How Effective are Macroprudential Policies on the Housing Market: Evidence from Hong Kong SAR

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Abstract. As counter-cycle tools, macroprudential policies have been utilized extensively in Asia to limit credit growth and tame housing price inflation. Utilizing a new policy action dataset and macroeconomic data of Hong Kong SAR, this paper analyzes the effects of macroprudential policies on stabilizing the credit and housing market. To investigate the efficacy of these measures, this paper adopts two empirical approaches. In traditional regressions, results show that loan-to-value (LTV) limit caps and debt-to-income (DTI) ratio have an indiscernible impact on the credit and housing market, and that most of policy actions are of less predictive value. In the difference-in-differences analysis, the loosening LTV policy in response to the Covid-19 crisis does not have the desired magnitude to heat up the credit and housing market, even if the asymmetric effects of tightening and loosening policies are taken into consideration. According to the analysis, heterogeneity in economies influences the effectiveness of macroprudential instruments and certain features in the financial system may make these policy instruments ineffective. Overall, these results shed light on guiding further exploration of the impacts of macroprudential policies in heterogeneous economies.

Keywords: Macroprudential policy instruments, credit growth, housing price growth, Hong Kong SAR.

1 Introduction

The real estate market has a significant impact on economic development and financial stability [1]. Real estate finance is the lubricant that facilitates the orderly operation of the housing market. However, when a real estate bubble bursts, the situation is reversed: as non-performance risks increase, banks raise credit standards and reduce credit supply, which causes a cascading decline in housing prices and rise in mortgage defaults [2]. Therefore, policymakers aim to mitigate risks of financial crises while enjoying benefits of housing finance. Apart from interest rates, macroprudential policies are policy instruments which central governments actively uses to stabilize the real estate market [3].

Banks for International Settlements (BIS) records indicate that the term 'macroprudential' dates to 1979, at a meeting where maturity transformation was discussed

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[4]. After the subprime crisis, researchers have increasingly shifted their attention to the use of macroprudential instruments to slow credit and housing price appreciation. Among them, the first one was Hilbers et al., who found that complementary to fiscal and monetary policies, macroprudential measures are crucial for stabilizing the financial system in Central and East European countries [5]. Baptista et al. found that macroprudential policies attenuate the housing price cycle in the UK by modelling the micro-level behavior and interactions of various parties [6]. Focusing on 57 advanced and emerging economies, Kutter and Shim showed that non-interest rate policy tools can be used to address financial stability concerns [7]. Using the data of macroprudential policy actions implemented in 28 EU countries, Poghosyan found that the impacts of macroprudential policies are generally delayed, and that tightening and loosening measures have asymmetric effects [8].

Furthermore, these measures have been used extensively in Asia to regulate the credit and housing market. Taking a comparative perspective, Funke and Paetz revealed that property acquisition taxes are more effective than LTV policies in curbing housing prices bubbles [9]. Kim and Oh employed a structural VAR model to examine the impacts of macroprudential policies on macroeconomic fundamentals [10]. Under the DSGE model, Deng et al. analyzed the transmission mechanism of housing price regulation in China, finding the merits of policy portfolio and ineffectiveness of real estate tax [11].

However, global evidences are mixed regarding how effective macroprudential policies are in stabilizing the financial system, after considering the heterogeneity of housing markets. Drawing on the evidence from Hong Kong SAR, this paper deals with the actual usage of macroprudential policies and critically assesses the efficacy of these measures on credit growth and housing prices. This paper uses both traditional regression analysis and difference-in-differences analysis to examine the effectiveness of these actions. The findings have policy implications for the use of macroprudential instruments and shed light on the further investigation of the ways in which the financial system influences the efficacy of these instruments.

2 Overview of Macroprudential Policies

Motivated by market failures and externalities, international organizations, represented by the Basel Committee, have designed various macroprudential tools, which have been prevalent in developed and emerging economies alike. These measures aim to mitigate systematic risks from various perspectives.

2.1 General credit policies

The Basel III added provisions for countercyclical capital buffers, requiring financial institutions to build up capital buffers so as to stop declines in economic downtown. The logic of this policy tool is as follows: capital buffer requirements are adjusted upward during economic booms to discourage bank lending and adjusted downward

during economic recessions to slow down the tightening of bank lending, thereby weakening the procyclical behavior of banks [3].

Policymakers typically require banks to maintain a minimum ratio of highly liquid assets to certain types of liabilities [12]. The primary goal is to avoid runs on banks or other financial institutions, especially when external shocks occur. The Basel III established two indicators. One is liquidity coverage ratio (LCR), which specifies a certain proportion of 'high-quality liquid assets' relative to their expected net cash flows [13]. Another is net stable funding ratio (NSFR), whose objective is to address longer-term liquidity mismatches.

During periods of increasing bank lending, limits are sometimes imposed on credit expansion in the private sector. This is typically in the form of a numerical cap on credit growth rates. Another characteristic of this policy measure is a range of penalties for violating specific limits. Relative to other general credit policies, this policy instrument was used less actively because it may cause distortions by imposing constraints beyond where financial instability originates [3].

2.2 Targeted Credit Policies

Regulators can adjust the pre-existing maximum ratio of residential mortgage to housing value to cool down or stimulate the housing market. LTV ratio affects the demand for lending through two main transmission channels [14]. From borrowers' perspective, LTV ratio implies the amount of down payment required, which affects their demand for mortgages. From investors' perspective, LTV ratio affects their ability to take on leverage to improve their return on equity.

DTI ratio is another policy instrument which affects the demand of mortgage loans. National authorities typically specify a certain proportion of home borrowers' monthly or annual income as the maximum monthly or annual repayment on housing mortgages. Therefore, this instrument directly aims to assess home borrowers' debt sustainability in the medium term [15].

There are three policy instruments targeted at the supply side of housing credit: provisioning, risk-weighting, and exposure limits. First, the provisioning system requires banks to establish loss allowance accounts for newly originated loans [16]. Second, risk weighting affects the cost of banks to extend housing mortgages relative to a fixed amount of bank equity [17]. Finally, exposure limits specify the maximum risk exposure of banks towards the housing market [18].

3 Data

The dataset draws on from a wide range of sources such as Hong Kong Monetary Authority (HKMA), Rating and Valuation Department of the Government of Hong Kong SAR and Census and Statistics of the Government of Hong Kong SAR. The author uses published data from central banks and government departments including circulars, statistical bulletins and chairman speeches from these institutions.

The data range is from 2008Q1 to 2022Q4 and this paper focuses on Hong Kong SAR. The policy dataset contains 20 policies, with most of them being tightening measures. Unless specified otherwise, daily, and monthly data in this paper are converted into quarterly data. Gross domestic product (denoted as Y) is in real terms. Housing credit (denoted as C) relates to property development and investment and purchase of residential properties. Housing price (denoted as HP) is calculated as the arithmetic mean of prices of domestic premises, offices, retail premises and flatted factories in the private sector. Because the quarterly population data (denoted as P) is not available, this paper uses the multiply of the number of households and the average number of household members as a proxy. Short-term interest rates (denoted as R) are in nominal values. Macroprudential variables (denoted as X) take on three discrete values: 1 for tightening measures, -1 for loosing measures and 0 for no action implemented. This means that if both a tightening measure and a loosening measure were taken in each quarter, they would cancel out each other. Due to distinct seasonal characteristics of GDP, housing credit and housing prices, these macroeconomic data are seasonally adjusted using the SPL decomposition method.

4 Empirical Analysis

4.1 Conventional Time Series Regression Analysis

This paper utilizes the change rate of housing credit and housing prices as indicators of the efficacy of macroprudential policies. Drawing on Kuttner and Shim's research, this paper first identifies macroeconomic variables that influence housing credit and housing prices. Then this paper establishes time series regression models as benchmarks, in which macroeconomic variables causing multicollinearity are excluded using the stepwise regression method. Finally, macroprudential variables are fitted to regression equations so that the effects of these policy actions can be analyzed from various perspectives [7].

This paper begins with the analysis of housing credit. Before analyzing the impact of the macroprudential policies, the author estimates the baseline regression equation for housing credit without these policy variables. Eq. (1) shows the baseline model for housing credit, with standard errors in parentheses where R2 = 0.36, F = 10.68:

$$\Delta \ln C_t = \underset{(0.12)}{0.35}\Delta \ln C_{t-1} + \underset{(0.08)}{0.23}\ \Delta \ln Y_{t-1} + \underset{(0.09)}{0.15}\Delta \ln Y_{t-2} \quad (1)$$

The coefficient of the first lag of housing credit is 0.35, suggesting that housing credit shows modest positive serial correlation. In addition, GDP growth accelerates housing credit growth. The coefficient of 0.23 on the first lag of GDP growth implies that a percent point increase in GDP growth tends to be followed by over one-fifth of a percent point in housing credit growth. Subsequently, this paper builds a model with macroprudential variables included in the regression equation:

$$\Delta \ln C_t = \alpha + \beta_1 \Delta \ln C_{t-1} + \beta_2 \Delta \ln Y_{t-1} + \beta_3 \Delta \ln Y_{t-2} + \sum_{i=1}^{2} \gamma_i \cdot X_{i,t} + \varepsilon_t \quad (2)$$

where X_i represents macroprudential variable. Macroprudential variables are included in two ways: one policy variable at a time and two variables altogether. The results are shown in Table 1. It is worth noting that neither of these two macroprudential policies has statistically significant impact on housing credit, both individually and jointly included. The parameter estimates of LTV and DTI from regression models have positive signs, paradoxically implying that macroprudential policies seem to strengthen the procyclical behavior of housing credit. This conclusion, however, should be reached with some caution warranted because of the caveats of endogeneity and the sample size (discussed further in Section 4.2). In fact, policymakers in Asia have frequently used macroprudential policies in the wake of conditions in the housing credit market.

Table 1. Time series regression results for housing credit.

Variable	Individually Included		Jointly Included
$\Delta \ln C_{t-1}$	0.343***	0.356***	0.397***
	(0.119)	(0.116)	(0.121)
$\Delta \ln Y_{t-1}$	0.224**	0.218**	0.229***
	(0.085)	(0.083)	(0.084)
$\Delta \ln Y_{t-2}$	0.138	0.121	0.152
	(0.097)	(0.092)	(0.096)
LTV	0.002		-.0009
	(0.004)		(0.008)
DTI		0.006	0.0140*
		(0.005)	(0.008)
R^2	0.366	0.383	0.398
F	7.938***	8.540***	7.127***

Notes: Standard errors are shown in parentheses. Asterisks stand for statistical significance: *** for 1%, ** for 5% and * for 10%.

Table 2. Time series regression results for housing prices.

Variable	Individually Included		Jointly Included
$\Delta \ln HP_{t-1}$	0.472***	0.522***	0.475***
	(0.097)	(0.098)	(0.098)
R_{t-1}	-3.345***	-3.239***	-3.378***
	(0.974)	(1.006)	(0.979)
R_{t-2}	2.336**	2.123**	2.380***
	(0.880)	(0.903)	(0.886)
LTV	0.027**		0.036**
	(0.011)		(0.018)
DTI		0.018	-0.014
		(0.013)	(0.020)
R^2	0.593	0.564	0.596
F	19.994***	17.813***	15.949***

Notes: Standard errors are shown in parentheses. Asterisks stand for statistical significance: *** for 1%, ** for 5% and * for 10%.

Turing to housing prices, the author first estimates the baseline regression equation for housing prices omitting macroprudential variable. Equation 3 shows the baseline

model for housing prices, with standard errors in parentheses with $R^2 = 0.55$ and F = 22.72.

$$\Delta \ln HP_t = 0.57\ (0.09)\Delta \ln HP_{t-1} - 3.23\ (1.01)\ R_{t-1} + \ 2.04(0.91)R_{t-2} \tag{3}$$

The above regression model yields similar results with those of housing credit. Housing price changes are positively serially correlated, though the correlation is higher than housing credit. The coefficients of the first and the second lag of the nominal interest rate are statistically significant. Moreover, the negative -3.23 coefficient on the first lag of interest rates suggests that a one percent increase in short-term interest rates gives rise to a decrease in housing prices by 3.23 percent points in the next quarter. Similarly, this paper then builds regression models with macroprudential variables included first one by one, and then all at once in the equation:

$$\Delta \ln HP_t = \delta + \zeta_1 \Delta \ln HP_{t-1} + \zeta_2 R_{t-1} + \zeta_3 R_{t-2} + \sum_{i=1}^{2} \eta_i \cdot X_{i,t} + \upsilon_t \tag{4}$$

As shown in Table 2, the coefficient for the LTV variable is statistically significant at the 5% level. However, the positive sign is inconsistent with previous expectations. Furthermore, DTI requirements do not have the desired effects and magnitudes which are economically meaningful. The caveats are still applicable about the policy sample size and the fire-fighting characteristic of macroprudential policies. Finally, when two policy variables are included, the coefficients for LTV and DTI have different signs. One reasonable conjecture is that LTV and DTI instruments are always used concurrently, causing multicollinearity. This conjecture can be further evidenced by the positive correlation between these two macroprudential variables.

4.2 Difference-in-differences Estimation

The regression analysis in the previous section yields preliminary results for the efficacy of macroprudential policies. Nevertheless, regressions such as equation 2 and equation 4 are susceptible to two main critiques. One critique is that endogeneity may give rise to biased parameter estimates, making it difficult to reliably analyze the policies' effectiveness. For instance, HKMA has introduced many rounds of countercyclical macroprudential measures in response to conditions in the property market. Statistically, the linear relationship between the policy variable and omitted variables may lead to reverse causality. Another critique is that the sample size of policy measures makes traditional regression analysis difficult. In the sample period when no action is observed, the ternary indicators cannot capture changes in policy actions. Tillmann argues that it is difficult to analyze the efficacy of macroprudential policies, because they are not actively taken and often used within a short time frame [19].

Due to the limitations of traditional regression analysis, this paper introduces difference-in-differences estimation to quantify the effectiveness of macroprudential policies. Relative to other techniques, DID estimation controls both unobservable individual heterogeneity within the sample and the effects of unobservable variables that vary over time, yielding unbiased estimates of policy effects [20].

In August 2020, HKMA announced to adjust LTV ratio caps for mortgage loans on non-residential properties upward from 40% to 50%. This release provides a quasi-natural experiment where the efficacy of macroprudential policies can be examined. The sudden and unexpected policy shock enables a DID approach to be carried out. As discussed in Section 3, properties are broadly classified into four types: private domestic premise, private office, private retail premise and private flatted factory. Specifically, the author defines the latter three types as the treatment group, since they are applicable to the LTV policy. By contrast, private domestic premise is defined as the control group, which is not applicable to the LTV policy.

The difference-in-differences models allow for the difference between the treatment group and the control group, but the parallel assumption should be satisfied before analysis. To test this precondition, the author compares the changes in the growth rate of housing prices between 2016 and 2022 in two groups. In this section, monthly data are used instead. As depicted in Fig. 1, the growth rate of housing prices for two groups were nearly at the similar level before 2020, indicating a pre-parallel trend essential to the validity of the DID estimation. Nevertheless, the patterns of changes in housing prices only provide weak visual evidence for a discontinuity in the trend after the introduction of the LTV policy in 2020.

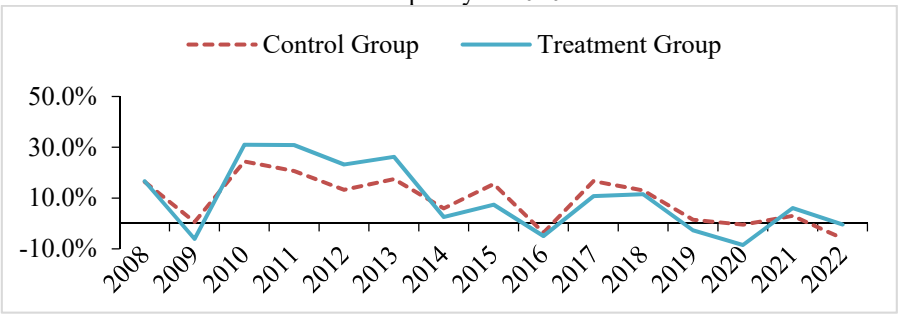

Fig. 1. Housing prices changes in two groups.

Table 3. The 2020 LTV policy and housing prices (2016-2022) DID.

	$\Delta \ln HP_{it}$		
	(1)	(2)	(3)
$d_t \times d_j$	0.009	0.010*	0.010*
	(0.006)	(0.006)	(0.006)
Constant	0.005***	0.015***	0.016***
	(0.002)	(0.003)	(0.004)
Post*Treatment	Yes	Yes	Yes
$\Delta \ln HP_{it-1}$	Yes	Yes	Yes
R_{t-1}	No	Yes	Yes
R_{t-2}	No	No	Yes
Observations	84	84	84
R^2	0.044	0.132	0.135

Notes: The baseline model is in column (3). Standard errors are shown in parentheses. Asterisks stand for statistical significance: *** for 1%, ** for 5% and * for 10%.

Having verified the above precondition, this paper implements the DID estimation in the following equation:

$$\Delta \ln HP_{it} = \alpha_0 + \alpha_1 d_t + \alpha_2 d_j + \beta d_t \times d_j + \alpha_3 X_{it} + \varepsilon_{it} \quad (5)$$

where $\Delta \ln HP_{it}$ is the growth rate of housing prices, d_t is a dummy variable that identifies the treatment group, and d_j is another dummy variable that equals 1 for months after August 2020 and 0 for months before August 2020. The vector of control variables includes the first lag of $\Delta \ln HP_{it}$ and the first and the second lag of short-term interest rates. The coefficient β estimates the effect of LTV ratio caps. Table 3 summarizes the DID regression results. From column (1) to column (3), control variables are fitted into the DID estimation equation respectively. It is clear that the LTV policy which takes effect from August 2020 does not have the desired magnitude to heat up the housing market considerably (only statistically significant at the 10% level). Though the DID analysis yields similar results as those for the traditional regression analysis, one possibility cannot be excluded that the effects of tightening and loosening actions are asymmetric[21]. Fortunately, the previous pre-parallel trend assumption test provides some assurance to the results derived. Consider the period before the beginning of the sample period, during which tightening LTV policies targeted at non-residential properties were actively used. No evidence is observed that tightening LTV policies created an obvious break point in housing price trend.

5 Conclusion

Using a newly organized policy database of Hong Kong SAR and two econometric methods, this paper has examined the impacts of macroprudential policies on housing credit and housing prices. The conventional regression analysis finds that LTV limit caps and DTI ratio had an indiscernible impact on the credit and housing market, and that most of policy actions were used to put out the existing fire in the market. Meanwhile, the DID analysis shows that the loosening LTV policy in response to the Covid-19 crisis does not have a tangible impact on heating up the credit and housing market.

One contribution of this paper is an extended policy action database of Hong Kong SAR. The database organizes speeches, press releases, circulars, and other information of HKMA, especially those published after the COVID-19 pandemic. Another contribution is that this paper introduces difference-in-differences estimation to quantify the effectiveness of macroprudential policies. Relative to other techniques, this empirical method is less susceptible to endogeneity and is more logically clear.

The analysis is based on the evidence from Hong Kong SAR. Certainly, there is no reason to argue that the effects of macroprudential policies will be the same in other countries or regions. Flexibility at the microprudential level is also critical in stabilizing the housing market since no single policy instrument fits in all economies. The focus of following studies is to understand how heterogeneous features in the financial system influences the efficacy of macroprudential policies.

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