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This study estimates the price elasticity of new housing supply in Malaysia. It models the new housing supply for different types of houses namely, detached, high-rise, semi-detached and terraced houses. This study employs structural approach that relates housing start to house price, construction cost and interest rate. The price elasticity of new housing supply is estimated directly from the coefficient of house price. The model is estimated based on autoregressive distributed lagged (ARDL) approach by using quarterly data covers the sample period from 2002 to 2015. The results show that housing start is positively related to house price. An increase in house price pushes the quantity supplied of new houses but the magnitude is less than unity showing that new housing supply is price inelastic in Malaysia during the period. Among the four types of houses, the supply of high-rise houses has the highest elasticity while the supply of detached houses has the lowest elasticity.

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1. Introduction

Housing is a basic human need and an important sector of a country's economic growth. It is the aim of the Malaysian government to deliver more affordable houses in the country. However, house prices in Malaysia have witnessed substantial increase during 2011-2015 where report claims that the Malaysian housing markets are seriously unaffordable (Bank Negara Malaysia (BNM), 2015). This scenario has motivated a number of studies to examine house price trends in Malaysia (for example, Hui, 2013; Lean and Smyth, 2013; Lean and Smyth, 2014; Yeap and Lean, 2020). With the worry of a possible house price bubble, the Malaysian government has implemented some anti-speculation measures such as reintroducing the real property gain tax (RPGT), lowering the loan-to-value ratio to 70% for third mortgage funding and restricting developer's sales program i.e. developer interest bearing scheme (DIBS). These policies are mainly used to tackle the demand-side of the housing market which aims to lower the housing demand and hence the house prices.

Nevertheless, recent reports show that Malaysia experienced shortage of housing supply during 2011-2015 (BNM, 2015; REHDA, 2016). BNM (2015) estimated that during 2011-2015, 80,089 units of average new housing completed annually were far below the 166,000 average annual increase in the number of households. This number tells us there is an annual shortage of 85,911 units of housing over the period. The increasing price of housing could be due to insufficient supply of housing to meet the increased demand (Khazanah Research Institute, 2015). In view of this, building more houses is suggested to revert the escalating house prices in the country. However, housing supply may be constrained by land availability and regulations. Physical limitations on land and the degree of urbanisation can restrict housing supply in certain areas (OECD, 2011). Furthermore, we should not assume the supply elasticity of different types of houses to be identical because some buildings like high-rise houses involve greater complexities in production (McLaughlin, 2011). As such, it is important to understand the supply elasticity in housing market.

Price elasticity of housing supply plays an important role in explaining the movement of house prices. The price elasticity of housing supply measures how responsive the supply of housing is to a change in house price, i.e. how many new houses to be built in response to an increase in demand. We are likely to observe a substantial house price increases with an inelastic supply of housing. A responsive housing supply to prices could reduce the volatility in house prices. However, there has been no empirical research to document the magnitude of the elasticity of housing supply in Malaysia thus far. Therefore, the purpose of this paper is to remedy the research gap by offering evidence of price elasticity of new housing supply in Malaysia at aggregate level as well as different housing sub-markets.

The contributions of our study are twofold. First, we contribute to the literature by developing a model of new housing supply based on autoregressive distributed lag (ARDL) framework. Although ARDL framework is a commonly used method in time series econometric analysis, it has not been applied in the previous empirical studies to estimating housing supply. Second, we apply ARDL to estimate the long-run and short-run price elasticity of new housing supply for different types of houses in Malaysia. While most studies on housing supply focus on estimating housing starts at national and aggregate level, both Gitelman and Otto (2012) and McLaughlin (2011) study housing supply in Australia by classifying the housing market into strata and non-strata categories or single- and multi-family units respectively. We extend their works by including four different types of dwellings in Malaysia, namely terraced, semi-detached, detached and high-rise houses.

We find evidence that new housing supply in Malaysia is price inelastic. The supply of high-rise houses has the highest price elasticity while the supply of detached houses has the lowest price elasticity. These findings provide new evidence to the international housing market. As an emerging economy, housing market in Malaysia is suffered with overhang issue (Lee, 2014). In order to mitigate the negative impact of properties overhang in the country, the authorities of Malaysia are cautious in housing project's approval. This action leads to an inelastic housing supply to house price changes. Furthermore, this unique feature can be extended more generally to other housing markets that have the similar characteristic.

The remainder of this paper is organized as follows. In Section 2, we review empirical studies of the determinants of new housing supply and report the estimates of price elasticity of new housing supply which have been obtained in recent studies. Section 3 discusses the data and methodology used in this study. The empirical results and discussions are presented in Section 4 while Section 5 concludes the study.

2. Literature Review

The price elasticity of housing supply is defined as the percentage change in quantity of new housing supplied to a percentage change in house price. Generally, there are two approaches used in identifying the price elasticity of housing supply. The first approach employs a reduced form price approach. This approach is used by Malpezzi and Mayo (1997), Malpezzi and Maclennan (2001), Harter-Dreiman (2004). A reduced form equation is estimated with house price as the dependent variable and indicators of demand and supply as the explanatory variables. The price elasticity of housing supply can be identified indirectly through the estimated reduced form equation with assumptions regarding the income and price elasticities of demand. One difficulty with this approach is that one needs to assume the parameters of demand elasticities. As such, recent studies apply a more direct approach or a structural approach that relates housing supply to a set of indicators such as price and cost variables. The price elasticity of housing supply is the coefficient of house price when the variables are expressed in natural logarithm form. This approach has been widely used by many authors such as Wigren and Wilhelmsson (2007), Ball et al. (2010), Caldera and Johansson (2012).

Some studies also examine supply elasticities across region based on structural approach. These studies mainly show that there are significant differences in supply elasticities across region, which is due to regulation for land and housing development policies. For instance, Green et al. (2005) conclude that highly regulated areas exhibit low elasticities and high density areas produce lower elasticities. They reported price elasticity of housing supply ranges from 1.43 to 21.6 in the US cities. However, Meen (2005) reports the price elasticity of housing supply in all regions in the UK is lower compared to the US. Long-run supply elasticity varies between 0.00 and 0.84. Oikarinen et al. (2015) also evidence a substantial regional variation in the supply elasticity across Finland with an inelastic supply of housing that ranges from 0.2 to 0.8.

All the above studies looking at the aggregate housing supply at national and regional level. Nonetheless, Ball et al. (2010) acknowledge that supply elasticities may vary across housing sub-markets by adding sub-market dummies into the hedonic model of housing stock growth. This study has not targeted to estimating the supply elasticities of different housing sub-markets. Only two studies are found to examine housing supply elasticity based on types of dwellings focusing on Australia housing market. In the first study, McLaughlin (2011) argues that price elasticity of new housing supply varies between housing types. For land-intensive housing, such as detached houses, which experience lesser new supply and higher prices tend to have relatively inelastic new supply while for land-economizing housing, such as high-rise units, with greater new supply and relatively smaller increase in prices tend to have relatively elastic new supply. Meanwhile, Gitelman and Otto (2012) find that housing supply is inelastic in Australia and it is relatively larger for strata properties like apartments and flats than non-strata properties like detached, semi-detached, terraced and townhouses. They conclude that demand-driven increase in house prices are likely to change the type of housing towards more flats and apartments.

For the study in Malaysia, Malpezzi and Mayo (1997) investigate aggregate housing supply in Malaysia and find that inelastic supply caused boom and bust cycle in Malaysian property market in the late 1980s. Even though Hui (2008) has not particularly focused on housing construction in Malaysia, his study provides two models which are quite related to the present study. The first model estimates the aggregate construction output based on house price and construction cost while the second model regresses gross fixed capital formation on house price and other macroeconomic factors. By using ARDL approach, house price and real GDP are found to have a positive and statistically significant impact on construction output as well as the residential investment in both the short-run and long-run. Hui (2009) has also found that a 1% increase in house price significantly increases gross investment spending by 0.5% in the long-run. However, due to data limitations, Hui (2008 and 2009) only estimate aggregate construction output and investment spending rather than the sub-components of construction sector specifically on residential sub-components.

3. Research Methodology

3.1 Data

Data used in this study are quarterly data covering the sample period from 2002Q3 to 2015Q4. Housing starts is used to proxy for new housing supply. This data is published by National Property Information Centre (NAPIC). The Malaysian house price index (HPI) published by NAPIC is used to represent house prices. For housing starts and house price index, we use the aggregate and disaggregate (namely high-rise, detached, semi-detached and terraced) data. Construction cost is proxied by building materials cost index (BMCI) and is collected from Construction Industry Development Board Malaysia (CIDB). Interest rate is represented by 3-month Treasury Bill (TB) which is collected from Monthly Statistical Bulletin published by Bank Negara Malaysia (BNM). All data are transformed into natural logarithm series except BLR. Taking natural logarithm for each variable allows us to interpret the coefficient as the supply elasticity where a percent change in the dependent variable is associated with a percentage change in housing approvals.

3.2 Methodology

We estimate new housing supply in Pesaran et al. (2001) autoregressive distributed lag (ARDL) framework. The relationship between housing starts (HS), house price (HP), construction cost (CC) and interest rate (IR) is specified as follows:

$$HS_t = \alpha + \sum_{i=1}^{p} \beta_i HS_t + \sum_{i=0}^{q} \theta_i HP_t + \sum_{i=0}^{r} \delta_i CC_t + \sum_{i=0}^{s} \gamma_i IR_t + \phi D_{GFC} + \mu_t \qquad (1)$$

To infer the long-run relationship between housing starts, house price, construction cost and interest rate, ARDL approach to cointegration is employed where Equation (1) can be specified in an unrestricted error correction model (UECM) as follows:

$$\Delta HS_t = \alpha_0 + \beta_0 HS_{t-1} + \theta_0 HP_{t-1} + \delta_0 CC_{t-1} + \gamma_0 IR_t + \phi D_{GFC} + \sum_{i=1}^{p-1} \beta_i^* \Delta HS_{t-i} + \sum_{i=0}^{q-1} \theta_i^* \Delta HP_{t-i} + \sum_{i=0}^{r-1} \delta_i^* \Delta CC_{t-i} + \sum_{i=0}^{s-1} \gamma_i^* \Delta IR_{t-i} + \varepsilon_t \quad (2)$$

where

HS: housing starts which is proxied by aggregate housing starts (HSA) as well as four different types of housing starts namely detached housing starts (HSD), high-rise housing starts (HSH), semi-detached housing starts (HSS) and terraced housing starts (HST).

HP: house price which is proxied by aggregate house price index (HPA) as well as four types of disaggregate house price index namely detached house price index (HPD), high-rise house price index (HPH), semi-detached house price index (HPS) and terraced house price index (HPT).

CC: construction cost which is proxied by building material cost index (BMCI)

IR: interest rate which is proxied by 3-month treasury bill rate (TB).

D_{GFC}: dummy variable that represents global financial crisis. D_{GFC} takes value 1 from 2008Q4 to 2010Q2 and 0 otherwise.

From Equation (2), the existence of a long-run relationship among the variables can be tested where the null hypothesis of no cointegration is stated as H_0: $\beta_0 = \theta_0 = \delta_0 = \gamma_0 = 0$. F-statistic is computed and compared with the critical bounds provided by Narayan (2005). After confirming the presence of cointegration among the variables, the long-run coefficients of HP, CC and IR are given by $-\theta_0/\beta_0$, $-\delta_0/\beta_0$ and $-\gamma_0/\beta_0$ respectively while the short-run coefficients of these explanatory variables are given as $\Sigma\theta_i^*$, $\Sigma\delta_i^*$, and $\Sigma\gamma_i^*$ respectively. To ensure the goodness of fit of the model, diagnostic tests on autocorrelation, heteroskedasticity and normality of the residuals are performed. Functional form misspecification is also performed by using Ramsey's RESET test.

The coefficient of interest in this equation is $-\theta_0/\beta_0$ which measure the long-run price elasticity of new housing supply and $\Sigma\theta_i^*$ which measure the short-run price elasticity of new housing supply. Economic theory predicts that new housing supply is inelastic in the short-run because construction takes time while new housing supply is elastic in the long-run. Based on this general consensus, the long-run price elasticity of new housing supply is expected to be greater than one and significantly different from zero (i.e. $-\theta_0/\beta_0 > 1$) and the short-run price elasticity of new housing supply to be significantly between zero and one.

4. Results and Discussions

Table 1 reports the descriptive statistics of all variables used in this study. The variables are shown in their levels and the quarterly percentage change (growth rate). Among the housing starts for different types of dwellings, terraced houses are the most common type of housing built in Malaysia with the highest mean followed by high-rise and semi-detached houses. Detached housing is the least common type of housing with the lowest mean over the study period. The growth rates of all variables are also reported. The average quarterly growth of aggregate housing starts declined by 0.05%. The negative growth of aggregate housing starts reflects falling rates of housing construction. For landed properties, detached housing is the only sub-market that provides a positive average quarterly growth of 0.21% while semi-detached and terraced housings show a negative quarterly growth with -0.33% and -1.16%, respectively. Over the sample period, mean house prices increased between 1.4-1.6%. Detached house prices experienced the highest growth rate (1.58% per quarter) while terraced house prices registered the lowest (1.44% per quarter).

Focusing on the relationship between housing starts and house prices, construction of new houses at aggregate level has declined despite the rise in average house price. At disaggregate level, construction of semi-detached and terraced houses has also declined despite the rise in the prices of these two types of houses. Although the quarterly growth of detached and high-rise housing starts recorded a positive rate, they have not kept pace with the changes in their house prices. This possibly shows that there is unmatched demand and supply in the high-rise and detached houses.

Table 1 Descriptive statistics

		Mean	Std. Dev.	Maximum	Minimum	Jarque-Bera	Obs.
HSA	Level	34,127	8,716	53,566	17,191	0.66	54
	(Growth rate)	-0.05%	18.63%	36.26%	-45.11%	1.67	53
HSD	Level	1,070	409	2,291	393	20.24***	54
	(Growth rate)	0.21%	42.38%	90.29%	-100.32%	0.5068	53
HSH	Level	13,030	6,175	33,917	3,310	20.02***	54
	(Growth rate)	0.76%	36.44%	59.81%	-94.82%	1.64	53
HSS	Level	3,310	714	4,844	1,843	0.92	54
	(Growth rate)	-0.33%	21.74%	43.19%	-44.00%	0.59	53
HST	Level	15,721	3,609	25,872	9,460	3.23	54
	(Growth rate)	-1.16%	16.28%	33.84%	-40.14%	0.27	53
HPA	Level	148.09	38.24	230.50	105.60	7.23**	54
	(Growth rate)	1.47%	1.20%	3.95%	-1.84%	0.39	53
HPD	Level	160.09	43.28	251.40	105.50	5.89*	54
	(Growth rate)	1.58%	2.63%	8.12%	-3.68%	1.21	53
HPH	Level	146.26	41.87	240.40	108.80	10.00***	54
	(Growth rate)	1.50%	2.22%	6.25%	-6.19%	9.51***	53
HPS	Level	153.89	39.35	235.30	104.50	5.82*	54
	(Growth rate)	1.53%	2.20%	8.07%	-3.40%	5.42*	53
HPT	Level	145.50	36.73	225.60	105.30	7.39**	54
	(Growth rate)	1.44%	1.36%	4.37%	-1.64%	0.79	53
CC	Level	83.98	14.44	102.97	60.38	5.52*	54
	(Growth rate)	0.89%	3.65%	13.39%	-15.91%	191.07***	53
TB	Level	0.72%	0.11%	0.89%	0.48%	4.25	54
	(Growth rate)	0.14%	6.22%	0.15%	-0.27%	115.64***	53

Note: ***, ** and * denote statistically significant at 1%, 5% and 10% respectively. HSA: aggregate housing starts; HSD: housing starts of detached houses; HSH: housing starts of high-rise houses; HSS: housing starts of semi-detached houses; HST: housing starts of terraced houses; HPA: aggregate houses price; HPD: detached houses price; HPH: high-rise houses price; HPS: semi-detached houses price; HPT: terraced houses price; CC: construction cost; TB: 3-month treasury bill quarterly rate (in %); Growth rate is calculated by using the first difference of natural logarithm.

The unit root tests of all variables were examined using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests as well as Zivot and Andrew (ZA) unit root test to endogenously determine the possible existence of structural break in the series. The results of unit root tests are reported in Table 2. Findings from ADF and PP unit root tests show that HSD and HSS are stationary in their level, I(0), while all other variables are stationary in their first differences, I(1). Moreover, ZA unit root test shows that all variables are stationary at level. The structural break point for HSA, HSH, and HSD fall on the period of GFC while break point for HSD and HSS occur later in 2011Q2 and 2011Q3, respectively. The results of unit root tests confirm that none of the variables is integrated of order two, I(2), and the ARDL bounds test can be used to test for cointegration of variables.

Table 2 Unit root tests

	ZA (Intercept and trend)		ADF (Intercept and trend)		PP (Intercept and trend)		
	Level	Break point	Level	First diff	Level	First diff	
HSA	-4.7674***	2008Q4	-2.5992	-7.3585***	-2.5400	-9.5243***	I(1)
HSD	-6.8308***	2011Q3	-5.8081***	-11.775***	-5.7811***	-29.4940***	I(0)
HSH	-5.9063**	2009Q4	-2.8198	-7.6748***	-2.7215	-15.3300***	I(1)
HSS	-5.0257***	2011Q2	-4.2941***	-6.9310***	-4.3870***	-12.0450***	I(0)
HST	-3.6173*	2008Q4	-2.0949	-10.757***	-3.0938	-10.7570***	I(1)
HPA	-4.9589***	2008Q4	-0.8144	-7.4153***	-0.8277	-7.4339***	I(1)
HPD	-4.1552***	2008Q4	-1.8961	-8.7943***	-1.7591	-8.9325***	I(1)
HPH	-4.6041***	2008Q4	-0.8631	-9.6502***	-0.8638	-9.3967***	I(1)
HPS	-3.7428**	2008Q4	-0.9163	-11.373***	-1.3364	-11.272***	I(1)
HPT	-4.8703***	2008Q4	-0.8112	-8.4192***	-0.7319	-8.4188***	I(1)
CC	-3.8747***	2007Q4	-2.4600	-6.0760***	-1.7448	-6.1128***	I(1)
TB	-4.9715***	2008Q4	-2.6474	-6.0115***	-2.5157	-6.0171***	I(1)

Note: *** and ** denote significant at 1% and 5% respectively. The lag length in ADF test is determined by using Schwarz Information Criteria. The PP test is based on Newey-West bandwidth with Barlett kernel estimation.

Due to small sample size of 54 observations, this study employs Schwarz Information Criteria (SIC) to select the optimum lag length. With the maximum lag of four, SIC suggests ARDL (1,0,0,2) for HSH model and ARDL (1,0,0,0) for all other models. Table 3 tabulates the results of ARDL[1]. The bounds test results show that the F-statistic is greater than the upper bound critical values at 1% significant level for all models except HST at 10% level. This shows strong evidence for the existence of a long-run relation between housing starts and the explanatory variables.

The long-run and short-run coefficients of the explanatory variables are reported in Table 3. In the long-run, house price is found to be significant and positive for all types of houses. Increase in house prices indicate more attractive returns for construction firms and induce more new construction of houses. This finding is identical to the finding reported by DiPasquale and Wheaton (1994), Mayer and Somerville (2000a and 2000b) and McLaughlin (2011) for the studies in the U.S. and Australia. Besides that, this finding provides an additional

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[1] To assess the robustness of the results, we also estimate the housing starts models by using real interest rate. The results are presented in Table A1 (refer Appendix). We find that the sign and the significance of the estimated coefficients are closely identical to the previous results.

support to Hui (2008) that house price positively influences construction output. Our results show that house price significantly affects construction of new houses. The long-run coefficient of house price provides an estimate of price elasticity of new housing supply which will be discussed latter in this section.

Table 3 ARDL results

$$\Delta HS_t = \alpha_0 + \beta_0 HS_{t-1} + \theta_0 HP_{t-1} + \delta_0 CC_{t-1} + \gamma_0 IR_t + \sum_{i=1}^{p-1} \beta_i^* \Delta HS_{t-i} + \sum_{i=0}^{q-1} \theta_i^* \Delta HP_{t-i} + \sum_{i=0}^{r-1} \delta_i^* \Delta CC_{t-i} + \sum_{i=0}^{s-1} \gamma_i^* \Delta IR_{t-i} + \phi D_{GFC} + \varepsilon_t$$

	HSA	HSD	HSH	HSS	HST
Optimum lag	(1,0,0,0)	(1,0,0,0)	(1,0,0,2)	(1,0,0,0)	(1,0,0,0)
Bounds test					
F-statistic	6.3042***	13.9439***	6.4181***	9.3384***	4.1612*
Long-run coefficients					
HP	0.8249***	0.3502**	1.5425***	0.4268***	0.6378**
CC	-1.0996**	-1.9802*	-1.8191**	-0.3464	-0.5907
IR	-0.1395	0.5458	0.6208	0.3607	-0.2213
Short-run coefficients					
ECT_{t-1}	-0.6366***	-1.1466***	-0.6544***	-0.8898***	-0.6137***
HP	-1.4744	0.4142	1.4781	1.0699	0.7460
CC	-0.4458	-2.3007*	-1.9077*	-0.5838	0.0596
IR	0.0282	1.5598**	-0.9613	1.0423***	-0.2881
D_{GFC}	-0.3165***	-0.4405***	-0.4292***	-0.2017**	-0.2338***
Diagnostic test					
R^2	0.6952	0.3272	0.6949	0.4894	0.6265
Adjusted R^2	0.6628	0.2557	0.6463	0.4351	0.5868
Serial correlation (χ^2)	9.7217**	6.0077	7.3582	1.1206	10.2682**
Heteroskedasticity (χ^2)	3.2298	1.7784	3.4649	1.2769	6.6316
Normality (χ^2)	1.7959	2.2135	2.8459	17.3187***	2.6574
Ramsey RESET (F)	0.0035	0.5727	0.5675	4.1486**	2.8593*

Note: ***, ** and * denote statistically significant at 1%, 5% and 10% level respectively. The optimum lags are selected based on Schwarz Information Criteria. The upper and lower bound critical values are from Narayan (2005), case III (unrestricted intercept and no trend) with n=55, k=3: 1% [4.828, 6.195], 5% [3.408, 4.623], 10% [2.843, 3.920].

Likewise, construction cost is found to be significant and negative for HSA, HSD and HSH models. An increase in construction cost would lower construction of new houses. By contrast, a positive long-run coefficient of construction cost on construction output was reported by Hui (2008). Nevertheless, construction cost has not prevailed to be significant for new construction of landed properties such as semi-detached and terraced houses. This result shows consistency with DiPasquale and Wheaton (1994) and Mayer and Sommerville (2000) that the coefficient of construction cost is not statistically significant different from zero. The reason might be due to the production or construction of landed properties, which is considered as land-intensive, is influenced more by land cost compared to construction cost[2].

Interest rate that reflects the cost of capital for developers is found to be insignificant in all housing starts models. This shows that changes in interest rate will not influence the decision of housing developers to alter the quantity of new houses built because developers can easily transfer the cost from rising interest rate to house buyers by increasing the selling price. The insignificance of interest rate is also noted in other studies such as DiPasquale and Wheaton (1994), Mayer and Sommerville (2000), Neto (2005) and McLaughlin (2011). By contrast, other authors like Topel and Rosen (1988) and Blackley (1999) find the interest rate has a significant negative impact on housing starts.

In the short-run, the coefficient of the ECT_{t-1} is negative and significant at 1% level for all models which confirm the finding that there is a long-run relationship among the variables. The coefficient of ECT_{t-1} indicates that new housing supply adjusts quite rapidly and instantaneously to the long-run equilibrium. The speed of adjustment for HSA, HSH and HST ranges between 61% to 66% while it is close to unity for HSS and rather more than 100% for HSD. This finding shows that high-rise and terraced housing starts revert to their long-run equilibrium within 1.5-1.6 quarters while detached housing starts adjust to equilibrium within one quarter. Similar to the long-run results, changes in construction cost influence housing starts of detached and high-rise houses significantly. Although interest rate was not found to influence housing starts for all types of houses in the long-run, it has significant positive impact on detached and semi-detached housing starts in the short-run.

The dummy variable for global financial crisis (D_{GFC}) has a statistically significant negative effect on housing starts for all types of houses. This shows the construction of new houses was slowed down during the crisis. Besides that, we also acknowledge that housing policy such as RPGT may affect new housing supply. To control the effect of housing policy, we use dummy variable to represent different revision of RPGT rate. However, the coefficient of the dummy variable has not turned out to be statistically significant and hence this dummy has been left out from the regression model.

Based on the results from ARDL, the long-run price elasticity of new housing supply has been estimated at aggregate and disaggregate levels. Table 4 summarizes the estimated price elasticity of new housing supply for different types of dwellings. At aggregate level, the price elasticity of new housing supply is 0.8249. This shows that for a 1% increase in house price, quantity supplied of new housing will increase 0.8249%. Although it is close to unity, it

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[2] We thank an anonymous referee for the suggestion. The opposite signs of the long-run coefficients of HP and CC provide evidence for Tobin's q mechanism. Tobin's q ratio for housing is defined as the market value of an additional unit of housing stock to its replacement cost. The Tobin's q ratio for HSA = 0.8249/-1.0996 = -0.75, HSD = 0.3502/-1.9802 = -0.18, HSH = 1.5425/-1.8191= -0.85, HSS = 0.4268/-0.3464 = -1.23 and HST = 0.6378/-0.5907 = -1.08. The absolute value of Tobin's q ratio for both HSS and HST is above unity which shows that developing semi-detached and terraced houses are more profitable. Hence, there is incentive for the developers to build more semi-detached and terraced houses. With the relatively higher price of housing to construction cost, semi-detached and terraced houses are considered as investment goods that generate income through capital gains.

suggests an inelastic supply of new housing with respect to house price. It reflects that the increase in housing starts is slow and much smaller than the proportional increase in house prices.

Table 4 Price elasticity of new housing supply by housing types

Housing types	HSA	HSD	HSH	HSS	HST
Long-run	0.8249^{***}	0.3502^{**}	1.5425^{***}	0.4268^{***}	0.6378^{**}

Note: ***, ** and * denote statistically significant at 1%, 5% and 10% level respectively.

At disaggregate level, price elasticity of new housing supply varies across housing sub-markets. For landed properties such as detached, semi-detached and terraced houses, the magnitude of the price elasticity of new housing supply is lower than unity which is 0.3502, 0.4268 and 0.6378 respectively. This suggests that new housing supply of landed property is price inelastic. For non-landed properties, particular the high-rise housing sub-market, the magnitude of price elasticity of new housing supply is 1.5425 which suggests an elastic supply. The supply of high-rise houses appears to be relatively elastic with respect to house prices.

Comparing these estimates of price elasticities with those reported by Malpezzi and Mayo (1997), the price elasticity of housing supply in Malaysia was estimated between 0.07 and 0.35 during 1972-1986. They believed that strict regulatory environments such as housing project approval procedures are associated with inelastic supply of housing in Malaysia in late 1980s. Our estimate of price elasticity of new housing supply is relatively more elastic than those reported by Malpezzi and Mayo (1997)[3]. We find that government housing programs have improved the price elasticity of housing supply but we still encounter inelastic supply due to delaying in bureaucracy and administration involve in the approval process. The government policies and programs intended to raise the quantity of housing seem to be ineffective to accelerate the production of new houses. The slow progress in the implementation of housing programs could be due to the problem of higher compliance cost and delaying in the planning approval process (Property Report, 2013). We strongly agree with Malpezzi and Mayo (1997) that the lengthy housing projects approval slows down the housing supply system and this problem remains unresolved until today. The relatively high compliance cost and delaying in approval process could have impeded potential new firms to enter the construction industry when there is rising in demand and slowdown the production of new houses.

Turning to the comparison of housing sub-markets, the result of this study is in line with McLaughlin (2011) and Gitelman and Otto (2012) in Australia. McLaughlin (2011) found that supply elasticity is greater for multifamily units than single-family units while Gitelman and Otto (2012) found that supply of strata properties is more price elastic than the supply of non-strata properties. In Malaysia, high-rise houses are multifamily units with strata title which show greater price elasticity of new supply than other types of houses. According to a survey conducted by iProperty.com (2016), the most preferred property for purchase in Malaysia is

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[3] One reason for the different price elasticity of housing supply reported is that Malpezzi and Mayo (1997) estimated the model for stock of housing (i.e. the aggregate supply of housing) while the present study models the new housing supply (i.e. housing starts). The housing starts are flow variable which represents the change in the stock of housing. Generally, the price elasticity of housing stock is expected to be lower than the price elasticity of housing start (see e.g. Mayer and Sommerville, 2000).

high-rise units and condominiums. Hence, developers are more interested in building high-rise houses than landed properties. Moreover, rising land price resulting from scarcity of land pushes up the cost of production to property developers. In order to maximize profit, developers are more interested to build high-rise houses. This makes the supply of high-rise segment more elastic than the landed properties.

5. Conclusions

In this study, we model new housing supply in Malaysia for the period between 2002 and 2015. We identify the factors that influence the supply of new housing as well as estimate the price elasticity of housing supply at both aggregate and disaggregate levels for different types of houses. The results show that all types of housing supply in the long-run is greatly influenced by house prices and global financial crisis. Construction cost is found to significantly influence the supply of aggregate houses and high-rise houses had a significant impact on new housing construction in Malaysia. Interest rate has not played a significant role in determining the supply of new houses in Malaysia. In the short-run, none of the explanatory variables namely house price, construction cost and interest rate influence new housing supply.

Besides that, the finding of this study supports the argument that housing supply in Malaysia is relatively inelastic. We find that for every one percent increase in the average house prices, the quantity of new housing supply increases by 0.85 percent. Our result suggests that low supply elasticity of housing in Malaysia has contributed to the substantial rise in house prices over 2002-2015. Looking at the disaggregate level, we find that the supply elasticity varies across housing types with the highest for high-rise houses and the lowest for detached houses. The supply of high-rise houses is more elastic compared to the landed units. It is about four times more elastic than the detached and semi-detached houses while it is about double of the supply elasticity of terraced houses.

Our study suggests a few policy implications to the Malaysia’s housing market. While demand-side regulations are found to have limited effects in reducing house price appreciations, more attentions should be focused on developing supply-side policies. Government should pay more attention to implement policy measures that can increase the elasticity of housing supply. The proposed Industrialized Building System (IBS) should be strongly encouraged by the government in all housing projects to accelerate the supply of housing. IBS is a construction system where all components are manufactured at factory before transferring to construction sites for installation. This system reduces the dependency on labour which result in cost savings and shorten the time taken for construction. Although IBS helps to improve the productivity and quality of housing construction, the rate of adoption is low. Many developers are still using the conventional building system due to lack of technical knowledge and financial resources. Besides that, government should also consider reducing the compliance cost associated to housing approvals such as development charges and land conversion premiums.

One possible extension of current work is to consider the elasticity of housing supply at different price range. This allows one to analyse the supply elasticity of affordable houses.

References

Ball, M., Meen, G., & Nygaard, C. (2010). Housing supply price elasticities revisited: Evidence from international, national, local and company data. *Journal of Housing Economics, 19*, 255-268.

Blackley, D. M. (1999). The long-run elasticity of new housing supply in the United States: Empirical evidence for 1950 to 1994. *18*(1), 25-42.

Bank Negara Malaysia (BNM). (2015). *Bank Negara Malaysia Annual Report 2015.* Kuala Lumpur.

Caldera, A., & Johansson, A. (2013). The price responsiveness of housing supply in OECD countries. *Journal of Housing Economics, 22*, 231-249.

DiPasquale, D., & Wheaton, W. C. (1994). Housing market dynamics and the future of housing prices. *Journal of Urban Economics, 35*, 1-27.

Gitelman, E., & Otto, G. (2012). Supply elasticity estimates for the Sydney housing market. *Australian Economic Review, 45* (2), 176-190.

Green, R. K., Malpezzi, S., & Mayo, S. K. (2005). Metropolitan-specific estimates of the price elasticity of supply of housing, and their sources. *American Economic Review, 95* (2), 334-339.

Harter-Dreiman, M. (2004). Drawing inferences about housing supply elasticity from house price responses to income shocks. *Journal of Urban Economics, 55*, 316-337.

Hui, H. C. (2009). The impact of property market developments on the real economy of Malaysia. *International Research Journal of Finance and Economics, 30*, 66-86.

Hui, H. C. (2008). Transmission channels linking real estate shocks with macroeconomic performance: Evidence fromMalaysia. *Nottingham Univ. Business School Malaysia Campus Research Paper No. 08-09* , 1-26.

Hui, H. C. (2013). Housing price cycles and aggregate business cycles: Stylised facts in the case of Malaysia. *Journal of Developing Areas, 47*(1), 149-169.

Ibrahim, M., & Law, S. H. (2014). House prices and bank credits in Malaysia: An aggregate and disaggregate analysis. *Habitat International, 42*, 111-120.

iProperty.com (2016). *Asia Property Market Sentiment Report (H2 2016).* Retrieved from: http://insights.iproperty.com.sg/Asia-Sentiment-Survey-Report-H2-2016-Singapore.pdf

Khazanah Research Institute. (2015). *Making Housing Affordable.* Kuala Lumpur:

Lean, H. H., & Smyth, R. (2013). Regional house prices and the ripple effect in Malaysia. *Urban Studies, 50*(5), 895-922.

Lean, H. H., & Smyth, R. (2014). Dynamic interaction between house prices and stock prices in Malaysia. *International Journal of Strategic Property Management, 18*(2), 163-177.

Lee, C.L. (2014). The inflation-hedging characteristics of Malaysian residential property. *International Journal of Housing Markets and Analysis*, *7*(1), 61-75.

Malpezzi, S., & Maclennan, D. (2001). The long-run price elasticity of supply of new residential constructionin the United States and the United Kingdom. *Journal of Housing Economics, 10*, 278-306.

Malpezzi, S., & Mayo, S. K. (1997). Getting housing incentives right: a case study of the effects of regulation, taxes and subsidies on housing supply in Malaysia. *Land Economics, 73*(3), 372-391.

Mayer, C. J., & Somerville, C. T. (2000a). Residential construction: using the urban growth model to estimate housing supply. *Journal of Urban Economics, 48*, 85-109.

Mayer, C. J., & Somerville, C. T. (2000b). Land use regulation and new construction. *Regional Science and Urban Economics, 30*, 639-662.

McLaughlin, R. B. (2011). New housing supply elasticity in Australia: a comparison of dwelling types. *The Annals of Regional Science*, *48*(2), 595-618.

Meen, G. (2005). On the Economics of the Barker Review of Housing Supply. *Housing Studies, 20* (6), 949-971.

Meen, G., & Nygaard, C. (2011). Local housing supply and the impact of history and geography. *Urban Studies*, *48*(14), 3107-3124.

Narayan, P. K. (2005). The saving and investment nexus for China: evidence from cointegration tests. *Applied Economics, 37*(17), 979-1990.

Neto, M. S. (2005). Analysis of the determinants of new housing investment in Spain. *Housing, Theory and Society, 22* (1), 18-31.

OECD (2011), *Economic Policy Reforms 2011: Going for Growth*, OECD Publishing.

Oikarinen, E., Peltola, R., & Valtonen, E. (2015). Regional variation in the elasticity of supply of housing, and its determinants: The case of a small sparsely populated country. *Regional Science and Urban Economics, 50*, 18-30.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of. *Journal of Applied Econometrics, 16*, 289–326.

Property Report (2013). *Malaysian developers blame compliance costs for rising property prices*. Retrieved from: http://www.property-report.com/malaysian-developers-blame-compliance-costs-for-rising-property-prices/

REHDA. (2016). Assessing Demand-Supply Dynamics in the Malaysian Housing Market. *REHDA Bulletin Feature Articles*. Retrieved from Real Estate and Housing Developers' Association Malaysia.

Topel, R., & Rosen, S. (1988). Housing investment in the United States. *Journal of Political Economy, 96*(4), 718-740.

Valuation and Property Service Department (JPPH). (2009). *Property Market Report 2009*. Putrajaya. Malaysia

Wigren, R., & Wilhelmsson, M. (2007). Housing stock and price adjustments in 12 West European countries between 1976 and 1999. *Housing, Theory and Society, 24*(2), 133-154.

Yeap, G.P. & Lean, H.H. (2020). Nonlinear relationship between housing supply and house price in Malaysia. *International Journal of Strategic Property Management* (in press).

Appendix

Table A1 Robustness tests

$$\Delta HS_t = \alpha_0 + \beta_0 HS_{t-1} + \theta_0 HP_{t-1} + \delta_0 CC_{t-1} + \gamma_0 RIR_t + \sum_{i=1}^{p-1} \beta_i^* \Delta HS_{t-i} + \sum_{i=0}^{q-1} \theta_i^* \Delta HP_{t-i}$$

$$+ \sum_{i=0}^{r-1} \delta_i^* \Delta CC_{t-i} + \sum_{i=0}^{s-1} \gamma_i^* \Delta RIR_{t-i} + \phi D_{GFC} + \varepsilon_t$$

	HSA	HSD	HSH	HSS	HST
Optimum lags	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)	(1,0,0,0)
Bounds test					
F-statistic	6.5919***	13.4130***	6.7569***	8.6542***	4.2267*
Long-run coefficient					
HP	0.9203***	0.3715**	1.6453***	0.4506***	0.5757**
CC	-1.2595**	-2.7186	-1.9033***	-0.2298	-0.8108*
RIR	-0.0396	-0.0438	-0.0647	0.0055	-0.0296
Short-run coefficient					
ECT	-0.6615***	-1.0837***	-0.6998***	-0.9438***	-0.5881***
HP	-0.4728	0.6550	1.3638	1.0711	0.8224
CC	-0.9194	-1.0969	-2.0175	0.0957	-0.3955
RIR	-0.0236	0.0248	-0.0203**	0.0222	-0.0236
GFC	-0.2778***	-0.5265***	-1.8037***	-0.2877***	-0.1696**
Diagnostic tests					
Rsq	0.7000	0.3131	0.6499	0.4723	0.6281
Rsq_a	0.6681	0.2400	0.6127	0.4162	0.5885
Serial correlation	5.4932*	0.6189	4.4174	0.7874	2.6824
Heteroskedasticity	1.0857	0.5240	1.1541	0.1722	0.6026
Normality	1.3471	2.0477	1.5110	12.9343***	2.1680
Ramsey	0.0773	0.5608	0.0128	7.0766**	2.8573*

Note: Real interest rate is represented by Real TB which is calculated by subtracting quarterly inflation rate from 3-month Treasury Bill rate (quarterly rate). ***, ** and * denote statistically significant at 1%, 5% and 10% level respectively. The optimum lags are selected based on Schwarz Information Criteria. The upper and lower bound critical values are from Narayan (2005), case III (unrestricted intercept and no trend) with n=55, k=3: 1% [4.828, 6.195], 5% [3.408, 4.623], 10% [2.843, 3.920].