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The contribution of (shadow) banks and real estate to systemic risk in China☆

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ABSTRACT

We empirically evaluate how accounting and financial variables affect the level of systemic risk in traditional and shadow banks, and in real estate finance services in China over the period 2006–2019. We also conduct some stability analysis by evaluating the impact of crisis sub-periods. We find that systemic risk increases in the *Size* of large financial institutions, particularly shadow entities, while it is insensitive to the *Size* of real estate finance services. Real estate finance services are instead particularly sensitive to *Maturity Mismatch* and *Leverage*. Finally, systemic risk differs across state and non state owned banks.

1. Introduction

In May 2014, the Chinese President Xi Jinping defines the *"new normal"* of the years ahead of the Chinese economy being characterized by a growth rate shifting from high to medium-high speed, an economic structure moving from an export- and investment-driven model to a consumption-based model, and a development model being an innovation-driven one. Over the last decades, with the opening of its stock market to the outside world, China has become more internationally integrated, and the rapid interconnection between financial institutions has drawn the attention of policy regulators (Dai and Fang, 2014; Hautsch et al., 2014; Fang et al., 2018; Morelli and Vioto, 2020). The International Monetary Fund (2011) emphasizes how China' financial system was facing some major risks including the distortions in capital allocation dictated by the government, the rise of shadow banking, tight control on interest and exchange rates and hidden deficits and unexpected contingent liabilities. Further, the International Monetary Fund (2017) identifies three critical concerns within the Chinese financial system: (i) the rapid build-up in risky credit, partly due to the strong political pressure faced by banks to keep non-viable companies running; (ii) the moral hazard and excessive risk-taking due to the mindset that the government will bail out troubled state-owned enterprises and local government financing vehicles; (iii) the risky lending, which had moved away from banks to the less-regulated parts of the financial system, i.e., the *"shadow banking"*. All these factors motivate the need to assess the systemic risk associated to the Chinese financial system, crucial not only for Asia but also for the stability of the global financial markets.

Despite the growing interest, the concept of systemic risk remains difficult to measure and quantify (Hansen, 2014). The current literature defines systemic risk as *"the risk of experiencing systemic events in the strong sense"* (De Bandt and Hartmann, 2000, p. 11), and *"hard to define but you know it when you see it"* (Benoit et al., 2017, p. 109). Several approaches have been proposed to identify the main mechanisms driving systemic risk. Adrian and Brunnermeier (2016), Acharya

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et al. (2017) focus on measuring tail interdependence between assets market indices, while Diebold and Yilmaz (2009), Billio et al. (2012) evaluate the risk stemming from interconnectedness. Hollo et al. (2012) and the Basel Committee on Banking Supervision (2013) study the multidimensionality of systemic risk by aggregating multiple market indicators to assess the level of stress in the system. An increasing number of models use microstructural approaches where interactions among agents are individually modeled to evaluate the evolution of a financial system and to study the diffusion of financial contagion via multiple channels in reaction to an exogenous initial shock (Allen and Gale, 2000; Gai et al., 2011; Acemoglu et al., 2012; Montagna and Kok, 2016). We refer to a recent paper by Ellis et al. (2021) for a detailed discussion of systemic risk definitions available in the literature.

Recent contributions have focused on systemic risk in the Chinese financial system. Hasan et al. (2015) investigate the Chinese banking structures and their effect on small business development. Fang et al. (2018) constructs a tail risk network to examine the overall systemic risk of Chinese financial institutions, finding that financial institutions' idiosyncratic risk can be affected by its connectedness with other institutions. Wang et al. (2018) investigate the interconnectedness and systemic risk of China' financial institutions by constructing dynamic tail-event driven networks finding that large traditional banks and insurers usually exhibit systemic importance, but some small firms are systemically important due to their high level of incoming (outgoing) connectedness. Huang et al. (2019) examine the Chinese systemic risk by estimating the CoVaR, MES, systemic impact index and the vulnerability index for 16 listed banks over 2007–2014 time period. They find that the time-series results for the CoVaR and MES measures suggest that systemic risk in the Chinese banking system decreased after the global financial crisis but started rising in 2014. Li et al. (2019) examine the firm-level driving factors of the systemic risk in the Chinese banking system and find that the Chinese banks' systemic risk contribution reached the highest level during the stock market crash in 2015. Zhang et al. (2020) find that, after the implementation of the China Banking Regulatory Commission, risk in traditional banks decreased significantly compared to risk in non-bank financial institutions. Morelli and Vioto (2020), analyzing the systemic risk on a sample of banks, insurance, brokerage industries, and real estate in the Chinese financial system over 2010–2016 time period, find that the banking sector contributed the most, followed by real estate and subsequently insurance and brokerage industries. They also show that the systemic risk level reached a major peak during the stock market crash of 2015. Zhang et al. (2021), using a sample of Chinese listed banks, study the impact of bank liquidity creation on systemic risk, finding that excessive liquidity creation increases systemic risk, while Cincinelli et al. (2022) evaluate China's changing financial interconnectedness via Granger-causality analysis. In addition, several papers emphasize the rise of shadow banking products after the fiscal stimulus by Chinese Government. Allen et al. (2021) show that the scale of trust products issued by trust companies began to take off in 2010, with the majority of capital raised going to real estate sectors and local government debt. In addition, Cong et al. (2019) show that, during 2009–2010, stimulus bank credit favored state-owned enterprises, which were less productive than private firms. Cincinelli et al. (2021) report the presence of pro-cyclicality of leverage and systemic risk, and Chen et al. (2020) show that local governments financed investment projects through stimulus bank loans in 2009, and then switched to nonbank, shadow banking debt financing after 2012, when faced with rollover pressure from bank loans coming due.

In this paper, we contribute to this stream of literature by investigating the role played by traditional banks (TBs), shadow banking entities (namely, finance services, FSs) and real estate finance services (REFs) and how their accounting and financial variables relate to systemic risk in the Chinese financial system. We use a sample of 264 financial institutions (43 TBs, 74 FSs and 147 REFs) listed between 2006:1 and 2019:4. In order to gain a better understanding of the overall systemic risk of the Chinese financial system, we also evaluate the impact of the *"Global Financial Crisis"* (2007:1-2009:4), the *"Chinese Monetary Policy Restriction"* (2010:1-2014:4) conducted by the People Bank of China (PBoC) and the *"2015 Chinese Stock Market Crash"* (2015:3-2016:3). As measures of systemic risk, we use the three most central metrics in the systemic risk literature (Zhang et al., 2015; Benoit et al., 2017; Dičpinigaitienė and Novickytė, 2018; Grundke and Tuchscherer, 2019; Ellis et al., 2021): the *ΔCoVaR* of Adrian and Brunnermeier (2016), the Marginal Expected Shortfall (*MES*) of Acharya et al. (2017), and the *SRISK* of Brownlees and Engle (2016). Finally, we evaluate how Non State Owned Banks (NSOBs) respond to the unexpectedly increasing competition from the State Owned Banks (SOBs) after the stimulus plan by Chinese government and during the monetary policy restriction by PBoC. This strategy allows us to link competition between traditional banks and how this competition increased the banking system vulnerability. Our analysis contributes to a better understanding of the relevance of China for the international banking risk. In particular, by considering a broad range of Chinese banks and financial institutions other than banks, we assess the determinants of risk in the Chinese financial system and on the possible transmission channels of Chinese systemic risk to Western countries (Feldkircher and Korhonen, 2014; Qiu and Zhan, 2016).

The main findings in this paper can be summarized as follows. First, systemic risk is particularly pronounced for large financial institutions, confirming that larger financial institutions increase systemic risk. This finding is consistent with López-Espinosa et al. (2012), Adrian and Brunnermeier (2016), Morelli and Vioto (2020), and Bellavite Pellegrini et al. (2022). When we interact the *Size* variable with the regime dummies associated to the global financial crisis and the 2015 Chinese stock market crash, the coefficients become positive and statistically significant for *MES* and *SRISK*. A one standard deviation increase in a large financial institution' size (i) increases its *MES* by 7.37 basis points in a quarter and thus increases its contribution to global financial fragility during the global financial crisis, and (ii) increases the *MES* and the *SRISK* by 7.01 and 1.1, respectively, during the 2015 Chinese stock market crash. During the monetary policy restriction, instead, the systemic risk is unaffected by the *Size* of financial institutions for all measures. However, we show that the size of shadow entities (FSs) has a critical impact on the financial system stability. For *SRISK*, larger shadow entities increase systemic risk much more than traditional banks and real estate finance services, as a clear effect of the rapid and sharp increase of shadow banking activities due to the restrictive banking regulation during the monetary policy contraction put in place by the PBoC (Ehlers et al., 2018). In contrast, we find that large traditional banks decrease systemic risk. A one standard deviation increase in a large traditional bank' size decreases its *ΔCoVaR* and *MES* by 3.58 and 22.19 basis points, respectively, and thus decreases its contribution to systemic risk. This finding confirms how banks, characterized by large capitalization, global activity and cross-border exposures are the target of current regulatory efforts in line with the *too-big-to-fail* policy issue. Systemic risk, instead, is not significantly affected by the size of REFs. However, for these entities what matters most are the *Maturity Mismatch* and *Leverage*. The moderate role of these financial entities, different from traditional banks, in engaging credit transformation activities, mitigates systemic risk. A possible explanation is the excess liquidity pumped by the Chinese Government, after the financial crisis, which pushed up demand for real estate and investment. Systemic risk, instead, increases in the *Leverage* of REFs. This result can be explained by the business model underlying these entities, which rely on levels of leverage higher than in any other sector and has long turnover cycle. In addition, a large share of capital, required by real estate companies, comes from bank loans causing a long-term structural unbalanced financing structure with banks bearing the majority of real estate market risk. Traditional banks and shadow entities are more sensitive to *Market-to-Book Value (MTBV)* ratio, as a proxy of market risk. For TBs, the increase of systemic risk is explained by the expected

Table 1
Variables: Summary statistics.

Description	Variables	Mean	Std. Dev.	Min.	Max.
Chinese Financial System	*ΔCoVaR* (%)	1.474	1.462	−0.321	7.774
	MES (%)	1.486	2.313	−0.992	24.041
	SRISK (mln $)	70,943.15	31,4357.4	−13,691.48	4,502,371.00
	Size (ln)	14.879	2.566	2.890	22.220
	Leverage (%)	2.726	6.235	0.001	48.677
	MTBV (%)	4.078	8.691	−11.473	58.810
	Maturity Mismatch	−0.165	0.561	−2.713	2.075
	Marketable (%)	12.144	15.412	0.089	84.502
Traditional Banks	*ΔCoVaR* (%)	1.679	2.094	−0.090	6.911
	MES (%)	2.900	4.870	−0.510	24.041
	SRISK (mln $)	583,630.8	777,859.5	2,124.732	4,502,371.00
	Size (ln)	18.747	1.405	16.175	22.220
	Leverage (%)	10.160	11.317	0.173	48.677
	MTBV (%)	1.259	0.670	0.390	3.480
	Maturity Mismatch	0.067	0.110	−0.117	0.257
	Marketable (%)	32.318	11.220	11.849	61.673
Shadow Banking Entities (Finance Services)	*ΔCoVaR* (%)	1.078	1.656	−0.020	7.774
	MES (%)	0.412	0.925	−0.992	5.462
	SRISK (mln $)	17,810.60	26,919.69	−10,682.00	260,853.70
	Size (ln)	15.135	1.825	6.683	19.470
	Leverage (%)	2.037	4.182	0.001	26.991
	MTBV (%)	2.115	2.554	−11.473	8.656
	Maturity Mismatch	−0.465	0.916	−2.713	2.075
	Marketable (%)	12.324	17.686	0.089	84.502
Real Estate Finance Services	*ΔCoVaR* (%)	1.624	1.058	−0.321	6.128
	MES (%)	1.613	1.031	−0.317	4.731
	SRISK (mln $)	5,768.032	20,780.14	−13,691.48	538,872.8
	Size (ln)	13.619	1.890	2.890	19.305
	Leverage (%)	0.899	1.957	0.001	13.767
	MTBV (%)	5.891	11.167	−5.630	58.810
	Maturity Mismatch	−0.129	0.453	−1.663	0.453
	Marketable (%)	8.765	12.596	0.089	75.602

The Table reports weekly summary statistics of the three measures of systemic risk (in turn, dependent variable) and quarterly summary statistics for the accounting and financial independent variables for the sample of listed Chinese financial institutions. The dependent variables are: $\Delta CoVaR$, *MES*, and *SRISK*. The independent variables are: $Size(ln)$ is the natural logarithm of total assets; $Leverage$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding); $MTBV$ is the Market To Book Value ratio; $Maturity\ Mismatch$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio; $Marketable$ is the marketable securities to total assets ratio. All variables are computed over the period 1st January 2006 to 31st December 2019, for the (a) Chinese Financial System, (b) Traditional Banks, (c) Shadow Banking Entities (Finance Services), and (d) Real Estate Finance Services, and are winsorized at 1st and 99th percentiles.

market value realignment due to the deleveraging process after the global financial crisis. For the shadow banking entities, instead, it may be explained by the fact that Chinese FSs became more and more linked to the financial markets' dynamics and managing balance sheets aggressively and actively. Another important finding to highlight is that financial institutions are particularly sensitive to *Mktb*. The positive relationship reflects the fire sale of distressed assets during financial turmoil. In particular, a shock to the real economy implies a negative demand shock in financial markets from investors with immediate liquidity needs. Stocks of marketable securities had risen relative to dealer balance sheets, and with market stress, transaction costs in principal trades rose sharply by causing financial instability. Our results suggest that an increase in *Mktb* of one standard deviation over the 2015 Chinese Stock Market Crash, would imply a 3.43 basis points increase in the systemic risk. We also find that a financial institutions' *Leverage* is negatively associated to systemic risk, showing pro-cyclical effect in that leverage falls during stressed market situations and builds up prior to a financial crisis (Fostel and Geanakoplos, 2008). Finally, our analysis focuses on the different role of SOBs vs NSOB, highlighting that SOBs relative to NSOBs are subject to higher additional regulatory capital requirements. We also find that the *Size* of NSOBs contributes more to systemic risk than SOBs, thus confirming that these banks are implicitly guaranteed by Government as they are perceived as "too-big-to-fail (TBTF)" or "too-important-to-fail (TITF)". SOBs also show a negative relationship between *Non Performing Loans* (NPLs) ratio and systemic risk. Their large assets, extensive business networks, and vast customer bases as well, allow them to better assess the creditworthiness of the customer.

Our results are robust to several sensitivity checks, involving alternative state variables for the calculation of the *ΔCoVaR*, and the implementation of the Romano and Wolf (2005) adjusted p-values, to evaluate the relevance of the regressors using alternative measures of systemic risks.

The reminder of the paper is organized as follows. Section 2 presents systemic risk measures used in this paper. Section 3 introduces the methodology, the data and the institution-specific variables used in our analysis. Section 4 presents the main findings. Section 5 reports sensitivity analyses. Section 6 concludes.

2. Systemic risk measures

A large body of literature on systemic risk has been developed over the last two decades, and several approaches to quantify systemic risk associated to financial institution have been proposed (Bisias et al., 2012; De Bandt et al., 2013; Benoit et al., 2017; Silva et al., 2017; Ellis et al., 2021). In this paper, we implement the three most prominent measures, such as the *ΔCoVaR* of Adrian and Brunnermeier (2016), the

Table 2
Systemic risk measures, accounting and financial variables correlation matrix and variance inflation factor.

	ΔCoVaR$_t$	*MES*$_t$	*SRISK*$_t$	Size$_{t-1}$	Leverage$_{t-1}$	MTBV$_{t-1}$	MM$_{t-1}$	Mktb$_{t-1}$
ΔCoVaR$_t$; *MES*$_t$; *SRISK*$_t$	1	1	1					
Size$_{t-1}$	0.1923*	0.2578*	0.4335*	1				
Leverage$_{t-1}$	−0.1426*	−0.0350*	0.0293*	0.4509*	1			
MTBV$_{t-1}$	−0.1227*	−0.0862*	−0.0603*	−0.3012*	−0.1487*	1		
MM$_{t-1}$	0.0866*	0.1392*	0.0643*	0.1544*	0.1269*	−0.0721*	1	
Mktb$_{t-1}$	−0.0152	0.2194*	0.2168*	0.2194*	0.2828*	−0.0196*	0.0796*	1
VIF	**1.21**	**1.21**	**1.21**	**1.43**	**1.32**	**1.14**	**1.11**	**1.03**

The Table reports the correlation matrix of the three measures of systemic risk, *ΔCoVaR*, *MES*, *SRISK* and the financial institutions variables for the sample of Chinese financial system. $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). VIF is the Variance Inflation Factor and it is used to detect collinearity of the regressors. *ΔCoVaR*, *MES*, *SRISK*, and the independent variables are winsorized at 1st and 99th percentiles.
*Denotes the statistical significance at 5% level.

Fig. 1. Shanghai Stock Index.
Shanghai Financial Index over the period 1st January 2006 to 31st December 2019. Dashed lines correspond to three sub-periods of the Global Financial Crisis, the Chinese Monetary Policy Restriction by People Bank of China, and 2015 Chinese Stock Market Crash.

MES of Acharya et al. (2017), and the *SRISK* of Brownlees and Engle (2016), that for convenience we may summarize below.

The CoVaR is an indicator of systemic risk defined as the VaR of the entire financial system conditional on a firm (set of firms), exceeding its (their) firm specific VaR. The VaR is defined by $Prob(X^i \leq VaR_q^i) = q\%$, then the $CoVaR_q^{system|C(X^i)}$ is the VaR of the financial system conditional on some event of institution i, $C(X^i)$, and it is defined by the $q\%$ quantile of the conditional probability distribution:

$$Prob(X^{system|C(X^i)} \leq CoVaR_q^{system|C(X^i)}) = q\% \tag{1}$$

where X^i is the market-valued asset return of institution *i*, and X^{system} is the return of the portfolio, computed as the average of the X^i's weighted by the lagged market value assets of the institutions in the portfolio. Adrian and Brunnermeier (2016) measure the contribution of each single institution to systemic risk by the *ΔCoVaR*, namely the difference between $CoVaR$ conditional on the institution being in distress and *CoVaR* in the median state of the institution. Formally, $\Delta CoVaR_q^i$ measures the contribution to systemic risk of institution i given the choice of quartile q:

$$\Delta CoVaR_q^i = CoVaR_q^i - CoVaR_{50}^i = \hat{\beta}_q^i (VaR_q^i - VaR_{50}^i) \tag{2}$$

where we set q to be the standard 5%, so that $CoVaR^i$ identifies the system losses predicted on the 5% loss of institution *i*, while $\Delta CoVaR^i$ identifies the deterioration in the system losses when the institution i moves from its median state to its 5% worst scenario. Quantile regression analysis (Koenker and Bassett, 1978) is used to estimate the time-varying variables $VaR_{q,t}^i$ and $CoVaR_{q,t}^i$ function of a set of Chinese state variables such as the *Shanghai Composite Index* (the weekly return of the Shanghai stock exchange index), the *Liquidity spread* (the difference between the three-month Chinese repo-rate and the three-month Chinese T-bill), the *T-Bill change* (the change in Chinese treasury bill three-month rate), the *Yield-Curve slope* change in slope of the yield curve represented by Chinese five-year minus three-month interest rate on Chinese government bond, the *5yBond* (the slope of the Chinese five-year government bond); we also incorporate the *VIX*, the volatility index of the Chicago board options exchange, as a measure of market risk and investors' sentiments.

The Marginal Expected Shortfall (*MES*), proposed by Acharya et al. (2017), is defined as the contribution of a financial institution to the Expected Shortfall (*ES*) of the system. The *ES* of the system is defined as the expected value of the market return conditional to the event that the market return is lower than a certain threshold, *C*, with the market return defined as the weighted average of all financial institutions' returns:

$$ES_{m,t}(C) = \mathbb{E}_{t-1}(r_{m,t}|r_{m,t} < C) = \sum_{i=1}^{N} \omega_{i,t} \mathbb{E}_{t-1}(r_{i,t}|r_{m,t} < C) \tag{3}$$

where $r_{m,t} = \sum_{i=1}^{N} \omega_{i,t} r_{i,t}$, and $\omega_{i,t}$ is the market share or capitalization of financial institution i. We set the threshold at the standard 5% level. The contribution of institution i to the System Expected Shortfall (the

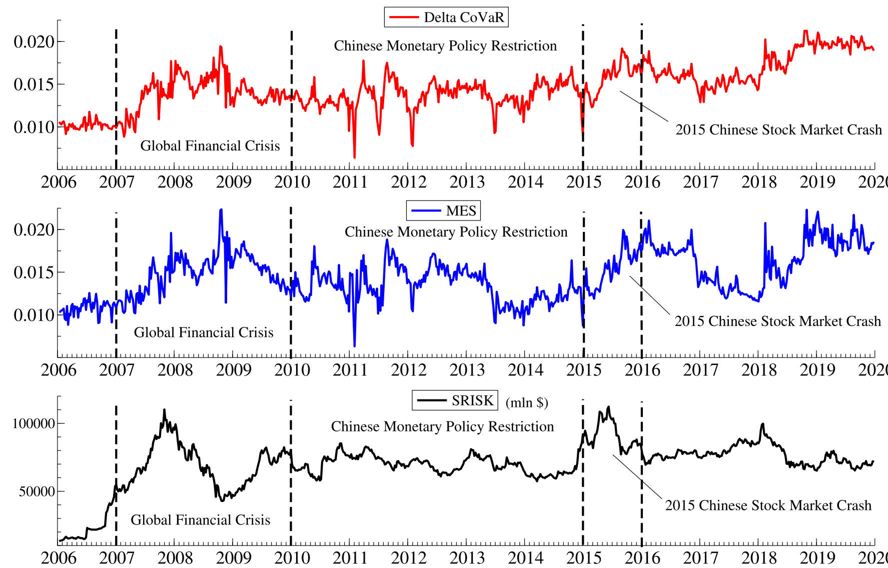

Fig. 2. $\Delta CoVaR$, MES, $SRISK$ - Chinese Financial System.
Note: $\Delta CoVaR, MES, SRISK$ over the period 1st January 2006 to 31st December 2019. Dashed lines correspond to three sub-periods of the Global Financial Crisis, the Chinese Monetary Policy Restriction by People Bank of China, and 2015 Chinese Stock Market Crash.

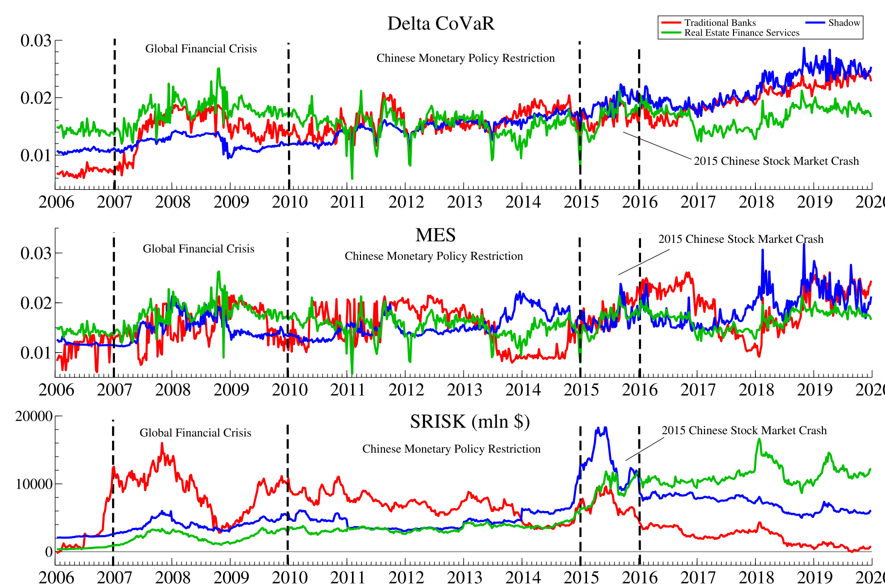

Fig. 3. Systemic Risk Measures - Traditional Banks, Shadow Entities, Real Estate Finance Services.
Note: $\Delta CoVaR, MES, SRISK$ over the period 1st January 2006 to 31st December 2019. Dashed lines correspond to three sub-periods of the Global Financial Crisis, the Chinese Monetary Policy Restriction by People Bank of China, and 2015 Chinese Stock Market Crash.

MES of institution i) is, therefore, defined as the partial derivative of the *ES* with respect to the weight of institution i:

$$MES_{i,t} = \frac{\partial ES_{m,t}(C)}{\partial \omega_{i,t}} = \mathbb{E}_{t-1}(r_{i,t}|r_{m,t} < C) \quad (4)$$

The *SRISK*, proposed by Brownlees and Engle (2016), measures the expected capital shortage faced by a financial institution during a period of system distress when the market declines substantially:

$$SRISK_{i,t} = max[0; \kappa(D_{i,t}) + (1 - LRMES_{i,t}W_{i,t}) - (1 - LRMES_{i,t})W_{i,t}] \quad (5)$$

where κ is the minimum fraction of capital as a ratio of total assets that each financial institution needs to hold (κ is set equal to the prudential capital ratio of 8%); $D_{i,t}$ and $W_{i,t}$ are the book value of its debt (total liabilities) and the market value of its equity, respectively; $LRMES$ is the Long-Run Marginal Expected Shortfall, i.e. the *MES* on a six-months horizon. We compute the $LRMES$ via the non-simulation method to estimate the expected fractional loss of the financial intermediary in a crisis when the Market Composite Indexes decline significantly in a six-months period. The empirical counterpart of (5) is :

$$\begin{aligned} SRISK_{i,t} = & max[0; (\kappa L_{i,t} - 1 + (1-\kappa)LRMES_{i,t})W_{i,t}], \\ & W_{i,t}[\kappa L_{i,t} + (1-\kappa)LRMES_{i,t} - 1] \end{aligned} \quad (6)$$

where $LRMES_{i,t} = 1 - exp(log(1-d) * MES_{i,t})$ with d indicating the six-month crisis threshold for the market index decline with its default value set at 40%, and $L_{i,t} = (D_{i,t} + W_{i,t})/W_{i,t}$ is the leverage ratio.

3. Data

Our empirical analysis focuses on a panel of 264 Chinese listed financial institutions over the period 2006:1-2019:4. Our dataset contains 43 TBs, 74 FSs, and 147 REFs and in Appendix A we provide a full

Table 3
Determinants of systemic risk — Baseline model and marginal effects for the Chinese financial system.

Variables	ΔCoVaR			MES			SRISK		
	[i]	[ii]	[iii]	[i]	[ii]	[iii]	[i]	[ii]	[iii]
$\Delta CoVaR_{i,t-1}$	0.6555***	0.6738***	0.6461***						
	(0.0473)	(0.0422)	(0.0439)						
$VaR_{i,t-1}$	0.0113	0.0082	−0.0021						
	(0.0086)	(0.0078)	(0.0078)						
$Size_{i,t-1}$	0.0012	0.0016	0.0031**	0.0061	0.0018	−0.0057	0.0029***	0.0014**	−0.0018
	(0.0015)	(0.0013)	(0.0013)	(0.0048)	(0.0038)	(0.0038)	(0.0009)	(0.0007)	(0.0014)
$Leverage_{i,t-1}$	−0.0016***	−0.0012**	−0.0004	−0.0059**	−0.0060**	−0.0036*	−0.0007	−0.0009	0.0000
	(0.0004)	(0.0004)	(0.0004)	(0.0026)	(0.0027)	(0.0022)	(0.0008)	(0.0009)	(0.0007)
$MTBV_{i,t-1}$	0.0000	0.0000	−0.0001	0.0001	−0.0002	−0.0005	0.0001	0.0000	−0.0003**
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0001)	(0.0001)	(0.0002)
$MM_{i,t-1}$	−0.0058*	−0.0037	−0.0004	−0.0029	−0.0007	0.0105	−0.0004	0.0008	0.001
	(0.0031)	(0.0029)	(0.0021)	(0.0073)	(0.0066)	(0.0065)	(0.0008)	(0.0006)	(0.0008)
$Mktb_{i,t-1}$	0.0202**	0.0221**	0.0063	0.0012	−0.0107	−0.0757	0.0031	0.0000	−0.0071
	(0.0087)	(0.0091)	(0.0070)	(0.0368)	(0.0374)	(0.0628)	(0.0056)	(0.0059)	(0.0092)
Regime 1 (GFC)		0.0261***	−0.0429		0.0702***	−0.3387***		0.0059	−0.0642*
		(0.0042)	(0.0281)		(0.0119)	(0.0871)		(0.0036)	(0.0372)
Regime 2 (CMPR)		0.0003	−0.0102		−0.0019	−0.0176		0.0021	−0.0623
		(0.0021)	(0.0136)		(0.0058)	(0.0462)		(0.0030)	(0.0388)
Regime 3 (CSMC)		0.0037	0.0305**		0.0483***	−0.3920***		0.0016	−0.0615**
		(0.0030)	(0.0137)		(0.0088)	(0.1077)		(0.0017)	(0.0213)
	Marginal Effects for Global Financial Crisis (Regime 1)								
$Size_{i,t-1}$			−0.0013			0.0288***			0.0039
			(0.0029)			(0.0064)			(0.0028)
$Leverage_{i,t-1}$			0.0003			−0.0028			0.0032*
			(0.0005)			(0.0030)			(0.0019)
$MTBV_{i,t-1}$			0.0000			0.0008			−0.0001
			(0.0005)			(0.0008)			(0.0003)
$MM_{i,t-1}$			0.0012			−0.0031			0.0005
			(0.0088)			(0.0131)			(0.0020)
$Mktb_{i,t-1}$			0.0317			0.2351**			0.0296*
			(0.0209)			(0.1112)			(0.0170)
	Marginal Effects for Chinese Monetary Policy Restriction (Regime 2)								
$Size_{i,t-1}$			−0.0018			0.0002			0.0041
			(0.0013)			(0.0034)			(0.0027)
$Leverage_{i,t-1}$			0.0004			0.0009			0.0004
			(0.0003)			(0.0019)			(0.0005)
$MTBV_{i,t-1}$			−0.0001			0.0003			0.0005*
			(0.0002)			(0.0007)			(0.0003)
$MM_{i,t-1}$			−0.0120**			−0.0205			−0.0012
			(0.0053)			(0.0131)			(0.0020)
$Mktb_{i,t-1}$			0.0138*			−0.001			0.008
			(0.0082)			(0.0455)			(0.0099)
	Marginal Effects for the 2015 Chinese Stock Market Crash (Regime 3)								
$Size_{i,t-1}$			−0.0007			0.0274***			0.0042**
			(0.0014)			(0.0073)			(0.0015)
$Leverage_{i,t-1}$			−0.0006			−0.003			−0.0007**
			(0.0004)			(0.0022)			(0.0002)
$MTBV_{i,t-1}$			0.0000			0.0021**			0.0004**
			(0.0002)			(0.0007)			(0.0001)
$MM_{i,t-1}$			0.0037			−0.0018			−0.001
			(0.0029)			(0.0101)			(0.0010)
$Mktb_{i,t-1}$			−0.0161			0.2228***			0.0130**
			(0.0106)			(0.0664)			(0.0060)
Constant	0.0495*	0.0486	0.0506*	0.2026**	0.2418***	0.3601***	0.0313**	0.0395**	0.0870***
	(0.0295)	(0.0297)	(0.0302)	(0.0644)	(0.0597)	(0.0594)	(0.0119)	(0.0120)	(0.0213)

(*continued on next page*)

description of the entities. The data source is *Refinitiv database*, with the list of entities reported in Appendix B.

ΔCoVaR, *MES*, and *SRISK* are the dependent variables function of a set of accounting and financial variables, constructed from the balance sheets of all the financial institutions belonging to our sample. In particular, $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the leverage ratio defined as the market value of bank assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*), able to capture both opportunity to growth and systemic risk due to potential asset pricing misalignment; $MM_{i,t-1}$ is the Maturity Mismatch ratio which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). This is a proxy for the proportion of financial instruments that account for fair value.

3.1. Summary statistics

Table 1 reports the summary statistics for the three measures of systemic risk and for the financial institutions characteristics used in our regression analysis.

Table 3 (*continued*).

Variables	ΔCoVaR			MES			SRISK		
	[i]	[ii]	[iii]	[i]	[ii]	[iii]	[i]	[ii]	[iii]
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	No	No	Yes	No	No	Yes	No	No
Dummy Regimes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
N. Obs.	10,355	10,355	10,185	10,355	10,355	10,185	10,355	10,355	10,185
R^2 *Adjusted*	0.42	0.41	0.46	0.04	0.02	0.04	0.01	0.06	0.09
F-Test	84.11***	108.73***	180.13***	10.13***	11.77***	11.37***	2.43***	2.28***	2.34***

The Table reports regressions using alternative specifications. The dependent variables are *ΔCoVaR*, *MES* and *SRISK*. $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). *GFC* captures the Global Financial Crisis over the period 2007:1–2009:4; *CMPR* captures the Chinese Monetary Policy Restriction conducted by the PBoC over the period 2010:1–2014:4; *CSMC* captures the 2015 Chinese Stock Market Crash over the period 2015:3–2016:3. [i] is the benchmark specification using accounting and financial variables and time dummies. [ii] includes accounting and financial variables and replaces time dummies with the three regimes. [iii] includes accounting and financial variables, time dummies and the interaction of explanatory variables with the three regime dummies. Standard errors are reported in parentheses. The coefficients of the marginal effects for GFC, CMPR, and CSMC for *ΔCoVaR* and *VaR95* are included in the equation but not reported in the table. Sample period: 2006:1–2019:4.

*Denote the 10% significance level.

**Denote the 5% significance level.

***Denote the 1% significance level.

We estimate the individual institutions systemic risk measures over the period January 2006–December 2019. Financial institutions' stock prices and characteristics, and state variables are taken from *Refinitiv* database. In our empirical analysis, we take the positive value of *ΔCoVaR* and *MES*. We find that *ΔCoVaR* ranges from a low of −0.321% to a high of 7.74%, *MES* ranges from a low of −0.992% to a high of 24.041%, and the *SRISK* ranges from a low of −13,691.48 (mln$) to a high of 4,502,371 (mln$). For all the systemic risk measures, on average, traditional banks show a higher systemic risk in comparison to shadow entities and real estate finance services. To control for outliers, we winsorized each systemic risk measure *ΔCoVaR*, *MES* and *SRISK* at 1st and 99th percentiles.

Regarding financial institutions characteristics, we find that traditional banks have the higher *Size* and *Leverage* rather than shadow entities and real estate finance services. In relation to *MTBV* ratio, the average is higher for real estate finance services and shadow entities, being respectively 5.89% and 2.11%. Traditional banks, instead, show a lower *MTBV* (1.25%), slightly greater than one, and a lower volatility coefficient (0.67%) in comparison to the other financial institutions. If we focus on *Maturity Mismatch* (*MM*), there is evidence of a relevant difference between all entities. Traditional banks show a positive value (6.7%) in contrast to shadow entities and real estate finance services, being −46.5% and −12.9% respectively. Moreover, in contrast to other financial entities, traditional banks are characterized by a greater share (32.32% over the total assets) of *Mktb*, marketable securities.

Table 2 reports the correlation matrix between the variables. The correlations do not show any extremely high value. The possibility of multicollinearity among the explanatory variables is also tested using the Variance Inflation Factors (VIFs). The maximum VIF that results from any of the models is 1.43, which is far below the generally employed cut-off of 10 and the average value of the model is not considerably larger than 1 (Chatterjee and Hadi, 2015). The average value is below 2 in all models. Therefore, the results show that multicollinearity is not matter of concern in our applications.

Fig. 1 shows the fluctuations in the Shanghai composite index over the period from 1st January 2006 to 31st December 2019, with dashed lines corresponding to three periods: the global financial crisis (2007:1-2009:4), the Chinese monetary policy restriction (2010:1-2014:4), and the 2015 Chinese stock market crash (2015:3:-2016:3). From July 2008 to January 2009, the Chinese export falls by 18%, imports by more than 40% and foreign direct investment by 30%. The stock crash, that took place in 2008, triggered the process for the Chinese government financial stability mechanism with macroprudential approaches. The Shanghai composite index dropped from 5,362.7 to 1,806.9 points over 2007:4-2008:4, and further dropped by 29% on 2015:3, when the renminbi suffered a 1.6% and 12% depreciation in relation to US Dollar and Euro exchange rate, respectively.

Moreover, at the end of 2009 till the end of 2015, the PBoC began to tighten the M2 supply for fear of an overblown bank credit expansion as a consequence of the 2008 financial crisis. Banks became more vulnerable to unexpected deposit withdrawals, which exposed banks to the risk of violating the loan-to-deposit ratio.

We also consider a third sub-period, covering the period between mid-June 2015 turning point when Chinese stock market collapses, losing over 34% in 20 days. Subsequently, on the 15 July the Chinese government adopts a series of supportive measures to restrict high frequency program trading in the stock index futures market (Han and Liang, 2017; Chen and Gong, 2019).

Fig. 2 shows the fluctuations of the three measures of systemic risk. As expected, well identified episodes of financial distress, such as the Global Financial Crisis and the second stock crash, are associated with an increase in systemic risk.

Fig. 3 reports the values of the three measures of systemic risk calculated separately for traditional banks, shadow entities and real estate finance services. Systemic events which took place since September 2008 (e.g., the collapse of Lehman Brothers and the rescue of AIG) show a relevant impact also on the Chinese real economy. The distress of several financial institutions determined distress to the full financial system. Moreover, the contribution to systemic risk by all financial intermediaries was low during the monetary policy restriction conducted by the PBoC from 2010 to 2015. After that, we observe a lower contribution to systemic risk by traditional banks in contrast to shadow entities and real estate finance services.

4. Empirical results

We now report the results of our regression analysis where systemic risk measures *ΔCoVaR*, *MES* and *SRISK* are in turn estimated as a function of financial institutions characteristics. In order to match the time frequency of the corporate variables (available quarterly), the weekly estimates of *ΔCoVaR*, *MES* and *SRISK* are aggregated (summed) by

Table 4
Determinants of systemic risk — Baseline model and marginal effects for TBs, FSs and REFs.

Variables	ΔCoVaR	MES	SRISK	ΔCoVaR	MES	SRISK	ΔCoVaR	MES	SRISK
	[i]	[ii]	[iii]	[i]	[ii]	[iii]	[i]	[ii]	[iii]
$ΔCoVaR_{i,t-1}$	0.7643***			0.7868***			0.6436***		
	(0.0513)			(0.0410)			(0.0645)		
$VaR_{i,t-1}$	0.0066			−0.0051			0.0306		
	(0.0077)			(0.0037)			(0.0234)		
$Size_{i,t-1}$	0.0013	0.0019	0.0015**	0.0002	−0.0007	0.0009	0.0018	−0.0078	−0.001
	(0.0013)	(0.0036)	(0.0006)	(0.0014)	(0.0030)	(0.0009)	(0.0031)	(0.0141)	(0.0025)
$Leverage_{i,t-1}$	−0.0002	−0.0009	0.0002	−0.0011**	−0.0088**	−0.0014	−0.0010**	−0.0084**	−0.0014
	(0.0005)	(0.0013)	(0.0002)	(0.0005)	(0.0033)	(0.0010)	(0.0005)	(0.0036)	(0.0011)
$MTBV_{i,t-1}$	0.0000	−0.0002	0.0000	−0.0001	−0.0003	0.0000	0.0006	0.0022	0.0007
	(0.0001)	(0.0002)	0.00	(0.0001)	(0.0002)	0.00	(0.0016)	(0.0028)	(0.0007)
$MM_{i,t-1}$	−0.003	0.0002	0.0004	−0.0013	−0.003	0.0013	−0.0035	0.0031	0.0013
	(0.0028)	(0.0067)	(0.0003)	(0.0023)	(0.0044)	(0.0012)	(0.0042)	(0.0090)	(0.0011)
$Mktb_{i,t-1}$	0.0229**	0.0151	0.003	0.017	−0.0169	−0.0001	0.0081	−0.1847	−0.0123
	(0.0087)	(0.0172)	(0.0019)	(0.0106)	(0.0418)	(0.0068)	(0.0183)	(0.1518)	(0.0255)
Regime 1 (GFC)	0.0204***	0.0498***	0.0024	0.0227***	0.0675***	0.0058	0.0233***	0.0713***	0.0067*
	(0.0040)	(0.0089)	(0.0026)	(0.0041)	(0.0116)	(0.0036)	(0.0041)	(0.0123)	(0.0038)
Regime 2 (CMPR)	−0.0006	−0.0088	0.0017	−0.0004	−0.0009	0.0024	0.0003	−0.0011	0.0025
	(0.0021)	(0.0065)	(0.0027)	(0.0017)	(0.0056)	(0.0031)	(0.0017)	(0.0060)	(0.0030)
Regime 3 (CSMC)	0.0014	0.0532***	0.0031**	0.0021	0.0528***	0.0030*	0.0017	0.0526***	0.0028*
	(0.0031)	(0.0096)	(0.0014)	(0.0026)	(0.0093)	(0.0015)	(0.0024)	(0.0091)	(0.0015)
	Marginal Effects for Traditional Banks			**Marginal Effects for Shadow Entities**			**Marginal Effects for Real Estate Finance Services**		
$Size_{i,t-1}$	−0.0255**	−0.1580**	−0.0475	0.0043	0.0123	0.0019**	−0.0004	0.0142	0.0033
	(0.0080)	(0.0667)	(0.0398)	(0.0036)	(0.0113)	(0.0009)	(0.0033)	(0.0143)	(0.0029)
$Leverage_{i,t-1}$	−0.0008	0.0083	−0.0003	0.0004	0.0066**	0.0015**	0.0001	0.003	0.0011*
	(0.0010)	(0.0057)	(0.0023)	(0.0011)	(0.0027)	(0.0007)	(0.0005)	(0.0024)	(0.0007)
$MTBV_{i,t-1}$	0.0079	0.1813**	0.0244	0.0007	0.0016	0.0001*	−0.0007	−0.0027	−0.0008
	(0.0108)	(0.0744)	(0.0519)	(0.0012)	(0.0031)	(0.0001)	(0.0017)	(0.0030)	(0.0008)
$MM_{i,t-1}$	0.0454	−0.1963	0.2335	−0.0043	0.0049	−0.0005	−0.0002	−0.0067	−0.0011*
	(0.0358)	(0.3168)	(0.1492)	(0.0046)	(0.0094)	(0.0012)	(0.0023)	(0.0046)	(0.0006)
$Mktb_{i,t-1}$	−0.0032	−0.3482	−0.0021	0.0166	0.0061	0.0000	0.0129	0.2041	0.0151
	(0.0388)	(0.3030)	(0.0598)	(0.0211)	(0.0528)	(0.0075)	(0.0211)	(0.1462)	(0.0241)
Constant	0.0913**	0.5596***	0.133	0.0450*	0.2521***	0.0422**	0.0366	0.2508**	0.0418**
	(0.0332)	(0.1544)	(0.0952)	(0.0236)	(0.0507)	(0.0134)	(0.0265)	(0.0778)	(0.0150)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dummy Regimes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. Obs.	10,210	10,210	10,210	10,210	10,210	10,210	10,210	10,210	10,210
R^2 *Adjusted*	0.44	0.06	0.12	0.45	0.03	0.01	0.44	0.03	0.02
F-Test	116.22***	9.51***	4.96***	115.55***	7.71***	7.08***	125.91***	8.61***	2.39***

The Table reports regressions using alternative specifications. The dependent variables are *ΔCoVaR*, *MES* and *SRISK*. $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). *GFC* captures the Global Financial Crisis over the period 2007:1–2009:4; *CMPR* captures the Chinese Monetary Policy Restriction conducted by the PBoC over the period 2010:1–2014:4; *CSMC* captures the 2015 Chinese Stock Market Crash over the period 2015:3–2016:3. [i, ii, iii] are the benchmark specifications using accounting and financial variables and the three regimes. The coefficients of the marginal effects for TBs, FSs, and REFs for *ΔCoVaR* and *VaR95* are included in the equation but not reported in the table. Standard errors are reported in parentheses. Sample period: 2006:1–2019:4.
*Denote the 10% significance level.
**Denote the 5% significance level.
***Denote the 1% significance level.

quarter (as in López-Espinosa et al. (2012); Adrian and Brunnermeier (2016). Our general unrestricted regression model with fixed effects is:

$$\begin{aligned} ΔCoVaR_{i,t} =& \beta_0 + \beta_1 ΔCoVaR_{i,t-1} + \beta_2 VaR_{i,t-1} \\ &+ \beta_3 Size_{i,t-1} + \beta_4 Leverage_{i,t-1} + \\ &+ \beta_5 MTBV_{i,t-1} + \beta_6 MM_{i,t-1} + \beta_7 Mktb_{i,t-1} + \\ &+ \sum_{i=1}^{264} Financial\ Institutions_i \\ &+ [\sum_{t=2006:1}^{2019:4} Time_t]\ or\ [\sum_{t=1}^{3} Regimes_t] + \varepsilon_{i,t} \end{aligned} \tag{7}$$

Eq. (7) can be rewritten to allow as dependent variable the other two systemic risk indicators, namely $SRIS_{i,t}$ (in turn $MES_{i,t}$ and $SRISK_{i,t}$):

$$\begin{aligned} SRIS_{i,t} =& \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 Leverage_{i,t-1} \\ &+ \beta_3 MTBV_{i,t-1} + \beta_4 MM_{i,t-1} + \\ &+ \beta_5 Mktb_{i,t-1} + \sum_{i=1}^{264} Financial\ Institutions_i + \\ &+ [\sum_{t=2006:1}^{2019:4} Time_t]\ or\ [\sum_{t=1}^{3} Regimes_t] + \varepsilon_{i,t} \end{aligned} \tag{8}$$

where *Financial Institutions* is a set of dummies capturing fixed effects for each financial institution (i.e., traditional banks, shadow entities (finance services) and real estate finance services); *Time* is a set of dummies capturing fixed effects for each quarter; *Regimes* is a set of dummy variables (replacing *Time* in some specifications), capturing the effects for the three sub-periods identified in our analysis, namely Global Financial Crisis (GFC) over the period 2007:1-2009:4 (Regime 1); the Chinese Monetary Policy Restriction (CMPR) conducted by the PBoC over the period 2010:1-2014:4 (Regime 2); the 2015 Chinese

Table 5
Ownership of the five largest Chinese Traditional Banks (in % of total, 2019).

Banks	MoF	Central Huijin	Total
Agricultural Bank of China	39.21	40.03	79.24
Bank of China	0.00	64.02	64.02
Bank of Communications	26.53	0.00	26.53
China Construction Bank	0.00	57.03	57.03
Industrial and Commercial Bank of China	34.6	34.71	69.31

The Table reports the total outstanding shares held by the Ministry of Finance (MoF) and by the Central Huijin at the end of 2019.

Stock Market Crash (CSMC) over the period 2015:3-2016:3 (Regime 3); with the pre-crisis and the post stock crash as our reference cases.

Moreover, we identify the marginal effect of each explanatory variable during the sub-periods considered, by introducing a dummy variable for the GFC, CMPR and CSMC sub-periods, and interacting it with each accounting and financial variable in the model. We also identify the marginal effect of each variable for each kind of financial institution introducing a dummy for traditional banks, shadow entities and real estate finance services to be interacted with all accounting and financial variables. Therefore, first we repeat our analysis by disentangling the marginal effects for traditional banks, shadow entities, and real estate finance services. Then, we introduce a dummy for each type of financial intermediary to be interacted with all financial institutions characteristics. The dummy is split into traditional banks (a dummy variable equal to 1 for traditional banks, and 0 for other entities), shadow banking entities (a dummy variable equal to 1 for shadow entities, and 0 for other entities) and REFs (a dummy variable equal to 1 for REFs and 0 for other entities).

Given that our estimate of *ΔCoVaR*, *MES* and *SRISK* refer to the whole financial system, comprising traditional banks, shadow entities (finance services) and real estate finance services, in the next section we disentangle the effects for each of them allows us to identify how strong is the impact of each group of entities on systemic risk.

4.1. Systemic risk of the Chinese financial system

In Table 3, we report our first set of results according to the following specifications: [i] is the benchmark specification using financial institutions characteristics variables and time dummies; [ii] includes financial institutions characteristics and replaces time dummies with the three regimes; [iii] includes financial institutions characteristics and the interaction of explanatory variables with the three regime dummies. Note that $\Delta CoVaR$, *MES* and *SRISK* are positive and therefore in all tables positive coefficients indicate increases of systemic risk, and vice versa.

There is clear evidence that *Size* is positively and significantly associated with systemic risk (in Table 3, specification [iii] when the dependent variable is *ΔCoVaR* and specifications [i] and [ii], when the dependent variable is *SRISK*), confirming that larger financial institutions increase systemic risk, and consistent with López-Espinosa et al. (2012), Adrian and Brunnermeier (2016), and Morelli and Vioto (2020). These findings are also in line with the results reported in Financial Stability Board (2021), in which Acharya, in presenting the evolution of SRISK, shows that the level of systemic risk in the Chinese financial have consistently increased since 2007. Similar results are also found by Fang et al. (2018), Yu et al. (2018), and Zhang et al. (2020). In particular, Furukawa et al. (2021) compare emerging markets and advanced economies during 2000–2019 time period and find that the former are characterized by a higher level of systemic risk, reflecting the growing presence of emerging markets' financial institutions in the global financial system. Emerging markets are more exposed to larger shock due to their less diversified economy, less domestic and political stability. In addition, (positive and negative) shocks are exacerbated because of structural and financial institution characteristics (Claessens and Ghosh, 2013).

In specification [iii] (for both *MES* and *SRISK*), when we interact the dummy regimes with the *Size* variable, the coefficients associated to the GFC and CSMC regimes become positive and statistically significant. This result suggests that larger financial institutions positively contributed to systemic risk during the 2008 global financial crisis and over the 2015 Chinese stock market crash. Our findings suggest that an increase in log of asset size of one standard deviation (2.56 in Table 1 for the entire financial system) and the coefficient in specification [iii] of 0.0288, for *MES* over the GFC, would imply a 7.37 basis points increase in the *MES* or (equivalently) an increase in systemic risk. In addition, we find that over the Regime 3 an increase in log of asset size of one standard deviation would imply a 7.01 and 1.1 basis points increase in the *MES* and *SRISK*, respectively, or (equivalently) an increase in systemic risk. However, over the CMPR Regime, the systemic risk is not affected in a significant way by the *Size* of financial institutions.

We now focus on the relation between *Leverage* and systemic risk, reported in the specifications [i], [ii] for *ΔCoVaR*, and [i], [ii], and [iii] for *MES*. There is strong statistical evidence that systemic risk decreases significantly in the leverage of financial institutions. In particular, we notice that *Leverage* decreases systemic risk over the second stock crash. These findings are in line with Fostel and Geanakoplos (2008), showing that leverage falls during stressed market situations and builds up prior to a financial crisis. Another explanation is that regulatory interventions may explain the negative impact of the *Leverage* variable on the systemic risk (Baker and Wurgler, 2015) and thus its contribution in decreasing the systemic risk.

We also find that financial institutions are sensitive to *MTBV* variable in particular during the global financial crisis and the second stock crash periods. A possible explanation is related to the potential asset pricing misalignment, generated by the financial institutions, which may cause both opportunity to growth and systemic risk.

The *MM* variable shows a negative relationship with systemic risk, particularly during the monetary policy restriction period. A possible explanation is that financial institutions with a greater maturity mismatch between assets and liabilities become less vulnerable to liquidity risk. The possibility of fire sales becomes less likely and the risk externalities to other intermediaries holding the same asset classes decreases (López-Espinosa et al., 2012). This feature seems to prevail during the monetary policy restriction conducted by the PBoC.

The *Mktb* variable, which captures the proportion of financial instruments at fair value, increases systemic risk (specification [iii] when the dependent variables are *MES* and *SRISK*). The positive relationship reflects the fire sale of distressed assets during financial turmoil. In particular, the shock to the real economy implied a negative demand shock in financial markets from investors with immediate liquidity needs. Stocks of marketable securities had risen relative to dealer balance sheets, so with market stress, transaction costs in principal trades (customer trades against dealer inventory) rose sharply by causing financial instability. Our results suggest that an increase in *Mktb* of one standard deviation (15.41 in Table 1 for the entire financial system) and the coefficient in specification [iii] of 0.222, for *MES* over the CSMC, would imply a 3.43 basis points increase in the *MES* or (equivalently) an increase in systemic risk.

4.2. Systemic risk: TBs, FSs and REFs

Specifications [i], [ii] and [iii] in Table 4 are the results by considering the traditional banks, shadow entities (i.e. finance services) and real estate finance services separately. A new evidence is the *Size* of the shadow entities. In specification [iii] (when the dependent variable is *SRISK*), larger shadow entities (FSs) increase systemic risk much more than traditional banks and real estate finance services. This evidence explains the effect of a rapid and sharp increase of shadow banking activities due to the restrictive banking regulation during the contractionary monetary policy put in place by the PBoC (Ehlers et al., 2018). On the one hand, this result reflects the capacity of the

Table 6
Determinants of systemic risk — Baseline model and marginal effects for NSOBs.

Variables	ΔCoVaR	MES	SRISK	**Marginal Effects for Non State Owned Banks**		
	[i]	[ii]	[iii]	[i]	[ii]	[iii]
$\Delta CoVaR_{i,t-1}$	0.4663***			−0.0228		
	(0.0479)			(0.0490)		
$VaR_{i,t-1}$	−0.0049			−0.0188		
	(0.0220)			(0.0158)		
$Size_{i,t-1}$	−0.0195	−1.0354**	−0.0019	0.0534*	0.5297*	0.0178
	(0.0432)	(0.4216)	(0.0313)	(0.0312)	(0.2902)	(0.0230)
$Leverage_{i,t-1}$	0.0008	0.0144	0.0009**	−0.0016	−0.0073	−0.0008**
	(0.0019)	(0.0105)	(0.0004)	(0.0021)	(0.0076)	(0.0004)
$MTBV_{i,t-1}$	0.0073	−0.0936**	−0.0010	0.0116	0.0283	−0.0002
	(0.0064)	(0.0428)	(0.0012)	(0.0086)	(0.0446)	(0.0021)
$MM_{i,t-1}$	0.1154	0.3800	−0.0145	−0.0180	−0.5825*	0.0402
	(0.0709)	(0.3333)	(0.0195)	(0.0934)	(0.3445)	(0.0257)
$Mktb_{i,t-1}$	0.0727*	0.1931	0.003	−0.1504**	−0.1424	−0.0061
	(0.0401)	(0.3082)	(0.0073)	(0.0554)	(0.3664)	(0.0077)
$NPLs_{i,t-1}$	−2.7160*	−9.5722	1.5407	2.7620*	9.2636	−1.5407
	(1.5353)	(9.2807)	(0.9312)	(1.5340)	(9.2789)	(0.9313)
$CAR_{i,t-1}$	0.5077	5.2245	−0.6923**	−0.2354	−1.29	0.6886**
	(0.8125)	(6.1371)	(0.2551)	(0.8629)	(6.3029)	(0.2596)
Constant	−0.1665	12.2066**	−0.1081			
	(0.4299)	(4.0067)	(0.2791)			
Fixed Effects	Yes	Yes	Yes			
Time Fixed Effects	Yes	Yes	Yes			
N. Obs.	1,090	1,090	1,090			
R^2 *Adjusted*	0.56	0.30	0.69			
F-Test	23,498.48***	778.35***	6,749.37***			

The Table reports regressions using alternative specifications. The dependent variables are *ΔCoVaR*, *MES* and *SRISK*. $Size_{i,t-1}$ is the total assets of bank *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of bank assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of bank *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of bank *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch as the total short-term debt minus cash to total liabilities ratio of bank *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of bank *i* at quarter (*t-1*); $NPLs_{i,t-1}$: the *Non Performing Loans* ratio as the ratio between net non performing loans and total net outstanding loans for bank *i* at quarter $(t-1)$; and $CAR_{i,t-1}$: the *Capital Adequacy Requirement* as the ratio between TIER 1 and 2 capital over Risk Weighted Assets for bank *i* at quarter $(t-1)$; *Fixed Effects* is a set of dummies capturing fixed effects for each traditional bank, both SOBs and NSOBs; *Time fixed effects* is a set of dummies capturing fixed effects for each quarter. Standard errors are reported in parentheses. Sample period: 2006:1–2019:4.
*Denote the 10% significance level.
**Denote the 5% significance level.
***Denote the 1% significance level.

shadow banking system to operate on a large scale. On the other hand, according to the International Monetary Fund (2014), shadow banking tends to flourish in presence of tight bank regulations, large amount of liquidity, low real interest rates and yields spreads, investors who are looking for higher returns, and when there is a considerable demand for assets coming from insurance companies and pension funds. Moreover, the importance of the growth in shadow banking size also depends on the growth of institutional investors such as insurance companies and pension funds which possibly reflect the demand for these shadow banking services (International Monetary Fund, 2014).

As far as REFs are concerned, there is no evidence of any impact of size on systemic risk. Instead, we find that large traditional banks decrease systemic risk. Our results suggest that an increase in log of asset size of one standard deviation (1.41 in Table 1 for the traditional banks) and the coefficient in specifications [i] and [ii], would imply a 3.58 and 22.19 basis points decrease in the *ΔCoVaR* and *MES*, respectively, or (equivalently) a decrease in systemic risk. These findings are in line with the "too-big-to-fail" or "too-important-to-fail" long-standing policy issues that have been emphasized by the financial crisis, where the failure of a large financial institutions may cause severe consequences on the financial system as a whole.

We also find that *Leverage*, for shadow banking entities (see specifications [ii] and [iii]) and for real estate finance services (see specification [iii]), increases the systemic risk much more than traditional banks. On the one hand, shadow entities (in particular FSs), in trading securities on their own account or on behalf of customers, have a level of leverage which may represent a source of financial instability. On the other hand, the real estate developers' business model relies on a higher levels with respect to other industries (e.g., the finance services sector), and has long turnover cycle. Moreover, a large share of capital, required by real estate companies, comes from bank loans causing a long-term structural unbalanced financing structure with banks bearing the majority of real estate market risk. Two main reasons explain this situation. First, real estate developers have insufficient funds of their own. Second, although the development of China' capital market has opened financing channels for real estate companies (e.g., issuance of shares, bonds, trust financing), these channels are subject to many restrictions (He, 2016).

As regarding the *MTBV* ratio, traditional banks and shadow entities show a positive and statistically significant relationship with *MES* (specification [ii] for TBs) and with *SRISK* (specification [iii] for FSs). As regards TBs, on the one hand, the increase on systemic risk captures the expected market value realignment due to the deleveraging process after the monetary policy restriction. One possible explanation is that to counter the funding and capital-related pressures, banks may be expected to reduce assets in order to improve their capital or liquidity positions, or both. These measures are, however, typically comparatively costly and difficult to implement within a short time span, especially in periods of distress, causing asset pricing misalignment and thus increasing systemic risk (European Central Bank, 2012). On the other hand, regarding the shadow banking entities (specification [iii] when the dependent variable is *SRISK*), one possible explanation is that Chinese FSs became more and more related to the financial markets' dynamics and that they manage balance sheets aggressively and actively. This behavior particularly reflects the composition of FSs balance sheets: the asset side is largely composed of risky assets (such as

Table 7
Determinants of systemic risk — Baseline model and marginal effects for the Chinese Financial System.

Variables	ΔCoVaR	ΔCoVaR with S&P 500	ΔCoVaR with Wilshire 5000	ΔCoVaR	ΔCoVaR with S&P 500	ΔCoVaR with Wilshire 5000	ΔCoVaR	ΔCoVaR with S&P 500	ΔCoVaR with Wilshire 5000
	[i]	[ii]	[iii]	[iv]	[v]	[vi]	[vii]	[viii]	[ix]
$\Delta CoVaR_{i,t-1}$	0.6555***	0.5803***	0.5747***	0.6738***	0.5911***	0.5843***	0.6461***	0.6013***	0.5810***
	(0.0473)	(0.0291)	(0.0292)	(0.0422)	(0.0278)	(0.0278)	(0.0439)	(0.0301)	(0.0332)
$VaR_{i,t-1}$	0.0113	0.0047**	0.0045**	0.0082	0.0038**	0.0036**	−0.0021	0.0019	0.0018
	(0.0086)	(0.0015)	(0.0016)	(0.0078)	(0.0012)	(0.0013)	(0.0078)	(0.0022)	(0.0016)
$Size_{i,t-1}$	0.0012	0.0018*	0.0020*	0.0016	0.0016*	0.0019**	0.0031**	0.0014*	0.0018**
	(0.0015)	(0.0009)	(0.0009)	(0.0013)	(0.0007)	(0.0007)	(0.0013)	(0.0006)	(0.0006)
$Leverage_{i,t-1}$	−0.0016***	−0.0013**	−0.0013***	−0.0012**	−0.0011**	−0.0010**	−0.0004	−0.0004	−0.0003
	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0004)	(0.0004)
$MTBV_{i,t-1}$	0.0000	−0.0001	−0.0001	0.0000	−0.0002	−0.0001	−0.0001	−0.0002*	−0.0002*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
$MM_{i,t-1}$	−0.0058*	−0.0045***	−0.0045**	−0.0037	−0.0026*	−0.0027*	−0.0004	−0.0004	−0.0019
	(0.0031)	(0.0013)	(0.0014)	(0.0029)	(0.0011)	(0.0012)	(0.0021)	(0.0017)	(0.0017)
$Mktb_{i,t-1}$	0.0202**	0.0102	0.0105*	0.0221**	0.0113*	0.0120*	0.0063	0.0013	0.007
	(0.0087)	(0.0054)	(0.0053)	(0.0091)	(0.0054)	(0.0053)	(0.0070)	(0.0057)	(0.0053)
Regime 1 (GFC)				0.0261***	0.0199***	0.0233***	−0.0429	−0.0161	−0.0016
				(0.0042)	(0.0025)	(0.0027)	(0.0281)	(0.0202)	(0.0220)
Regime 2 (CMPR)				0.0003	−0.002	−0.0007	−0.0102	−0.0022	0.0026
				(0.0021)	(0.0012)	(0.0011)	(0.0136)	(0.0109)	(0.0094)
Regime 3 (CSMC)				0.0037	0.0073***	0.0080***	0.0305**	0.0261	0.0329*
				(0.0030)	(0.0020)	(0.0019)	(0.0137)	(0.0153)	(0.0140)
							Marginal Effects for Global Financial Crisis (Regime 1)		
$\Delta CoVaR_{i,t-1}$							0.1545**	0.0613*	0.0855**
							(0.0532)	(0.0236)	(0.0270)
$VaR_{i,t-1}$							0.0205**	0.0012	0.001
							(0.0086)	(0.0021)	(0.0016)
$Size_{i,t-1}$							−0.0013	0.001	−0.0002
							(0.0029)	(0.0017)	(0.0020)
$Leverage_{i,t-1}$							0.0003	0.0000	0.0000
							(0.0005)	(0.0003)	(0.0004)
$MTBV_{i,t-1}$							0.0000	−0.0001	0.0000
							(0.0005)	(0.0003)	(0.0003)
$MM_{i,t-1}$							0.0012	−0.0004	0.0016
							(0.0088)	(0.0040)	(0.0038)
$Mktb_{i,t-1}$							0.0317	0.0216	0.0095
							(0.0209)	(0.0122)	(0.0126)
							Marginal Effects for Chinese Monetary Policy Restriction (Regime 2)		
$\Delta CoVaR_{i,t-1}$							0.0686**	0.0341*	0.0409**
							(0.0252)	(0.0151)	(0.0144)
$VaR_{i,t-1}$							0.0085**	0.0014	0.0016
							(0.0026)	(0.0015)	(0.0012)
$Size_{i,t-1}$							−0.0018	−0.0011	−0.0014
							(0.0013)	(0.0009)	(0.0008)
$Leverage_{i,t-1}$							0.0004	0.0004	0.0003
							(0.0003)	(0.0003)	(0.0003)
$MTBV_{i,t-1}$							−0.0001	0.0000	0.0000
							(0.0002)	(0.0002)	(0.0001)
$MM_{i,t-1}$							−0.0120**	−0.0046	−0.0029
							(0.0053)	(0.0028)	(0.0027)
$Mktb_{i,t-1}$							0.0138*	0.0175*	0.0103
							(0.0082)	(0.0075)	(0.0065)
							Marginal Effects for the 2015 Chinese Stock Market Crash (Regime 3)		
$\Delta CoVaR_{i,t-1}$							−0.0241	0.0024	0.0095
							(0.0347)	(0.0260)	(0.0250)
$VaR_{i,t-1}$							−0.0021	0.0021**	0.0014*
							(0.0048)	(0.0007)	(0.0007)
$Size_{i,t-1}$							−0.0007	−0.0013	−0.0017
							(0.0014)	(0.0013)	(0.0012)
$Leverage_{i,t-1}$							−0.0006	−0.0004	−0.0004
							(0.0004)	(0.0004)	(0.0003)
$MTBV_{i,t-1}$							0.0000	0.0001	0.0000
							(0.0002)	(0.0001)	(0.0001)
$MM_{i,t-1}$							0.0037	0.0038	0.0060*
							(0.0029)	(0.0027)	(0.0027)
$Mktb_{i,t-1}$							−0.0161	−0.0211	−0.0163
							(0.0106)	(0.0113)	(0.0106)
Constant	0.0495*	0.0774***	0.0712***	0.0486	0.0791***	0.0743***	0.0506*	0.0829***	0.0791***
	(0.0295)	(0.0136)	(0.0134)	(0.0297)	(0.0125)	(0.0123)	(0.0302)	(0.0118)	(0.0123)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	No	No	No	No	No	No
Dummy Regimes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
N. Obs.	10,355	10,355	10,355	10,355	10,355	10,355	10,185	10,185	10,185
R^2 *Adjusted*	0.42	0.50	0.50	0.41	0.48	0.48	0.46	0.52	0.51
F-Test	84.11***	130.93***	120.91***	108.73***	200.26***	185.58***	180.13***	219.38***	184.47***

The dependent variable is *ΔCoVaR* computed using S&P 500 and Wilshire 5000 in addition to the Shanghai composite index. $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). *GFC* captures the Global Financial Crisis over the period 2007:1–2009:4; *CMPR* captures the Chinese Monetary Policy Restriction conducted by the PBoC over the period 2010:1–2014:4; *CSMC* captures the 2015 Chinese Stock Market Crash over the period 2015:3–2016:3. [i], [iv], [vii] are the benchmark specification using accounting and financial variables and time dummies. [ii], [v], [viii] include accounting and financial variables and replaces time dummies with the three regimes. [iii], [vi], [ix] include accounting and financial variables, time dummies and the interaction of explanatory variables with the three regime dummies. Standard errors are reported in parentheses. The coefficients of the marginal effects for GFC, CMPR, and CSMC for *ΔCoVaR* and *VaR95* are included in the equation but not reported in the table. Sample period: 2006:1–2019:4.

*Denote the 10% significance level.
**Denote the 5% significance level.
***Denote the 1% significance level.

cash, credit market instruments, equities, security credit, miscellaneous assets), while the liability side is composed of short-term and collateralized borrowing (such as, net repo, corporate and foreign bonds, trade payables, security credit, taxes payable, miscellaneous liabilities). This finding is also consistent with Adrian et al. (2014).

As far as *MM* is concerned, the variable decreases systemic risk in the case of the real estate finance services. This result confirms the moderate role of these financial entities, different from traditional banks, in engaging credit transformation activities. The negative relationship between *MM* and systemic risk observed for REFs may be explained by

Table 8
Determinants of systemic risk — Baseline model and marginal effects for TBs, FSs, and REFs.

Variables	ΔCoVaR	ΔCoVaR with S&P 500	ΔCoVaR with Wilshire 5000	ΔCoVaR	ΔCoVaR with S&P 500	ΔCoVaR with Wilshire 5000	ΔCoVaR	ΔCoVaR with S&P 500	ΔCoVaR with Wilshire 5000
	[i]	[ii]	[iii]	[i]	[ii]	[iii]	[i]	[ii]	[iii]
$\Delta CoVaR_{i,t-1}$	0.7643***	0.6502***	0.6492***	0.7868***	0.6487***	0.6349***	0.6436***	0.6184***	0.6055***
	(0.0513)	(0.0283)	(0.0284)	(0.0410)	(0.0149)	(0.0167)	(0.0645)	(0.0367)	(0.0413)
$VaR_{i,t-1}$	0.0066	0.0030**	0.0027**	−0.0051	0.0029**	0.0033**	0.0306	0.0028**	0.0015
	(0.0077)	(0.0011)	(0.0011)	(0.0037)	(0.0012)	(0.0014)	(0.0234)	(0.0013)	(0.0014)
$Size_{i,t-1}$	0.0013	0.0014**	0.0017**	0.0002	0.0011	0.0012*	0.0018	0.0007	0.0015
	(0.0013)	(0.0006)	(0.0006)	(0.0014)	(0.0007)	(0.0007)	(0.0031)	(0.0015)	(0.0013)
$Leverage_{i,t-1}$	−0.0002	−0.0003	−0.0003	−0.0011**	−0.0012**	−0.0010**	−0.0010**	−0.0010*	−0.0007
	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0004)
$MTBV_{i,t-1}$	0.0000	−0.0002**	−0.0001*	−0.0001	−0.0002*	−0.0001	0.0006	−0.0017	−0.0011
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0016)	(0.0013)	(0.0012)
$MM_{i,t-1}$	−0.003	−0.0020*	−0.0021**	−0.0013	−0.0007	−0.0014	−0.0035	−0.0009	−0.0007
	(0.0028)	(0.0010)	(0.0011)	(0.0023)	(0.0012)	(0.0012)	(0.0042)	(0.0016)	(0.0018)
$Mktb_{i,t-1}$	0.0229**	0.0108**	0.0113**	0.017	0.0079	0.0077	0.0081	0.0099	0.016
	(0.0087)	(0.0049)	(0.0046)	(0.0106)	(0.0050)	(0.0051)	(0.0183)	(0.0127)	(0.0130)
Regime 1 (GFC)	0.0204***	0.0160***	0.0192***	0.0227***	0.0174***	0.0205***	0.0233***	0.0178***	0.0207***
	(0.0040)	(0.0022)	(0.0024)	(0.0041)	(0.0024)	(0.0026)	(0.0041)	(0.0024)	(0.0026)
Regime 2 (CMPR)	−0.0006	−0.0026**	−0.0012	−0.0004	−0.0024**	−0.0011	0.0003	−0.0018*	−0.0006
	(0.0021)	(0.0010)	(0.0010)	(0.0017)	(0.0010)	(0.0009)	(0.0017)	(0.0010)	(0.0009)
Regime 3 (CSMC)	0.0014	0.0059**	0.0065***	0.0021	0.0062**	0.0068***	0.0017	0.0054**	0.0061***
	(0.0031)	(0.0019)	(0.0018)	(0.0026)	(0.0019)	(0.0018)	(0.0024)	(0.0019)	(0.0018)
	Marginal Effects for Traditional Banks			**Marginal Effects for Shadow Entities**			**Marginal Effects for Real Estate Finance Services**		
$\Delta CoVaR_{i,t-1}$	0.0115	0.0515	0.0036	−0.1519	−0.0257	−0.0129	0.1911**	0.0577	0.0637
	(0.0672)	(0.0465)	(0.0430)	(0.1157)	(0.0599)	(0.0660)	(0.0835)	(0.0379)	(0.0425)
$VaR_{i,t-1}$	−0.0750***	−0.0629**	−0.0612***	0.0395	0.0001	−0.0018	−0.0372	−0.0003	0.0012
	(0.0188)	(0.0204)	(0.0158)	(0.0250)	(0.0017)	(0.0018)	(0.0237)	(0.0018)	(0.0019)
$Size_{i,t-1}$	−0.0255**	−0.0161**	−0.0131**	0.0043	−0.0005	0.0009	−0.0004	0.0011	0.0006
	(0.0080)	(0.0055)	(0.0055)	(0.0036)	(0.0016)	(0.0015)	(0.0033)	(0.0017)	(0.0015)
$Leverage_{i,t-1}$	−0.0008	−0.0013	−0.0006	0.0004	0.0016*	0.0008	0.0001	−0.0001	−0.0006
	(0.0010)	(0.0011)	(0.0008)	(0.0011)	(0.0008)	(0.0007)	(0.0005)	(0.0005)	(0.0004)
$MTBV_{i,t-1}$	0.0079	0.0074	0.0175*	0.0007	−0.0013**	−0.0008*	−0.0007	0.0018	0.0011
	(0.0108)	(0.0094)	(0.0094)	(0.0012)	(0.0004)	(0.0004)	(0.0017)	(0.0015)	(0.0013)
$MM_{i,t-1}$	0.0454	0.0386	0.0576**	−0.0043	−0.0017	−0.0007	−0.0002	−0.0012	−0.0014
	(0.0358)	(0.0277)	(0.0291)	(0.0046)	(0.0021)	(0.0022)	(0.0023)	(0.0010)	(0.0010)
$Mktb_{i,t-1}$	−0.0032	0.0225	0.0096	0.0166	0.0083	0.0168	0.0129	0.0006	−0.0056
	(0.0388)	(0.0295)	(0.0345)	(0.0211)	(0.0170)	(0.0140)	(0.0211)	(0.0128)	(0.0130)
Constant	0.0913**	0.1056***	0.0936***	0.0450*	0.0767***	0.0708***	0.0366	0.0682***	0.0609***
	(0.0332)	(0.0163)	(0.0165)	(0.0236)	(0.0100)	(0.0097)	(0.0265)	(0.0114)	(0.0111)
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dummy Regimes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. Obs.	10,210	10,210	10,210	10,210	10,210	10,210	10,210	10,210	10,210
R^2 *Adjusted*	0.44	0.52	0.51	0.45	0.52	0.51	0.44	0.52	0.51
F-Test	116.22***	270.94***	240.38***	115.56***	342.64***	259.92***	125.91***	332.82***	273.37***

The dependent variable is *ΔCoVaR* computed using S&P 500 and Wilshire 5000 in addition to with Shanghai composite index. $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). *GFC* captures the Global Financial Crisis over the period 2007:1–2009:4; *CMPR* captures the Chinese Monetary Policy Restriction conducted by the PBoC over the period 2010:1–2014:4; *CSMC* captures the 2015 Chinese Stock Market Crash over the period 2015:3–2016:3. [i, ii, iii] are the benchmark specifications using accounting and financial variables and the three regimes. The coefficients of the marginal effects for TBs, FSs, and REFs for *ΔCoVaR* and *VaR95* are included in the equation but not reported in the table. Standard errors are reported in parentheses. Sample period: 2006:1–2019:4.

*Denote the 10% significance level.
**Denote the 5% significance level.
***Denote the 1% significance level.

the excess of liquidity pumped by the Chinese Government, after the financial crisis, which pushed up demand for real estate consumption and investment.

4.3. State and non state owned banks

Banks play a dominant role in the Chinese financial market. At the end of 2019, the total assets of Chinese banking system was $ 52.06 trillion equivalent to 275.47% of annual GDP RMB, having more than quadrupled since the global financial crisis (People's Bank of China, 2020). During 2004–2010, the Chinese banking system was re-engineered and stabilized, and since 2010, both financial innovation and regulatory development strengthened and developed banks to meet the challenges of the economy in transition (Zhang et al., 2020). Amid this time period, in 2008, the crash in Wall Street had some consequences for Chinese banks, particularly related to the fear that demand for China' export would dry up as Western economies went into recession. As response, 4 trillion yuan stimulus was launched by Beijing Government, where most of the funds were released in the form of bank credit extension. Since banks played a pivotal role in financing the expansion, they started to expand off-balance sheet business, both to circumvent stringent regulation on capital and liquidity, and to acquire new clients and asset classes (Liao et al., 2016).

Table 5 reports the total outstanding shares held by the Ministry of Finance (MoF) and by the Central Huijin at the end of 2019 as reported in the annual reports of each of the bank. The MoF, established in October 1949, is a Ministry responsible for macro-economic control and regulation under the State Council, and is empowered to perform its duties in respect of state finance and taxation policies. Central Huijin Investment Ltd. (i.e., "Central Huijin"), established in 2003 by the PBoC, is a state-owned investment company which exercise the rights and the obligations in major state-owned financial enterprises, on behalf of the People's Republic of China.

Given that much of the existing empirical financial literature examining systemic risk is based upon the US financial system (Adrian and Brunnermeier, 2016; Brownlees and Engle, 2016; Acharya et al., 2017), and European banking system (López-Espinosa et al., 2012), we further investigate whether the systemic importance of China' banks has a different fundamental relationship with idiosyncratic bank variables. We extend Morelli and Vioto (2020) work by evaluating the role played by SOBs and NSOBs. To undertake such an analysis, we perform the following regression model with fixed effects:

$$\begin{aligned}\Delta CoVaR_{i,t} = & \beta_0 + \beta_1 \Delta CoVaR_{i,t-1} + \beta_2 VaR_{i,t-1} \\ & + \beta_3 Size_{i,t-1} + \beta_4 Leverage_{i,t-1} + \\ & + \beta_5 MTBV_{i,t-1} + \beta_6 Mktb_{i,t-1} + \beta_7 MM_{i,t-1} \\ & + \beta_8 NPLs_{i,t-1} + \beta_9 CAR_{i,t-1} + \\ & + \sum_{i=1}^{43} Banks_i + \sum_{t=2006:1}^{2019:4} Time_t + \varepsilon_{i,t}\end{aligned} \tag{9}$$

$$\begin{aligned}\Delta SRIS_{i,t} = & \beta_0 + \beta_1 Size_{i,t-1} + \beta_2 Leverage_{i,t-1} + \beta_3 MTBV_{i,t-1} \\ & + \beta_4 Mktb_{i,t-1} + \beta_5 MM_{i,t-1} + \\ & \beta_6 NPLs_{i,t-1} + \beta_7 CAR_{i,t-1} + \sum_{i=1}^{43} Banks_i + \sum_{t=2006:1}^{2019:4} Time_t + \varepsilon_{i,t}\end{aligned} \tag{10}$$

Table 9
Determinants of systemic risk — Baseline model and marginal effects for NSOBs.

Variables	ΔCoVaR		ΔCoVaR with S&P 500		ΔCoVaR with Wilshire 5000	
	[i]		[ii]		[iii]	
	Baseline	Marginal Effects for Non State Owned Banks	Baseline	Marginal Effects for Non State Owned Banks	Baseline	Marginal Effects for Non State Owned Banks
$ΔCoVaR_{i,t-1}$	0.4663***	−0.0228	0.6101***	−0.2372***	0.2349**	0.1632
	(0.0479)	(0.0490)	(0.0455)	(0.0410)	(0.0996)	(0.1093)
$VaR_{i,t-1}$	−0.0049	−0.0188	−0.0797***	0.2245***	0.2022*	−0.2045*
	(0.0220)	(0.0158)	(0.0138)	(0.0296)	(0.1163)	(0.1183)
$Size_{i,t-1}$	−0.0195	0.0534*	−0.0286	0.0707**	0.0113	0.0291
	(0.0432)	(0.0312)	(0.0386)	(0.0296)	(0.0470)	(0.0331)
$Leverage_{i,t-1}$	0.0008	−0.0016	−0.0002	−0.0006	0.0005	−0.0008
	(0.0019)	(0.0021)	(0.0013)	(0.0016)	(0.0017)	(0.0019)
$MTBV_{i,t-1}$	0.0073	0.0116	0.0044	0.0045	0.0097	0.0074
	(0.0064)	(0.0086)	(0.0063)	(0.0067)	(0.0062)	(0.0076)
$Mktb_{i,t-1}$	0.0727*	−0.1504**	0.0506*	−0.1197**	0.0735	−0.1700**
	(0.0401)	(0.0554)	(0.0296)	(0.0427)	(0.0492)	(0.0626)
$MM_{i,t-1}$	0.1154	−0.018	0.0811	0.0004	0.0767	0.0074
	(0.0709)	(0.0934)	(0.0631)	(0.0704)	(0.0693)	(0.0988)
$NPLs_{i,t-1}$	−2.7160*	2.7620*	−3.3772**	3.3278**	−2.2467	2.2745
	(1.5353)	(1.5340)	(1.6286)	(1.6281)	(1.5178)	(1.5156)
$CAR_{i,t-1}$	0.5077	−0.2354	1.2271	−1.0259	0.0653	0.3532
	(0.8125)	(0.8629)	(0.7658)	(0.7854)	(0.8002)	(0.8647)
Constant	−0.1665		−0.3232		−0.4073	
	(0.4299)		(0.3458)		(0.4755)	
Fixed Effects	Yes		Yes		Yes	
Time Fixed Effects	Yes		Yes		Yes	
N. Obs.	1,090		1,090		1,090	
R^2 *Adjusted*	0.56		0.69		0.51	
F-Test	23,498.48***		8,321.95***		178,160.16***	

The dependent variable is *ΔCoVaR* computed using S&P 500 and Wilshire 5000 in addition to the Shanghai composite index. $Size_{i,t-1}$ is the total assets of bank *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of bank assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of bank *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of bank *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch as the total short-term debt minus cash to total liabilities ratio of bank *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of bank *i* at quarter (*t-1*); $NPLs_{i,t-1}$: the *Non Performing Loans* ratio as the ratio between net non performing loans and total net outstanding loans for bank *i* at quarter $(t-1)$; and $CAR_{i,t-1}$: the *Capital Adequacy Requirement* as the ratio between TIER 1 and 2 capital over Risk Weighted Assets for bank *i* at quarter $(t-1)$; *Fixed Effects* is a set of dummies capturing fixed effects for each traditional bank, both SOBs and NSOBs; *Time fixed effects* is a set of dummies capturing fixed effects for each quarter. Standard errors are reported in parentheses. Sample period: 2006:1–2019:4.
*Denote the 10% significance level.
**Denote the 5% significance level.
***Denote the 1% significance level.

where $SRIS_{i,t}$ is the systemic risk measure *MES*, *SRISK*, respectively. In addition to the independent variables used in Eqs. (7) and (8), the specification above also contains two additional explanatory variables which capture the banks management behavior regarding capital requirements and credit risk: $NPLs_{i,t-1}$ (*Non Performing Loans*) ratio as the ratio between net non performing loans and total net outstanding loans for bank *i* at quarter $(t-1)$ and $CAR_{i,t-1}$ (*Capital Adequacy Requirement*) as the ratio between TIER 1 and TIER 2 capital over Risk Weighted Assets for bank *i* at quarter $(t-1)$; *Banks* is a set of dummies capturing fixed effects for each bank, both SOBs and NSOBs; *Time* is a set of dummies capturing fixed effects for each quarter. To disentangle the marginal effects for SOBs and NSOBs, we repeat our analysis by introducing a dummy variable equal to 1 for NSOBs and 0 otherwise in Eqs. (9) and (10). Table 6 reports the results.

Regarding the impact of the *Size* variable, the results show that SOBs reduce systemic risk while NSOBs increase it. A possible explanation is that SOBs are implicitly guaranteed by Government because are perceived as "too-big-to-fail" (Jiang et al., 2019). A failure of one of them may cause severe consequences on the financial system as a whole. As far as *Leverage* is concerned, NSOBs are characterized by a lower level of leverage which explains the negative relationship with systemic risk relative to state owned banks. This result is in line with Adrian and Brunnermeier (2016), Acharya et al. (2017). We find that SOBs' *MTBV* ratio decreases systemic risk relative to NSOBs. These findings show that asset pricing misalignment are lower for SOBs than NSOBs. A further explanation is related to the fact that, over the years, bank competition has also increased, leading to changes in bank management behaviors. Gao et al. (2019) find that after bank entry was partially deregulated in 2009, entrant banks preferred to lend to inefficient state owned enterprises over more productive private firms. Before 2009, the big four SOBs (i.e., Bank of China, Agricultural Bank of China, China Construction Bank, and Industrial and Commercial Bank of China) dominated China' banking system, while the twelve joint equity banks faced great limitations when opening new branches. In April 2009, the China Banking Regulatory Commission partially lifted this entry barrier.

A higher proportion of marketable securities (*Mktb*) increases systemic risk only for SOBs. One possible explanation is that these banks hold more financial instruments that account for fair value which may be sensitive to financial markets dynamics. As far as *MM* is concerned, the variable decreases systemic risk in the case of NSOBs. This result confirms the moderate role of these banks in engaging credit transformation activities. According to Beltratti and Stulz (2012) and Raddatz (2016) banks with a low dependence on wholesale funding are less fragile and experience less significant declines in share prices.

Regulatory capital (i.e., TIER1 and TIER 2), as percentage of risk-weighted assets, is associated with a negative relationship to systemic risk, reporting a greater magnitude in SOBs. A possible explanation is that these banks, identified as G-SIFIs, are subject to higher additional regulatory capital requirements and are more likely to obtain capital

Table 10
Romano and Wolf (2005) Adjusted *p*-value – Baseline Model, Marginal Effects for Financial Crises.

Adjusted p-values Table 7	Specification [i]						Specification [ii]						Specification [iii]					
Dep. Var.	ΔCoVaR		MES		SRISK		ΔCoVaR		MES		SRISK		ΔCoVaR		MES		SRISK	
P-values	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W
$\Delta CoVaR_{i,t-1}$	0.000	0.009					0.000	0.001					0.000	0.001				
$VaR_{i,t-1}$	0.188	0.227					0.295	0.161					0.209	0.628				
$Size_{i,t-1}$	0.421	0.633	0.205	0.171	0.000	0.064	0.236	0.153	0.631	0.817	0.040	0.001	0.000	0.003	0.465	0.764	0.265	0.070
$Leverage_{i,t-1}$	0.000	0.001	0.026	0.007	0.379	0.246	0.003	0.002	0.027	0.001	0.298	0.110	0.000	0.007	0.113	0.137	0.986	0.967
$MTBV_{i,t-1}$	0.882	0.841	0.600	0.834	0.130	0.147	0.957	0.965	0.480	0.613	0.562	0.268	0.479	0.967	0.347	0.684	0.047	0.002
$MM_{i,t-1}$	0.063	0.059	0.690	0.834	0.592	0.310	0.197	0.153	0.919	0.905	0.146	0.020	0.100	0.344	0.010	0.002	0.216	0.041
$Mktb_{i,t-1}$	0.021	0.039	0.973	0.950	0.577	0.310	0.016	0.017	0.776	0.905	0.993	0.978	0.551	0.986	0.297	0.547	0.483	0.251
Regime 1 (GFC)							0.000	0.001	0.000	0.001	0.104	0.007	0.084	0.332	0.000	0.002	0.087	0.009
Regime 2 (CMPR)							0.875	0.965	0.745	0.905	0.474	0.163	0.220	0.663	0.749	0.917	0.100	0.011
Regime 3 (CSMC)							0.215	0.153	0.000	0.001	0.322	0.128	0.094	0.344	0.000	0.002	0.004	0.001
													Marginal Effects for Global Financial Crisis (Regime 1)					
$\Delta CoVaR_{i,t-1}$													0.028	0.116				
$VaR_{i,t-1}$													0.006	0.028				
$Size_{i,t-1}$													0.946	0.995	0.000	0.001	0.155	0.017
$Leverage_{i,t-1}$													0.413	0.932	0.508	0.772	0.093	0.010
$MTBV_{i,t-1}$													0.873	0.995	0.417	0.762	0.719	0.702
$MM_{i,t-1}$													0.833	0.995	0.449	0.764	0.841	0.853
$Mktb_{i,t-1}$													0.097	0.344	0.019	0.007	0.076	0.005
													Marginal Effects for Chinese Monetary Policy Restriction (Regime 2)					
$\Delta CoVaR_{i,t-1}$													0.084	0.332				
$VaR_{i,t-1}$													0.002	0.020				
$Size_{i,t-1}$													0.509	0.982	0.956	0.967	0.125	0.011
$Leverage_{i,t-1}$													0.348	0.892	0.370	0.726	0.390	0.153
$MTBV_{i,t-1}$													0.589	0.986	0.725	0.917	0.069	0.004
$MM_{i,t-1}$													0.002	0.020	0.030	0.012	0.466	0.223
$Mktb_{i,t-1}$													0.054	0.216	0.876	0.967	0.406	0.153
													Marginal Effects for the 2015 Chinese Stock Market Crash (Regime 3)					
$\Delta CoVaR_{i,t-1}$													0.303	0.836				
$VaR_{i,t-1}$													0.628	0.986				
$Size_{i,t-1}$													0.907	0.995	0.000	0.001	0.004	0.001
$Leverage_{i,t-1}$													0.105	0.344	0.261	0.528	0.003	0.001
$MTBV_{i,t-1}$													0.682	0.986	0.003	0.002	0.004	0.001
$MM_{i,t-1}$													0.612	0.986	0.664	0.917	0.244	0.051
$Mktb_{i,t-1}$													0.146	0.438	0.000	0.002	0.028	0.001

The dependent variables are *ΔCoVaR*, *MES* and *SRISK*. For each dependent variable, we report p-values for the baseline model *Model* and the adjusted p-values *R-W* computed using Romano and Wolf (2005). $Size_{i,t-1}$ is the total assets of financial institution *i* at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution *i* at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution *i* at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution *i* at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution *i* at quarter (*t-1*). *GFC* captures the Global Financial Crisis over the period 2007:1–2009:4; *CMPR* captures the Chinese Monetary Policy Restriction conducted by the PBoC over the period 2010:1–2014:4; *CSMC* captures the 2015 Chinese Stock Market Crash over the period 2015:3–2016:3. [i] is the benchmark specification using accounting and financial variables and time dummies. [ii] includes accounting and financial variables and replaces time dummies with the two regimes. [iii] includes accounting and financial variables, time dummies and the interaction of explanatory variables with the three regime dummies. Sample period: 2006:1–2019:4.

injections at times of distress. Specifically, a bank with a higher level of capital adequacy requirement is unlikely to behave in an opportunistic manner in its risk taking choices, and the impaired loans should decrease (Salas and Saurina, 2002). This could also explained the negative relationship between NPLs ratio and systemic risk for SOBs. These banks have advantages such as large assets, extensive business networks, and vast customer bases which allow them to better assess the creditworthiness of the customer by using extensive databases. These findings are in line with the results reported in Zhang et al. (2016) and in Zhang et al. (2020). Another explanation is also related to the amount of foreign currency reserves injected by the Chinese Government to reduce the level of NPLs for SOBs (Allen et al., 2012).

5. Sensitivity analysis

In this section, we provide evidence of the robustness of our findings. First, we estimate *ΔCoVaR* with alternative state variables *(Section* 5.1*)*. In addition, we validate our results with Romano and Wolf adjusted *p*-value *(Section* 5.2*)*.

5.1. Alternative state variables for ΔCoVaR

This paper emphasizes the importance of studying the systemic risk of financial institutions in China. One intended contribution is to understand how this is connected with the stability of the global

Table 11
Romano and Wolf (2005) Adjusted p-value — Baseline Model, Marginal Effects for TBs, FSs and REFs.

Adjusted p-values Table 8	Specification [i]						Specification [ii]						Specification [iii]					
Dep. Var.	ΔCoVaR		MES		SRISK		ΔCoVaR		MES		SRISK		ΔCoVaR		MES		SRISK	
P-values	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W	Model	R-W
$\Delta CoVaR_{i,t-1}$	0.000	0.001					0.000	0.001					0.000	0.001				
$VaR_{i,t-1}$	0.395	0.797					0.170	0.331					0.191	0.363				
$Size_{i,t-1}$	0.292	0.589	0.935	0.987	0.007	0.002	0.862	0.929	0.961	0.937	0.306	0.127	0.572	0.956	0.332	0.188	0.698	0.318
$Leverage_{i,t-1}$	0.609	0.951	0.207	0.321	0.364	0.250	0.022	0.028	0.007	0.001	0.191	0.036	0.044	0.044	0.034	0.005	0.200	0.022
$MTBV_{i,t-1}$	0.857	0.991	0.326	0.385	0.591	0.388	0.338	0.734	0.192	0.141	0.979	1.000	0.717	0.987	0.222	0.128	0.325	0.065
$MM_{i,t-1}$	0.275	0.581	0.861	0.987	0.125	0.032	0.586	0.876	0.415	0.607	0.285	0.111	0.403	0.858	0.933	0.878	0.250	0.036
$Mktb_{i,t-1}$	0.009	0.019	0.531	0.707	0.117	0.027	0.110	0.240	0.870	0.937	0.989	1.000	0.658	0.985	0.161	0.077	0.630	0.318
Regime 1 (GFC)	0.000	0.001	0.000	0.001	0.353	0.251	0.000	0.001	0.000	0.001	0.111	0.006	0.000	0.001	0.000	0.001	0.076	0.004
Regime 2 (CMPR)	0.765	0.975	0.228	0.321	0.522	0.296	0.816	0.929	0.651	0.903	0.435	0.271	0.851	0.995	0.580	0.647	0.413	0.104
Regime 3 (CSMC)	0.651	0.951	0.000	0.001	0.030	0.004	0.425	0.824	0.000	0.001	0.051	0.003	0.488	0.934	0.000	0.001	0.061	0.004
	Marginal Effects for Traditional Banks						**Marginal Effects for Shadow Entities**						**Marginal Effects for Real Estate Finance Services**					
$\Delta CoVaR_{i,t-1}$	0.863	0.991					0.190	0.371					0.022	0.020				
$VaR_{i,t-1}$	0.000	0.001					0.116	0.240					0.118	0.174				
$Size_{i,t-1}$	0.001	0.007	0.035	0.012	0.234	0.131	0.232	0.469	0.674	0.903	0.041	0.002	0.893	0.995	0.134	0.055	0.257	0.004
$Leverage_{i,t-1}$	0.414	0.823	0.238	0.321	0.909	0.912	0.736	0.929	0.017	0.001	0.025	0.001	0.828	0.995	0.579	0.647	0.097	0.005
$MTBV_{i,t-1}$	0.469	0.863	0.026	0.012	0.638	0.430	0.545	0.876	0.198	0.141	0.062	0.003	0.669	0.985	0.191	0.100	0.331	0.067
$MM_{i,t-1}$	0.205	0.437	0.893	0.987	0.118	0.028	0.349	0.734	0.787	0.937	0.661	0.706	0.921	0.995	0.298	0.158	0.066	0.004
$Mktb_{i,t-1}$	0.933	0.991	0.300	0.385	0.971	0.936	0.431	0.824	0.533	0.781	0.999	1.000	0.541	0.952	0.088	0.031	0.531	0.189

The dependent variables are *ΔCoVaR*, *MES* and *SRISK*. For each dependent variable, we report p-values for the baseline model *Model* and the adjusted p-values *R-W* computed using Romano and Wolf (2005). $Size_{i,t-1}$ is the total assets of financial institution i at quarter (*t-1*); $Leverage_{i,t-1}$ is the market value of assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of financial institution i at quarter (*t-1*); $MTBV_{i,t-1}$ is the Market To Book Value ratio of financial institution i at quarter (*t-1*); $MM_{i,t-1}$ is the Maturity Mismatch which captures the relative level of short-term wholesale funding as the total short-term debt minus cash to total liabilities ratio of financial institution i at quarter (*t-1*); $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of financial institution i at quarter (*t-1*). *GFC* captures the Global Financial Crisis over the period 2007:1–2009:4; *CMPR* captures the Chinese Monetary Policy Restriction conducted by the PBoC over the period 2010:1–2014:4; *CSMC* captures the 2015 Chinese Stock Market Crash over the period 2015:3–2016:3. [i, ii, iii] are the benchmark specifications using accounting and financial variables and the three regimes. The coefficients of the marginal effects for TBs, FSs, and REFs for *ΔCoVaR* and *VaR95* are included in the equation but not reported in the table. Sample period: 2006:1–2019:4.

financial markets. While systemic risk of China's financial institutions is measured mainly based on the stock market performance in China via the *Shanghai Composite Index*, defined as weekly returns of the Shanghai stock exchange index, however it is of paramount important to understand how do we use such measures to assess its effect internationally. The only state variable outside China used to estimate CoVaR is the weekly Volatility Index (VIX) of the Chicago board options exchange. Moreover, the connection between the Chinese market and the global market may also be measured using other global stock market indexes outside China such as the S&P 500 and the Wilshire 5000, in conjunction with Shanghai composite index.[1]

In Table 7, we report the results of Eq. (7) where the *ΔCoVaR* is estimated including S&500 (specification [ii]), and Wilshire 5000 (specification [iii]). Table 8 reports the results for the entire Chinese financial system and the marginal effects for TBs, FSs, and REFs, while Table 9 presents the results for SOBs and NSOBs. We find that: (i) overall the signs and the significant of the coefficients remain unchanged, thus we confirm that systemic risk increases in the size, while it decreases in the leverage of financial institutions (Table 7); (ii) the sign and significant of coefficients are unchanged, though the size of coefficients in absolute value decreases, in particular for the size variable (Table 8); (iii) systemic risk increases in the size of NSOBs, while it decreases for SOBs, thus confirming that these banks are perceived as "too-big-to-fail" (Table 9).

5.2. Romano and Wolf adjusted p-values

To validate the relevance of accounting and financial variables across our *ΔCoVaR*, *MES*, and *SRISK* systemic risk measures, we report the Romano and Wolf adjusted p-value (Romano and Wolf, 2005). Given the large number of variables included in all our specifications, ordinary level of p-values may be too lenient, and possibly lead to spurious (Type I) significance of the estimated coefficients. Therefore, we implemented bootstrap re-sampling methods to control for the probability of rejecting at least one true null hypothesis in the Family Wise Error Rate (FWER) of hypotheses under test. The procedure is noteworthy given that in addition to controlling the FWER, it also offers considerably more power (i.e., the ability to correctly reject false null hypotheses) compared to earlier multiple hypothesis correction procedures such as Bonferroni (1936). We repeated the test for the baseline regression model, for the marginal effects for different sub-periods, for the marginal effects for Traditional Banks, for Shadow Entities, for Real Estate Finance Services requesting 1,000 bootstrap repetitions. The main empirical results are confirmed in Tables 10–12. The only consistent difference is for *Size* and *MM* variables (when the dependent variable is *SRISK*, Table 10), where the Romano and Wolf p-values are significant (specification [iii] for the Baseline Model and Marginal Effects for each sub-period). In Table 11, the Romano and Wolf p-values are significant for: (i) the *MM* of TBs (specification [i]); (ii) the *Size* of REFs (specification [iii] when the dependent variable is *MES*); (iii) the *Size* and *MM* of REFs (specification [iii] when the

[1] We thank the Referee for this valuable and constructive comment.

Table 12
Romano and Wolf (2005) Adjusted *p*-value — Baseline Model, Marginal Effects for Non State Owned Banks.

Dep. Var.	ΔCoVaR		MES		SRISK	
P-values	Model	R-W	Model	R-W	Model	R-W
$\Delta CoVaR_{i,t-1}$	0.000	0.019				
$VaR_{i,t-1}$	0.580	0.745				
$Size_{i,t-1}$	0.393	0.568	0.017	0.039	0.953	0.961
$Leverage_{i,t-1}$	0.559	0.725	0.183	0.470	0.020	0.039
$MTBV_{i,t-1}$	0.573	0.803	0.012	0.039	0.374	0.607
$MM_{i,t-1}$	0.226	0.254	0.432	0.941	0.444	0.607
$Mktb_{i,t-1}$	0.159	0.137	0.251	0.784	0.587	0.705
$NPLs_{i,t-1}$	0.060	0.110	0.328	0.862	0.100	0.100
$CAR_{i,t-1}$	0.058	0.090	0.369	0.862	0.009	0.019
	Marginal Effects for Non State Owned Banks					
$\Delta CoVaR_{i,t-1}$	0.032	0.156				
$VaR_{i,t-1}$	0.092	0.588				
$Size_{i,t-1}$	0.060	0.098	0.064	0.176	0.442	0.607
$Leverage_{i,t-1}$	0.472	0.549	0.356	0.862	0.043	0.039
$MTBV_{i,t-1}$	0.033	0.170	0.448	0.941	0.929	0.960
$MM_{i,t-1}$	0.704	0.745	0.126	0.333	0.123	0.110
$Mktb_{i,t-1}$	0.003	0.039	0.438	0.862	0.383	0.607
$NPLs_{i,t-1}$	0.052	0.098	0.346	0.862	0.110	0.110
$CAR_{i,t-1}$	0.149	0.274	0.802	1.000	0.011	0.019

The dependent variables are *ΔCoVaR*, *MES* and *SRISK*. For each dependent variable, we report p-values for the baseline model *Model* and the adjusted p-values *R-W* computed using Romano and Wolf (2005). $Size_{i,t-1}$ is the total assets of bank *i* at quarter *(t-1)*; $Leverage_{i,t-1}$ is the market value of bank assets (market capitalization of equity plus debt) over market capitalization (equal to the share price multiplied by the number of shares outstanding) of bank *i* at quarter *(t-1)*; $MTBV_{i,t-1}$ is the Market To Book Value ratio of bank *i* at quarter *(t-1)*; $MM_{i,t-1}$ is the Maturity Mismatch as the total short-term debt minus cash to total liabilities ratio of bank *i* at quarter *(t-1)*; $Mktb_{i,t-1}$ is the marketable securities to total assets ratio of bank *i* at quarter *(t-1)*; $NPLs_{i,t-1}$: the *Non Performing Loans* ratio as the ratio between net non performing loans and total net outstanding loans for bank *i* at quarter $(t-1)$; and $CAR_{i,t-1}$: the *Capital Adequacy Requirement* as the ratio between TIER 1 and 2 capital over Risk Weighted Assets for bank *i* at quarter $(t-1)$; *Fixed Effects* is a set of dummies capturing fixed effects for each traditional bank, both SOBs and NSOBs; *Time fixed effects* is a set of dummies capturing fixed effects for each quarter. Sample period: 2006:1–2019:4.

dependent variable is *SRISK*). In Table 12, the Romano and Wolf p-values are no longer significant for *NPLs* and *MTBV* of SOBs when the dependent variable is *ΔCoVaR*, and for the Size of NSOBs when the dependent variable is *SRISK*.

6. Conclusions

In this paper, we studied the role of traditional banks, shadow entities and real estate finance services in determining systemic risk in China. We conducted an extensive empirical analysis where *ΔCoVaR*, *MES* and *SRISK* are estimated as a function of accounting and financial variables. We estimated our models considering a large number of Chinese financial institutions listed between 2006:1 and 2019:4, of which 43 traditional banks, 74 shadow banking entities (i.e., finance services) and 147 real estate finance services. We also disentangled the effect effects of these variables considering three relevant periods such the global financial crisis (2007:1-2009:4), the Chinese monetary policy restriction (2010:1-2014:4), and the 2015 Chinese stock crash (2015:3-2016:3).

First, we found that larger financial institutions increased systemic risk over the entire sample period. Moreover, when we interacted the crises dummy (i.e. the global financial crisis and the 2015 Chinese stock market crash) with *Size*, for all the financial institutions the coefficient was positive and statistically significant. This result raises interesting questions about whether an institution' size is a fixed determinant of systemic risk, as its influence during the period of 2006–2016 varies. Second, we identified specific roles for TBs, FSs, and REFs. We found that systemic risk increased significantly in the *Size* of larger shadow banking entities, while it was insensitive to the *Size* of real estate finance services. The larger banks, instead, decreased systemic risk. TBs and FSs were more sensitive to proxy for market risk, *MTBV*. In addition, systemic risk increased in the *Leverage* of REFs, while their moderate role in engaging credit transformation activities, *MM*, mitigated systemic risk. We also found that financial institutions were particularly sensitive to *Mktb*. We also investigated the determinants of systemic risk by distinguishing between State and Non State Owned Banks. We found that the former, subject to higher additional regulatory capital requirements, better managed the high stock of *NPLs* due to their larger assets, and that they had a higher proportion of *Mktb* which increased system risk. We also found that systemic risk increased in the *Size* of larger Non State Owned Banks.

Our results are robust to several sensitivity checks, involving alternative state variables for the calculation of the *ΔCoVaR*, and the implementation of the Romano and Wolf (2005) adjusted p-values, to evaluate the relevance of the regressors using alternative measures of systemic risks.

The main findings in this paper have a number of relevant policy implications and suggest interesting developments for future research. First, the important role played by the *Size* calls for the need of a simultaneous supervision of traditional, shadow banks. In particular, large finance services and their leverage play a major role in the creation of systemic risk, and thus are expected to be the target of ad-hoc supervision measures. It would be useful if future research is developed to help regulators to better understand how the leverage of large financial services and real estate finance services contributes to systemic risk in order to identify appropriate leverage ratios. Second, the results in this paper highlight that long-standing policy issues "too big to fail" or "too-important-to-fail" apply to the state owned banks which continue to dominate China' banking system, with the Chinese Government retaining a dominant share also to pursuing financial stability. To this purpose, it will be interesting to evaluate the impact of shadow entities also under the control of the Chinese Government. Third, our main findings emphasize the consequences related to the rapid growth and development of the Chinese financial system. The financial innovation favored the creation of a new set of financial products, i.e. the wealth management products, which led to a rapid increase and a growing complexity in the banks' balance sheets. Moreover, the rapid development has strengthened the interconnectedness among banks and other non bank financial intermediaries, and thus increased systemic risk. Therefore, it is urgent to quantify systemic risk by accurately assessing the interconnectedness among China' financial institutions. The financial crisis reminds that the supervision of the financial system in isolation can no longer effectively prevent systemic risk. This requires important monitoring actions from the Chinese financial authorities. Finally, we are also aware that shadow banking entities go beyond finance services considered in this paper and when data will be available, it will be interesting to extend the evaluation of other Chinese shadow entities to systemic risk, for example by considering those entities not publicly listed. We leave these developments to future research.

Appendix A. Traditional banks, listed and unlisted shadow banking entities, and real estate finance services in China

We provide a description of the Chinese financial entities involved in the credit intermediation process, within and outside the regular banking system, which may raise systemic risk concerns such as traditional banks, the listed (finance services, the only available) and the unlisted shadow entities, and real estate finance services.

A.1. Traditional banks

The China Banking Regulatory Commission classifies China' traditional banks into five categories: policy banks, five state banks, joint-stock or commercial banks, rural banks, and other banks, which include small cooperative banks. We distinguish between SOBs and NSOBs. There are five SOBs controlled by the central Government: (i) the Industrial and Commercial Bank of China; (ii) the Bank of China; (iii) the Construction Bank of China; (iv) the Agricultural Bank of China; (v) the Bank of Communication. The NSOBs represent almost half of the entire banking system; in 2019, the share of their assets was 55.38%. Agricultural Bank of China, Bank of China, China Construction Bank Corporation and Industrial and Commercial Bank of China are also recognized as global systemically important financial institutions (G-SIFIs). The share of their assets, at the end of 2019, was 50.26%. We select 43 listed Chinese traditional banks, and collect the accounting and financial variables from *Refinitiv* which provides a specific section labeled as "Banks".

A.2. Listed shadow entities: Finance services

We follow Ehlers et al. (2018) to identify Chinese shadow banking entities. Traditional banks are the dominant players in the shadow banking system, issuing key instruments (i.e., wealth management products), which are then channeled to non-bank entities such as trust companies. Shadow credit intermediation in China involves securitization or wholesale funding. Shadow banking in China is closer to traditional banking in that it collects deposits or cash from retail and corporate investors, and then transforms their savings into credit of different forms to provide funding to firms. Shadow banking activity in China is driven by domestic financial institutions, savers and investors. It also involves fewer types of entities, as well as fewer steps of shadow credit intermediation than in the United States (Adrian and Ashcraft, 2016). To identify shadow banking entities for China, we followed the Financial Stability Board (2012, p. 3) which provides a *broad*[2] and a *narrow*[3] definition of shadow banking. The FSB (2018) replaces the term *shadow banking* with *"non-bank financial intermediation"* We also consider the Pozsar et al. (2010, 2013) shadow banking classification, specifically the *internal shadow banking*: activities that are conducted by subsidiaries of banking holding; the *external shadow banking*: independent and regulated institutions that conduct shadow banking activities; the *independent shadow banking*: entities specialized in shadow banking, i.e., structured investment vehicle, stand-alone money market mutual funds, independent collateralize debt obligation, etc..; finally, the *government-sponsored-enterprise*, which are entities that, unlike traditional banks, are not funded by deposits but through capital markets where they issue short and long-term agency debt securities, e.g., Fannie Mae and Freddie Mac in US.

The only shadow entities we used in this study are the Finance Services, which are securities or broker companies, stock market intermediaries, developed from the securities departments of commercial banks and trust companies. They have a high degree of dependence on intermediary business, in particular with agency securities trading business. During 2014 and the first half of 2015, China's securities considerably grew. However, during the second half of 2015, due to high volatility in the Shanghai and Shenzhen indices, some investors were forced to liquidate their positions when the price of underlying stocks fell below a certain threshold. We identify the Finance Services as shadow entity if the financial institution satisfies the *narrow* definition of the credit intermediation process (FSB, 2018). In addition, we carefully check the business description for each financial institution identified as Finance Services by *Refinitiv* with the criteria provided by Pozsar et al. (2010, 2013) and Ehlers et al. (2018). We only include *external* and *independent* shadow banking entities collecting accounting and financial variables for 74 listed finance services/broker companies.

A.3. Unlisted shadow entities

There are other unlisted shadow bank entities in China, which being unlisted do not play any role in determining systemic risk. For completeness, we only provide a short description of these entities.

A.3.1. Trust companies

China' trust sector is the third largest financial subsector and the riskiest. The trust companies have as their main objectives the support for private sector development and the financing outside the credit quotas imposed to traditional banks. They were established both by Chinese banks to support a growing market demand for loans on behalf of the rapid economic growth and local governments in raising funds directly, in order to finance local priority projects and obtain higher returns on their investment than through bank deposits. Trust companies are created in China' "shadow banking system" and despite the lending in subprime debt in the United States, these products are often opaque and most of the time they depend on high-risk underlying assets. Close to the trust companies, we can also find the asset management companies which are independent companies that received non performing loans from banks in order to manage and recover them by using several asset recovery methods.

A.3.2. Quasi-real estate investment trusts

The Quasi-Real Estate Investment Trusts (Q-REITs) carry out investment in real estate management and operations. These kinds of investments are relatively novel since the China' first REIT (The Penghua Qianhai Vanke Real Estate Investment Trust) went public on the Shenzhen stock exchange on June 26, 2015. In 2002, the PBoC issued the "Trust Investment Management" guidelines outlying the permissible operations of "real estate trust companies", recognized in China as "quasi-REITs" (Q-REITs) due to their similar structures and functions. Similarly to the REITs, these trust companies assemble portfolios of real estate assets and issue shares to a pool of investors. However, unlikely REITs, these entities are not publicly listed. The most common Q-REIT form is the trust and several players compose the Q-REITs: the fund holder, the fund supervisor, the property supervisor, the fund trustee and the consultant firm.

A.3.3. Credit guarantee companies

The Credit Guarantee Companies guarantee credit risk, by taking the responsibility for the risk. These companies are particularly subject to the riskiness of the transactions they guarantee. They are divided into financial bonding companies and non financial bonding companies; the first ones provide a guarantee for the fund holder, while the second guarantees advanced payments and commercial contracts. During 2001 to 2007, credit guarantee companies developed rapidly due to the joined by China of the World Trade Organization. Between 2008 to 2010, the Chinese government, in response to the financial crisis, has guaranteed the industry, causing some inflows of finance. From 2011, several regional credit guarantee companies have arisen, others, instead, have experienced difficulties. Some of them have engaged in riskier activity and have aroused supervisory organizations to examine them more in depth.

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[2] *"Credit intermediation involving entities and activities outside the regular banking system"* This definition is subsequently modified to include *"entities and activities fully or partially outside the regular banking system, or non-bank credit intermediation in short"* (Financial Stability Board, 2014, p. 4).

[3] *"A system of credit intermediation that involves entities and activities outside the regular banking system, and raises systemic risk concerns, in particular by maturity/liquidity transformation, leverage and flawed credit risk transfer, and/or regulatory arbitrage concerns"* (Financial Stability Board, 2014, p. 4).

A.4. Real estate finance services

Finally, in this paper we also consider the REFs. Real estate is considered as a pillar industry of the Chinese economy and its growth. Through the years, it has been promoted by the deep support of financial sector, particularly, the banking sector. A large share of capital, required by real estate companies, comes from bank loans thus determining a long-term structural unbalanced financing structure with banks bearing the majority of real estate market risk. Two main reasons explain this situation. On the one hand, real estate developers have insufficient funds of their own. On the other hand, although the development of China' capital market has opened financing channels for real estate companies (e.g., issuance of shares, bonds, trust financing), these channels are subject to many restrictions. Real estate sector is also particularly policy-sensitive. From December 2009 to December 2013, China began a massive real estate controls in order to curb housing prices (He, 2016).

Real estate finance developers face different kinds of financial risks. At a micro level, they could incur in operational, liquidity and credit risks; at a macro level, policy and bubbles risk require close attention by regulatory authorities. For the purpose of this paper, we are able to select listed 147 real estate finance services included in the group "Real Estate Finance and Services" provided by *Refinitiv*.

Appendix B. List of financial institutions

See Tables B.1–B.3.

Table B.1
Traditional banks.

Traditional Banks	
State Owned Banks	CHINA CONSN; BANK OF CHINA LTD; INDUSTRIAL & COML.BK.OF CHINA; BANK OF COMMS; AGRICULTURAL BANK OF CHINA
Non State Owned Banks	PING AN BANK; CHINA MERCHANTS BANK; CHINA MINSHENG BANK; HUA XIA BANK COMPANY; INDUSTRIAL BANK; CHINA CITIC BANK; BANK OF NINGBO; BANK OF NANJING; BANK OF BEIJING; SHAI.PUDONG DEV.BK.; CHINA EVERBRIGHT; CHONGQING RUR.COML.BK.; HARBIN BANK COMPANY; BANK OF CHONGQING; HUISHANG BANK; SHENGJING BANK; BANK OF QINGDAO CO.; BANK OF JINZHOU CO.; BANK OF ZHENGZHOU CO.; CHINA ZHESHANG BANK; BANK OF JIANGSU; BANK OF GUIYANG; JIANGSU JYN.RUR.CMLBK.; WUXI RURAL CMLBK.; POSTAL SAVINGS BOC.; JIANGSU CHGSH.RUR.CMLBK.; BANK OF HANGZHOU CO LTD; JIANGSU ZHANGJIAGANG RCBK.; ZHONGYUAN BANK; BANK OF CHENGDU; JIANGXI BANK.

Table B.2
Finance services.

Finance Services
SOUTHWEST SECURITIES; SHAANXI INTL.TRUST; SHANGHAI AJ GP.; HAITONG SECURITIES; CITIC SECURITIES; CHINA FINANCE ONLINE ADR 1:733; PACIFIC SECURITIES; EVERBRIGHT SECS.; CHINA MERCHANTS SECS.; HUATAI SECURITIES; INDUSTRIAL SECS.; SHANXI SECURITIES; NOAH HOLDINGS 'A' 2:684; FOUNDER SECURITIES; SOOCHOW SECURITES; AVIC CAPITAL; GUOSHENG FINL.HLDG.; WESTERN SECURITIES; HANHUA FINANCIAL HLDG.; CHINA GALAXY SECURITIES; NORTHEAST SECURITIES; GUANGDONG GLDN. DRAGON DEV.; SDIC CAPITAL; GF SECURITIES; GUOYUAN SECURITIES; SEALAND SECURITIES; CHANGJIANG SECURITIES; CENTRAL CHINA SECURITIES; SINOLINK SECURITIES; CHINA CINDA ASSET MANAGEMENT; GUOSEN SECURITIES; ZUOLI KECHUANG MCRFIN.; SHENWAN HONGYUAN GROUP; DONGXING SECS.; ORIENT SECS.; GUOTAI JUNAN SECS.; GUOLIAN SECURITIES; LUZHENG FUTURES; JUPAI HOLDINGS ADR 1:689; HENGTAI SECURITIES; CHINA HUARONG ASTMGMT.; CHINA INTL.CAP.; YIREN DIGITAL ADR 1:685; GUANGDONG JOIN-SHAREZHESHANG SECURITIES; FNG.GTEE.INV.; YINTECH INV.HDG.ADR 1:703; FIRST CAPITAL SECS.; HUAAN SECURITIES; CSC FINANCIAL; CHINA RAPID FINANCE ADR; ZHESHANG SECURITIES; QUDIAN ADR 1:684; CAITONG SECURITIES; HEXINDAI ADR; FINVOLUTION GROUP ADR 1:688; JIANPU TECHNOLOGY ADR 2:688; LEXINFINTECH HDG. ADR 1:685; HUAXI SECURITIES; JIANGSU FINANCIAL LEASING; NANJING SECURITIES; X FINANCIAL ADR 1:685; TIANFENG SECURITIES; CHINA GREATWALL SECURITIES; CNFINANCE HDG.ADR 1:703; WEIDAI ADR1:684; 1043 FINANCE ADR 1:2; CHINALIN SECURITIES; UP FINTECH HOLDING ADR 1:698; SHANGHAI DONGZHENG AUTOMOTIVE FINANCE; JIAYIN GROUP ADR 1:687; HAUN.INTL.LSG.; HONGTA SECURITIES; 9F ADR 1:684; NANHUA FUTURES; RUIDA FUTURES.

Table B.3
Real estate finance services.

Real Estate Finance Services
SHANGHAI SHIMAO; METRO LAND; JINAN HIGH-TECH DEVELOPMENT; GZH.PER.RVR.IND.DEV.; SHANGHAI GUIJIU; CHINA ENTERPRISE; CINDA REAL ESTATE; BEIJING ELECTRONIC ZONE HIGH-TECH GROUP; DONGGUAN WINNERWAY INDL. ZONE; ZHONGTIAN FINL.GP.; JINYUAN EP; LANDER SPORTS DEV.; WEDGE INDUSTRIAL; TIANJIN GUANGYU DEV.; HAINAN JINGLIANG HOLDINGS; ZHONGRUN RES.INV.; CHONGQING YUKAIFA; RONGAN PROPERTY; XIAMEN UNIGROUP XUE; LVJING HOLDING; TANDE; SHAI.CHENGTOU HLDG; SHANGHAI FUKONG INTACT. ENTM.; SHANGHAI NEW HUANG PU INDUSTRIAL GROUP; SHANGHAI CHNGTU.HDGCO.; SHANGHAI WANYE ENTS.; SHANGHAI FENGHWA GP.; SHANXI GUOXIN ENERGY; SHANGHAI TIANCHEN; EVERBRIGHT JIABAO; GUANGHUI LOGISTICS; SHANGHAI SHIBEI HI- TECH; GREENLAND HOLDINGS; TUNGHSU AZURE RENEW.EN.; SHENZHEN CENTRALCON INV. HLDG.; CHIN.MRCH.PR.OPRTN. & SER.; OCEANWIDE HOLDINGS; CHINA UNION HDG.; GRANDJOY HOLDINGS GROUP; SHAHE INDUSTRY; CHINA BAOAN GP.; SHN.ZHENYE (GROUP); SHN.FOUNTAIN; CHINA VANKE; HAINAN HAIDE IND.; SHAI.LJZ.FN&T.ZONE DEV.; SHAI.TONGJI SCTC.INDL.; SHANGHAI LINGANG HOLDINGS; TIANJIN REALITY DEV.; NANJING CHIXIA DEV.; ZHONGCHANG BIG DATA; SICHUAN LANGUANG DEVELOPMENT; BLACK PEONY (GP.); BEIJING CAPITAL DEV.; GUANGZHOU YUETAI; GEMDALE; DELUXE FAMILY; HUBEI WUCHANGYU; BEIJING VANTONE RLST.; BEIJING CAPITAL LAND; SHENYANG PUBLIC UTILITY HOLDINGS; LUSHANG HEALTH INDUSTRY DEVELOPMENT; TIANJIN SONGJIANG; TIANJIN TIANBAO INFR.; YINYI; HUAFA INDUSTRIAL ZHUHAI; GUANGDONG SHIRONGZHAOYE; YIHUA HEALTHCARE; GUANGZHOU R&F PROPS.; SHN.CAPSTONE INDL.; POLY DEVELOPMENTS AND HOLDINGS GROUP; JIANGSU DAGANG 'A'; COSMOS GROUP; RISESUN REAL ESTATE DEV.; XINYUAN RLST.ADR 1:685; HEFEI URBAN CON.DEV.; HANGZHOU BJ.RLST.GP.; WUHAN ET.LK.HI.TECH.GP.; WUHAN DDMC CULTURE & SPORTS; SICHUAN JINYU AUTMB.CITY (GROUP); CHINA SPORTS IND.GP.; BEIJING DALONG WEIYE RLST.DEV.; SHENZHEN HEUNGKONG HLDG.; GUANGDONG HIGHSUN GP.; BBMG 'H'; SHENZHEN WORLDUNION GROUP; LANGOLD RLST.; BEJ.URBAN CON.INV.DEV.; CHINA WLD.TRD.CENTER; WOLONG RLST.GP.; TIANJIN JINBIN DEV.; GREE REAL ESTATE; XINHU ZHONGBAO; BEJ.CENTERGATE TECHS. (HLDG.); CHINA CALXON GROUP; LANGFANG DEVELOPMENT; YUNNAN MET.RLST.DEV.; FANG ADR 1:684; WENFENG GT.WLD.CHN.DEV.; FINANCIAL STR.HLDG.; JIANGSU PHOENIX PR.INV.; ZHE JIANG DONG RI; YANGO GROUP; LEJU HOLDINGS ADR 1:684; SHN.WONGTEE INTL. ENTER.; FUJIAN START GROUP; SUZHOU NEW DISTRICT HI- TECH INDL.; SHANGHAI AIKO SOLAR ENERGY; BEIJING QIANFENG ELECTRONIC; YANG GUANG; HUA YUAN PROPERTY; CRED HOLDING; SHAI. ZHANGJIANG; SHANGHAI INDL.DEV.; FJN.ORNTL.SIS.INV.; BEIJING ZODI INVESTMENT; MACROLINK CRNT.DEV.; TIBET URBAN DEV.& INV.; HNA INV.GP.; WINSAN SHAI.MED.SCTC.; CHENGDU HIGH-TECH DEV.; SHUNFA HENGYE; VANFUND URB.INVDV.; JINKE PROPERTY GROUP; MYHOME RLST.DEV.GP.; RONGFENG HOLDING GROUP; BEH-PROPERTY; HAINAN YATAI INDL.DEV.; SUNING UNIVERSAL; ZHEJIANG GUANGSHA; KUNWU JIUDING INVESTMENT HOLDINGS; CCCG REAL ESTATE; BEIJING NORTH STAR; TIANJIN HI-TECH DEV.; CASIN REAL ESTATE DEVELOPMENT GROUP; NANJING GAOKE; CHINA WU YI; SANXIANG IMPRESSION; RED STAR MACALLINE GROUP; SEAZEN HOLDINGS; CHINA MRCH.SHEKOU INDL. ZONE; NACITY PROPERTY SERVICE GROUP; SIC.LANGUANG JUSTBON SSGP.; CHNG.NEW DAZHENG PR.GP.; POLY PROPERTY DEVELOPMENT; CHINA-SINGAPORE SZH. INPK.DEVGP.

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