HONG KONG INSTITUTE FOR MONETARY RESEARCH

THE PROPERTY MARKET AND THE MACROECONOMY OF THE MAINLAND: A CROSS REGION STUDY

Wensheng Peng, Dickson C. Tam and Matthew S. Yiu

HKIMR Working Paper No.5/2007

March 2007

Hong Kong Institute for Monetary Research

(a company incorporated with limited liability)

The Property Market and the Macroeconomy of the Mainland: A Cross Region Study

Wensheng Peng*
Hong Kong Monetary Authority

and

Dickson C. Tam
Hong Kong Monetary Authority

and

Matthew S. Yiu
Hong Kong Institute for Monetary Research

March 2007

Abstract

This paper studies the nexus between the property market and the macroeconomy of Mainland China in 1998-2004, using panel data models covering 31 provinces and major cities. The estimates suggest three main conclusions. First, there seemed to be a two-way linkage between property price and GDP growth. In particular, property price increase had a significant positive impact on investment, but no evidence of a wealth effect on consumption is obtained. Second, bank credit expansion did not seem to play an 'accelerating' role in property price inflation, although the latter is found to have contributed to bank credit increase in recent years. Third, property price growth may have deviated from fundamentals in coastal areas, as evidenced by a negative relationship between housing and rental prices.

JEL: C33; E22; R1
Key words: Property Market; Macroeconomy; China

This paper was prepared for the third HKIMR conference on the Mainland economy, held on 11-12 July 2005. The authors are grateful to Hans Genberg, and conference participants for useful comments. The views expressed in the paper are solely those of the authors and do not necessarily reflect those of the Hong Kong Monetary Authority, the Hong Kong Institute for Monetary Research, its Council of Advisors, or the Board of Directors.

* Corresponding author: Wensheng Peng, HKMA, 55/F, Two International Finance Centre, 8 Finance Street, Central, Hong Kong. Email: Wensheng_Peng@hkma.gov.hk.

1. Introduction

The property market in Mainland China has grown rapidly and become an important source of economic growth. The development of the Mainland property market, which started in the late 1980s with a series of gradual reforms on land use and housing systems, has accelerated in recent years. This was helped by the abolition of the administrative housing allocation system in 1998, the quickened pace of urbanisation, strong income growth and the expansion of mortgage loan business by commercial banks, which reduces home buyers' liquidity constraint.

Property prices started to pick up in 2001, following declines in the earlier years. The nation-wide property price index for building has increased by 23% since 2000. Price rises have been sharp in major cities and coastal provinces and in the luxury residential property sector. In particular, the property price index for Shanghai increased by an average of about 13% per annum in 2001-04.

The booming property market has had a significant impact on the wider economy. In particular, real estate investment for residential building has grown strongly, by an average rate of about 28% per annum in 2001-04. It is estimated that the real estate industry raised GDP growth by 1.9-2.5 percentage points in 2002-03 (Gu, 2005). The strong investment demand contributed to sharp increases in producer and investment goods price inflation in 2002-04. The housing component was also the second largest contributor (after food prices) to the rise in the consumer price index. Sales of land and property development have become an important source of income for local governments.[1] Moreover, banks' exposure to the property market has increased. It is estimated that about 60% of real estate investment was financed by bank loans in the past five years, with mortgage and development loans accounting for 35% and 25% respectively (Liu and Huang, 2004).

The surge of property prices and rising real estate investment have raised concerns about their macroeconomic consequences and housing affordability for ordinary people. In particular, there is a heated debate about whether a property bubble has developed. Associated with that, some worry about the impact of any sharp swing in the property market on macroeconomic and financial stability on the Mainland. Reflecting these concerns, the authorities have implemented a number of policy measures in order to rein in the booming property market, particularly to curb speculative demand for properties.

Against this backdrop, it would be useful to investigate how property market developments have affected the macroeconomy on the Mainland. However, existing studies are mostly related to the analysis of

[1] Chan (1999) estimates that sixty per cent of land sales revenue goes to the local governments and the rest to the central government.

housing demand and its impact on housing prices and real estate investment.[2] Few studies analyse the nexus between the property market and the macroeconomy in a quantitative and systematic way, partly because of data limitations. Using Granger causality analysis of nation-wide data, Liu, Park and Zheng (2002) find that housing investment has a long-run effect on economic growth whereas economic growth affects both housing and non-housing investment.

This paper investigates the relationships between the macroeconomy and the property market in Mainland China in 1998-2004, using data of six major cities and twenty-five provinces. [3] In particular, we consider how property price changes may have affected macroeconomic variables such as GDP growth, investment, consumption and bank credit expansion. The econometric study uses linear panel data models, which have the advantage of increasing the sample size by 31-fold. This reduces the data limitation problem, and allows the analysis to focus on the recent upswing in the property market. The latter differs markedly from the previous cycles in that it has been driven more by private housing demand, in part owing to the abolition of the administrative allocation system of housing in 1998.

However, the pooled estimates using panel data assume that the coefficients on each regressor are the same for all sections (in this case all provinces and cities), and this assumption may not be valid given regional differences in economic structure and development. The validity of the homogeneity restriction will be tested. If it is rejected, we explore how estimates may differ between groups of provinces. First, the sample is divided into a group of six cities and coastal provinces and that of interior provinces. Second, provinces in the Yangtze River Delta (Shanghai, Jiangsu and Zhejiang) are grouped to compare with the rest of the sample. An examination of stylised facts suggests that property price have risen faster in metropolitan cities, coastal areas, and particularly the Yangtze River Delta.

The rest of the paper is organised as follows. Section II provides some stylised facts based on data used in the econometric analysis. Section III considers panel data models and some estimation issues, such as heteroskedasticity in residual variances, dynamic GMM methods for models having lagged dependent variable as an explanatory variable and heterogeneity of coefficient estimates across sections. Section IV presents the empirical results and discusses their implications. The last section concludes.

---

[2] In particular, based on the aggregated price data, Liu and Huang (2004) obtain no clear evidence of a property bubble, but Shen and Liu (2004) find that the increase in property prices can only be partially explained by economic fundamentals, using data for 14 cities. Sun (1998) shows marked differences between the coastal and inland areas in property development, with investment from Hong Kong, Macau and Taiwan playing an important role in the coastal areas. Two interesting studies by Huang (2003) and Huang (2004) examine the dynamics of housing demand and residential crowding in urban China. His findings suggest that housing consumption and residential investment are affected not only by demographic and socio-economic factors but also by institutional factors that are unique to Mainland China including the dualism in housing reform and local government behaviour. Based on the "Survey of China Real Estate Industry (1999-2002)" on 35 metropolitan areas, Ping and Chen (2004) try to establish a relationship among real estate financing, land price and housing price. Leung (2003), using data on Asian cities, shows that the relative housing price is increasing over time as economic growth persists, even when population growth is zero. Leung (2004) also provides an extensive survey on literature about the nexus of the housing market and the macroeconomy.

[3] The contribution of our empirical work in this paper over the existing literature is that we use extensive disaggregate and more up-to-dated data, i.e. 31 provincial and city data and time span from 1998 to 2004, to estimate the relationship between housing price and several macroeconomic variables. Furthermore, we test whether the relationship may be different across different regions in China given their different economic development stages.

2. Data and Stylised Facts

Annual data for six cities and twenty-five provinces are selected.[4,5] The series include the property price index for building, land price index, rental price index, real estate investment, fixed asset investment, retail sales of consumer goods, GDP (by industry), bank loans, bank deposits, inflation rate, and one-year lending and deposit rate.[6] Bank loans refer to RMB loans in financial institutions, including the four major state-owned banks.[7] However, data on the outstanding loans of the four banks reflect a reduction associated with the disposal of bad loans to the four asset management companies. It was estimated that loans of about 1.4 trillion renminbi were carved out from the big four state banks in 1999-2000 (Ma and Fung, 2002). To derive a proper measure of credit growth, these disposed loans were added back to the total outstanding loans. As the bulk of the disposal took place in 2000 (no information is available on the exact distribution between the two years), it is assumed that 25% of the disposal took place in 1999 and the remainder affected the figures from 2000 onward (See Ma and Fung, 2002).

Provincial consumer price indices are used to deflate nominal fixed asset and real estate investment, retail sales, and bank loans and deposits and lending rates to obtain their respective real values. These and real GDP are then transformed into log-first differences (annual growth rates) for the empirical analysis, except the interest rate.

To get a sense of the impact of property market developments on macroeconomic conditions on the Mainland, provinces are grouped according to certain characteristics to derive some stylised facts. One grouping is made into those with above and below average real property price growth. The two groups are then compared in terms of average growth in GDP, real estate investment, fixed asset investment, retail sales and bank loans. To explore the interaction between property price and GDP growth, we also compare real property price inflation between two groups with above and below average GDP growth.

Compared with provinces with below average GDP growth, provinces with above average GDP growth had a much higher average rate of inflation in property prices during 1998-2004 except in 2001 (Figure 1A). In the other direction, provinces with above average property price inflation also had stronger output growth (Figure 1B). This suggests that increases in property prices are generally associated with rises in real GDP.

---

4 The time span of the data is quite short, from 1998-2004, and covers the economic boom period in Mainland China. Thus, some data series may have persistence characteristics. However, it is very difficult to test the non-stationarity because of the short time span and the low power of unit root tests. Thus, we have not done any unit root tests on the data series. The problem of persistence characteristics may not be very serious with respect to our empirical analysis since we are investigating the relationship between the changes of the data variables and four out of the six equations in the empirical results session are dynamic panel models, in which the changes of the variable need to be first differencing to remove the fixed effect in the model.

5 The sample includes (for cities): Beijing, Chongqing, Shanghai, Tianjin, Shenzhen and Guangzhou, and (for provinces) Anhui, Fujian, Gansu, Guangxi, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Ningxia, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Xinjiang, Yunnan, Zhejiang, and Inner Monogolia.

6 The data are from the CEIC Data Ltd, a data provider whose data are from official sources.

7 The four major state-owned banks are the Bank of China, China Construction Bank, Industrial and Commercial Bank of China, and Agriculture Bank of China.

Four panels of Figure 2 compare growth in real estate investment, fixed asset investment, retail sales, and bank loans between provinces with above and below average property price growth. It shows that provinces with above average property price growth had higher growth in real estate investment in each year of 1999-2004, and also higher fixed asset investment growth during the period except 2001. This suggests that increases in property prices have boosted real estate investment in recent years, which has become an important part of aggregate investment.[8] It is also possible that higher fixed asset investment contributed to property price increases, as it led to higher household income and thus higher demand for housing.

Retail sales also appeared to increase at a higher rate in provinces with above average property price inflation than in those with below average inflation. This may reflect some wealth effect arising from housing price increases, but the relationship could also be driven by common factors such as income growth, which tends to raise consumption demand for both goods and housing services. However, the gap in retail sales growth associated with differential property price inflation seems to be smaller than the gap in investment growth. Thus, the booming property market seems to be associated more closely with investment than consumption growth.

Bank loans also increased relatively quickly in provinces with above average property price inflation. The relationship could be driven by common factors such as output growth. A proper analysis of the causality between the two variables would thus require control of the influence of other relevant variables.

An examination of data also suggests that property prices increased at a relatively fast rate in cities and coastal areas, and in provinces of the Yangtze River Delta. Thus, it is also useful to group provinces by their geographical locations to explore possible differences in developments. Figure 3 compares growth in property prices, GDP, fixed asset investment, real estate investment, retail sales, bank credit, land price, and the real lending interest rate between coastal provinces and interior areas, and between Yangtze River Delta provinces and the rest of the country. It shows that real GDP growth and bank credit expansion followed broadly the same trends across provinces, although they were higher in the Yangtze River Delta than in interior provinces. There was no systematic difference in retail sales growth between the groups. Fixed asset and real estate investment growth were higher in the Yangtze River Delta in recent years. The gaps in property and land price inflation were much greater, however, with the growth rates in coastal areas and the Yangtze River Delta several times that in other parts of the country.

While these stylised facts are indicative, they lose information about across-province differences due to aggregation and averaging of data. Also the apparent association between property price changes and growth in macroeconomic variables do not provide information on the direction of causality and the size of the effects. To explore these issues, formal econometric analysis is presented in the next two sections.

[8] Real estate investment growth may also affect property price inflation. However, this direction of causality would imply a negative relationship as increases in real estate investment would raise housing supply and thus depress property prices for given demand.

3. Panel Data Model

To explore the empirical relationships formally, panel data models are used. This raises the sample size sharply. It is also appropriate for our investigation because these provinces have considerable commonality in macroeconomic fluctuations. This section discusses some estimation issues, and the next section presents the empirical results.

3.1 General and Dynamic Panel Models

The general panel model can be expressed in the following linear form:[9]

$$Y_{it} = c + X_{it}'\beta + \alpha_i + \varepsilon_{it} \quad (1)$$

where Y_{it} is the dependent variable, X_{it} is a vector of regressors, β is a vector of coefficients which are assumed to be the same across i and t, α_i is individual-specific (fixed) effect to allow for differences across provinces and ε_{it} are the error terms for $i = 1,2,...,M$ cross-sectional units observed for periods $t = 1,2,...,T$.

Some dependent variables may have strong autocorrelation. To account for this, Equation 1 (called static panel equation) is modified into a dynamic panel equation:

$$Y_{it} = c + \sum_{j=1}^{p} \rho_j Y_{it-j} + X_{it}'\beta + \alpha_i + \varepsilon_{it} \quad (2)$$

3.2 Estimation Issues

A number of estimation issues need to be addressed. First, the residuals may be correlated across sections, which can lead to inefficient estimates. To obtain efficient estimates, Generalised Least Squares (GLS) estimation is used. For fixed individual effects, GLS is straightforward. Preliminary estimations are performed to produce cross-section specific residual vectors. These residuals are used to form estimates of the cross-specific variances, which are then employed in a weighted least squares procedure to form GLS estimates.

Second, there may be correlation between regressors and the error terms, which will produce biased estimates. Such correlation may be introduced by endogeneity of some explanatory variables. For example, GDP growth may lead to greater demand for housing and thus higher property prices, while higher property prices may raise consumption and investment through wealth and balance-sheet effects. To test the presence of endogeneity (or simultaneity bias), a Hausman test is performed, (Hausman, 1978). If evidence of simultaneity bias is found, the Instrumental Variable (IV) approach will be used, with lagged regressors used as instruments.

---

9 For details of panel data models, see Hsiao (2003) and Baltagi (2001).

Third, the presence of the lagged dependent variable among the regressors in Equation 2 violates the strict exogeneity assumption of regression. As a result, estimates of Equation 2 would be biased and inconsistent, particularly when the panel involves a large number of individuals but over a fixed period of time. One way to obtain consistency is to take the first difference of Equation 2.[10] First-differencing the equation eliminates individual effects and constant terms, and produces an equation of the following form:

$$\Delta Y_{it} = \sum_{j=1}^{p} \rho_j \Delta Y_{it-j} + \Delta X_{it}' \beta + \Delta \varepsilon_{it} \qquad (3)$$

for which Generalised Method of Moments (GMM) is used to obtain efficient estimates of β and ρ_j.[11]

Fourth, as it will be seen in the next session, the six equations we investigate are estimated separately. However, some equations can be estimated together as a simultaneous system because the independent variable in one equation is the dependent variable in another equation and vice versa (e.g. Equations 1 and 2). On the other hand, as discussed by Baltagi (1981 and 2001), individual equations in a simultaneous equation system can still be estimated separately when the errors of different equations are uncorrelated with each other. Using IV methods for ordinary panel equation or GMM techniques for dynamic panel equation will provide consistent parameter estimates even in the so-called single equation approach because the simultaneous bias will be removed. The system estimation approach will provide asymptotically efficient estimates when the errors are correlated. However, in practice, when the time span of the panel data is very short, as in our case here, the estimation of the variance-covariance matrix of the errors of different equations will not be precise and the efficiency gain will be very small. Kimhi and Rekan (2005) use the single equation approach and GMM techniques to estimate the simultaneous evolution of farm size and specialization in Israel.

3.3 Heterogeneity

By pooling the data, it is assumed that the coefficients of the regressors are identical for all provinces. Given the differences in size, economic structure and stage of development, this assumption may not be valid. Neglecting heterogeneity across sections may lead to biased estimates and misleading inference. To guard against this, we test whether the assumption of homogeneity (i.e. identical coefficients across provinces) is valid.

If the linear relationship differs between provinces and this is neglected in estimation, spurious non-linearity in the panel estimates may be introduced. This suggests that tests of the homogeneity assumption can be based on tests for the presence of non-linearity in the estimated relationship. This approach is taken by Haque et al. (2000) and Pesaran et al. (1999) who propose to test for neglected heterogeneity by introducing a quadratic term for each regressor and testing whether it is significantly different from zero. If this is the case, then that particular variable may be subject to heterogeneity across section. In order to explore cross province differences while retaining a reasonable degree of freedom for estimation,

[10] Another approach is to use orthogonal deviations, suggested by Arellano and Bover (1995).

[11] For more details on GMM, please see Hayashi (2000).

interactive dummies are applied to different groups of provinces. One comparison is between cities and coastal provinces, and the interior provinces, and another is between the Yangtze River Delta and the rest of the sample (see below).

4. Empirical Results

Six models are estimated with real growth in property price, GDP, fixed asset investment, real estate investment, retail sales and bank credit respectively as the dependent variable.[12] The GLS method is used to estimate a benchmark model. In some cases, instrumental variables need to be employed to deal with reverse causality/endogeneity concerns. Also, in some equations, the lagged dependent variable is a significant explanatory variable, and therefore the GMM method is applied.[13] If evidence of heterogeneity is detected for a particular explanatory variable (i.e. the restriction of the same coefficient for all provinces may not be valid), a dummy variable is multiplied with that variable and the interactive term is included as an additional explanatory variable. One dummy takes the value of one for coastal provinces and cities, and zero for the rest of the sample. Another takes the value of one for the three provinces in the Yangtze River Delta (including Shanghai) and zero for the remaining provinces. What this effectively does is to allow different coefficients for that explanatory variable between the two groups of provinces.

4.1 Property Price Growth

Changes in real housing prices can be affected by demand and supply-side factors such as income growth, demographic changes, rental yield, mortgage rates and construction costs (Jud and Winkler, 2002; Hwang and Quigley 2004). Furthermore, Goodhart and Hofmann (2003) show that in some countries housing prices are affected by the availability of bank credit.

In the benchmark model for property price growth below, we use real GDP growth and changes in real land price to proxy households' income growth and changes in construction cost respectively. Changes in real rental prices are included to capture possible effects of rental changes on housing price inflation. Inflation rates are used to capture variations in real mortgage rates because nominal mortgage rates are the same across all provinces and cities. A variable capturing population growth is also considered but found to have statistically insignificant correlation with real property price movements.

---

[12] To derive the empirical models, we explore and select explanatory variables from a typical set of macroeconomic factors as suggested by the general economic theory. For example, to model property price inflation, we use a set of explanatory variables including income growth (proxied by real GDP growth), rental and land price inflation, and indicators of financial conditions such as interest rates and bank credit expansion. Reflecting data limitations as well as our focus on macroeconomic relationships, other variables such as increases in the number of households and the supply of housing units are not captured. The rationale for the final set of explanatory variables in each model will be explained along with the discussion of the results.

[13] In this case, the Durbin-Watson statistic would not be reported with the estimation using the GMM method. It is because the DW test is invalid if there is lagged dependent variable on the right-hand side of the regression. The adjusted R^2 would be replaced by the Generalized R^2 suggested by Pesaran and Smith (1994) for models with a first differenced explanatory variable in GMM.

Equation 1 of Table 1 presents the estimation results of the benchmark model for property price growth, using the GLS method. Real property price growth is found to be positively and significantly related to real GDP growth. As will be shown below, contemporaneous property price growth also has a positive and significant coefficient in the real GDP growth equation. Hausman tests suggest that there is evidence of simultaneity bias in the two equations.[14] Therefore, lagged GDP growth is employed as an instrumental variable. As tests suggest that the estimated residuals in Equation (1) are correlated with the lagged dependent variable, Equation 2 shows the estimated coefficients of a dynamic panel model using the GMM method. It is noted that the coefficient on rental price growth increases and becomes significant after the GMM and instrumental variable are used, but coefficients of other variables are broadly unchanged.

The estimated coefficient of the inflation rate is positive and statistically significant. This is consistent with the argument that higher inflation rates lead to lower real mortgage interest rates, and thus higher demand for housing. As the estimated coefficient for bank loan growth is insignificant in the benchmark equation, it is dropped in the extended models. The coefficient on rental price changes is as expected - positive and statistically significant.

Evidence of heterogeneity is found for rental price growth, suggesting that the same coefficient restriction for all provinces may not be valid for this variable. Equation 3 shows that the interactive dummies for coastal areas are indeed significant. The estimated coefficients suggest that the elasticity of property price with respect to rental price is around -0.04 for coastal areas and cities, compared with 0.27 for interior provinces. The elasticity is around 0.24 for the Yangtze River Delta, but is not statistically significant. This suggests that the positive correlation between rental price and housing price inflation does not hold for coastal areas.

The main observations on the property price growth equation are summarised as follows. First, GDP growth, as a proxy for income growth, seemed to have a significant impact on property price inflation in recent years. Second, the rise in land price, which is an important indicator of the construction costs of housing, also contributed. Third, the negative correlation between rental price and property price increases suggests that property price growth may have deviated from fundamentals in some coastal areas and cities.

4.2 Real GDP Growth

The macroeconomy is influenced by fluctuations in property prices through a variety of channels. Specifically, changes in property prices generate wealth and balance-sheet effects on consumption and investment (Trichet, 2003). As documented in IMF (2000) and BIS (2001), property price changes

[14] The Hausman test involves the following procedures. First, an auxiliary regression of GDP growth is estimated on a set of instrumental variables that are likely correlated with GDP growth but not with the error term of the property price growth equation. Next, the property price growth equation is re-estimated by adding the residuals from the auxiliary regression. If the coefficient on the first-stage residuals is significantly different from zero, it is taken as evidence of possible simultaneity bias in the equation. A pedagogic explanation of the testing strategy is given in Pindyck and Rubinfeld (1991)

tend to lead output growth in industrial countries. The model for real GDP growth includes as explanatory variables real property price growth, and some other control variables such as bank credit increase and lending rates.

Equation 1 of Table 2 shows the estimated benchmark model for real GDP growth. The coefficient on real property price growth is of the expected positive sign and significant. The real lending rate coefficient is also of the expected negative sign and significant, although its economic size is small (implying that a one percentage point rise would reduce real GDP growth by only 0.008 percentage point). The bank credit growth has a positive sign but is not statistically significant.

The Hausman test points to possible simultaneity bias due to the presence of the contemporaneous property price growth variable in the equation. Also, the estimated residuals seem to be correlated with the lagged dependent variable. Equation 2 presents a model with lagged real GDP growth as an explanatory variable, using the GMM method with lagged property price growth as an instrumental variable. The lagged dependent variable is indeed significant, and the estimated coefficients of other explanatory variables (except bank credit) are little changed from the GLS estimates. Bank credit growth is found to be negatively and significantly related to GDP growth.[15] This seemingly surprising result, however, is consistent with other studies using provincial data that find a negative correlation between economic growth and bank credit expansion (Boyreau-Debray, 2003). Boyreau-Debray attributes this mainly to the burden to support the state-owned corporate sector rather than the poor performance of the banks. In particular, provinces that grew relatively slowly tended to rely more on credit provided by the state-owned banks, while coastal provinces and major cities had more diversified sources of financing (including foreign direct investment) and faster growth.

The homogeneity test indicates possible heterogeneous effects on economic growth of the lending rate. The interactive dummies are therefore applied, and the results are presented in Equation 3 and 4 respectively. It suggests that a rise in the lending rate would have a larger negative effect on real GDP growth in the Yangtze River Delta than in the rest of the country. This may reflect more developed market forces in the region.

In sum, property price growth seems to be significant in explaining real GDP growth over time and its dispersion across provinces. It would be useful to examine the main channels through which property price changes may have affected economic growth. This is done below by studying models of investment and consumption growth.

4.3 Fixed Asset Investment Growth

Real estate investment is an important part of fixed asset investment. Furthermore, investment can be affected by changes in property prices since rising property prices improve firms' balance sheets, inducing

[15] In a fully integrated financial system, after controlling for aggregate shocks, lending by a region's banks and local economic performance should be uncorrelated. However, there is evidence of a low degree of capital mobility within Chinese provinces. See Boyreau-Debray and Wei (2002) and Park and Sehrt (2001). Furthermore, the dominance of the banking sector in financial intermediation suggests that a local credit channel is possible. In sum, the inclusion of a credit growth variable would be justifiable.

banks to charge a lower finance premium on loans (IMF, 2000). The accelerator model of investment also suggests a close relationship between the rate of investment spending and changes in aggregate output. In addition, interest rates and bank credit growth, two monetary policy transmission channels in Mainland China, may be important variables affecting investment spending.

The models below for fixed asset investment growth thus include GDP, property price and bank loan growth as explanatory variables. The real lending rate is also considered, but turns out to be statistically insignificant. Change in land prices is included as a measure of construction cost.

In the benchmark model of Equation 1 in Table 3, changes in real property price and real land price and the lagged real GDP growth rate are significant explanatory variables. The lagged rather than contemporaneous real GDP growth was chosen to avoid endogeneity and reverse causality concerns, as fixed asset investment has been the main driving force behind output growth in recent years. This is also consistent with the 'accelerator' theory of investment, which implies that increases in output induce increases in investment. The coefficient on land price, an important indicator of construction costs, has the expected positive sign and is significant. The positive (and significant) coefficient on bank credit growth suggests that bank financing supported increases in fixed asset investment.

4.4 Real Estate Investment Growth

Equation 1 of Table 4 presents the benchmark model for real estate investment. Compared with fixed asset investment, real estate investment growth is found to be more closely related to property price changes. Specifically, the coefficient on property price growth is estimated to be around 0.9 for real estate investment, compared with about 0.5 in the fixed asset investment growth model. The estimated coefficients for land price, bank credit growth, and lagged GDP growth are statistically insignificant.

The residuals suggest that the relationship may be dynamic in nature. Also, the Hausman test suggests possible simultaneity bias in relation to the credit growth variable. Equation 2 shows the estimated coefficients of a dynamic panel model using the GMM method with the lagged change in bank loans as an instrumental variable. In the dynamic model, the coefficient on property price growth is still significant, but its size is reduced. The coefficients on land price and bank credit growth become statistically significant and are of the expected sign. Overall, it seems that property price, land price, and changes in bank credit help explain real estate investment growth over time and its dispersion across provinces.

4.5 Retail Sales Growth

There are three possible channels through which property price changes can affect consumption spending (IMF, 2000; and BIS, 2001). First, rising property prices lead to increases in lifetime wealth. Second, consumption is also a function of households' expectations about their future income growth. To the extent that property prices affect such expectations by signalling faster or slower growth of real incomes in the future, they will influence current consumption. Third, an increase in property price reduces households' financing constraints. Because of data limitations, we use retail sales to proxy consumption spending. The explanatory variables include changes in property prices, GDP growth, real deposit rate and changes in bank deposits. Real GDP growth captures possible income effect on consumption. A

rise in the real deposit rate may defer consumption due to the inter-temporal substitution effect or raise current consumption on increased interest income. The net impact depends on the relative importance of these two effects. Because of limited choice of investment vehicles, bank deposit is the main form of wealth holdings by the household sector.[16] Thus, this variable may also capture possible wealth effect on consumption.

Table 5 presents a model relating retail sales growth to growth in property price and GDP, the lagged growth of bank deposits, and the real deposit interest rate. The GLS estimates are presented in Equation 1. The coefficient on real GDP growth—an indicator of income growth—is of the expected positive sign and statistically significant. The coefficient on the real deposit rate is also positive and significant, suggesting that the income effect arising from a change in the real interest rate outweighs the intertemporal substitution effect. The economic size of the net impact is small, as implied by the magnitude of the coefficient.

To deal with possible simultaneity bias due to the presence of contemporaneous GDP growth in the equation, lagged GDP growth and lagged property price growth are used as instrumental variables, and the results are presented in Equation 2.[17] The coefficients on GDP growth and the deposit interest rate become larger, but the coefficients on both property price and bank deposit growth remain insignificant. The latter suggests little wealth effect on consumption despite the rises in property prices in recent years. This is perhaps not surprising due to the following considerations. First, private home ownership is still a relatively new concept in urban areas, and many households are either yet to get into the private market or want to trade up. Price increases make this group of households financially worse off. Second, for those who already own a private residential unit and thus have benefited from price appreciation, the increased wealth could not be used to finance current consumption unless they are willing to trade down. The underdeveloped mortgage market prevents these households from using equity withdrawal to fund current consumption spending.

4.6 Bank Credit Growth

Equation 1 of Table 6 presents the benchmark model of real bank credit growth, using the GLS method. The coefficient on lagged fixed asset investment growth is positive and statistically significant, suggesting that investment demand has been an important force driving credit expansion by banks. The coefficient on real GDP growth is negative and significant. As noted above, provinces with relatively slow economic growth (mainly the interior provinces) tend to rely more on large state-owned banks for financing. The coefficient on property price growth is positive and statistically significant.

As tests suggest that the estimated residuals are correlated with the lagged dependent variable, Equation 2 shows a dynamic panel model with lagged bank credit growth as an explanatory variable. It is noted

[16] Bank deposits are sums of deposits at the four major state-owned banks only, because data for other banks and financial institutions are not available by provinces.

[17] The large Durbin-Watson (DW) statistics in Equations 1 and 2 suggest that the residuals may be auto-correlated. To remove the autocorrelation, the AR(1) model is applied to the residuals. The estimation results are shown in Equation 3. The DW statistic is now reduced to 2.437 from 2.547. The estimated coefficients of other variables are not much different from those in Equations 1 and 2.

that the coefficient on the lending rate becomes negative and significant, but the coefficient of fixed asset investment growth turns out to be insignificant.

Tests of homogeneity suggest that fixed asset investment and lending rate might have heterogeneous effects on bank credit expansion across provinces. Equation 3 presents results after adding an interactive dummy to Equation 2. It suggests that fixed asset investment growth had a significant impact on bank credit growth in coastal areas and cities, although this is not the case for the rest of the provinces. It is noted that the coefficient on property price growth remains significant, and its size is little changed.

5. Concluding Remarks

The development of the property market has been supported by rising income, the rapid pace of urbanisation, and the expansion of mortgage business by commercial banks. However, the speed and size of the increase in property prices in some areas, together with high investment growth, has raised concerns about the macroeconomic consequences of any sharp swing in the property market.

This paper studies the nexus between the property market and the macroeconomy in Mainland China. To overcome data limitation problems, panel data models are employed, using macroeconomic statistics for thirty-one provinces and major cities. This has the advantage of increasing the sample size 31-fold. It also allows an analysis of possible differences across regions, given the varied pace of development and different economic structure between provinces. The main conclusions are summarised as follows.

First, there seems to be a two-way linkage between real GDP and property price growth. Thus, property price inflation over time and its dispersion across provinces are at least partially attributable to differentiated income growth.

Second, property price inflation contributed to real GDP growth mainly through the investment channel. Property price growth is found to have a significant and positive effect on fixed asset investment and particularly on real estate investment. By contrast, it did not appear to have a significant effect on retail sales growth. The lack of a wealth effect on consumption spending may reflect the fact that a large number of households have not benefited from house price appreciation. Moreover, those who own a private residential unit have limited means to withdraw housing equity to finance current consumption.

Third, while property price increases are found to be a significant explanatory variable for bank credit expansion, causality in the opposite direction is not supported by data. This suggests that bank credit growth probably did not play an ‘accelerating’ role in property price inflation in recent years. However, there is evidence that bank credit expansion contributed to real estate investment growth in recent years.

Property price growth has a perverse (negative) relationship with rental price inflation for coastal provinces. This provides potential evidence that property price growth has deviated from fundamentals in some areas.

Finally, some caveats should be noted. This paper focuses on macroeconomic relationships, and neglect microeconomic aspects of the property market. In particular, local governments play an important role in land and property developments on the Mainland. This issue should be further explored.

References

Arellano, M. and O. Bover (1995), "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, 68: 29-51.

Baltagi, B. H. (1981), "Simultaneous Equations with Error Components," *Journal of Econometrics*, 17: 189-200.

Baltagi, B. H. (2001), *Econometric Analysis of Panel Data*, Chichester: Wiley.

BIS (2001), *71st Annual Report*.

Boyreau-Debray, G. (2003), "Financial Intermediation and Growth–Chinese Style," *World Bank Policy Research Working Paper*, WPS 3027.

Boyreau-Debray, G. and S. J. Wei (2002), "How Fragmental is the Capital Market in China?" Presented at the Chinese Economic Society Conference, "The Integration of the Greater Chinese Economies: Causes, Consequences, and Implications," Hong Kong, June 2002.

Chan, N. (1999), "Land-use Rights in mainland China; Problems and Recommendation for Improvement," *Journal of Real Estate Literature*, 7: 53-64.

Goodhart, C. and B. Hofmann (2003), "Deflation, Credit, and Asset Prices," in P. Siklos and R. Burdenkin, eds., *The Anatomy of Deflation*, Cambridge: Cambridge University Press.

Gu, Y. (2005), "China's Real Estate Market in Rapid Development," China Real Estate Association, memo.

Haque, N., M. Pesaran and D. Opez-Salido (2000), "Neglected Heterogeneity and Dynamic in Cross-County Savings Regressions,' in J. Krishnakumar and E. Ronchetti, eds., *Panel Data Econometrics: Future Directions*; Papers in Honour of Professor Pietro Balestra, Elsevier Science.

Hausman, J. A. (1978), "Specification Tests in Econometrics," *Econometrica,* 46: 1251-72.

Hayashi, F. (2000), *Econometrics,* Woodstock: Princeton University Press

Hsiao, H. (2003), *Analysis of Panel Data,* Cambridge: Cambridge University Press.

Huang, Y. (2003), "A Room of One's Own: Housing Consumption and Residential Crowding in Transitional Urban China," *Environment and Planning A,* 35: 591-614.

Huang, Y. (2004), "Housing Markets, Government Behaviours, and Housing Choice: a Case Study of Three Cities in China," *Environment and Planning A,* 36: 45-68.

Hwang, M. (2004), "Economic Fundamentals in Local Housing Markets: Evidence from U.S. Metropolitan Regions," Working Paper No. W03-005, Institute of Business and Economic Research and Fisher Centre for Real Estate and Urban Economics, UC Berkeley.

Hwang M. and J. Quigley (2004), "Selectivity, Quality Adjustment and Mean Reversion in the Measurement of House Values," *The Journal of Real Estate Finance and Economics, Springer,* 28(2-3): 161-78.

IMF (2000), *World Economic Outlook*, May 2000.

Jud, G. and D. Winkler (2002), "The Dynamics of Metropolitan Housing Prices," *Journal of Real Estate Research,* 23: 29-45.

Kimhi, A. and H. Rekah (2005), "The Simultaneous Evolution of Farm Size and Specialisation: Dynamic Panel Data Evidence from Israeli Farm Communities," Discussion Paper No. 13.05, Hebrew University of Jerusalem.

Leung, C. (2003), "Economic Growth and Increasing House Price," *Pacific Economic Review,* 8(2): 183-90.

Leung, C. (2004), "Macroeconomics and Housing: A Review of the Literature," *Journal of Housing Economics,* 13: 249-67.

Liu, H., Y. Park and S. Zheng (2002), "The Interaction between Housing Investment and Economic Growth in China," *International Real Estate Review,* 5: 40-60.

Liu, H. and Y. Huang (2004), "Prospects of Real Estate Markets in China," Memo, Institute of Real Estate Studies, Tsinghua University, Beijing, P. R. China.

Ma, G. and B. Fung (2002), "China's Asset Management Corporations," BIS Working Papers No.115, Bank for International Settlements.

McKenzie, D. and R. Betts (1996), *Essentials of Real Estate Economics,* New Jersey: Prentice Hall.

Park, A. and K. Sehrt (2001), "Tests of Financial Intermediation and Banking Reform in China," *Journal of Comparative Economics,* 29(4): 608-44.

Pesaran, M. and R. Smith (1994), "A Generalized R^2 Criterion for Regression Models Estimated by the Instrumental Variables Method," *Econometrica,* 62: 705-10.

Pesaran, M., Y. Shin and R. Smith (1999), "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels," *Journal of the American Statistical Association,* 94: 621-34.

Pindyck, R. S. and D. L. Rubinfeld (1998), *Econometric Models and Economic Forecasts,* fourth ed., New York: McGraw-Hill.

Ping, X. and M. Chen (2004), "Real Estate Financing, and Price, and the Trend of Housing Price," Working Paper No.2004-3, China Centre for Economic Research, Peking University (in Chinese).

Shen, Y. and H. Liu (2004), "Housing Prices and Economic Fundamentals: A Cross City Analysis of China for 1995-2002," *Economic Research Journal,* Beijing, 15: 78-86 (in Chinese).

Sun, S.H. (1998), "Real Estate Development in China: A Regional Perspective," *Journal of Real Estate Literature,* 6: 121-31.

Trichet, J.-C. (2003), "Asset Price Bubbles and Their Implications for Monetary Policy and Financial Stability," in W. Hunter, G. Kaufman and M. Pomerleano, eds., *Asset Price Bubbles: The Implication for Monetary, Regulatory, and International Policies,* Massachusetts: MIT Press.

Table 1. Property Price Growth Equation

Dependent variable: Change in property price

	GLS	GMM	GMM	GMM
	(1)	**(2)**	**(3)**	**(4)**
Change in rental price	0.051 (0.035)	0.075 (0.033)**	0.273 (0.029)***	0.069 (0.036)*
Change in land price (-1)	0.161 (0.030)***	0.220 (0.033)***	0.210 (0.034)***	0.225 (0.044)***
GDP growth	0.261 (0.063)***	0.267 (0.048)***	0.359 (0.044)***	0.238 (0.079)***
Change in bank loan	0.018 (0.029)			
Inflation rate (-1)	0.005 (0.001)***	0.003 (0.001)***	0.002 (0.001)***	0.003 (0.001)***
Constant	-0.013 (0.007)*	–	–	–
Change in property price (-1)	–	-0.093 (0.026)***	-0.109 (0.022)***	-0.097 (0.034)***
Dummy			**Coastal**	**Yangtze**
Change in rental price * Dummy			-0.316 (0.068)***	0.174 (0.156)
Adjusted R^2	0.458	0.107#	0.043#	0.101#
SE of regression	0.032	0.040	0.041	0.040
Durbin-Watson stat	2.026	–	–	–
Sargan statistic	–	Passed	Passed	Passed
Range	99-03	00-04	00-04	00-04
Panel observation	155	155	155	155

Notes: a) All variables in real terms and in logarithms (except the inflation rate). Figures in brackets are standard errors.

b) The sample size varies for each regression depending on data availability.

c) The estimation assumes fixed effects across sections.

d) Cross section weighting is used to estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.

e) *, **, *** denote statistical significance at 10%, 5% and 1% level.

f) # refers to the Generalized R^2 suggested by Pesaran and Smith (1994). The measure of GR^2 is not necessarily monotonous in the number of explanatory variables.

g) Sargan statistic refers to a test of validity of overidentifying restrictions.

Table 2. GDP Growth Equation

Dependent variable: GDP growth

	GLS	GMM	GMM	GMM
	(1)	**(2)**	**(3)**	**(4)**
Change in property price	0.252 (0.055)***	0.355 (0.018)***	0.370 (0.034)***	0.339 (0.020)***
Change in bank loans (-1)	0.020 (0.018)	-0.063 (0.010)**	-0.052 (0.009)***	-0.066 (0.011)***
Lending rate	-0.008 (0.001)***	-0.007 (0.000)***	-0.009 (0.001)***	-0.007 (0.001)***
Constant	0.140 (0.005)***	–	–	–
GDP growth (-1)	–	0.336 (0.031)***	0.294 (0.037)***	0.343 (0.042)***
Dummy			**Coastal**	**Yangtze**
Lending rate * Dummy			0.003 (0.002)	-0.002 (0.004)
Adjusted R^2	0.578	0.332#	0.364#	0.331 #
SE of regression	0.028	0.039	0.038	0.039
Durbin-Watson stat	1.911	–	–	–
Sargan statistic	–	Passed	Passed	Passed
Range	98-04	99-04	99-04	99-04
Panel observation	217	186	186	186

Notes: a) All variables in real terms and in logarithms (except the lending rate). Figures in brackets are standard errors.

b) The sample size varies for each regression depending on data availability.

c) The estimation assumes fixed effects across sections.

d) Cross section weighting is used to estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.

e) *, **, *** denote statistical significance at 10%, 5% and 1% level.

f) # refers to the Generalized R^2 suggested by Pesaran and Smith (1994). The measure of GR^2 is not necessarily monotonous in the number of explanatory variables.

g) Sargan statistic refers to a test of validity of overidentifying restrictions.

Table 3. Fixed Asset Investment Growth Equation

Dependent variable: Change in fixed asset investment

	GLS
	(1)
Change in property price	0.509 (0.097)***
Change in land price	0.096 (0.050)*
GDP growth (-1)	1.178 (0.138)***
Change in bank loan	0.151 (0.051)***
Constant	0.006 (0.015)
Adjusted R^2	0.774
SE of regression	0.066
Durbin-Watson stat	1.883
Range	98-03
Panel observation	180

Notes: a) All variables in logarithms and in real terms. Figures in brackets are standard errors.

b) The sample size varies for each regression depending on data availability.

c) The estimation assumes fixed effects across sections.

d) Cross section weighting is used to estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.

e) *, **, *** denote statistical significance at 10%, 5% and 1% level.

Table 4. Real Estate Investment Growth Equation

Dependent variable: Change in real estate investment

	GLS	GMM
	(1)	**(2)**
Change in property price	0.920 (0.315)***	0.484 (0.254)*
Change in land price	-0.104 (0.174)	0.467 (0.107)***
GDP growth (-1)	0.195 (0.373)	-0.466 (0.288)
Change in bank loan	-0.080 (0.179)	0.307 (0.034)***
Constant	0.254 (0.040)***	–
Change in real estate investment (-1)	–	-0.187 (0.011)***
Adjusted R^2	0.583	0.437#
SE of regression	0.225	0.272
Durbin-Watson stat	2.138	–
Sargan statistic	–	Passed
Range	98-03	99-03
Panel observation	186	154

Notes: a) All variables in logarithms and in real terms. Figures in brackets are standard errors.

b) The sample size varies for each regression depending on data availability.

c) The estimation assumes fixed effects across sections.

d) Cross section weighting is used to estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.

e) *, **, *** denote statistical significance at 10%, 5% and 1% level.

f) # refers to the Generalized R^2 suggested by Pesaran and Smith (1994). The measure of GR^2 is not necessarily monotonous in the number of explanatory variables.

g) Sargan statistic refers to a test of validity of overidentifying restrictions.

Table 5. Retail Sales Growth Equation

Dependent variable: Change in retail sales volumn

	GLS	TSLS	TSLS
	(1)	**(2)**	**(3)**
Change in property price	0.002	0.092	-0.099
	(0.030)	(0.302)	(0.125)
GDP growth	0.258	0.783	0.500
	(0.041)***	(0.128)***	(0.149)***
Deposit rate	0.004	0.008	0.006
	(0.001)***	(0.002)***	(0.001)***
Change in bank deposit (-1)	0.003	-0.026	0.002
	(0.009)	(0.019)	(0.013)
Constant	0.055	-0.004	0.027
	(0.005)***	(0.013)	(0.015)*
AR(1)			-0.254
			(0.068)***
Adjusted R^2	0.934	0.876	0.900
SE of regression	0.033	0.039	0.035
Durbin-Watson stat	2.613	2.563	2.437
Range	99-04	99-04	99-04
Panel observation	186	186	186

Notes: a) All variables in real terms and in logarithms (except the deposit rate). Figures in brackets are standard errors.

b) The sample size varies for each regression depending on data availability.

c) The estimation assumes fixed effects across sections.

d) Cross section weighting is used to estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.

e) *, **, *** denote statistical significance at 10%, 5% and 1% level.

Table 6. Bank Loans Growth Equation

Dependent variable: Change in bank loans

	GLS	GMM	GMM
	(1)	**(2)**	**(3)**
Change in property price	0.295 (0.087)***	0.220 (0.127)***	0.266 (0.098)***
GDP growth (-1)	-0.313 (0.134)**	-0.347 (0.138)***	-0.628 (0.135)***
Change in Fixed asset investment (-1)	0.117 (0.037)***	0.023 (0.034)	-0.014 (0.069)
Lending rate	0.002 (0.002)	-0.001 (0.002)**	-0.007 (0.003)**
Constant	0.134 (0.019)***	–	–
Change in bank loans (-1)	–	-0.418 (0.025)***	-0.377 (0.030)***
Dummy			**Coastal**
Change in Fixed asset investment (-1) * Dummy			0.247 (0.128)*
Lending rate * Dummy			0.007 (0.004)
Adjusted R^2	0.517	-0.067#	-0.116#
SE of regression	0.063	0.084	0.086
Durbin-Watson stat	2.433	–	–
Sargan statistic	–	Passed	Passed
Range	98-03	99-03	99-03
Panel observation	184	153	153

Notes: a) All variables in real terms and in logarithms (except the lending rate). Figures in brackets are standard errors.

b) The sample size varies for each regression depending on data availability.

c) The estimation assumes fixed effects across sections.

d) Cross section weighting is used to estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.

e) *, **, *** denote statistical significance at 10%, 5% and 1% level.

f) # refers to the Generalized R^2 suggested by Pesaran and Smith (1994). The measure of GR^2 is not necessarily monotonous in the number of explanatory variables.

g) Sargan statistic refers to a test of validity of overidentifying restrictions.

Figure 1. Property Price and GDP Growth

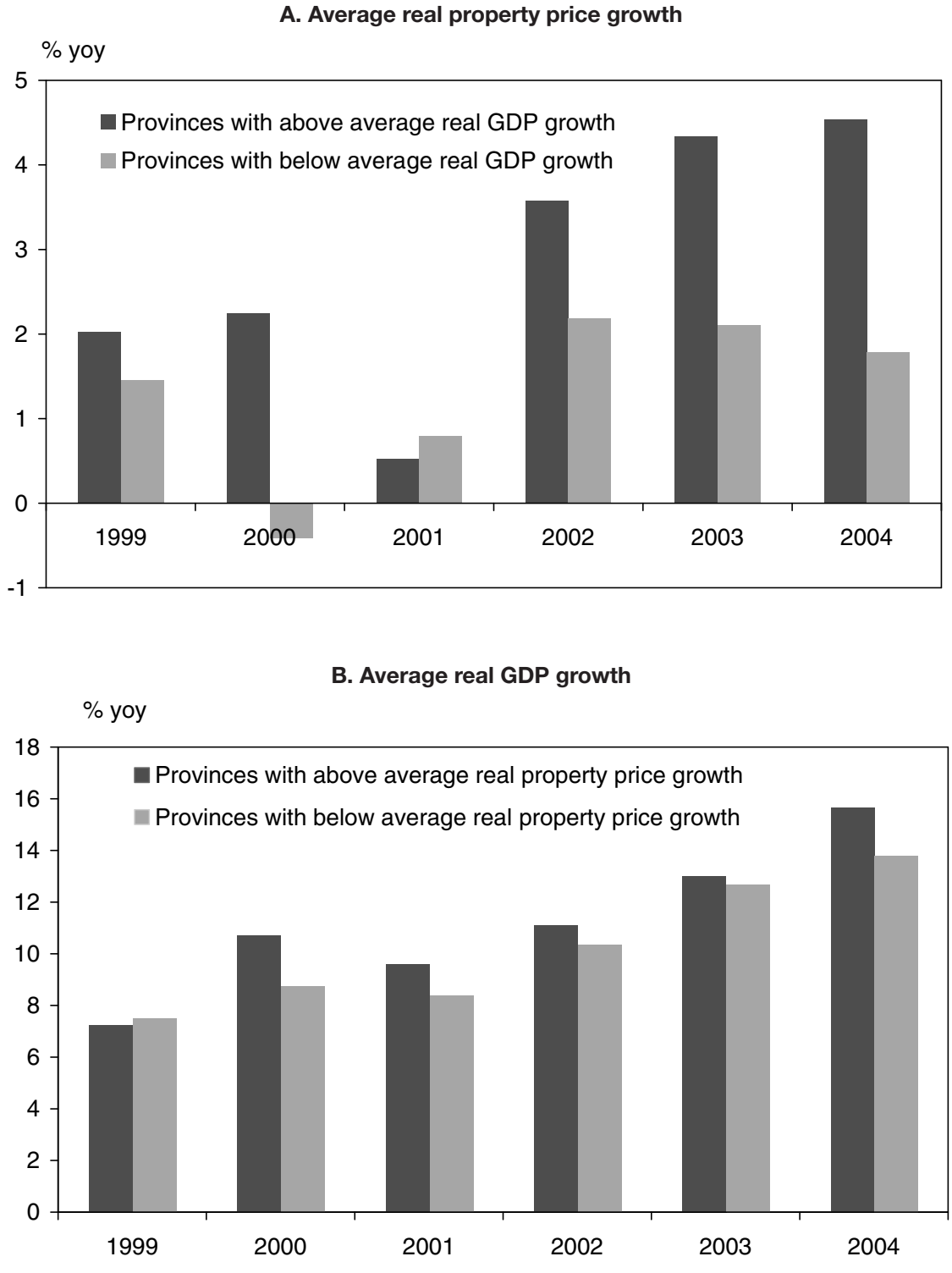
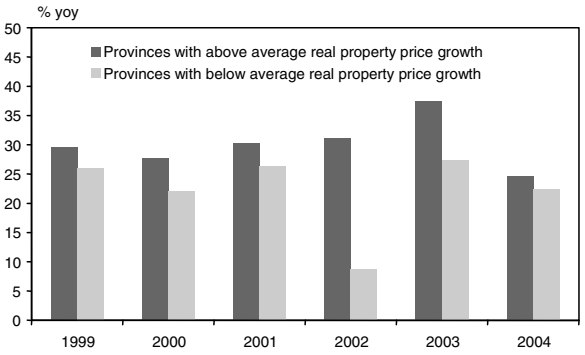
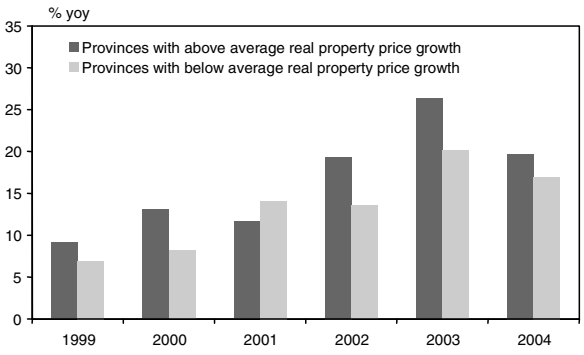


Figure 2. Property Price, Investment, Consumption and Bank Loans Growth

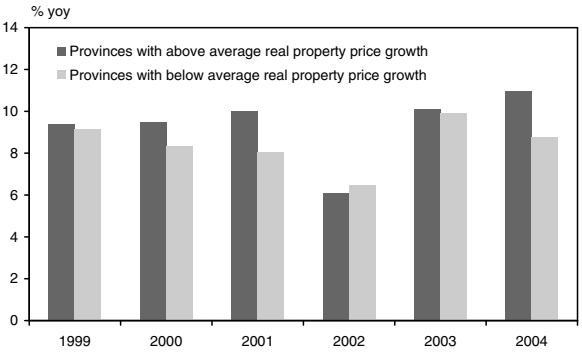
A. Average growth in real estate investment



B. Average growth in fixed asset investment



C. Average growth in retail sales



D. Average growth in bank loans

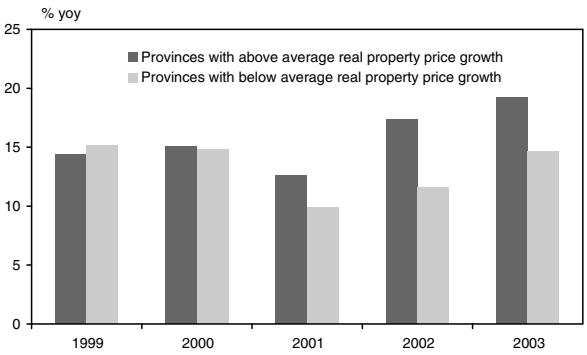
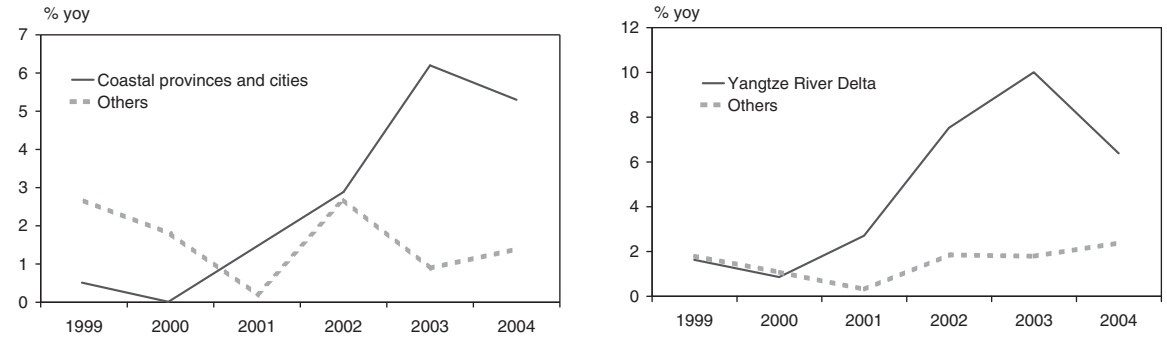
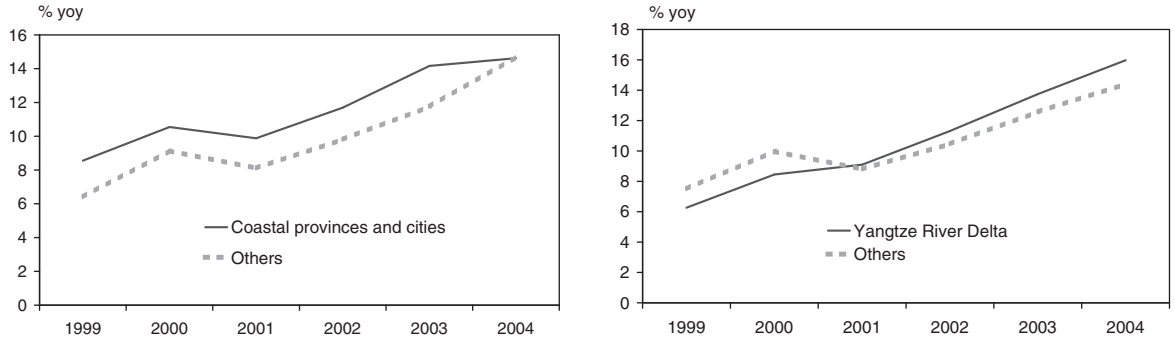


Figure 3. Cross Region Comparisons

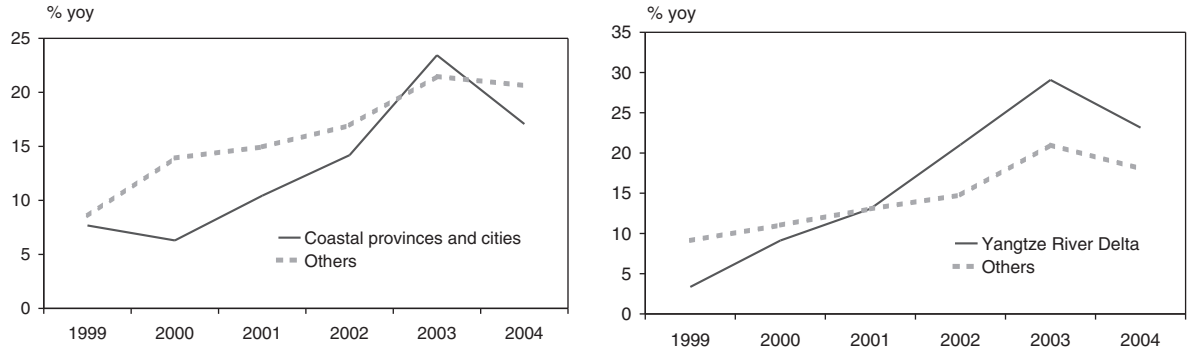
A. Property price growth



B. Real GDP growth



C. Fixed asset investment growth



D. Real estate investment growth

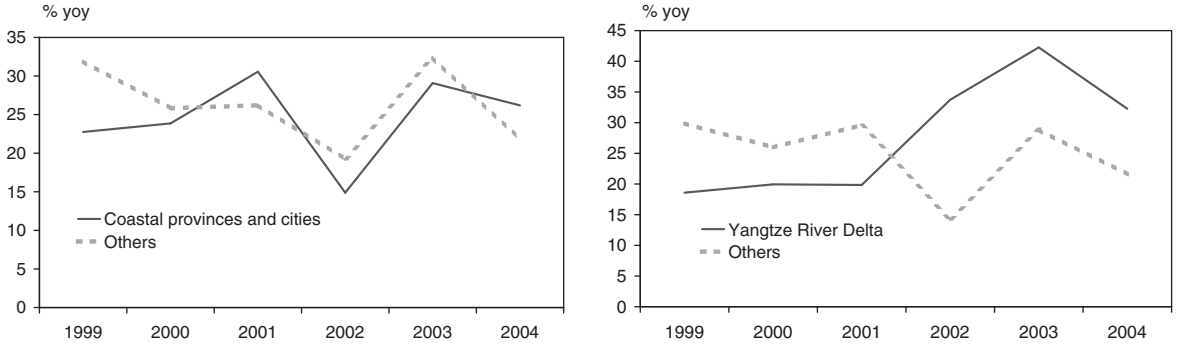
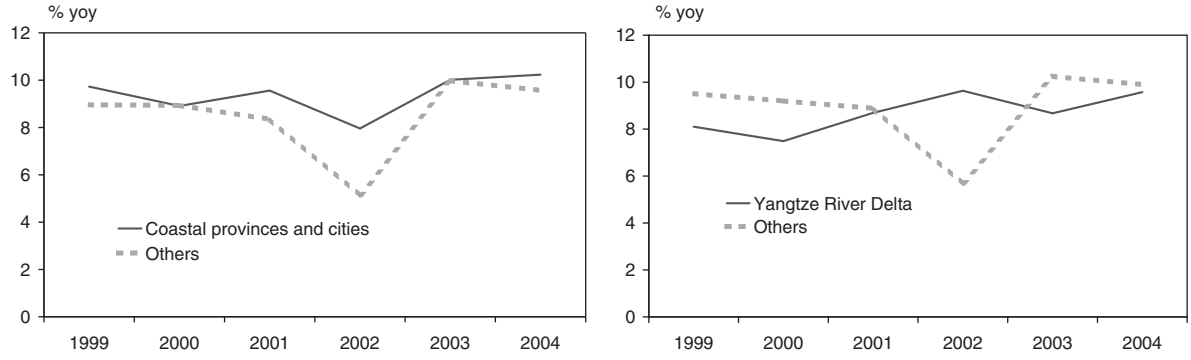
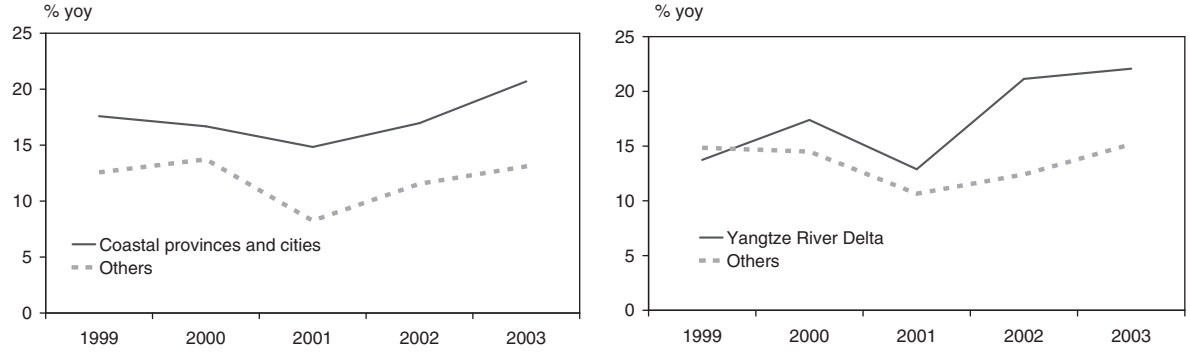


Figure 3. Cross Region Comparisons (continued)

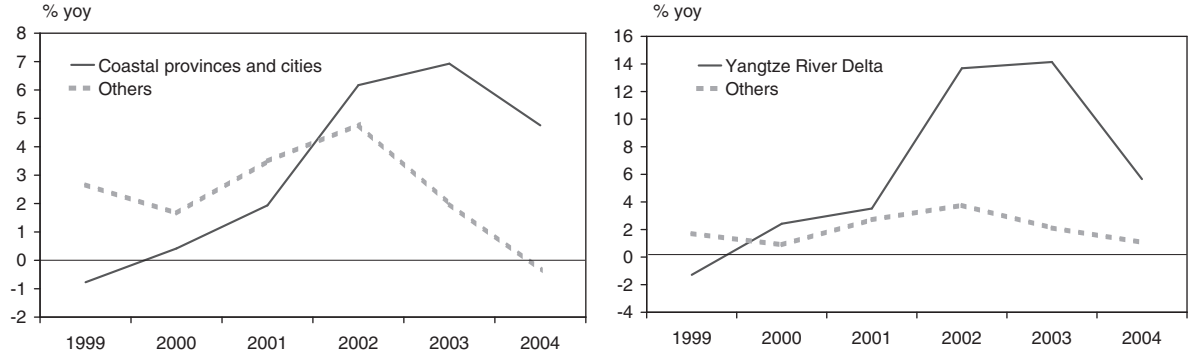
E. Retail sales growth



F. Bank credit growth



G. Land price growth



H. Lending rate