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Do house prices squeeze marriages in China?

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ABSTRACT

This study reviews the threshold effect of house prices (HPs) on marriage (MR) in China by utilizing a panel threshold regression. The findings indicate that HPs have a positive impact on MR when the price is below the threshold value. Homeownership is an extremely important factor in MR in China, and MR without housing is considered incomplete. However, HPs have a negative effect on MR when the price is higher than the threshold value. Unemployment and female education have a negative effect on MR, while GDP per capita has a positive effect. These results are supported by the duration model, which shows that as HPs increase, the rate of MR decreases. The study makes a contribution on the asymmetric impact of high HPs on MR in China in the two regimes. The paper offers insight into the economic outlook on HPs and MR driven by societal and institutional changes, such as privatization and state ownership of enterprises, that have changed marriage behavior. Increasing HPs slow MR and may have a more serious impact on China than on other countries. The government should balance housing supply and demand by enhancing antimonopoly supervision in the private market. The government should establish policy measures to meet housing demand and create incentives to wed, which can relieve competition in marriage markets. Diversified investment, in turn, can control HPs.

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1. Introduction

Marriage (MR) is a fundamental institution of society (Edlund et al., 2013) that offers several benefits, such as happiness, fertility and controlling the crime rate (Zhang et al., 2014). It is argued that soaring housing prices (HPs) may depress MR (Farzanegan & Fereidouni, 2014) as they may prevent couples from forming households to a greater extent compared to those who are unmarried. A fall in MR, in

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turn, lowers the demand for houses and ultimately negatively influences HPs (Fisher & Gervais, 2011). This phenomenon has gained attention among governments and investors in particular since the 2008 global crisis (Larissa-Margareta et al., 2009; Kishor & Marfatia, 2017). Rising HPs increase the average age and timing of MR (Li, 2018). Rising rates of MR can drive demand for new housing, which increases HPs, and falling rates decrease demand, which decreases HPs. Increasing HPs decrease householding spending, increase the cost of living and financial stress (Aksoy, 2016; Batrancea et al., 2019) and lessen the probabilities of MR (Farnham et al., 2011). Such depressive elements arising from higher HPs push people to invest in buying homes, which might decrease effective demand. Similarly, higher HPs might drive growth among real estate businesses and strengthen investment (Zhang et al., 2012; Su et al., 2019a). Nonetheless, the rising HP tendency may have negative consequences for social stability and may cause a decrease in MR.

The housing reforms of China were one of the important initiatives at the time of the opening of the economy in 1978 (Wrenn et al., 2019; Su et al., 2017). Among the Chinese people, housing is considered an integral component of economic growth and the safest investment. The housing sector constitutes 15% of gross domestic product (GDP) and makes an enormous contribution to the revenue of local governments. During the reform process, the welfare housing scheme was substituted with the distribution of monetized housing benefits (Li & Song, 2016), paving the way towards the potential growth of the housing sector (Wrenn et al., 2019). However, other reform processes have brought about social and demographic changes, with most important among these changes being the falling MR (Yu & Xie, 2015). In the postreform period, the government delegated authority to the private sector for the development of housing. Housing and MR move simultaneously, putting pressure on the real estate market and pushing up HPs (Wei et al., 2017). MR without buying housing, called “bare marriages¹,” has become popular in China since 2008 because of the greater cost of MR. That said, 70% of women in China still assert that housing is the most important element of MR (Lim et al., 2013). Further, the role of “mother in law economics²” is very emphatic in this regard and highlights housing as a condition of MR. The correlation between HPs and MR has been increased by government policies such as the one-child policy after the 1978 reforms. This policy has increased the gender imbalance and resulted in a shortage of marriageable women (Wei & Zhang, 2011). In the face of this situation, housing is one way to enhance the male attractiveness for MR; these dynamics have driven the government to target housing ownership rates of 70% (Wei et al., 2017; Wrenn et al., 2019).

All the reform initiatives of the government were not fully successful, and the growth of the housing market remained modest during 1998-2002 (Fang et al., 2016). On the other hand, MR decreased for six consecutive years. The marriage registration process was made more convenient through the “Regulations on Marriage Registration” passed in 2003, which led to marriages being carried out more quickly (Cheng, 2016). Likewise, in the decade after 2003, the housing sector witnessed a tremendous growth trend. To encourage the market, the government withdrew the subsidized housing facility for urban residents, which resulted in rising housing demand (Li & Song, 2016). The marriage service was further improved by the Ministry of

Civil Affairs in 2007, which pushed up MR rates. Meanwhile, all of the major cities witnessed an almost twofold increase in HPs compared to disposable income and GDP growth (Chen & Wen, 2017). The government then issued the “State 6³” policy intended to adjust the housing supply as well as a credit policy to control increasing HPs.

A short boom in the housing market occurred in 2007 due to the stagnant position of manufacturing, which increased the capital inflow to the real estate industry (Wu, 2015). Moreover, the government introduced fifteen suggestions in its “9 Ministries 15⁴” document aimed at controlling HPs through land supervision and prosecuting foreign speculation (Li & Song, 2016). These plans were effective, and HPs were corrected around the time of the 2008 financial crisis, which lasted for one year (Wu, 2015; Su et al., 2019b). The stimulus package passed thereafter was extended to the real estate sector by the government to counter the effects of the global recession (Zhang et al., 2012). This led to rapid HP growth during 2009-2010 and an average 30% HP increase in the most important cities in China. A new round of policies named “State 11⁵” was implemented in 2010 to control the housing bubble and assign the provision of affordable housing to local governments. Similarly, for low-income families, the “social security housing” project was introduced in 2009.

At this time, MR rates experienced an increase, with an average rise of 1.8%. Progress in MR produces constant growth in housing demand and HPs and is likely to have a considerable impact on housing affordability. The government managed this situation by introducing “New State 8⁶” to address the high HPs, and provinces were made responsible for controlling rising HPs through strict measures. The down payment on the purchase of a second house was increased from 50% to 60% (Li & Song, 2016). During 2003-2013, HPs increased fivefold, which in turn increased investment growth in real estate by up to 30.3% annually (Waxman et al., 2020). High economic growth and accelerated urbanization have increased the purchasing power of households, which is translated into higher housing demand (Wei & Zhang, 2011). In addition, MR plays an important role in housing demand in China due to housing being an integral part of the wedding gift. Nevertheless, MR rates decreased in 2015-2017 by an average of 6.7%, while HPs increased in the same period due to economic factors such as housing availability and the increasing cost of raising children.

Our problem statement is that the reform process of 1978 resulted in several effects on the form of economic development as well as social change (Ruzhi et al., 2019). The institution of MR has witnessed a declining trend. The societal perception of homeownership as a component of social status and a prior condition of marrying has increased competition in the marriage market and has been inflated by the disparity in gender ratios across China (Wei et al., 2017). It is estimated that there are 34 million more marriageable men than marriageable women in China, which may cause pressure on real estate (Zhang et al., 2012; Wei et al., 2017). Likewise, as China has the highest saving rate in the world and the central government imposes strict capital controls, a lack of investment opportunities for households in the global financial market has pushed investors towards real estate (NBSC, 2010). The astonishing economic development of recent decades has raised the anticipation that China’s

economy will continue to grow and household revenue will rise. Last, the process of capital accumulation within a regulated regime has attracted foreign investment in the economic development process of the country. The commodification of housing has turned it into an investment item and provides revenues to local governments (Wu, 2015). This future outlook makes high HPs appear more affordable. Therefore, the housing sector is a crucial contributor to the overall development of MR rates in China.

This study is undertaken with the following purpose. It evaluates a possible threshold effect of HPs on MR at the provincial level in China. Moreover, this paper assesses whether MR is reduced at a certain HP level. The nature of the relationship is detected when the value lies above or below a certain threshold. The paper explicates whether HPs behave differentially at different levels due to MR. The study considers whether different HP regimes have different relationships with MR. Further, this study inspects whether numerous control variables, such as gross domestic product (GDP) per capita, urbanization, unemployment, and education, impact MR. The results reveal that increasing levels of urbanization and unemployment result in a decline in family formation. Moreover, while the educational attainment of females has enhanced women's contribution to the workforce, it has caused extended families to collapse and young women with higher education to marry less or later in life (Wrenn et al., 2019).

The main goal of this study is to evaluate the impact of HPs on MR by applying a panel threshold regression to detect whether HPs influence MR and whether the relationship is asymmetric. Further, this study makes a contribution in the following mode. First, it provides insight into the economic outlook on HPs and MR driven by societal and institutional changes, such as privatization and state ownership of enterprises, that have changed marriage behavior. Second, it inspects the asymmetric impact of high HPs on MR in China in two regimes by using a threshold panel regression. The finding reveals a single threshold effect of HPs on MR: When the price value is below the established threshold, rising HPs decrease MR; however, the results reveal a positive effect of HPs on MR if the price value is above the threshold. These results are in line with the duration model, which shows that as HP increases, the rate of MR decreases. The government should balance housing supply and demand by enhancing antimonopoly supervision of the private market. Similarly, incentives should be extended to people to wed, which can relieve marriage market competition. Diversified investment, in turn, can control skyrocketing HPs.

The remainder of this article is arranged as follows. [Section 2](#) consists of the literature review. [Section 3](#) provides the theoretical foundation of the duration model. [Section 4](#) defines the panel threshold regression method. [Section 5](#) defines the data. [Section 6](#) analyzes the results derived from the threshold model taking into account the duration model. [Section 7](#) summarizes this study.

2. Literature review

Martínez-Granado and Ruiz-Castillo (2002) study one reason for declining formation and find that MR decisions are heavily dependent on HPs. Lauster (2006) tests

different theories to elucidate the details of the decline in family formation and indicates that greater access to housing is accompanied by increasing MR. Martins and Villanueva (2009) evaluate the consequences of greater housing costs for young couples, and the results indicate that increasing HPs resulted in low MR rates. Mulder and Billari (2010) consider the correlation of homeownership with family formation and conclude that there is a negative impact of low housing ownership on MR. Rainer and Smith (2010) report the importance of HP shocks in MR dissolution and find that HP has an asymmetric impact on MR. Further, the negative HP shocks increase the risk of decreasing MR, while positive HP shocks have no impact. Farnham et al. (2011) state that MR stability is extremely vulnerable to HP shocks and that low house prices have a significant impact on MR. Hui et al. (2012) study the demographic factors that constrain MR formation and fertility and conclude that increasing HPs lead to delaying MR. Mulder (2013) reviews the connection between MR and housing, and the results show that housing supply is the most decisive element in MR formation. Moreover, the higher tendency of married couples to move into their own house coupled with a decline in housing can lead to the dissolution of MR. Farzanegan and Fereidouni (2014) probe the MR crisis and relevant determining factors, and their findings reveal higher housing costs decrease the rate of MR. Fereidouni (2016) estimates the relationship between HPs and MR dissolution and concludes that when HPs rise, MR decreases. Assaad et al. (2017) review the relationship between the time of MR and housing market behavior and find that HPs have a positive influence on MR. Li (2018) considers the nexus between HPs and MR and confirms that a lack of homeownership makes MR difficult. Klein (2017) analyzes the impact of HP changes on marital status in the U.S. and shows that positive shocks stabilize MR.

Wei and Zhang (2011) note the negative relationship between MR and skewed gender ratios and observe that families with a son spend most of their savings to buy a house for MR in China. Zhang et al. (2012) classify the relationship between HPs and MR and suggest that MR has minimal impact on HPs. Wei et al. (2012) address the perceived status symbol of housing and its significant role in attracting a partner for MR. Li and Chand (2013) show that MR is a meaningful factor in housing demand and is considered incomplete without housing. Li et al. (2014) inspect housing prices and affordability and find that homeownership is necessary for MR. Yu and Xie (2015) find that higher HPs are associated with early entry into MR and vice versa. Li and Song (2016) discuss the different reasons, including economic, social and cultural, for the dramatic increase in HPs and the decline in housing affordability. The results confirm that cultural factors have pushed up HPs, as owning a house is a condition for the majority of marriages. Wei et al. (2017) test the hypothesis that homeownership increases attractiveness in the marriage market and find that MR pushes couples to buy housing and may cause an increase in HPs. Chen and Liu (2018) evaluate MR decisions in terms of housing and show that HPs have a contributing role in MR. Wrenn et al. (2019) describe the falling MR rate as dictated by the social norm of purchasing housing preceding MR, and their results reveal that a 1% surge in HPs depressed MR rates by 0.31%. Zheng et al. (2018) examine the contributing element of HPs and note the long-term positive relationship between HPs

and divorce in China. Ruzhi et al. (2019) detect that HPs affect MR in the Central and Eastern regions of China due to shortages of land supply, income and population. The results find no relationship between HPs and MR in the Western region, mainly driven by relaxed land supply and low economic development.

We summarize different aspects of the gaps in the previous literature. First, several prior studies have examined HPs and MR focusing on the country overall and lacking regional heterogeneity components. As MR is a social norm and dominated by regional factors, ignoring regional variation will produce biased findings (Breitung, 2005). Further, China is a vast country with a huge population characterized by different regional traditions that have a critical role in MR. Second, some of the previous research was based on survey evidence that is restricted to a limited area. The outcomes thus cannot be generalized to the entire population. Last, in terms of the methodology, previous studies have concentrated on conventional linear methods, which mainly operate on the assumption of symmetric relationships (Dhaoui & Bacha, 2017). However, some studies focus on cointegration, which allows for assessment of the long and short term (Dhaoui & Bacha, 2017). The linear techniques basically measure movements in the dependent and independent variables on a straight line; however, the assumptions of the existence and validity of linearity are not always suitable in all conditions. Similarly, these techniques may overemphasize the mean of both variables and ignore the extreme values. Moreover, due to frequent policy changes, the linear model is not a suitably precise or consistent measure of the estimated results, as asymmetrically adjusted time series may exist. The housing market has witnessed several cycles since 1998 because the government made policy changes according to the existing market demand and restrained the market from abnormal behavior.

3. The duration model

Similar to Weiss (1977) and Yi and Zhang (2009), we apply the duration model to measure the association between HPs and MR. Rising HPs can cause a negative impact on MR in line with the budget constraint on household consumption (Waxman et al., 2020). Utility is the basic motive behind MR and determines whether individuals marry or not. Therefore, when the combined utility of a man and a woman exceed their individual utility levels, the individuals choose MR. However, the transition from being single to becoming a married couple requires several direct expenses, such as providing a dowry and buying a house and car (Wrenn et al., 2019). Rising HPs can delay or reduce the number of marriages (Yi & Zhang, 2009). Likewise, MR is assumed to be a normal good, and households maximize their utility by deciding MR and consumption under budget constraints. Thus, the maximization problem for an individual is as follows:

$$\max U(MR, C) \text{ s.t. } P_{MR} + P_{HP}H(MR) + C = I \quad (1)$$

where MR indicates marriage, C expresses consumption and H represents housing. P_{MR} and P_{HP} are the prices of marriage and housing, respectively. As housing is

imperative for MR, it is included as a budget constraint. Consumption utility increases along with MR: $U_{MR} > 0$ and $U_C > 0$. Moreover, marginal utility is assessed across marriage and consumption: $U_{MRC} > 0$. $\frac{dHP}{dMR}$ is positive as HPs are an increasing function of MR, and the first-order condition as follows:

$$U_{MR}(MR^*, C^*) + \lambda^* \left(-P_{MR} - P_{HP} \frac{dHP}{dMR} \right) = 0 \quad (2)$$

$$U_C(MR^*, C^*) - \lambda^* = 0 \quad (3)$$

where the marginal utility of income is denoted by λ . From Equation (3), we have $\frac{U_{MR}}{\lambda} = P_{MR} + P_{HP} \frac{dHP}{dMR}$, which is the shadow price of MR. Since $\frac{dHP}{dMR} > 0$, the shadow price of MR increases as house prices increase. We estimate MR statistics in terms of HP as

$$\frac{dMR}{dPH} = \frac{\left[-\lambda \frac{dHP}{dMR} + H(MR^*) * \left(U_{MRC} \left(P_{MR} + P_{PH} \frac{dHP}{dMR} \right) U_{CC} \right) \right]}{\left[-U_{MR} + U_{MRC} \left(P_{MR} + P_{PH} \frac{dHP}{dMR} \right) \right]} \quad (4)$$

where $U_{MRC} > 0$, $U_{MR} < 0$, $U_{CC} < 0$, $\lambda^* > 0$. HP has a negative impact on MR as $\frac{dMR}{dPH} < 0$. However, the compensated substitution $\frac{dHP}{dMR}$ reveals that variation in housing demand changes MR. An increase in HPs causes a reduction in the demand for housing, which may lead to a decrease in MR. Expenditures on housing increase with the rise in HPs, which makes the budget more constrained. We assume that MR is a normal good that decreases with higher HP. Thus, it is concluded that higher HPs reduce the demand for MR through the income and compensated substitution effects. After the 1978 reforms, housing in China played an important role in economic activity. In contrast, MR has been on a declining trend, and homeownership is one of the leading contributors. This trend has boosted competition in marriage markets and has been increased by the imbalance in gender ratios across China (Wei et al., 2017; Ruzhi et al., 2019). In view of these facts, we use a threshold effect model to analyze the impact of HPs on MR in China. The method determines a threshold value that divides the observations into various regimes. A certain level of HPs has a positive impact; households do not experience budget constraints and increase the demand for both housing and MR. However, a rapid rise in HPs puts pressure on household demand and increases marriage costs, which ultimately has a negative impact on MR (Ruzhi et al., 2019).

4. Methodology

We evaluate the impact of HPs on MR at the provincial level in China by applying a panel threshold regression to detect whether HPs influence MR and whether the relationship is asymmetric. When the HP level is lower than the threshold value, HPs have a positive effect on MR. Over the last decades, economic and social changes have contributed to a trend of rising household income and living

standards, which has increased housing demand. Higher homeownership has a positive impact on MR, and women prefer to have their own housing before MR. However, when the HP level is above the threshold value, it indicates that the rising HPs drive household savings and diminish housing affordability, which results in declining MR rates. The discussion leads to the hypothesis that an increase in HPs causes a decrease in MR in China.

The threshold regression approach framed by Hansen (1999) is applied to explain the structural break threshold and divide the observation into multiple regimes by assuming fixed effects. An observation value can be above or between the threshold value. HP is selected as a threshold variable, and the single threshold regression model is estimated as follows:

$$MR_{it} = \begin{cases} \mu_i + \beta_1 HP_{it} + \alpha' x_{it} + \varepsilon_{it}, & \text{if } HP \text{ is } \leq \gamma \\ \mu_i + \beta_2 HP_{it} + \alpha' x_{it} + \varepsilon_{it}, & \text{if } HP \text{ is } > \gamma \end{cases}$$

$$\alpha = (\alpha_1, \alpha_2, \alpha_3)' x_{it} = (GDP_{it}, URB_{it}, UM_{it}, EDA_{it}) \quad (5)$$

where MR_{it} is the dependent variable; HP is the independent threshold variable; and x_{it} is a set of a control variables that affect MR. Per capita GDP (GDP_{it}), the education level (EDA_{it}), the unemployment rate (UM_{it}) and urbanization (URB_{it}) are used as control variables (Zhang et al., 2014). The findings suggest that the increasing level of urbanization, as well as unemployment, resulted in the decline of family formation (Li & Song, 2016). While the educational attainment of females has accelerated women's participation in the workforce (Hui et al., 2012), it has also resulted in the disintegration of extended families and young women with higher education marrying less or later in life (Wrenn et al., 2019). μ_i is the fixed effect; the value of the threshold is γ ; β_1 and β_2 are the variable coefficients; and $\alpha = (\alpha_1, \alpha_2, \alpha_3)'$ are the estimated coefficients of the control variables. ε_{it} is the error term having a mean of zero and finite variance. It is used compared to random effects due to the threshold estimator's consistency, as the interpretation of the regression coefficient assumes that the threshold is consistent with the ordinary linear fixed effect model. The regression assumes that each sample observation is independent and identically distributed with its particular fixed intercept, which indicates the individual characteristics of each observation (Pan et al., 2016).

Equation (5) is rearranged into the following regression format:

$$MR_{it} = \mu_{it} + \beta_1 HP_{it} I(HP \leq \gamma) + \beta_2 HP_{it} I(HP > \gamma) + \alpha' x_{it} + \varepsilon_{it}$$

where $I(\cdot)$ is an indicator function.

In the case of double threshold regression, the equation is rearranged as follows:

$$MR_{it} = \begin{cases} \mu_i + \beta_1 HP_{it} + \alpha' x_{it} + \varepsilon_{it}, & \text{if } HP \leq \gamma_1 \\ \mu_i + \beta_2 HP_{it} + \alpha' x_{it} + \varepsilon_{it}, & \text{if } \gamma_1 < HP \leq \gamma_2 \\ \mu_i + \beta_3 HP_{it} + \alpha' x_{it} + \varepsilon_{it}, & \text{if } HP > \gamma_2 \end{cases} \quad (6)$$

$$MR_{it} = \mu_i + \alpha' x_{it} + \beta_1 HP_{it} I(HP_{it} \leq \gamma) + \beta_2 HP_{it} I(\gamma_1 < HP_{it} \leq \gamma_2) + \beta_3 HP_{it} I(HP_{it} > \gamma_2) + \varepsilon_{it} \quad (7)$$

This method can be used to detect multithreshold models. This paper uses the panel threshold regression technique to evaluate the nonlinear impact of HPs on MR in China. We use Gauss 10 to estimate the results. Further explanation of the methodology is reported in [Appendix C](#).

The panel threshold method has several advantages over traditional nonlinear techniques. First, it can make apparent diverse links in the form of coefficient signs and magnitude, which can cause heterogeneity problems. The method examines the relationships among variables in different regimes. Second, the nonlinear equation is not the prerequisite for the uncovering of threshold effects; the threshold is derived endogenously based on the sample data (Pan et al., 2016). Third, a less fitted technique to evaluate the asymmetric relationship may be unable to capture sharp turning points. However, panel threshold methods have the power to detect turning points (Kourtellos et al., 2016). Finally, the method can examine additional sample splits as well as fixed effects to detect comovement caused by external shocks (Asimakopoulou & Karavias, 2016).

5. Data

We evaluate the threshold effect of HPs on MR in 31 provinces of China from 1998 to 2017. After 1998, the reform process was followed by an extraordinary boom in the housing market. The turning point occurred with the dissolution of the welfare system and adoption of the private housing system (Wu et al., 2012). Thus, housing emerged as the most profitable market sector, making a meaningful contribution to the GDP. This astonishing boom is accompanied by a decline in MR during the study period (Zhang et al., 2012). One of the primary drivers of rising HPs is government policies such as the one-child policy, which increased the gender imbalance, causing an oversupply of marriageable men and increasing competition in the marriage market (Wrenn et al., 2019). On the other hand, a persistent drop was observed in MR from approximately 1998, and the current rate of newly registered marriages shows a 9% decline over its level at that date. Since 2013, the scenario has been a matter of great concern for the government in seeking to preserve the birth rate and counteract population aging and the gender imbalance. Chinese society considers housing part and parcel of MR and pushes up HPs. Greater competition for MR is apparent in the higher rates of homeownership in China, which can strengthen the chances of MR. It is predicted that this gender inequality will further increase, and there will be more than 30 million people who are unable to marry. Consequently, the government abolished the one-child policy in 2015 to alleviate the potential for even more serious problems arising from the gender imbalance.

In the analysis, HP is equal to the average commercial selling price of a house divided by the sales area (Guo & Chen, 2015; Su et al., 2018). MR is equivalent to the rate of registered marriages per 10000 population for each province (Farzanegan & Fereidouni, 2014). The Real Estate Statistics Yearbook is the source of the data (Wei

Table 1. Descriptive statistics.

	MR	HP	GDP	EDA	URB	UM
Mean	13.160	7.991	9.895	3.288	3.850	1.247
Std. Dev.	0.830	0.730	0.900	0.282	0.363	0.235
Skewness	-0.656	0.271	-0.144	0.103	3.017	-2.045
Kurtosis	3.184	2.993	2.044	16.269	39.461	9.436
Jarque Bera	44.001***	7.367***	24.891***	4402.725***	3415.56***	1454***

Note *** indicate significance at the 1% level.

Source: Authors' calculation.

et al., 2017). Several control variables, among them GDP per capita, population density, education, and unemployment, have been applied in previous literature, such as the study by Wrenn et al. (2019). Wang and Zhou (2010) analyzed the impact on MR of GDP per capita and education. The outcome suggests that economic growth contributes to MR. Similarly, the female education level improves the MR rate in China. During the period, a higher GDP per capita boosted family income and encouraged rapid housing demand, which is correlated with MR (Chen & Wen, 2017). The female educational level is measured as the proportion of women with high school or higher education in the total population over six years old. Female education has increased assortative matching and plays an important role in MR (Xia & Zhou, 2003; Tian, 2013). Urbanization is measured as the urban to total population ratio (Xinhua & Kun, 2010). It is one of the outcomes of the economic reforms and has been shown to have a negative impact on MR (Zhang et al., 2014). The unemployment rate is equal to the ratio of registered unemployed individuals to total persons employed. Unemployment has a negative impact on MR because Chinese women value employment and its related factors. The effect shows that economic aspects occupy a significant position in MR decisions (Wrenn et al., 2019).

Table 1 provides the descriptive statistics. The mean values of MR and HP are 13.160 and 7.991, respectively. A higher GDP per capita supports household savings, and due to the lack of an organized financial market, people tend to invest in real estate (Hu, 2013). Housing is believed to be a store of wealth and the safest investment. Similarly, homeownership is considered a symbol of social status and enhances the likelihood of MR. Thus, the housing sector will be under constant pressure to meet the demand resulting from MR. Slowing economic activity may decrease household investment ability and can result in low MR rates, eventually translated into low housing demand. The HP, education and unemployment levels are positively skewed, suggesting greater changes in these than other included variables over the period. Similarly, MR and urbanization are negatively skewed, highlighting the low level of decline. The kurtosis of HP and GDP per capita is less than 3, suggesting that both variables are less volatile. However, the kurtosis value of the remaining variables is more than 3, indicating greater volatility. The Jarque-Bera test establishes that the variables are nonnormally distributed.

The housing market in China has witnessed booms since 1979 due to the market-oriented approach and fiscal reforms. However, it remained moderate during 1998-2002 due to the Asian financial crisis, which slowed down foreign investment. The lowest registration of MR was recorded during this time period. The housing market

experienced an unprecedented rise during 2003-2013, accelerated by the abolition of the public housing system, investment returns, and rapid rural-urban migration (Glaeser et al., 2017). However, the global financial crisis curtailed the pace of increase of HPs, and the government provided a stimulus package and lowered the interest rate to minimize the effects of the crisis (Wu, 2015; Gaban, 2016). The housing market witnessed another round of rising prices around 2015, driven by slowing economic growth, and HPs experienced an average 10% increase (Chen & Wen, 2017). However, the MR rate fell during 2014-2017, and fewer marriages were registered. Homeownership gives a marriage advantage to young people, which in turn increases housing demand. The basic impetus behind this study is the booming trend in HPs, driven by economic growth, MR and the rapid process of urbanization.

6. Empirical results

The stationarity test of all variables is mandatory for the panel threshold regression to overcome the issue of spurious regression. Table 2 presents the results of the panel unit root tests, which imply that all variables are stationary and that the panel threshold model is appropriate for the estimation of the effects of HPs on MR. Further, the threshold number is specified for the estimation of the model.

The F -statistics are obtained using the bootstrap method for this purpose, and the findings on the threshold effect are presented in Table 3. They indicate that the F -statistic of the single threshold is 87.707, which is greater than the 1% critical value of 77.123. This result confirms the existence of a single threshold at the value of 12.247, which is significant. The single threshold effect demonstrates that HP plays an important role in MR.

The estimated threshold value $\gamma_1=12.247$ provides the dividing point, and the results are reported in Table 4. When HP is below the threshold value (12.247), the estimated $\hat{\beta}_1$ is 0.035, with the t -statistics for the homogeneous and heterogeneous standard errors both being significant. The results indicate that when HP increases by 1%, the MR rate rises by 0.035%. The findings are supported by Assaad et al. (2017), who noted the positive influence of HP on MR. China has undergone economic and social changes over the last decades attributed to rapid economic growth. This growth trend has improved household income and living standards, a dynamic that in turn has increased housing demand. Higher income per capita has enabled real estate to become one of the most lucrative sectors in the Chinese economy. The lack of an organized financial market and strict regulation leads to few investment opportunities at the global level. However, in considering housing price movements, the social perspective is extremely important in the Chinese context, as the institution of MR is universally regarded as incomplete without housing. It has been observed in recent decades that homeownership has a noteworthy influence on MR. Recent surveys on housing and MR have strengthened the argument that almost all women prefer to have their own housing before MR. The prevailing scenario has increased the demand for housing to increase social standing in competitive marriage markets. Appendix B deals with the endogeneity problem to provide support for the results.

Table 2. Panel Augmented Dickey-Fuller unit root tests.

Variables	Levin et al. (2002)		Im et al. (2003)	
	<i>t</i> -statistic	<i>p</i> -value	<i>t</i> -statistic	<i>p</i> -value
MR	-6.317***	0.000	-4.176***	0.000
HP	-30.492***	0.000	-18.982*	0.000
GDP	-7.891***	0.000	-5.737**	0.000
FE	-8.886***	0.000	-3.877***	0.000
URB	-3.270***	0.000	2.649***	0.000
UM	-15.874***	0.000	-15.406***	0.000

Note: *, ** and *** show significance at the 10%, 5% and 1% levels, respectively.

Source: Authors' calculation.

Table 3. Tests for the threshold effects of HP on MR.

Test	Threshold Estimates	<i>F</i> -statistics	Bootstrap <i>p</i> -value	Critical values		
Single threshold	12.247	87.707***	0.000	77.123	47.004	40.819
Second threshold	12.824	13.639	0.640	49.553	37.068	32.065
	12.247					
Triple threshold	13.907	4.089	0.880	38.083	22.369	19.601
	12.824					
	12.247					

1. *p*-value and *F*-statistics are obtained by repeating the bootstrap procedures 10000 times for every test.

2. *** indicates significance at the 1% level.

Source: Authors' calculation.

Table 4. Estimated coefficients of the Housing Prices.

	Coefficients	OLS se	<i>t</i> _{OLS}	White se	<i>t</i> _{White}
$\hat{\beta}_1$	0.035	0.017	2.058**	0.015	2.333**
$\hat{\beta}_2$	-0.019	0.009	-2.199**	0.008	-2.375**

1. OLS se (White se) refers to homogeneous (heterogeneous) standard errors.

2. $\hat{\beta}_1(\hat{\beta}_2)$ indicates that the coefficient estimates are smaller (larger) than the threshold value.

3. ** indicate significance level 5 %.

Source: Authors' calculation.

In the case when the HP value is greater than the threshold ($HP > 12.247$), the estimated $\hat{\beta}_2$ is -0.019 . This reveals a negative and significant impact of HP on MR, implying that when HPs rise by 1%, MR declines by -0.09 . Under the prereform welfare system, housing was not a prerequisite for MR because housing provision was the responsibility of the state. However, when the welfare system was replaced by private ownership, housing gained in importance in relation to MR (Wrenn et al., 2019). It has become a social custom to buy a new house before marrying, and approximately 70% of Chinese women consider that housing is vital for MR (Lim et al., 2013). Rising HPs have a negative impact on social stability, and as the gender ratio increases, household savings increase. Homeownership can improve the comparative position of a male in marriage markets (Zhang et al., 2012). In turn, a rise in MR can increase the demand for housing, drive up HP and diminish affordability, which makes it hard for young people to marry (Wrenn et al., 2019). Housing is considered the most visible form of wealth and can improve one's attractiveness to potential marriage partners, which can trigger demand for housing. Insufficient housing supply can in turn increase competition in marriage markets, which ultimately translates into higher HPs. The past decade shows that MR has declined in China

Table 5. Estimated coefficients of the control variables.

	Coefficients	OLS se	t_{OLS}	White se	t_{White}
$\hat{\alpha}_1$	0.696	0.015	46.400***	0.014	49.714**
$\hat{\alpha}_2$	-0.066	0.032	-2.062**	0.029	-2.275**
$\hat{\alpha}_3$	-0.112	0.061	-1.836*	0.059	-1.898*
$\hat{\alpha}_4$	0.008	0.032	0.250	0.010	0.800

1. $\hat{\alpha}_1$, $\hat{\alpha}_2$ and $\hat{\alpha}_3$ indicates that the coefficient estimates of per capita GDP, female education level and unemployment rate, respectively.

2. *, ** and *** indicates significance at the 10%, 5% and 1% level, respectively.

Source: Authors' calculation.

and is simultaneously determined by the rise in HPs, which has increased the costs of MR. The simultaneous issue is solved in [Appendix D](#).

This study uses control variables such as GDP per capita, urbanization, unemployment and education to isolate the impact of HPs on MR. [Table 5](#) presents the control variable coefficients. The GDP per capita coefficient α_1 has a positive and significant impact on MR. This illustrates that increasing people's income boosts MR. Higher GDP per capita implies increased family income, which is highly correlated with MR. During this period, China observed average annual economic growth rates of 10%, which encouraged rapid housing demand and pushed HPs up (Chen & Wen, 2017). Similarly, robust economic growth has accelerated rural-urban migration and has strengthened the consumption patterns and living standards of the younger generation, which has been reflected in MR (Yu & Xie, 2013). The economic aspect of MR is observed in the fact that high HPs have increased pressure on the young to own a house, which can enhance their attractiveness to marital partners. Economic growth and improved living standards result in greater individual economic independence, especially among women. This has increased partners' welfare and marriage incentives, which contributes positively to MR rates. Likewise, contrary to the traditional considerations of Chinese marriage decisions, economic prospects have enhanced importance in MR decisions in the postreform period (Yu & Xie, 2015). The two-stage regression i examined in [Appendix F](#) to support the simultaneous issue.

The female education coefficient α_2 has a negative impact on MR. Education has experienced a dramatic expansion since the economic reforms. As per the NBSC, fiscal expenditure on education reached 4% of GDP in 2011. Female education has increased rapidly compared to male education, and women prefer to stay in urban areas with greater employment opportunities, which has a negative impact on MR (Nie & Xing, 2018). Assortative matching by education level has increased in MR (Tian, 2013). Female education has an impact on spouse selection: the prevailing criteria are based on education, career development and housing (Xia & Zhou, 2003). Higher female education has increased women's future economic security, enhanced the likelihood of strengthening their independent position, and relieved them of the pressure of entering MR (Hannum et al., 2008). Education has provided women with self-identity, and they can now absorb the social penalty pressures of rejecting or delaying MR (Fussell & Palloni, 2004). However, the population with less or no education faces difficulties in finding their soulmates. There is another pronounced social trend in China called the "leftover women" phenomenon; such women are disliked in

society, and one of the contributing factors behind the trend is the expansion of female education (Ji & Yeung, 2014). The problem of multicollinearity examined in [Appendix E](#).

The unemployment coefficient α_3 has a negative impact on MR, suggesting that an increase in unemployment reduces MR. This is in line with the work of Wrenn et al. (2019), which reveals the negative impact of unemployment on MR. Chinese women give more value to MR than do men, and employment has become an important position in MR decisions (Yu & Xie, 2015). Unemployment reduces household income and decreases housing affordability, which diminishes the chances of MR. This effect is more pronounced in the Chinese context due to the skewed gender ratios, which have increased marriage market competition (Li, 2018). Employment is considered secure and commendable and unemployment insecure and distasteful in the marriage calculus. The urbanization coefficient $\hat{\alpha}_4$, for its part, is insignificant, indicating that urbanization has no role in explaining MR. Gautier et al. (2009) show that large cities with dense populations serve a large MR market for single people who have migrated from rural areas and have more opportunities for a stable life. The ever-increasing urbanization and living standards are one of the upshots of the economic reforms. The process of rapid urbanization took place in the 2000s, while MR showed a decreasing trend during the period (Zhang et al., 2014). The greater the population density in highly urbanized cities, the greater the wedding cost (Li, 2018). Nonetheless, urbanization has no impact on MR, as rapid urbanization has coincided with the maturity of the first generation born under the one-child policy, which has reached marriageable age under conditions of a higher gender imbalance. The MR has been affected by the gender imbalance instead of urbanization. As the sole inheritors of family wealth and property in highly urbanized cities enjoy more financial freedom, the effects of urbanization do not dominate MR dynamics (Hu, 2013). The robustness check of this result is provided in [Appendix A](#).

Our study considers the consequences of HPs for MR using the panel threshold regression model. The empirical results illustrate that HPs have a negative impact on MR when the price is above the threshold value. This result is supported by the duration model, which shows that as HP increases, the rate of MR decreases. Conversely, HPs have a positive impact on MR when the price is below the threshold value. Moreover, GDP per capita has a positive effect, and unemployment and female education have a negative effect on MR. This study is crucial for policymakers and investors. First, HP has a negative impact on MR, suggesting that a lack of affordable housing can threaten marital stability. Therefore, the relevant authorities should take serious measures to control HPs with more vigilance at the time of residential land bidding to discourage manipulation by the limited number of housing suppliers. Such measures can help the government maintain a constant supply of housing, which will minimize the pressure on HPs. Second, the demand side is pressured by the traditional perspective in China that a family is incomplete without housing, which leads to the highest household investment being made in housing and puts persistent pressure on HPs. Therefore, the government should discourage this phenomenon by formulating strict rules on dowries. Similarly, actions should be taken to supervise couples who divorce to buy a second home that they cannot buy as a married couple.

Likewise, son preference should be discouraged to support correcting the skewed gender ratios in China. Fourth, because housing investment is one of the most attractive and safest ways to accumulate wealth due to the lack of other investment opportunities, the government should relax the strict rules related to investment and establish a diversified investment environment at the local level. This can help to reduce the pressure on the housing market and balance risk, as the market has on several occasions shown vulnerability in the form of burst bubbles.

7. Conclusion

We apply a threshold regression model to detect the impact of HPs on MR in China. After we control for other variables that influence MR, the findings indicate that HPs have a negative impact on MR when the price is above the threshold value. Homeownership is an extremely central aspect of MR decisions in China, and MR without housing is considered incomplete. This result is supported by the duration model, which shows that as HPs increase, the rate of MR decreases. Similarly, HPs have a positive impact on MR when the price is below the threshold value. GDP per capita has a positive effect, and unemployment, as well as female education, a negative effect on MR. Rising HPs slow MR rates and can cause even more serious problems for society. The government should balance housing supply and demand with higher supervision to discourage private market monopolies. Similarly, incentives should be extended to low-income people to wed, which can relieve MR competition, while more diversified investments can control skyrocketing HPs. This study examines the threshold effect of HPs on MR at the provincial level. The findings confirm that HPs have a significant impact on MR with respect to the threshold value. However, there are limitations because each province has specific economic and education characteristics, which can have different impacts on MR. China has various regions, i.e., the Eastern, Central, Western and Northeastern regions, each with its own industries, economic development, education level, housing affordability, gender imbalance, and female labor force participation. HPs are higher in the Eastern region compared to the remaining regions, causing greater competition in its marriage market. The present study covers all provinces, including both urban and rural regions that have drastic differences in income level, education, and traditions. In rural areas, people adhere more to tradition and give more importance to MR. Urban regions are more developed, with greater per capita income and education and more emphasis on career instead of marrying at an early age. Thus, the current work can be extended by using the most developed cities with similar characteristics in China to analyze the threshold effect of HPs on MR. Further, the skewed gender ratio, which varies across provinces, can be considered in future studies. Further, such studies can analyze the HP and MR relationship in terms of the distinctive characteristics of urban and rural areas.

Notes

1. A form of marriage seen after 1980 in China, where the marriage takes place without solid material foundation.

2. Mothers of brides prefer men for their daughters who own housing, which is taken as an indication of wealth and saving.
3. The basic purpose of this policy was to regulate the housing supply mechanism as well as reinforce the government contribution in taxation, credit and land policy.
4. This policy was intended to control house prices through better management and the curbing of speculative foreign investment.
5. This policy was designed to enhance the supply of affordable housing by local governments along with the provision of an environment conducive to housing growth and control of credit risk.
6. These policies aimed to enhance the function of the real estate market and raised the down payment for buying a second house.

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Appendix A. Robustness test

We add new control variables to obtain precise results and assess the robustness of our outcomes. The explanations are emphasized in Table A1. Control variables such as the divorce rate (DR_t), previous house prices (HP_{t-1}), the previous marriage rate (MR_{t-1}) and the birth rate (BR_t) are added into the equation for panel threshold models (1) to (3). Zheng et al. (2018) estimate that the divorce rate has a significant impact on MR in China in the short run. Moreover, house prices (HP_{t-1}) and marriages (MR_{t-1}) in the previous period are leading MR, similar to in the work of Ruzhi et al. (2019), who identifies the same relationship. Hui et al. (2012) conclude that a low birth rate causes delaying MR.

$$MR_{it} = \begin{cases} HP_{it}I(HP_{it} \leq \gamma) + \beta_2 HP_{it}I(HP_{it} > \gamma) + \alpha_1 DR_{it-1} + \alpha_2 UM_{it-1} + \alpha_3 HP_{it-1} & (1) \\ HP_{it}I(HP_{it} \leq \gamma) + \beta_2 HP_{it}I(HP_{it} > \gamma) + \alpha_1 DR_{it-1} + \alpha_2 UM_{it-1} + \alpha_3 HP_{it-1} + \alpha_4 MR_{it-1} & (2) \\ HP_{it}I(HP_{it} \leq \gamma) + \beta_2 HP_{it}I(HP_{it} > \gamma) + \alpha_1 DR_{it-1} + \alpha_2 UM_{it-1} + \alpha_3 HP_{it-1} + \alpha_4 MR_{it-1} + \alpha_5 BR_{it-1} & (3) \end{cases}$$

The F -statistics are obtained by means of the bootstrap method, and threshold effect findings are demonstrated in Table A2. It shows that the F -statistics of the single threshold are greater than their critical value, which validates the use of the single threshold for all the models. Similarly, the results on the threshold effect and control variables are reported in Table A3. It concludes for all the models that HP has a positive impact on MR when it is below the threshold value. However, HP has a negative impact on MR when it is above the threshold value. Thus, the robustness test confirms that the HP threshold effect is significant after adding several control variables, in line with the main results of this paper, and makes the outcomes more conclusive.

Table A1. Models with different control variables.

Dependent Variable		Threshold variable	Control variables
Model (1)	MR	HP	$UM_{t-1}, DR_{t-1}, HP_{t-1}$
Model (2)	MR	HP	$UM_{t-1}, DR_{t-1}, HP_{t-1}, MR_{t-1}$
Model (3)	MR	HP	$UM_{t-1}, DR_{t-1}, HP_{t-1}, MR_{t-1}, BR_{t-1}$

Table A2. The threshold effect results between MR and the control variables.

	Single-threshold effect			Double-threshold effect		
	Threshold value	F -statistics	p -value	Threshold value	F -statistics	p -value
Model (1)	8.159	29.047***	0.010	6.622	10.720	0.160
Model (2)	8.833	9.585**	0.043	10.011	6.954	0.360
Model (3)	7.278	8.116*	0.086	7.608	4.368	0.840

Note: ***, ** and * indicate significance at the 1% 5% and 10% levels.

Source: Authors’ calculation.

Table A3. The results of each model.

	Coefficients	Estimated values	OLS se	t_{OLS}	White se	t_{White}
Model (1)	$\hat{\beta}_1$	0.434	0.046	9.434***	0.145	2.99***
	$\hat{\beta}_2$	-0.527	0.034	-15.500***	0.119	-4.428***
Model (2)	$\hat{\beta}_1$	1.072	0.026	41.230***	0.033	32.484***
	$\hat{\beta}_2$	-1.030	0.019	-54.210***	0.019	-54.210***
Model (2)	$\hat{\beta}_1$	1.026	0.050	20.520***	0.044	23.318***
	$\hat{\beta}_2$	-0.976	0.040	-24.400***	0.043	-22.697***

Note: *** indicates significance at the 1% level.

Source: Authors' calculation.

Appendix B. Endogeneity test

We use new assumptions other than lag value to avoid the identification problem and misleading inference which helps in solving the endogeneity problem (Bellemare *et al.*, 2017). The birth rate (BR) and divorce (DR) are the new assumption to examine HP threshold effect on MR, and the results are illustrated in Table BI. The results indicate the single threshold effect of HP on MR. This highlights that HP has a significant role in MR. Further, when HP is below the threshold value of 6.259, the estimated $\hat{\beta}_1$ is 0.060. Table B2 confirms that when HP increases 1%, MR will rise by 0.060. The results are similar to the work of Ruzhi *et al.* (2019), who find that HP has a significant impact on MR in China. Marriage market competition has been rising due to the greater income of the household, skewed gender ratio, and greater divorce rate. However, homeownership offers a sense of security in the marriage market and helps in the selection of partners. However, HP has a negative effect on MR when it is higher than the threshold value. Table B2 also demonstrates the results with control variables such as BR and DR. The DR has a negative impact on MR, which implies that rising DR has declined MR. Moreover, the BR leads MR positively. Thus, these results obtained on the threshold effect of HPs on MR help in solving the endogeneity problem.

Table B1. Tests for the threshold effects of HP on MR.

Test	Threshold Estimates	F-statistics	Bootstrap p-value	Critical values		
Single threshold	6.259	7.568*	0.027	15.915	14.500	13.098
Second threshold	8.698	6.084	0.150	22.229	16.629	15.775
	6.259					
Triple threshold	7.804	7.099	0.150	16.209	12.836	10.896
	8.698					
	6.259					

1. p-value and F-statistics are obtained by repeating the bootstrap procedures 10000 times for every test.

2. * indicates significance at the 10% level.

Source: Authors' calculation.

Table B2. Estimated coefficients of the marriage and control variables.

	Coefficients	OLS se	t_{OLS}	White se	t_{White}
$\hat{\beta}_1$	0.060	0.032	1.875*	0.019	3.157***
$\hat{\beta}_2$	-0.035	0.020	-1.750*	0.016	-2.187**
$\hat{\alpha}_1$	-0.026	0.014	1.857**	0.010	2.600**
$\hat{\alpha}_2$	0.045	0.022	2.045**	0.019	2.368**

Note: *, ** and *** indicates significance at the 10%, 5% and 1% level, respectively.

Source: Authors' calculation.

Appendix C. Interpretation of the methodology

The F-statistics are estimated by the bootstrap method, followed by approximating the p-values after repeating the bootstrap procedure 10000 times. In the case of a single threshold, the F-statistics values are greater than the critical values. However, the F-statistics for the double and

triple threshold effects are all smaller than the 10% critical values, which indicates a single threshold should be used in this study. The threshold value is 12.247, which is the turning point for the two different effects of HP on MR. Table 4 specifies that when HP is below the threshold value of 12.247, the estimated $\hat{\beta}_1$ is 0.035, and the t-statistics for the homogeneous and heterogeneous standard errors are both significant. Thus, when HP increases 1%, MR rises by 0.035. In the case when the HP value is greater than the threshold ($HP > 12.247$), the estimated $\hat{\beta}_1$ is -0.019 . This reveals a negative and significant impact of HP on MR, implying that when HP rises by 1%, MR declines by -0.019 . Last, GDP per capita has a positive effect, and unemployment and female education have a negative effect on MR. This study is crucial for policymakers and investors. A lack of housing affordability can threaten marital stability. Therefore, the relevant authorities should take serious measures to control HPs with more vigilance at the time of residential land bidding to discourage manipulation by the limited number of housing suppliers. This can help the government maintain a constant supply of housing, which will minimize the pressure on HPs.

Appendix D. Simultaneity problem

In order to solve the simultaneity problem, we examine MR threshold impact on HP and results are illustrated in Table D1. The results indicate the single threshold effect of MR on HP. It highlights that MR has a significant role in HP. Further, when MR is below the threshold value 8.629 the estimated $\hat{\beta}_1$ is 0.201. Table D2, confirms that when MR increases 1% HP will rise by 0.201%. The results are similar to the work of Ruzhi et al. (2019) detects that MR has a significant impact on HP in China. The competition for MR has been rising due to greater income of the household, skewed gender ratio, and greater divorce rate. However, homeownership is a sense of security in the marriage market and helps in the selection of partners. However, MR has a negative effect on HP when it is higher than the threshold value.

Table D1. Tests for the threshold effects of MR on HP.

Test	Threshold Estimates	F-statistics	Bootstrap p-value	Critical values		
Single threshold	8.629	22.594*	0.008	32.884	26.134	19.431
Second threshold	8.804	15.074	0.120	23.429	17.628	15.805
	8.629					
Triple threshold	7.804	7.099	0.170	15.209	11.836	9.306
	8.804					
	8.629					

1. * indicates significance at the 10% level.

Table D2. Estimated coefficients of the Marriage.

	Coefficients	OLS se	t_{OLS}	White se	t_{White}
$\hat{\beta}_1$	0.201	0.068	2.955***	0.065	2.309**
$\hat{\beta}_2$	-0.172	0.065	-2.646**	0.059	-2.915***

3. ** and *** indicates significance at the 10% and 5%, respectively.

Table D3. Estimated coefficients of the control variables.

	Coefficients	OLS se	t_{OLS}	White se	t_{White}
$\hat{\alpha}_1$	0.244	0.070	3.485***	0.056	4.357***
$\hat{\alpha}_2$	0.054	0.030	1.800*	0.025	2.212**
$\hat{\alpha}_3$	0.143	0.081	1.762*	0.078	1.82*
$\hat{\alpha}_4$	-0.431	0.059	-1.670*	0.258	-1.670*

1. $\hat{\alpha}_1$, $\hat{\alpha}_2$ and $\hat{\alpha}_3$ indicates that the coefficient estimates of per capita GDP, female education level and unemployment rate, respectively.

2. *, ** and *** indicates significance at the 10%, 5% and 1% level, respectively.

Table D3 illustrates the results about the control variable impact on HP. Unemployment has a negative effect on HP while GDP per capita and urbanization have a positive effect. Moreover, the female education level has a positive influence on HP. Thus, the results obtained from MR threshold effect on HP help in solving the Simultaneity problem.

Appendix E. Multicollinearity test

We evaluate the presence of multicollinearity and the results are given in Table E. The variance inflation factor of the individual as well as the mean value indicate that model has no issue of the multicollinearity.

Table E1. Test of Multicollinearity.

Variables	Coefficients	VIF
C	12.336***	
HP	-0.270***	2.100
GDP	0.470	3.340
EDU	0.399***	1.710
UM	0.333*	1.170
URB	-0.792***	1.970
Mean VIF		2.050
R Square	0.702	
F-statistics	0.000	

Note: * and *** are at the 10% and 1% significance level, respectively.

Appendix F. Two-stage least square regression

To solve the problem of the endogeneity problem we examine the two-stage least square regression (2SLS) and the results are illustrated in Table F1. It indicates that HP is highly correlated with the MR. Likewise, the control variables such as GDP and URB have positively correlated with MR while UM has a negative relationship. The finding suggests that after controlling, unemployment, female education, urbanization and economic growth, the birth rate (BR) explains a significant part of MR, implies that by introducing BR the biasness declined. Furthermore, the Hausman tests reveal that variables are not endogenous and there is no endogeneity problem.

Table F1. Two stage regression.

Variables	Coefficients	p-values
HP	0.149***	0.001
EDU	-0.074	0.434
GDP	0.800***	0.002
UM	-2.782***	0.000
URB	0.973**	0.014
Endogenous variable		
BR	0.057**	0.008
R ²	0.650	
Durbin (score)	20.563 (p = 0.000)	
Wu-Hausman test	21.151 (p = 0.000)	

Note: ** and *** are significance level at 1 and 5%, respectively.