HONG KONG MONETARY AUTHORITY

Research Memorandum 06/2018

6 August 2018

PROPERTY PRICES AND CORPORATE DEFAULT LIKELIHOOD IN MAINLAND CHINA *

Key points:

- *There have been mixed views on whether financial stability is susceptible to real estate cycles in Mainland China amid the recent property price rally. By exploring the extent to which changes in Mainland property prices affect the credit risk of corporate borrowers, this study adds to our understanding of the issue. It finds that real estate cycles are a contributing factor in corporate default likelihood, which is a barometer of financial stability in Mainland China.*

- *For a large panel of listed non-financial firms, this study finds that changes in property prices have an asymmetric effect on corporate default likelihood, as perceived by stock market investors. While property price increases do little to decrease the perceived default likelihood, property price declines significantly increase it. These effects are also non-linear, as the corporate default likelihood tends to be much larger if property price declines are abrupt.*

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* The authors thank Lillian Cheung, Frank Leung, Eric Wong and Jason Wu for their valuable comments.

I. INTRODUCTION

Real estate cycles can have significant impact on financial stability. Over the past few decades, the experience of developed countries clearly shows that the bursting of property bubbles has major repercussions for financial stability. For example, the US experienced the 1990s savings and loan crisis, followed by the sub-prime mortgage crisis that culminated in the Global Financial Crisis (GFC) during 2007-2008. In Europe, the sovereign debt crises occurred following the bursting of property bubbles, particularly in Greece, Ireland and Spain[1].

In recent years, property prices in Mainland China, the largest emerging economy in the world, have picked up notably. In first-tier cities, including Beijing, Shanghai, Guangzhou and Shenzhen, property prices have, on average, increased by 60% since 2015. With buoyant market conditions, property prices in second-tier cities have also recorded substantial rises in the same period. As a result, housing affordability on the Mainland has worsened notably, and some first-tier cities such as Beijing and Shanghai have been named among the least affordable housing markets in the world[2].

Policymakers as well as some market analysts have voiced concerns about this development, given the potential impact of property price declines on the real economy and financial stability as suggested by the experience of developed economies. However, there are also some who believe that financial stability in Mainland China is unlikely to be affected by real estate cycles. They point to several reasons why this may be the case. First, unlike banks in developed economies, Chinese banks' direct exposure to the property market is not large. By the end of 2017, the share of developer loans and mortgages together in total bank loans in Mainland China was about 26%. In comparison, the share of real estate loans in total loans was around 60% for the US and Spain before the GFC. Secondly, Mainland

[1] The impact of house price declines/busts on financial stability has been documented by researchers. For instance, Claessens, Kose, and Terrones (2008) review business and financial cycles in 21 OECD countries over the period 1960–2007 and find that housing-associated recessions tend to be more severe than those that are not associated with the collapse of property markets.

[2] The Bloomberg global city housing affordability index, 2017.

households do not seem to be highly leveraged. Indeed, overall household leverage, measured by the total household loans over total household deposits, remained low at around 49% in 2017. The household leverage in Spain and the US reached about 130% and 180% respectively before the GFC. Thirdly, unlike developed economies, the need for further expansion in property development remains strong for Mainland China given its relatively low urbanization ratio. According to the World Bank's latest statistics, the Mainland's urbanization ratio in 2016 was only 57%, far below the level of 70-90% in advanced economies.

Understanding whether Mainland financial stability is susceptible to real estate cycles is crucial to policy making. This study adds to the debate by exploring the extent to which changes in Mainland property prices affect the credit risk of corporate borrowers. We view the health of the corporate sector as a key barometer of financial stability in China as around 80% of bank loans have been granted to the corporate sector, a significant part of which are secured by real estate[3]. That's not to mention the credit risk of highly leveraged property developers and the strong linkages between the real estate sector and other economic segments as well.

One difficulty facing researchers studying the credit risk of Mainland corporate borrowers is the paucity of information publicly available on corporate defaults. Therefore, this study uses a forward-looking measure of market-perceived default probability, which is estimated based on the stock prices and balance-sheet data of around 2,000 listed non-financial firms in Mainland China during the period from 2007 Q1 to 2016 Q3. Changes in property prices have an asymmetric effect on corporate default likelihood: while property price increases do little to decrease the perceived default likelihood, property price declines significantly increase it. These effects are also non-linear, as the corporate default likelihood tends to be much larger if property price declines are abrupt.

The remainder of this paper is organized as follows. Section 2

[3] International Monetary Fund (IMF). (2011), "People's Republic of China: Financial System Stability Assessment", IMF Country Report No. 11/321, Washington DC.

discusses the theoretical background and empirical framework. The empirical findings are presented in the next section and the last section concludes.

II. THEORETICAL BACKGROUND AND EMPIRICAL FRAMEWORK

2.1 Theoretical background

Theoretically speaking, the debt-servicing ability of firms can be affected by declines in property prices through three channels: the firms' balance sheet channel, the macroeconomic performance channel, and the impaired bank balance sheet channel, which we elaborate on in the following subsection.

First, holding properties or land as an asset on firms' balance sheets is enough to make them vulnerable to real estate cycles (von Peter, 2009). In particular, declines in property prices can affect the asset value and in turn their debt-servicing ability.

Secondly, even if firms do not hold property or land as an asset, property price declines can still affect the viability of firms, as the economic performance may be adversely affected by asset price declines, especially abrupt corrections which in turn cause a drag on profitability (von Peter, 2009). If such effects are large enough, the liquidity positions and thus the debt-servicing ability of firms will also be affected.

Thirdly, as banks usually reduce their lending supply to borrowers when collateral value decreases, they face heightened refinancing and liquidity risks in the event of a property market downturn. In a stress scenario, an abrupt property market downturn may significantly impair banks' balance sheets and their willingness to lend, which in turn may form a vicious cycle jeopardising financial stability. In part, this explains why credit risks can spill over from developers to firms not only in property-related sectors, but also to those in industries with remote connection to the real estate sector, such as the chemical industry, ship-building, and IT in Mainland China, as documented in Chan et al. (2016).

2.2 Empirical framework

To confirm the theoretical predictions summarised in the previous section, we regress a default risk index of Mainland firms, following Altman, Fargher, and Kalotay (2011), on the quarterly property price changes and a set of macro and firm-level variables, as follows:

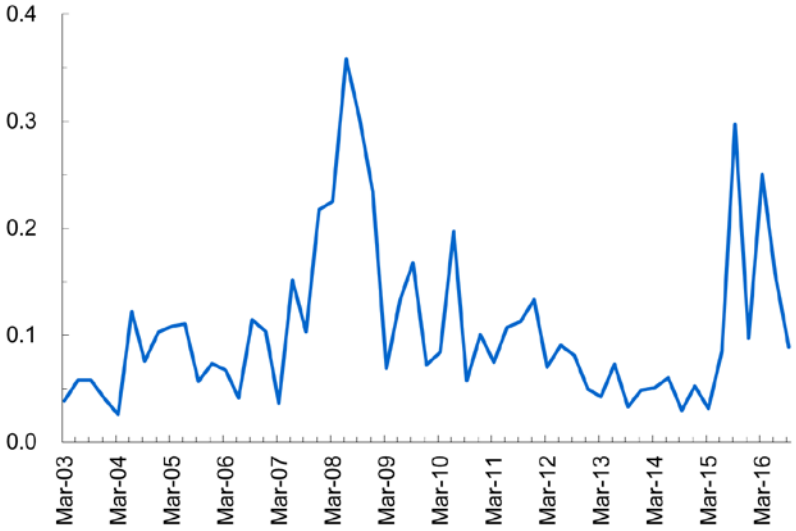
$$Y_{i,t} = \alpha + \beta \cdot \Delta HP_{t-1} + \gamma \cdot firm\_characteristic_{i,t-1} + \varphi \cdot macro\ variables_t + \theta \cdot stock\ market\ PB_{t-1} + stock\ market\ stress\ dummy + firm\ fixed\ effects + \varepsilon_{i,t} \quad (1)$$

The dependent variable $Y_{i,t}$ is the default risk index of firm i at time t and defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$, where $DL_{i,t}$ is the market-perceived, one-year-ahead default likelihood for each Chinese listed non-financial firm, computed as follows:

$$DL = N(-(V/D + (\mu - \delta^2/2))/\delta), \quad (2)$$

where V is the firm's asset value implied by the stock price, D is the book value of corporate liabilities, μ and δ are the trend growth and volatility of the firm's asset value respectively. In essence, $DL_{i,t}$ captures the market-perceived probability that the asset value of the firm will fall below its liabilities at the end of the following year. Therefore, higher $DL_{i,t}$ means greater market-perceived default risk. We extend $DL_{i,t}$ calculated by Han and Zhen (2016), which runs from 2007 Q1 to 2013 Q2, to 2016 Q3 using the same methodology. Our sample consists of around 2,000 Mainland-listed non-financial firms.

Chart 1. Estimated market-perceived default likelihood of Mainland-listed non-financial firms



Sources: Han and Zhen (2016) and staff estimation.
Note: This index is a simple average of the estimated market-perceived default likelihood of all listed Mainland firms in our sample.

Chart 1 shows that the market-perceived default likelihood used in our study peaked during the GFC in 2008 and 2009, increased during the European Debt Crisis in 2011 and 2012, and picked up notably in 2015 and 2016 amid a strong renminbi depreciation and rising concerns about a hard landing for the Chinese economy. This suggests that $DL_{i,t}$ as an ex ante measure of default risk tracks well the events that might have triggered a greater credit risk of Mainland firms in our sample period.

In Equation (1), ΔHP_{t-1} is the quarter-on-quarter percentage change of a moving average of property prices, defined as $((HP_{t-1} + HP_{t-2}) - (HP_{t-2} + HP_{t-3}))/(HP_{t-2} + HP_{t-3}) \times 100\%$. In particular, property prices are derived from the national sales value and area of residential commodity building. In our study, lagged instead of contemporaneous property price changes are used to explain the market-perceived default likelihood of firms. This is because the impact of property price changes will only be reflected in firms' balance sheet and stock prices in subsequent quarters β, the coefficient of ΔHP_{t-1} is therefore the key

interest of our study.

Lagged financial information of the firm extracted from quarterly financial reports, $firm\_characteristics_{i,t-1}$, including profitability, liquidity position and size of a firm, are also included into the specification to control for their potential impacts on the perceived default likelihood of the firm.[4] In addition, to control for the potential impact of macroeconomic and monetary conditions on firms' default risk, we include a set of variables ($macro\ variables_t$), which consist of the contemporaneous real GDP growth and the lagged estimate of the monetary condition index (MCI) in the regression.[5]

By construction, the estimated market-perceived default likelihood of firms (DL), hinges on stock market volatility, which can be affected not only by the fundamentals of listed firms but also by broad-based factors. To control for this, we include in the specification the Mainland stock market valuation, proxied by the lagged price-to-book value of the CSI 300 Index ($stock\ market\ PB_{t-1}$)[6&7]. In addition, since stock market volatility on the Mainland increased significantly following the authorities' crackdown on margin-based trading in 2015 and 2016, a dummy variable that is equal to 1 from 2015 Q1 to 2016 Q2 is added to control for the potential distortions to $DL_{i,t}$.

[4] Following Han and Zheng (2016) and Chan, Han and Zhang (2016), profitability is measured as $\ln\left(1-\left(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right)\right)$, liquidity is measured as $\ln\left(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right)$ and firm size is measured as $\ln\left(\frac{total\ asset_t}{stock\ market\ index_t}\right)$.

[5] The MCI is the monetary condition index estimated using the same methodology as in "Box 1. How tight are monetary conditions in Mainland China?" of the *Half-yearly Monetary and Financial Stability Report* (September, 2011), the HKMA.

[6] The CSI 300 Index consists of the 300 largest and most liquid A-share stocks listed in Mainland China.

[7] Ideally a contemporaneous measure of the Mainland market stock valuation is correlated more with market sentiments. However, including the contemporaneous measure may induce endogeneity issues stemming from reverse causality. To tackle this issue, we opt for lagged measures of the Mainland market stock valuation instead.

III. ESTIMATION RESULTS

To estimate Equation (1), we employ a dataset consisting of the financial data of around 2,000 listed non-financial firms in Mainland China during the sample period from 2007 Q1 to 2016 Q3. Table 1 reports the summary statistics of our dataset.

The estimation results of Equation (1) are reported in Table 2. Most of the estimated coefficients of the control variables carry the expected signs. For example, faster GDP growth helps lower the perceived default likelihood of firms. In addition, firms with larger size, better liquidity positions and greater profitability have a lower perceived default likelihood.

In terms of the effects of property prices, the left panel of Table 2 shows that when the market stress dummy is not included in the specification, changes in property prices are found to have a statistically significantly negative impact on firms' default likelihood as perceived by the market[8]. However, such impact becomes significantly positive when the market stress dummy is added to the specification, as shown in the right panel of Table 2. Because this period coincides with increases in property prices, the sign flip suggests that some asymmetry may be at play. That is, the sensitivity of default likelihood on house prices may depend on whether house prices are going up or going down. To test this, we re-estimate Equation (1) by adding into the specification the interaction term between ΔHP_{t-1} and a dummy variable Up that is equal to 1 if ΔHP_{t-1} is larger than zero.

The estimation results reported in Table 3 confirm the existence of asymmetric impacts between property price increase and decrease, as the coefficient of the interaction term between ΔHP_{t-1} and the dummy variable is statistically different from zero. More specifically, property price declines tend to increase the perceived default likelihood of firms, as suggested by the

[8] To facilitate a more convenient interpretation of the result, the coefficients of the explanatory variables reported in the table except that of the profitability variable are multiplied by -1, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm i. The coefficient of profitability is not multiplied by -1 as by construction the variable increases when profitability goes down.

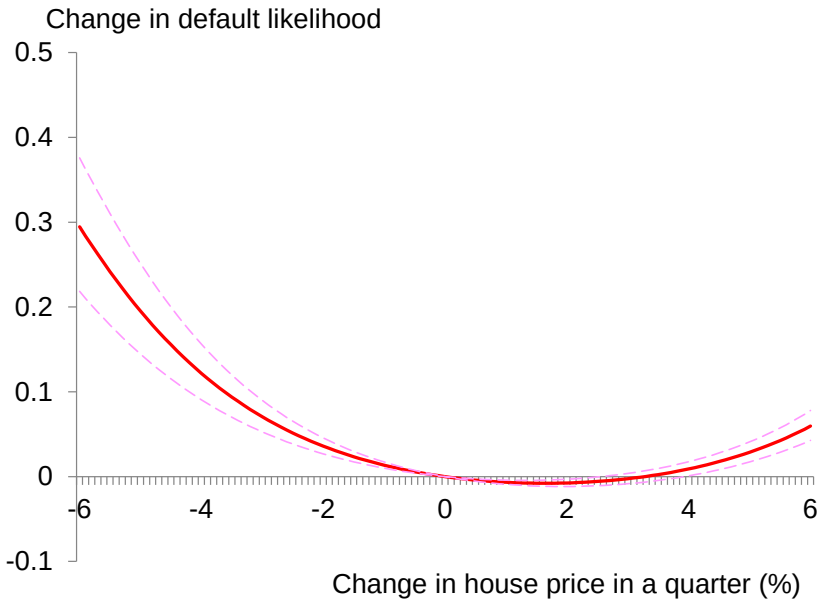
statistically significantly negative coefficient of ΔHP_{t-1}. By contrast, however, property price increases are likely to lead to a greater rather than lower default likelihood, as the coefficients of ΔHP_{t-1} and the interaction term are jointly significantly positive, especially when the market stress dummy is included.

In the next step, we relax the linear restriction on the impact of property price changes and examine whether our findings still hold. In this regard, we re-estimate Equation (1) by adding squared property price changes into the specification. The estimation results are reported in Table 4. The coefficients of the squared property price changes are found to be statistically significantly positive across all specifications, pointing to a non-linear impact of property price changes on firms' default likelihood as perceived by the market. In addition, the sensitivity of default likelihood to property prices is qualitatively the same whether or not the market stress period is included.

The non-linear effect of changes in property prices derived from the estimated coefficient in Column (f) of Table 4 is plotted in Chart 2.[9] This chart confirms our previous findings that the impact of declines and increases in property prices is asymmetric. In particular, Chart 2 shows that while property price declines seem to significantly increase the perceived default likelihood of Mainland firms, property price increases appear to do little to decrease the perceived default likelihood of Mainland firms. Instead, property price increases faster than 3% per quarter will make the perceived default likelihood start to rise. This is probably due to the fact that a property price rally on the Mainland usually leads to a faster increase in corporate leverage (Cheung et al, 2017), which in turn worsens the debt-servicing ability of firms.

[9] To estimate the impact of change in property prices on firms' default likelihood, we first take the mean of the default likelihood of all firms $\overline{DL}$ as a benchmark and obtain the corresponding default risk index $\bar{Y}$. The estimated impact of a change in property prices on default likelihood is then calculated by DL^* - $\overline{DL}$ where DL^* is the default risk derived from the new default risk index $Y^* = \bar{Y} + \Delta Y$ and ΔY is the change in default risk index due to the change in property prices.

Chart 2: Non-linear effect of changes in property prices on firms' default likelihood



Source: Staff estimation
Note: The non-linear effect is derived from the estimation results of Column (f) in Table 4, assuming the perceived default likelihood of firms is at the sample average.

Chart 2 also highlights that abrupt declines in property prices may lead to much larger increases in the perceived default likelihood of Mainland firms. In particular, while on average a decline of two percentage points in property prices in one quarter will lead to an increase of four percentage points in the perceived corporate default likelihood, a decline of four percentage points will lead to an increase of twelve percentage points in the perceived corporate default likelihood. Our finding of the non-linear effect of changes in property prices is in line with the general perception that abrupt corrections in property markets can jeopardise financial stability by inducing a vicious cycle between falling property prices and borrower defaults.

Our findings that property price changes can affect corporate default likelihood are unlikely to be driven by reverse causality for several reasons. First, the impacts of property prices on the default probability of firms are found to be asymmetric as both property price declines and increases may lead to a greater default probability. Indeed, if reverse causality plays a role here, we should, instead, probably detect a symmetric effect, as property price

decreases are more associated with a greater default probability of firms and property price increases with a lower default likelihood. Secondly, in our study we use national property prices to explain the default probability of individual firms. In this sense, changes in the default likelihood of an individual firm are unlikely to affect national property prices.

To test whether these results are robust, we relax the restriction of the quadratic form of non-linearity by adding a cubic term of property price changes into the specification. Here we find the coefficients of the cubic term are not significantly different from zero in all three specifications (Table 5). These findings are robust in a further sub-sample test using only the data from 2007 to 2014 before the stock market stress period of 2015-16 (Table 6). In an additional exercise, we use property price changes in the province where the headquarters of a firm is located, instead of using national property price changes. The estimation results point to a qualitatively similar sensitivity of default likelihood to property prices (Table 7).

IV. CONCLUSION

There have been mixed views on whether financial stability is susceptible to real estate cycles in Mainland China amid the recent property price rally. By exploring the extent to which changes in Mainland property prices may affect the credit risk of corporate borrowers, this study adds to our understanding of the issue and finds that real estate cycles do have a bearing on financial stability in Mainland China.

Using financial data from some 2,000 listed non-financial firms in Mainland China between 2007 Q1 and 2016 Q3, this study finds that changes in property prices have an asymmetric and non-linear impact on corporate default likelihood as perceived by Mainland stock market investors. Specifically, after controlling various firm-level factors, we find that while property price increases do little to decrease the perceived default likelihood, property price declines significantly increase it, highlighting the asymmetry. Also, the impact on the perceived corporate default likelihood tends to be much

large if property price declines are abrupt.

Our findings highlight the risks associated particularly with sharp corrections in property prices. Therefore, policymakers may want to strike a balance between cooling down an overheated real estate market and maintaining financial stability.

One caveat to our study is that the corporate default likelihood we employ is the expected default risk derived from stock prices and financial data of listed firms rather than estimated from actual default cases. Therefore, caution is required when interpreting the empirical results.

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Table 1. Summary statistics for key variables

	Default risk index $Y_{i,t}$	*Firm size*	*Liquidity*	*Profitability*	*Stock market PB*	*GDP growth*	*MCI*	ΔHP
Mean	5.59	3.00	-0.95	-0.15	2.56	9.07	10.89	2.21
Median	3.87	2.86	-0.83	-0.12	2.15	8.10	10.81	1.68
Maximum	103.70	9.83	6.06	11.52	6.92	15.00	13.18	8.95
Minimum	-16.64	-5.47	-8.16	-5.55	1.36	6.40	8.02	-3.30
No. of firms	2,058	2,058	2,058	2,058				
No. of observations	63,842	63,842	63,842	63,842	39	39	39	39

Note: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-\left(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right))$, *Stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated using the same methodology as in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP growth* is the year-on-year quarterly GDP growth, and ΔHP is the quarterly change of the two-quarter moving average of the national sales price of residential commodity building.

Table 2. The impact of property price changes on default likelihood of Mainland firms: estimation results of Equation (1)

	(a)	(b)	(c)	(d)	(e)	(f)
$Liquidity_{i,t-1}$^	-2.202***	-2.197***	-2.197***	-1.704***	-1.681***	-1.670***
$Firm\ size_{i,t-1}$^	-1.596***	-1.598***	-1.599***	-1.104***	-1.127***	-1.103***
$Profitability_{i,t-1}$	-1.920***	-1.920***	-1.919***	-2.154***	-2.145***	-2.169***
$Stock\ market\ PB_{t-1}$^	0.885***	0.893***	0.891***	0.983***	1.060***	1.067***
GDP_t^		-0.007	-0.004		-0.068**	-0.091***
MCI_{t-1}^			-0.007			0.098***
ΔHP_{t-1}^	**-0.056*** **	**-0.056*** **	**-0.057*** **	**0.021****	**0.024*** **	**0.039*** **
Stock market stress dummy	No	No	No	Yes	Yes	Yes
No. of observations	54,531	54,531	54,531	54,531	54,531	54,531
R-squared	0.470	0.470	0.470	0.506	0.506	0.507

Notes: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-\left(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right))$, *stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP* is the year-on-year quarterly GDP growth, ΔHP is the quarterly change of the two-quarter moving average of the national sales price of residential commodity building, and *Stock market stress dummy* equals 1 for the period of Q1 2015 to Q2 2016. ^ denotes that the coefficient is multiplied by -1 to facilitate a more convenient interpretation of the result, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm *i*. The coefficient of profitability is not multiplied by -1 as the variable is an inverted scale of profitability by construction. ***, ** and * denote the estimated coefficient is statistically significant at 1%, 5% and 10% respectively.

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Table 3. The impact of property price changes on default likelihood of Mainland firms: estimation results of Equation (1) with asymmetric effect

	(a)	(b)	(c)	(d)	(e)	(f)
$Liquidity_{i,t-1}$^	-2.104***	-1.923***	-1.915***	-1.658***	-1.598***	-1.562***
$Firm\ size_{i,t-1}$^	-1.366***	-1.409***	-1.373***	-0.985***	-1.044***	-0.979***
$Profitability_{i,t-1}$	-1.751***	-1.726***	-1.775***	-2.013***	-1.980***	-2.032***
$Stock\ market\ PB_{t-1}$^	0.929***	1.232***	1.300***	0.980***	1.188***	1.214***
GDP_t^		-0.271***	-0.360***		-0.184***	-0.246***
MCI_{t-1}^			0.237***			0.239***
$\boldsymbol{\Delta HP_{t-1}}$^	**-0.533*** **	**-0.548*** **	**-0.534*** **	**-0.295*** **	**-0.300*** **	**-0.284*** **
$\boldsymbol{\Delta HP_{t-1}*Up}$^	**0.631*** **	**0.665*** **	**0.691*** **	**0.400*** **	**0.418*** **	**0.443*** **
Stock market stress dummy	No	No	No	Yes	Yes	Yes
Is $\hat{\beta}_{\Delta HP_{t-1}}$+ $\hat{\beta}_{\Delta HP_{t-1}*up}$ significant at 5% level?	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	54,531	54,531	54,531	54,531	54,531	54,531
R-squared	0.488	0.489	0.490	0.512	0.512	0.513

Notes: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-\left(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right))$, *stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP* is the year-on-year quarterly GDP growth, ΔHP is the quarterly change of the two-quarter moving average of the national sales price of residential commodity building, and *Stock market stress dummy* equals 1 for the period of Q1 2015 to Q2 2016. and *Up* is a dummy variable equals 1 if $\Delta HP$is larger than zero. ^ denotes that the coefficient is multiplied by -1 to facilitate a more convenient interpretation of the result, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm *i*. The coefficient of profitability is not multiplied by -1 as the variable is an inverted scale of profitability by construction. ***, ** and * denote the estimated coefficient is statistically significant at 1%, 5% and 10% respectively.

Table 4. The impact of property price changes on default likelihood of Mainland firms: estimation results of Equation (1) with additional squared property price changes

	(a)	(b)	(c)	(d)	(e)	(f)
$Liquidity_{i,t-1}$^	-2.230***	-2.203***	-2.205***	-1.712***	-1.681***	-1.654***
$Firm\ size_{i,t-1}$^	-1.539***	-1.546***	-1.535***	-1.010***	-1.041***	-0.968***
$Profitability_{i,t-1}$	-1.925***	-1.924***	-1.938***	-2.168***	-2.155***	-2.213***
$Stock\ market\ PB_{t-1}$^	0.896***	0.943***	0.961***	0.991***	1.101***	1.126***
GDP_t^		-0.042	-0.066**		-0.097***	-0.153***
MCI_{t-1}^			0.063**			0.215***
ΔHP_{t-1}^	**-0.152*** **	**-0.154*** **	**-0.152*** **	**-0.105*** **	**-0.104*** **	**-0.100*** **
ΔHP_{t-1}^2^	**0.019*** **	**0.019*** **	**0.021*** **	**0.024*** **	**0.025*** **	**0.031*** **
Stock market stress dummy	No	No	No	Yes	Yes	Yes
No. of observations	54,531	54,531	54,531	54,531	54,531	54,531
R-squared	0.471	0.471	0.471	0.507	0.507	0.508

Notes: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}))$, *stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP* is the year-on-year quarterly GDP growth, ΔHP is the quarterly change of the two-quarter moving average of the national sales price of residential commodity building, and *Stock market stress dummy* equals 1 for the period of Q1 2015 to Q2 2016. ^ denotes that the coefficient is multiplied by -1 to facilitate a more convenient interpretation of the result, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm *i*. The coefficient of profitability is not multiplied by -1 as the variable is an inverted scale of profitability by construction. ***, ** and * denote the estimated coefficient is statistically significant at 1%, 5% and 10% respectively.

Table 5. The impact of property price changes on default likelihood of Mainland firms: estimation results of Equation (1) with additional squared and cubic property price changes

	(a)	(b)	(c)
$Liquidity_{i,t-1}$^	-1.713***	-1.682***	-1.656***
$Firm\ size_{i,t-1}$^	-1.010***	-1.040***	-0.965***
$Profitability_{i,t-1}$	-2.164***	-2.154***	-2.209***
$Stock\ market\ PB_{t-1}$^	0.994***	1.100***	1.124***
GDP_t^		-0.096***	-0.149***
MCI_{t-1}^			0.218***
ΔHP_{t-1}^	**-0.102*** **	**-0.103*** **	**-0.097*** **
ΔHP^2_{t-1}^	**0.020*** **	**0.024*** **	**0.026*** **
ΔHP^3_{t-1}^	**0.001**	**0.000**	**0.001**
Stock market stress dummy	Yes	Yes	Yes
No. of observations	54,531	54,531	54,531
R-squared	0.507	0.507	0.508

Notes: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}))$, *stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP* is the year-on-year quarterly GDP growth, ΔHP is the quarterly change of the two-quarter moving average of the national sales price of residential commodity building, and *Stock market stress dummy* equals 1 for the period of Q1 2015 to Q2 2016. ^ denotes that the coefficient is multiplied by -1 to facilitate a more convenient interpretation of the result, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm *i*. The coefficient of profitability is not multiplied by -1 as the variable is an inverted scale of profitability by construction. ***, ** and * denote the estimated coefficient is statistically significant at 1%, 5% and 10% respectively.

Table 6. The impact of property price changes on default likelihood of Mainland firms: estimation results of Equation (1) with additional squared and cubic property price changes for sample period of 2007Q1-2014Q4

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
$Liquidity_{i,t-1}$^	-1.704***	-1.695***	-1.690***	-1.664***	-1.653***	-1.661***	-1.662***	-1.653***	-1.662***
$Firm\ size_{i,t-1}$^	-2.003***	-2.024***	-2.033***	-1.832***	-1.861***	-1.829***	-1.829***	-1.855***	-1.821***
$Profitability_{i,t-1}$	-1.669***	-1.662***	-1.658***	-1.709***	-1.699***	-1.712***	-1.702***	-1.695***	-1.707***
$Stock\ market\ PB_{t-1}$^	0.702***	0.744***	0.739***	0.740***	0.800***	0.816***	0.747***	0.797***	0.813***
GDP_t^		-0.040	-0.029		-0.058*	-0.084***		-0.050*	-0.077**
MCI_{t-1}^			-0.032			0.074**			0.076**
ΔHP_{t-1}^	**0.016***	**0.018****	**0.013**	**-0.115*****	**-0.113*****	**-0.109*****	**-0.110*****	**-0.110*****	**-0.105*****
ΔHP^2_{t-1}^				**0.025*****	**0.025*****	**0.027*****	**0.017*****	**0.019*****	**0.020*****
ΔHP^3_{t-1}^							**0.001**	**0.001**	**0.001**
No. of observations	41,964	41,964	41,964	41,964	41,964	41,964	41,964	41,964	41,964
R-squared	0.519	0.519	0.519	0.521	0.521	0.521	0.521	0.521	0.521

Notes: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-\left(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right))$, *stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP* is the year-on-year quarterly GDP growth, ΔHP is the quarterly change of the two-quarter moving average of the national sales price of residential commodity building, and *Stock market stress dummy* equals 1 for the period of Q1 2015 to Q2 2016. ^ denotes that the coefficient is multiplied by -1 to facilitate a more convenient interpretation of the result, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm *i*. The coefficient of profitability is not multiplied by -1 as the variable is an inverted scale of profitability by construction. ***, ** and * denote the estimated coefficient is statistically significant at 1%, 5% and 10% respectively.

Table 7. The impact of provincial property price changes on default likelihood of Mainland firms: estimation results of Equation (1) with additional squared property price changes

	(a)	(b)	(c)	(d)	(e)	(f)
$Liquidity_{i,t-1}$^	-2.194***	-2.173***	-2.182***	-1.715***	-1.695***	-1.693***
$Firm\ size_{i,t-1}$^	-1.628***	-1.633***	-1.612***	-1.071***	-1.09***	-1.068***
$Profitability_{i,t-1}$	-1.899***	-1.899***	-1.917***	-2.145***	-2.137***	-2.155***
$Stock\ market\ PB_{t-1}$^	0.823***	0.859***	0.885***	1.004***	1.074***	1.085***
GDP_t^		-0.031	-0.054*		-0.06**	-0.071**
MCI_{t-1}^			0.08***			0.065**
$\boldsymbol{\Delta Prov\_HP_{t-1}}$^	**-0.04*** **	**-0.04*** **	**-0.04*** **	**-0.018*** **	**-0.016** **	**-0.017** **
$\boldsymbol{\Delta Prov\_HP^2_{t-1}}$^	**0.005*** **	**0.005*** **	**0.005*** **	**0.004*** **	**0.004*** **	**0.004*** **
Stock market stress dummy	No	No	No	Yes	Yes	Yes
No. of observations	53,633	53,633	53,633	53,633	53,633	53,633
R-squared	0.47	0.47	0.47	0.506	0.506	0.506

Notes: Default risk index $Y_{i,t}$ is the logit transformation of firms' default likelihood $DL_{i,t}$, which is defined as $ln(\frac{1-DL_{i,t}}{DL_{i,t}})$. *Firm size* is measured as $\ln(\frac{total\ asset_t}{stock\ market\ index_t})$, *Liquidity* is measured as $\ln(\frac{current\ assets_t}{estimated\ firm\ value\ based\ on\ stock\ price_t})$, *Profitability* is measured as $\ln(1-\left(\frac{retained\ earnings_t}{estimated\ firm\ value\ based\ on\ stock\ price_t}\right))$, *stock market PB* is the price-to-book ratio of CSI 300, *MCI* is the monetary condition index estimated in "Box 1. How tight are monetary conditions in Mainland China?" of HKMA (2011), *GDP* is the year-on-year quarterly GDP growth, $\Delta Prov\_HP$ is the quarterly change of the two-quarter moving average of the provincial sales price of residential commodity building, and *Stock market stress dummy* equals 1 for the period of Q1 2015 to Q2 2016. ^ denotes that the coefficient is multiplied by -1 to facilitate a more convenient interpretation of the result, as $Y_{i,t}$ is a monotonically decreasing function of default likelihood of firm *i*. The coefficient of profitability is not multiplied by -1 as the variable is an inverted scale of profitability by construction. ***, ** and * denote the estimated coefficient is statistically significant at 1%, 5% and 10% respectively.