 The structure of population of Shenzhen in 2001 (Ten-thousand persons)

Sort	2001		
	Permanent population	Population registered	Flowing population
Shenzhen	468.76	132.04	336.72
Luohu	68.67	29.61	39.06
Futian	84.43	33.27	51.16
Nanshan	55.07	17.64	37.43
Yantian	13.51	2.71	10.80
Baoan	144.12	27.55	116.57
Longgang	102.96	21.26	81.70

Table A8-5 The structure of population of Shenzhen in 2002 (Ten-thousand persons)

Sort	2002

	Permanent population	Population registered	Flowing population
Shenzhen	504.25	139.45	364.80
Luohu	71.81	29.93	41.88
Futian	88.59	35.61	52.98
Nanshan	57.60	19.29	38.31
Yantian	14.22	2.76	11.46
Baoan	160.61	28.88	131.73
Longgang	111.42	22.98	88.44

Table A8-6 The structure of population of Shenzhen in 2003 (Ten-thousand persons)

Sort	2003		
	Permanent population	Population registered	Flowing population
Shenzhen	700.84	221.31	479.53
Luohu	77.48	30.21	47.27
Futian	90.93	40.17	50.76
Nanshan	72.21	27.02	45.19
Yantian	15.24	4.11	11.13
Baoan	273.50	40.17	233.33
Longgang	171.48	27.16	144.32

Table A8-7 The natural growth rate, dead rate and registered growth rate of Shenzhen population

Year	1999	2000	2001	2002	2003
Natural growth rate	9.61‰	12.13‰	12.33‰	15.14‰	10.12‰
Dead rate	2.97‰	2.55‰	1.73‰	1.46‰	1.31‰
Registered growth rate	12.58‰	14.68‰	14.06‰	16.60‰	21.71‰