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Housing Loan and the Price of Housing in Singapore

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Abstract: We use the Johansen co-integration test and the Vector Error Correction Model (VECM) to analyze data on housing loan, housing price, interest rate and GDP from 19911Q to 20102Q to particularly ascertain the extent to which housing loan affects house prices in Singapore. The results show the existence of a long run co-integration among housing loan, house price, interest rate and GDP. Furthermore, housing loan is found to be positively correlated with house price and GDP but negatively correlated with interest rate in the long run. There seems to be no correlation between housing loan and house price in the short run. Moreover, a change in housing loan per se does not affect house price, neither does a change in house price per se affect housing loan in the short run. Thus, while there is long run equilibrium among housing loan, house price, interest rate and GDP, the causality direction between housing loan and house price is somewhat obscure. This implies that targeting housing loan as a means to control property price inflation in Singapore may not achieve the immediate desired result.

Key words: housing loan; housing price; Johansen test; vector error correction model; correlation
JEL codes: C12, C30, C32, R21, R30, R38

1. Introduction

The Singapore residential property price index fell by 33.16% over four quarters from the peak of 177.5 in 2Q2008 to the trough of 133.3 in 2Q2009. When the market began to recover from its trough in 2Q2009, the index rose by 15.8% in just one quarter (i.e., 2Q2009-3Q2009). Over a period of four quarters (2Q2009-2Q2010), the index rose by 38.18% to 184.2. The high probability of property price bubble so soon after the immediate past financial crisis caused anxiety in the market. Young Singaporeans particularly got worried that the sharp property price inflation over such a short period would make it impossible for them to purchase their dream housing. The Asian Development Bank (ADB) was also concerned about the Singapore banking sector when it found the sector's exposure to property market (51% of total loan) to be the highest among the nine major economies in East Asia. Alarmed by the socio-economic and political consequences of a looming property price bubble, the government twice introduced measures in 2010 to control property prices. The first measure, introduced in February 2010, reduced the loan-to-value (LTV) ratio from 90% to 80%. This was followed by a further lowering of the LTV ratio to 70% for second home purchase. It is implicit from these measures that the government considers housing loan to be the major cause of the property price inflation. We therefore investigate the long and

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short-run relationships between housing loan and house price to ascertain the extent to which the government can use the loan-to-value ratio as a viable policy option to control property price inflation.

2. Literature Review

There are two main theories on the relationship between housing loan and house price. One theory posits that house price affects housing loan while the other conversely argues that housing loan affects house price.

2.1 House Price Affect Housing Loan

Davis and Zhu (2010) argue that the change in aggregate demand is a function of the change in the value of assets including real property. When the value of assets increases, the owners feel richer and thus tend to spend more. Ando and Modigliani (1963) took an individual consumer’s utility as a function of the individual’s aggregate consumption in current and future periods. Ando and Modigliani (1963) found that the maximization of utilities of that person is subject to the resources available to him, which include the sum of current and discounted future earnings over his lifetime and his current net worth. Thus the current spending and borrowing of the individual can be expressed as a function of his resources. The more resources he has, the more he spends and borrows money. Therefore, high housing price, real or expected, triggers more Housing Loans.

This conclusion is confirmed by Muellbauer (1994) who finds that the slump in consumer expenditure is associated with a slump in asset price. In other words, low housing price lowers consumer expenditure to lower housing loan accordingly. The wealth effect explanation for the relationship between housing price (HP) and housing loan (HL) is replicated by Iacoviello (2004) who conclude that borrowers’ credit capacity, constrained by their collateral values, provides a reasonably good description of consumption dynamics. People consume more/less when the collateral values are high/low. Similarly, borrowers more freely spend and/or take bigger loans than usual during periods of rising property values.

Furthermore the proposition that HP affects HL is supported by the agency cost (deadweight loss) theory. The agency costs of undertaking physical investments are, on one hand, inversely related to the borrower’s collateralized net worth (Bernanke & Gertler, 1989). On the other hand, agency cost is also inversely related to Housing Loan. This means that agency cost is low when the collateralized house’s price is high and thus, encourages people to take more loans (Gerler, 1988).

The final theory that supports the causal relationship between HP and HL is the collateral effect theory (Oikarinen, 2008). Banks are more willing to expand loans vis-a-vis better security. Property owners have a better chance of getting larger loans when property price increases because of the balance sheet effect (Oikarinen, 2008). Increase in collateral value improves bank capital, augmenting banks’ possibilities and willingness to grant Loan.

2.2 Housing Loan Affects Housing Price

The price of real property is a function of the anticipated income and the discount factor used to convert the expected flow of income into capital value. Since the discount factor directly varies with the interest rate, the price of real property is inversely related to interest rate (Oikarinen, 2009). Moreover, as an increase in the availability of loan relative to demand lowers interest rate to stimulate current and future economic activities, the resultant expected higher returns from property and lower discount factor lead to increased HP. Thus, an increase in HL leads to HP inflation.

Miguel et al. (2006) argue that the relationship between HL and HP is a function of supply and demand. Property is a durable good with inelastic supply in the short run. Cheaper loans make housing affordable to more people to increase the demand for housing. The synergistic effect of inelastic supply and rising demand is increased HP. This implies that cheap bank lending is a contributory factor of increased HP. The sustained HP inflation in the US over the decade before the sub-prime crisis attests to the proposition that cheap bank lending, among other things, leads to house price inflation.

2.3 Past Empirical Studies

Hong Kong bank lending and property price were examined in 2004 by Gerlach and Peng (2004). The results of the Error Correction models indicate that property price determines bank lending and that the latter does not seem to affect the former. Furthermore co-integration analysis shows that property price is weakly exogenous as bank lending adjusts to property price rather than the converse. Moreover, Gerlach and Peng (2004) demonstrate that the sensitivity of credit to property price declined in the early 1990s as banks tightened credit. These results suggest that bank lending was not responsible for the boom and bust cycles of the property market in Hong Kong.

Liang and Cao (2006) use a high dimensional autoregressive distributed lag (ARDL) framework with gross domestic product (GDP) and Interest Rate to find that there is a unidirectional causality running from bank Lending to property price. In addition, the causality runs interactively through the Error Correction term from bank Lending, GDP and Interest Rate to property price. Liang and Cao (2006) conclude that while interest rate might not be a sufficient tool to control property price, the Government still can use it together with other tight credit policy to control property price inflation.

Gimeno and Carrascal (2006) investigate the relationship between HL and HP by using loan for house purchase (consumers' viewpoint) instead of banking loan as a whole, real GDP and Interest Rate as variables in their analyses. The results show that in the long run, both HP and HL are inter-dependent—HL is positively related to HP while there is also a causality running from the HL to HP. However the causality seems to go in both directions in the short run to imply the existence of mutually reinforcing cycles in both variables.

Greece, Brissmis and Vlasspoulos (2008) investigate the relationship between HP and HL in Greece via the multivariate co-integration techniques. The results of the long run analysis reveal that HP is weakly exogenous—It does not react to disequilibria in the mortgage Lending market. Thus, it is not so certain that there is the causality from HL to HP in the long run. However, the short run analyses provide clear indications of a contemporaneous bi-directional dependence between HL and HP

Oikarinen (2008) examines the interaction between HP and household borrowing to conclude that there is a strong two-way interaction between HP and HL in the short term. This interaction adds to the boom-bust cycles in the economy to increase the fragility of the financial sector. In addition, Housing Price movements have a notable positive impact on consumption Loan. Moreover, it is found that the interaction between HP and credit substantially increased after the financial deregulation in the late 1980s.

Oikarinen (2009) studies Household borrowing and metropolitan Housing Price dynamics in Helsinki. While previous studies were carried out on the national level, this paper targets a single regional housing market—the Helsinki Metropolitan area in Finland. HL to GDP ratio is used to find a stationary long-run relation between household borrowing and Housing Price. The co-integration analysis indicates that the long run connection between real Housing Price, real income and Loan to GDP ratio has been stable despite the credit market deregulation and other institutional changes that took place during the period under investigation. This finding suggests that the Loan to GDP ratio is useful in explaining the changes in long-run relationship between Housing Price and income that we would expect as a result of credit market liberalization.

This two-way causality between borrowing and Housing Price helps to understand the mutually reinforcing cycles in credit and housing markets. A positive effect of the availability of credit is increased household borrowing which causes higher demand for housing to push up HP. Similarly, increased Housing Price will further loosen borrowing constraints to lead to the availability of more credit. However, the short-run dynamics is not stable under credit market liberalization. Causality from Housing Price to credit only seems to appear in the long-run. On the whole, the analyses support the hypothesis that household borrowing provides significant information that relates to housing demand and thus, HP.

The above discourse shows that there is no consensus on the relationship between HP and HL. While some of the empirical studies conclude that both HP and HL are mutually inter-dependent, others conclude causality from one to the other and vice versa. Furthermore the variables that have been used in all the studies are, HL, HP, GDP and interest rates. Given the policy implications of the relationship between HP and HL, and the use of HL as a regulatory tool for the residential property market of Singapore, we proceed to examine the relationship between HP and HL in Singapore.

3. Data

We use quarterly HL, HP, interest rate and GDP data over the period of 1991Q1 to 2010Q2 for the study. The end period of 2010Q2 is a reflection of when the study was started. The housing loan data relate to consumers' quarterly housing loans extracted from the Emerging Market Information Service (EMIS). Figure 1 shows an upward trend of housing loans (about 4% per quarter increase) during the period. The only notable decline occurred in 2004Q3—26% decline from SGD 165,575 million in 2004Q2 to SGD 122,398 million in 2004Q3.

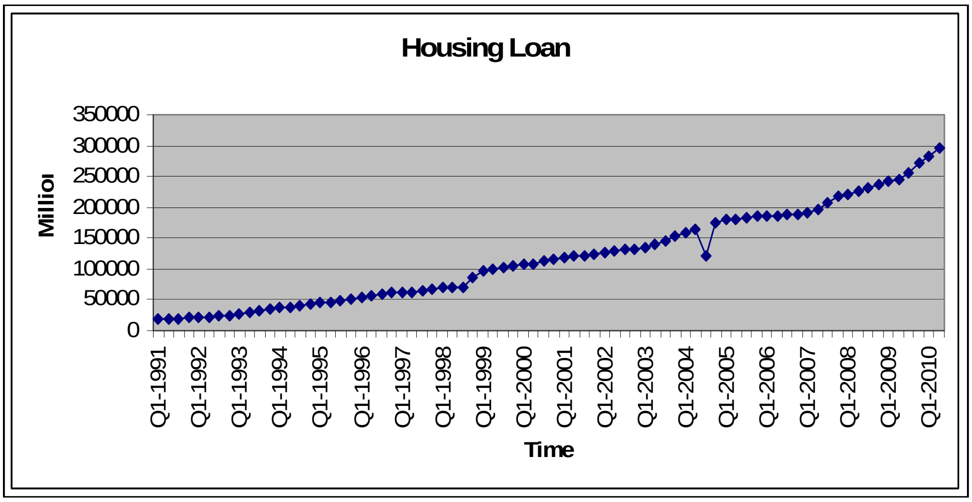

Figure 1 Housing Loan

Source: Based on data from EMIS

The HP data were extracted from the Private residential Property Price Index (Figure 2) obtained from the Real Estate and Land Information System (REALIS). Figure 2 demonstrates an upward trend in property prices from 1991 (58.7) to 1996Q2 when the index reached a peak of 184.4. The price index then began to decline as a result of the anti-speculation legislation, South-East Asian Financial Crisis and oversupply until it reached a trough of 100 at the end of 1998. The next notable decline was from a peak of 177.5 in 2008Q2 to 133.3 by 2009Q3. The first two quarters of 2009 registered a decline of 14.07% and 4.71% respectively in property prices.

The index began an upward trend at the end of 2009Q3, and by 2010 Q2, a period of three quarters, the index had reached a new peak of 184.2.

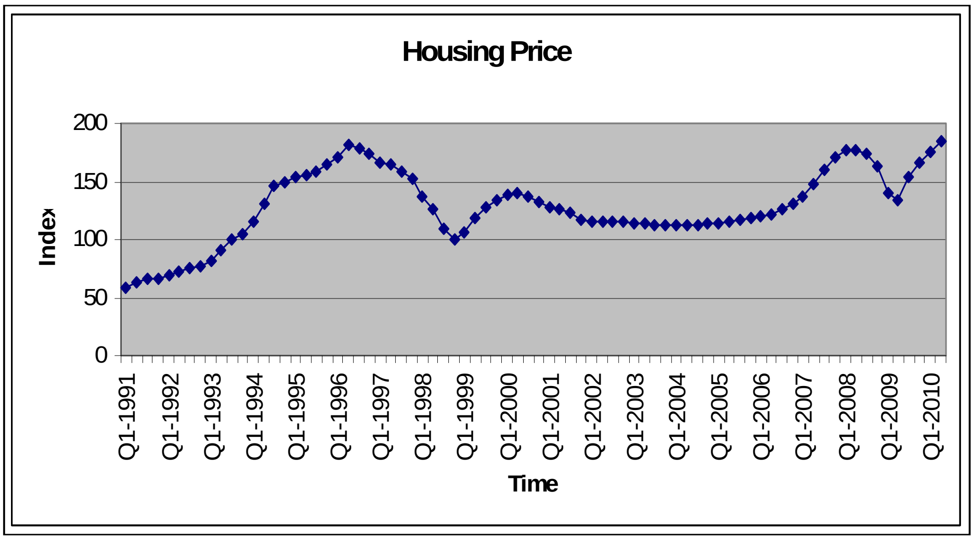

Figure 2 Singapore Private Residential Property Price Index (1991Q1-2010Q20)

Source: Based on data from REALIS

The interest rate data used for the study are the 3-month Singapore Inter Bank Offer Rate (SIBOR) as lending rates are virtually based on SIBOR. The data were extracted from the Monetary Authority of Singapore's (MAS) website. Figure 3 shows how interest rates have been ridiculously low over the years.

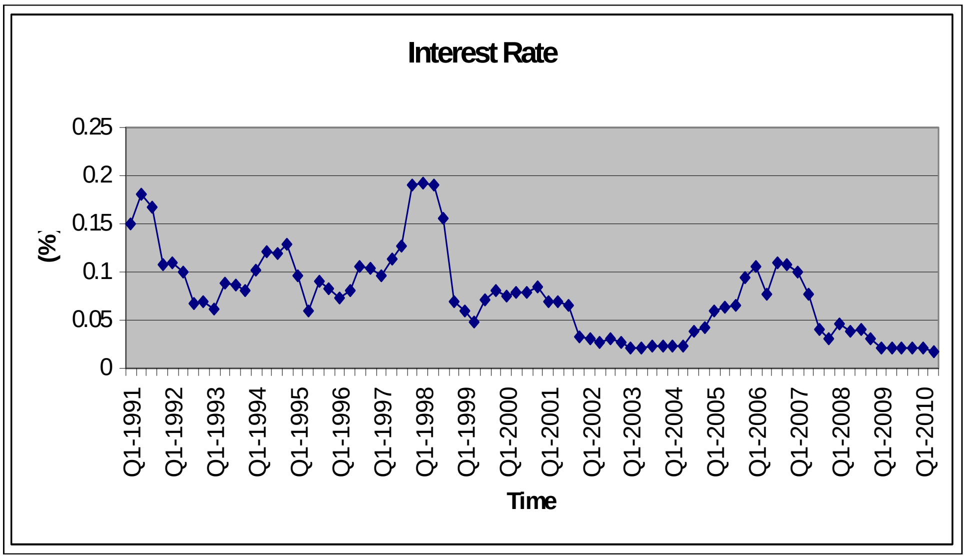

Figure 3 Singapore Inter Bank Offer Rate

Source: Based on data from MAS

The GDP data for the study were obtained from Singstat Time series Online Directory. Figure 4 depicts an upward trend over the period except in 2009Q1 when there was a decline of 10% from the preceding quarter. However, this was followed by a quick recovery in 2009Q2.

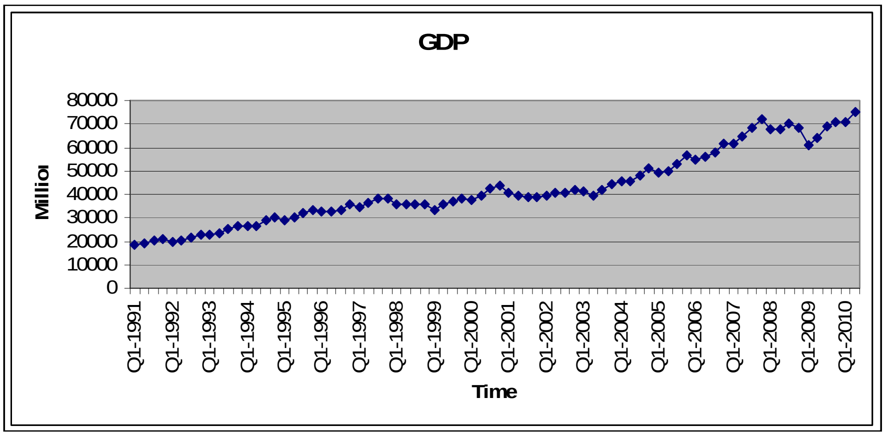

Figure 4 Singapore GDP

Source: Based on data from STS

4. Methodology

We investigate the relationship between HP and HL via the unit root test and Johansen Co-integration test. The unit root test is operationalized through the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The two unit root tests are used for robustness check. Both tests have three cases related to three formulae and yield similar results. However, PP test has been shown to be more powerful when the data exhibit heteroscedasticity and serial correlation (Phillips & Perron, 1998). Furthermore it is used as a cross-check as ADF test loses power for sufficiently large values of *p*, the number of lags (Ghosh et al., 1999). The three cases of ADF in accordance with the three formulae are:

Case one: Time series is flat and potentially slow-turning around zero:

$$\Delta Zt = \theta Zt - 1 + \alpha 1 \Delta Zt - 1 + \alpha 2 \Delta Zt - 2 + ... + \alpha p \Delta Zt - p + at \qquad (1)$$

This equation does not have an intercept term or a time trend.

The null hypothesis of ADF t test: H_0: $\theta = 0$

The alternative hypothesis: H_1: $\theta < 0$

Case two: Time series is flat and potentially slow-turning around a non-zero value:

$$\Delta Zt = \alpha 0 + \alpha 1 \Delta Zt - 1 + \alpha 2 \Delta Zt - 2 + ... + \alpha p \Delta Zt - p + at \qquad (2)$$

This equation has an intercept term but no time trend.

Null hypothesis, H_0: $\theta = 0$

Alternative hypothesis, H_1: $\theta < 0$

Case three: Time series has a trend, and is potentially slow-turning around a trend line:

$$\Delta Zt = \alpha 0 + \theta Zt - 1 + \gamma t + \alpha 1 \Delta Zt - 1 + \alpha 2 \Delta Zt - 2 + ... + \alpha p \Delta Zt - p + at \qquad (3)$$

This equation has an intercept term and a time trend.

Null hypothesis, H_0: $\theta = 0$

Alternative hypothesis, H_1: $\theta < 0$

Where $\alpha 0$ is the constant, γ is coefficient of the time trend t, αi are coefficients of the ith order lagged differenced series $\Delta Zt\text{-}i$. The number of augmenting lags p used in ADF formula is determined by either minimizing the Schwartz Bayesian or Akaike information criterion.

The Johansen's estimation model for analyzing the long run relationships between HP and HL is:

$$\Delta Xt = \mu + \sum_{i=1}^{p} \prod_{i} \Delta Xt - i + \alpha\beta Xt - i + \varepsilon t \tag{4}$$

$X\,t\text{-}i$ = (n x 1) vector of all the non- stationary variables

$\prod_i$ = (n x n) matrix of coefficients.

ε: error term

α = (n x r) matrix of Error Correction coefficients or matrix of loading factors where r is the number of co-integrating relationships in the variables, so that 0 < r < n. This measures the speed at which the variables adjust to their equilibrium. It is also known as the adjustment parameter.

β = (n x r) matrix of r co-integrating vectors, so that 0 < r < n. This is what represents the long-run co-integrating relationship between the variables.

As mentioned above, there are two different co-integration test statistics under Johansen' method: Trace Test and Maximum Eigenvalue Test. The Trace Test is a joint test that tests the null hypothesis of no co-integration (H_0: r = 0) against the alternative hypothesis of co-integration (H_1: r ≥ 0). The Maximum Eigenvalue test on each eigenvalue tests the null hypothesis that the number of co-integrating vectors is equal to r against the alternative of (r + 1) co-integrating vectors (Brooks, 2008).

$$\lambda\, trace\ (r) = -T \sum_{i=r+1}^{g} \ln(1 - \lambda i) \tag{5}$$

$$\lambda \max(r, r+1) = -T \ln(1 - \lambda(r+1)) \tag{6}$$

r = number of co-integrating vectors under the null hypothesis

λi = estimated i-th ordered eigenvalue from the $\alpha\beta$ matrice

A significantly non-zero eigenvalue indicates a significant co-integrating vector.

One of the concerns of performing Co-integration test is the assumption of deterministic components since it would have great impact on the asymptotic distribution of the λ-trace and λ-max statistics. Hence if it is not carefully specified, the role of deterministic components might cause mis-interpretation of co-integration results (Yunus, 2009).

Five trend assumptions in Johansen include:

Assumption one - H0(r): quadratic trend in levels of data and linear trend in the Error Correction term

Assumption two - H0*(r): linear trend in both levels of data and the co-integrating relationships

Assumption three - H1(r): linear trend in levels of data and co-integrating equations contain intercept only

Assumption four - H1*(r): no deterministic trend in the levels of data, intercept in co-integrating relationships

Assumption five - H2(r): no deterministic trend in the levels of data and no intercept in Error Correction term

In practice, assumption one and five are rarely used. Assumption one may provide a good fit in-sample but produce implausible forecasts out of sample. Assumption five is only used if all series have zero mean. According to the guide book for EVIEWS, assumption four is applied if none of the series appears to have a trend. For trending series, it is recommended to use assumption three if all trends are stochastic. In case of some trend stationary, assumption two would be a good choice. Therefore assumption two is used in this paper.

4.1 Normalizing on Housing Loan and Error Correction

We will normalize the resulting co-integrating relationship on the log of Housing Loan so that the coefficient on this variable is equal to one. This step is equivalent to the finding matrix β in Equation (4). Matrix β or the normalizing equation serves as a guide to how each variable (Housing Price, Interest Rate and GDP) moves relative to Housing Loan (Hill & Carter, 2008).

Lastly, the Error Correction or loading factors, which is matrix α in equation 4 will show the direction of causality between Housing Loan and Housing Price in the long run (Gerlach & Peng, 2004; Brissmis & Vlassopoulos, 2008). The |t-statistic| of loading factors/error correction for these two variables will be compared with the |Critical t-value|. If that loading factor for one variable (for example, Housing Price) is significant (|t-statistic| is bigger than |Critical t-value|), the disequilibrium in the market for the other variable (for example Housing Loan) appears to lead to adjustment in Housing Price. In other words, the change in Housing Loan causes the change in Housing Price. Conversely, if the loading factor for Housing Price is not significant (|t-statistic| is smaller than |Critical t-value|), the disequilibrium in the market for Housing Loan does not appear to lead to adjustment in Housing Price. In other words, a change in Housing Loan does not cause a change in Housing Price (Table 1)

Table 1 Condition Whether Change in Housing Loan Causes Change in Housing Price

$\lvert t_{HP\ LF}\rvert > \lvert t_{critical}\rvert$	Change in HL causes change in HP
$\lvert t_{HP\ LF}\rvert < \lvert t_{critical}\rvert$	Change in HL does not cause change in HP

Note: $t_{HP\ LF}$ is the t-statistic of Housing Price's loading factor
Source: Author

4.2 Short Run Analysis

To complete the investigation of interaction between Housing Loan and Housing Price we turn to the short-run analysis and estimate the dynamic relationships for each of the variables. The regression model is in the form:

$$\Delta HL = f\,(\Delta HP, \Delta GDP, \Delta\ IR) + Zt \tag{7}$$

Where $Zt = HL- f\ (HP, GDP, IR)$; $f\ (HP, GDP, IR)$ is obtained from the normalizing equation; ΔHL, ΔHP, ΔGDP, ΔIR are accordingly the difference of Housing Loan, Housing Price, GDP and Interest Rate. The coefficient for each variable shows how a change in an independent variable (Housing Price, GDP and Interest Rate) affects a change in the dependent variable (Housing Loan). EVIEWS is used for all our computations.

5. Results

According to the results in Tables 2 and 3, ADF tests lead to the conclusion that HL has/has not unit root at the level form/first differencing. The PP tests (not reported) yield similar results. Thus, HL is integrated of order one, I(1). The test results for HP and GDP (Table 3) are similar to HL–integration at order one, I(1). However, interest rate neither has a unit root at the level form nor at first differencing. The PP test results, on the other hand, show that interest rate is integrated at order one, I(1). Since PP test is superior to ADF for being robust to heteroscedasticity and autocorrelation of unknown form (Phillip & Perron, 1998), interest rate meets the requirement for co-integration test.

Table 2a ADF test for Housing Loan at Level Form

Null Hypothesis: HOUSING_LOAN has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG = 11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.234406	0.4638
Test critical values:	1% level	-4.083355	
	5% level	-3.470032	
	10% level	-3.161982	

*MacKinnon (1996) one-sided p-values.

Table 2b ADF Test for Housing Loan at First Difference

Null Hypothesis: D(HOUSING_LOAN) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG = 11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.35540	0.0001
Test critical values:	1% level	-4.083355	
	5% level	-3.470032	
	10% level	-3.161982	

*MacKinnon (1996) one-sided p-values.

Table 3a ADF and PP test for Housing Price and GDP

Variable		ADF test		PP test	
		Level form	First difference	Level form	First difference
HP	ADF&PP-t	-2.38503	-4.364243	-2.453788	-3.760081
	5% Critical-t	-2.900137	-2.90067	-2.899619	-2.900137
	Unit root (non-stationary)?	Yes	No	Yes	No
GDP	ADF&PP-t	-2.429385	-4.41763	-2.574255	-8.152644
	5% Critical-t	-3.473447	-3.553447	-3.469235	-3.470032
	Unit root (non-stationary)?	Yes	No	Yes	No

Source: Author – Based on EVIEWS

Table 3b ADF and PP test for Interest Rate

Variable		ADF test		PP test	
		Level form	First difference	Level form	First difference
IR	ADF&PP-t	-3.133902	-7.457154	-2.451376	-7.471329
	5% Critical- t	-2.900137	-2.900137	-2.899619	-2.900137
	Unit root (non-stationary)?	No	No	Yes	No

Source: Author - Based on EVIEWS

5.1 Long Run Analysis

The trace test and the maximum Eigenvalue test results presented in Tables 4a and 4b indicate that there is one co-integration equation among the four variables: HL, HP, GDP and interest rate (IR).

Table 4a Johansen Co-integration with Trace Test

Sample (1991 Q1- 2010 Q2)
Included observations = 76 after adjustments
Trend assumption = linear trend in both levels of data and co-integrating relationships
Series included: log10 Housing Loan, log10 Housing Price, Interest Rate, log10 GDP
Rank (1, 1) - (determined by AIC-Akaike Information Criteria)

Hypothesized Number of Co-integrating Equations	Trace Statistic	0.05 Critical Value	Probability
None	67.88973	63.87610	0.0221
At Most 1	28.19062	42.91525	0.6106
At Most 2	15.84747	25.87211	0.5048
At Most 3	7.35499	12.51798	0.3089

Source: Author - Based on EVIEWS

Table 4b Johansen Co-integration with Maximum Eigenvalue

Sample (1991 Q1- 2010 Q2) Included observations = 76 after adjustments Trend assumption = linear trend in both levels of data and co-integrating relationships Series included: log10 Housing Loan, log10 Housing Price, Interest Rate, log10 GDP Rank (1, 1) - (determined by AIC-Akaike Information Criteria)			
Hypothesized Number of Co-integrating Equations	Max-Eigen Statistic	0.05 Critical Value	Probability
None	39.69911	32.11832	0.0049
At Most 1	12.34315	25.82321	0.8507
At Most 2	8.492477	19.38704	0.7754
At Most 3	7.354992	12.51798	0.3089

Source: Author - Based on EVIEWS

5.2 Normalizing on Housing Loan

The purpose of this section is to find β matrix in Equation (4), which indicates the long run elasticity of Housing Loan with respect to Housing Price, Interest Rate and GDP. The results in Table 5 show that HP and GDP are positively correlated with HL, while IR is negatively correlated to HL. All the coefficients are statistically significant at the 5% level of significance. Every 1% increase/decrease in HP and GDP is associated with a 6.707% and 24.333% increase/decline respectively in HL in the long run. Alternatively, every 1% increase/fall in IR leads to a 0.125% reduction/increase in HL in the long run.

Table 5 Normalizing on Housing Loan

Sample (1991 Q1 - 2010 Q2) Included observations = 76 after adjustments Number of co-integrating equation = 1 Series included: log10 Housing Loan, log10 Housing Price, Interest Rate, log10 GDP			
Variable	Coefficient	Standard errors	t-statistics
Housing Loan	1	-	-
Housing Price	-6.707668	1.22595	-5.47143
Interest Rate	0.125580	0.02105	5.96639
GDP	-24.33317	3.86765	-6.29145

Source: Author - Based on EVIEWS

5.3 Error Correction

Given the long run equilibrium among the four variables, the causality direction between HP and HL is explored through vector of loading or adjustment coefficients or Error Correction, which is the α matrix in the Equation (4). The results in Table 6 show that neither of the variables has a statistically significant causality effect on the other in the long run.

Table 6 Error Correction

Variable	Loading coefficients	Standard errors	t-statistics
Housing Loan	-0.00295	0.00823	-0.03584
Housing Price	0.008533	0.00535	1.59455

Source: Author - Based on EVIEWS

5.4 Short Run Analysis

Table 7 shows the results for the short-run analysis, with the dependent variable being a change in HL while the independent variables are ΔHP (change in Housing Price), ΔIR (change in Interest Rate), ΔGDP (change in

GDP), and *Zt variable* as in Equation (7).

A change in IR is negatively related to a change in HL while a change in GDP is positively correlated with a change in HL. Both variables are statistically significant at the 0.05 level of significance. This implies that a change in HL is associated with a change in IR and GDP in short run. However, the focus of the study is the association between HL and HP. Although a change in HP is positively correlated to a change in HL, the correlation is not statistically significant at the 0.05 level. This implies that there is no significant association between HL and HP in the short-run. Notwithstanding that HL and HP significantly move in the same direction in the long run, they appear to be independent of each other in the short run.

Table 7 Short-run Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δ *HP*	0.105675	0.172519	0.612538	0.5421
Δ *IR*	-0.003836	0.001819	-2.108991	0.0384
Δ *GDP*	1.074298	0.080225	13.39101	0.00000
Zt	-0.000336	0.000753	-0.445908	0.657
C	0.049601	0.097881	0.506744	0.6139
R-squared	0.997403	Adjusted R-squared		0.997261
F-statistic	7009.348	Prob (F-statistic)		0.00000

6. Conclusion

The paper set out to investigate the long- and short-run causal relationship between HL and HP to ascertain the effectiveness of HL as a regulatory tool for controlling HP in Singapore. We therefore used the Johansen co-integration test and the Vector Error Correction Model (VECM) to analyze data on housing loan, housing price, interest rate and GDP from 19911Q to 20102Q to particularly ascertain the extent to which housing loan affects house prices in Singapore.

The results show the existence of a long run co-integration among housing loan, house price, interest rate and GDP. Furthermore, housing loan is found to be positively correlated with house price and GDP but negatively correlated with interest rate in the long run. There seems to be no correlation between housing loan and house price in the short run. Moreover, a change in housing loan per se does not affect house price, neither does a change in house price per se affect housing loan in the short run. Thus, while there is long run equilibrium among housing loan, house price, interest rate and GDP, the causality direction between housing loan and house price is somewhat obscure. This implies that targeting housing loan as a means to control property price inflation in Singapore may not achieve the immediate desired result.

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