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Property Tax in China: Is It Effective in Curbing Housing Price?

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Abstract

This paper studies the effects of the property tax, implemented in Shanghai and Chongqing since January 28, 2011, on the housing price. Applying the synthetic control method of Abadie, Diamond, and Hainmueller (2010), we construct counterfactual housing price for Shanghai and Chongqing using monthly data from 33 cities that have no property tax. Comparing the counterfactual and actual price, we estimate that by November 2012 the average housing price in Shanghai was about 2127 RMB/m2 or 13.4% lower than it would have been in the absence of the property tax. This evidence is found to be significant using placebo test. We find no significant evidence that property tax is effective in curbing the housing price in Chongqing.

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1. Introduction

Shanghai and Chongqing pioneered the unprecedented property tax in China on January 28, 2011 in an attempt to curb speculative demand and ease housing price. It has been more than two years since the trial of the property tax, both cities experience soaring housing price like the others. Would the housing price in Shanghai and Chongqing have risen more dramatically had there been no property tax? This paper aims to answer this question and shed light on the feasibility of extending the property tax, currently implemented in Shanghai and Chongqing only, to the other cities in China, one of the potential tightening controls unveiled by the State Council of China on March 1st, 2013.

Studies on the relation between property tax and housing price are generally inconclusive and vary with the characteristics of housing market. [1] Given that current property tax in China differs significantly from common international practices, i.e., it targets a small proportion of potential speculators instead of most homeowners and the tax revenue is used to subsidize the low-income housing instead of financing public goods, it seems not suitable to apply existing evidence to evaluate its impact directly. Moreover, current literature on the determination of housing price is both voluminous and contentious, making it difficult to filter the impact of the property tax on housing price. The interactions between housing price and various economic conditions and market expectations may contaminate results on the effects of the property tax if endogeneity issues are not well addressed.

The synthetic control method formalized in Abadie, Diamond, and Hainmueller (2010, henceforth ADH) allows us to steer away from these difficulties and avoid many endogeneity issues. [2] It uses data-driven procedures to simulate the counterfactual housing price of Shanghai (or Chongqing) in the absence of property tax as a weighted average of housing price from cities that have no property tax. Based on monthly city-level data from May 2009 to November 2012, our results suggest that the housing price in Shanghai could have risen by another 2127 RMB/m^2 or 13.4% in the absence of property tax. There is not significant evidence that the property tax has an impact on the housing price of Chongqing.

2. Methodology and Data

2.1. Methodology

Let P_{it} be the observed residential housing price for city i at period t, where $i = 1,...I+1$ and $t = 1,\ldots,T_0,\ldots,T$ with T_0 being the period when the property tax was implemented. Here $i = 1$ for the city that imposed property tax (treated city) and $i > 1$ for cities unaffected by the policy (control cities). Denote P_{it}^N as the housing price in the absence of property tax, we have

[1] Kuang (2009) and Crowe, et al. (2011) suggest that property tax reduces housing price while Simon (1943) shows the opposite. More recently, Keen, et al. (2010) argues that tax do not drive housing price. See Zodrow (2001) for a survey.

[2] See Abadie and Gardeazabal (2003), Abadie, et al. (2012), Jinjarak, et al. (2012) and Cavallo, et al. (2013) for the application of this methodology in different contexts. The ADH algorithm does not require us to make many structural assumptions that would have been difficult to theoretically justify and can estimate unbiased coefficients with relatively few pre-intervention observations.

$$P_{it} = P_{it}^N + \alpha_{it} D_{it}, \quad (1)$$

where $D_{it}=1$ for $i=1$ and $t \geq T_0$ and $D_{it}=0$ otherwise; and α_{it} measures the impact of property tax on housing price. Our aim is to estimate α_{1t} for all $t \geq T_0$ (note that $P_{it} = P_{it}^N$ for $i = 2,...,I+1$). This requires knowledge on P_{1t}^N for $t \geq T_0$, which is not observable after the implementation of property tax. We review below the ADH methodology of constructing a synthetic control of P_{1t}^N using data on control cities that are not affected by the property tax.

Suppose P_{it}^N follows an autoregressive model with time-varying coefficients:

$$P_{it+1}^N = \beta_t P_{it}^N + \mathbf{\Phi}_{t+1} \mathbf{Z}_{it+1} + u_{it+1},$$
$$\mathbf{Z}_{it+1} = \gamma_t P_{it}^N + \mathbf{\Pi}_t \mathbf{Z}_{it} + v_{it+1},$$

where $\mathbf{Z}_{it}$ is a $(r \times 1)$ vector of observed covariates at period t, Φ_{t+1} and Π_t are $(1 \times r)$ vectors of unknown parameters at period $t+1$ and t respectively, and both u_{it+1} and v_{it+1} have mean zero conditional on $\Omega_t = \{P_{is}, Z_{is}\}_{1 \leq i \leq I+1, s \leq t}$. Let $\mathbf{W} = (\omega_2,...,\omega_{I+1})'$ be a $(I \times 1)$ vector of weights allocated to the control cities, with $\omega_i \geq 0$ for $i = 2,...,I+1$ and $\sum_{i=2}^{I+1} \omega_i = 1$. The goal is to find an optimal weight matrix $\mathbf{W}^* = (\omega_2^*,...,\omega_{I+1}^*)'$ to construct a synthetic control for P_{1t}^N such that

$$\hat{P}_{1t}^N = \sum_{i=2}^{I+1} \omega_i^* P_{it}^N = \sum_{i=2}^{I+1} \omega_i^* P_{it}. \quad (2)$$

We next proceed to the estimation of $\mathbf{W}^*$.

Let $\overline{P}_i^{\mathbf{K}} = \sum_{s=1}^{T_0-1} k_s P_{is}$ be a linear combination of the pre-intervention housing price, where $\mathbf{K} = \{k_1,...,k_{T_0-1}\}$ is a vector of weights allocated to the sample periods before the policy change. Consider M possible values of $\mathbf{K}$ defined by $\mathbf{K}_1,...,\mathbf{K}_M$. Denote $\mathbf{X}_1 = (\mathbf{Z}'_1, \overline{P}_1^{\mathbf{K}_1},..., \overline{P}_1^{\mathbf{K}_M})$ a vector of pre-intervention characteristics for the treated city, and similarly $\mathbf{X}_0$ for the group of control cities. The vector $\mathbf{W}^*$ is estimated by minimizing the distance between $\mathbf{X}_1$ and $\mathbf{X}_0\mathbf{W}$ before the intervention:

$$\|\mathbf{X}_1 - \mathbf{X}_0\mathbf{W}\|_{\mathbf{V}} = \sqrt{(\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})' \mathbf{V} (\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})},$$

where $\mathbf{V}$ is a $(k \times k)$ symmetric and positive semi-definite matrix ($k = r + M$). The value of V is chosen to minimize the mean squared prediction error of P_{1t}^N prior to the intervention.[3]

Given $\mathbf{W}^*$, following from Eq.(1) and (2), the estimated impact of the property tax is

$$\hat{\alpha}_{1t} = P_{1t} - \hat{P}_{1t}^N = P_{1t} - \sum_{i=2}^{I+1} \omega_i^* P_{it},$$

[3] The estimation can be carried out by the STATA program *synth*, which is described at: http://www.mit.edu/~jhainm/synthpage.html.

for $t \in \{T_0, ..., T\}$.

To access the statistical significance of this estimation, we conduct placebo studies by iteratively applying the ADH methodology to produce a counterfactual for each control city, which is assumed to implement a similar (and imaginary) property tax at period T_0. These synthetic controls for the placebos are then used to calculate the impact of the placebo property tax ($\hat{a}_{it}^{p}$) in every period following its (non)-occurrence with the following formula:

$$\hat{a}_{it}^{p} = P_{it} - \hat{P}_{it}^{N} = P_{it} - \sum_{j \neq i}^{j \in \{1,...,I+1\}} \omega_j^* P_{jt}, \quad (3)$$

for $t \geq T_0$ and $i \geq 2$. If $\hat{\alpha}_{1t}$, the impact of property tax on the treated city that actually implements the property tax, is statistically different from $\hat{a}_{it}^{p}$, the placebo impact, for $t \geq T_0$ and $i \geq 2$, the effect of the property tax is considered to be statistically significant.

2.2. Data

We collect from China Real Estate Index System (CREIS) the monthly residential housing price (RMB/m^2) for Shanghai, Chongqing and 33 other cities from May 2009 to November 2012. [4] To access the robustness of estimation results, we also collect other predictors of housing prices including land space purchased (tens of thousands m^2), investment of real estate development on residential buildings (RMB) and total funding (RMB) that consists of domestic loans, foreign investment, self-raising funds and other sources of funds. In this paper $i = 1$ for Shanghai in the first case study and $i = 1$ for Chongqing in the second case study. In both case studies, we have $I = 33$ (33 control cities) and T_0 corresponds to January 28, 2011.

3. Results

3.1. The effect of property tax in Shanghai

Figure 1 graphs the residential housing price for Shanghai (P_{1t}) and its synthetic counterpart ($\hat{P}_{1t}^{N}$) from May 2009 to November 2012. The synthetic Shanghai is constructed as a weighted average of the 33 control cities, with weights listed in Appendix A. Apparently, the synthetic housing price tracks the trajectory of the actual housing price closely before the imposition of the property tax, which indicates a good fit of the synthetic method prior to the intervention ($t < T_0$).[5] The two lines begin to diverge after the intervention. The gap between the real and synthetic Shanghai, which is essentially our estimate of the effect of the property tax ($\hat{\alpha}_{1t}$ for $t \geq T_0$), suggests that the property tax reduces housing price in Shanghai[6]. The

[4] Due to the missing data on April 2009 for most cities in our sample, this is the longest sample period that covers the date when property tax was first implemented in Shanghai and Chongqing when this paper is written.
[5] Appendix B further shows that the pre-intervention characteristics of the synthetic Shanghai closely resembled that of the actual Shanghai.
[6] The housing price declined significantly in December 2011 and started to recover in February 2012. The decline is mainly due to nation-wide tightening policies on housing market and monetary policies. While the recovery may be attributed to loose monetary policies – starting from February 2012, People's Bank of China lowered the benchmark interest rate and the required reserve ratio consecutively.

effect of the property tax is relatively moderate in the first year after its implementation and escalates sharply one year later before it shrinks recently. Our results suggest that, on average, the property tax reduced the housing price in Shanghai by about 2127 RMB/m^2 (or 13.4%) from February 2011 to November 2012.

To access the significance of the impact of property tax in Shanghai, we conduct a series of placebo tests by applying the synthetic control method to each of the 33 control cities as if the city, instead of Shanghai, had imposed the property tax in January 28, 2011, and shifting Shanghai to the group of control cities. The estimated effect associated with each of the 33 placebo runs ($\hat{a}_{it}^{p}$ for $i \geq 2$) is computed as the placebo gap in the housing price between this city and its synthetic counterpart (see Eq.(3)). Figure 2 shows that, the estimated housing price gap between Shanghai and synthetic Shanghai ($\hat{\alpha}_{1t}$) is usually large relative to the placebo gaps of 33 control cities ($\hat{a}_{it}^{p}$ for $i \geq 2$) after the policy change. Our analysis therefore provides significant evidence that property tax reduces housing price in Shanghai.

3.2. The effect of property tax in Chongqing

Figure 3 shows that the residential housing price for Chongqing (P_{1t}) and synthetic Chongqing ($\hat{P}_{1t}^{N}$) move closely before the implementation of the property tax,[7] but have a gap that turns from positive to negative afterwards. The effect of the property tax in Chongqing appears to be mixed – it raises the housing price in the short term (February to July 2011) and distress the housing price in the medium-long term (August 2011 to November 2012). The magnitude of the effect, however, appears to be economically small. The results of placebo tests presented in Figure 4 show that, the estimated gap for Chongqing is not much different from the majority of the placebo gaps. It suggests that the impact of the property tax in Chongqing is not significant.

4. Discussion and Conclusion

Using monthly city-level data from May 2009 to November 2012, we find that the property tax has reduced the residential housing price in Shanghai by an average of 2127 RMB/m^2 or 13.4%, but had not significant impact in Chongqing. Why is the property tax found to be effective in curbing soaring housing price in Shanghai but not in Chongqing? One explanation is that the property tax is relatively prevailing in Shanghai but not so much in Chongqing. In Shanghai, except for the first house purchased by local residents, all housing transacted after January 28, 2011 are taxed. At the end of 2011, there were more than 20,000 taxable housing in Shanghai, which accounts for about 12% of the total number of housing transacted in 2011.[8] In Chongqing, the property tax applies on housing newly purchased by non-local residents who previously own at least one housing in Chongqing, and all (existing and newly-purchased) villas, town houses and other high-end houses that are more than twice of the average housing price. The total number of taxable housing in the first category is only 70 from January 28, 2011 to December 31, 2012, which is negligible. The

[7] See Appendix A for a list of synthetic weights $\omega_2^*, \ldots, \omega_{I+1}^*$, and Appendix B for a comparison on the pre-intervention characteristics of actual and synthetic Chongqing.

[8] The total number of houses transacted in 2011 was 175,817 according to China Statistical Yearbook 2012. The data on taxable units of houses in 2011 is from the news report by People's Daily Online http://house.people.com.cn/n/2012/1231/c164220-20064930.html.

total number of villas, town houses and other high-end houses transacted in 2011 was 8965, which accounted for only 2% of the total housing transactions in Chongqing.[9] Given the small proportion of taxable housing relative to all transactions, even if the property tax has an impact in Chongqing, it will reflect little on its relation with the average residential housing price.

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[9] The total floor space of villas, town houses and other high-end houses transacted in 2011 was 1.42 million square meters, which was about 3.5% of the total transactions measured in floor spaces.

Appendix

A. City Weights in the Synthetic Shanghai and Chongqing

City	Weight in Synthetic Shanghai	Weight in Synthetic Chongqing
Beihai	0.003	0.000
Beijing	**0.198**	0.000
Changsha	0.002	**0.565**
Chengdu	0.003	0.000
Dalian	0.004	0.000
Guangzhou	0.007	0.000
Hangzhou	**0.244**	0.000
Harbin	0.003	0.000
Hefei	0.003	0.000
Hohhot	0.002	0.000
Jilin	0.003	0.000
Kunming	0.002	0.000
Lanzhou	0.002	0.000
Nanchang	0.002	0.000
Nanjing	0.006	0.000
Nanning	0.003	0.000
Ningbo	0.045	0.000
Qingdao	0.003	0.000
Shenyang	0.002	0.072
Shenzhen	0.070	0.000
Shijiazhuang	0.002	0.000
Suzhou	0.004	0.000
Taiyuan	0.003	0.000
Tianjin	0.004	0.000
Wenzhou	**0.350**	0.000
Wuhan	0.003	0.000
Wulumuqi	0.002	0.000
Wuxi	0.005	0.000
Xiamen	0.010	0.000
Xian	0.002	0.000
Xining	0.002	**0.363**
Yinchuan	0.002	0.000
Zhengzhou	0.002	0.000

B. Housing price predictor means[10]

Panel A of this table compares the pre-intervention characteristics of the actual Shanghai with that of the synthetic Shanghai. The synthetic Shanghai is constructed as a combination of cities that most closely resembled the housing price evolution of actual Shanghai before the implementation of the property tax. The reported statistics are the mean values of the actual and synthetic explanatory variables for the pre-intervention periods. Root Mean Squared Prediction Error (RMSPE) is calculated as the root mean of the weighted squared distance between the actual and synthetic housing price before the intervention. Panel B reports similar statistics for actual and synthetic Chongqing.

Panel A: Shanghai		
Variables	Actual	Synthetic
Housing price in January 2010 (RMB/m^2)	13,461.00	13,441.30
Housing price in August 2010 (RMB/m^2)	14,279.99	14,260.07
Land space purchased (Tens of thousands m^2)	140.25	140.05
RMSPE	377.02	
Panel B: Chongqing		
Variables	Real	Synthetic
Housing price in December 2009 (RMB/m^2)	3,266.06	3,318.64
Housing price in January 2011 (RMB/m^2)	4,779.62	4,707.00
Land space purchased (Tens of thousands m^2)	521.36	167.87
RMSPE	73.60	

[10] Other than the lagged housing prices and land space, we also control for other variables specified in the data section (investment of real estate development on residential buildings, total funding and its four components) while constructing the synthetic control. Including one or some of these variables does not affect our main results. As including additional variable(s) does not reduce RMSPE, these results are available upon request.

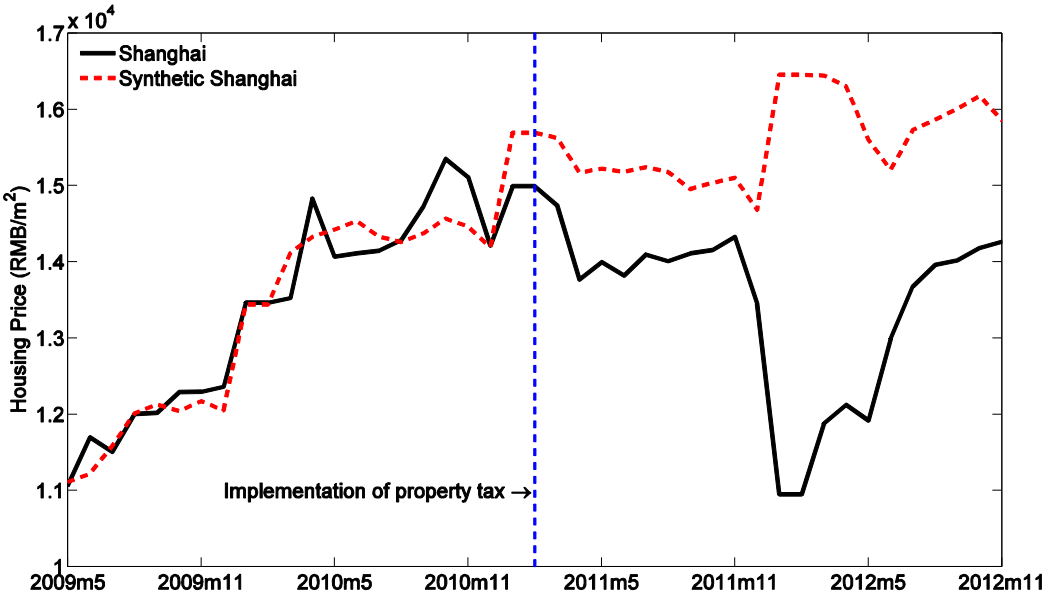

Figure 1. The housing price of Shanghai and synthetic Shanghai.

The solid line plots the actual housing price of Shanghai, while the dashed line plots the counterfactual evolution of the housing price had the property tax not been implemented in Shanghai.

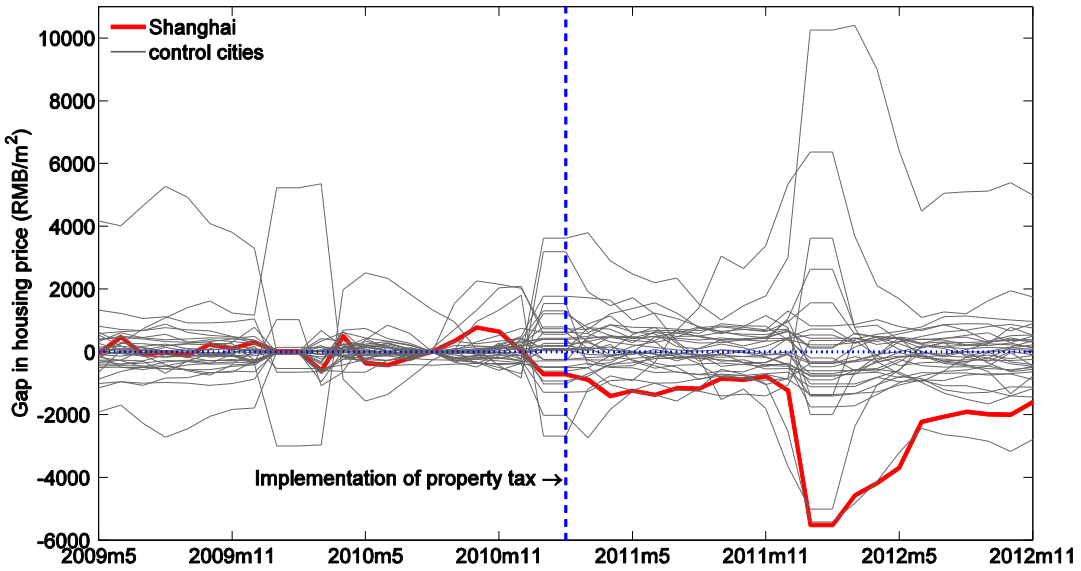

Figure 2. The housing price gap in Shanghai and placebo gaps in all 33 control cities.

The superimposed line plots the gap between the actual housing price in Shanghai and synthetic Shanghai; each of the grey line plots the placebo gap between the actual and counterfactual housing price of one of the control cities as if this city instead of Shanghai had implemented the property tax in January 2011.

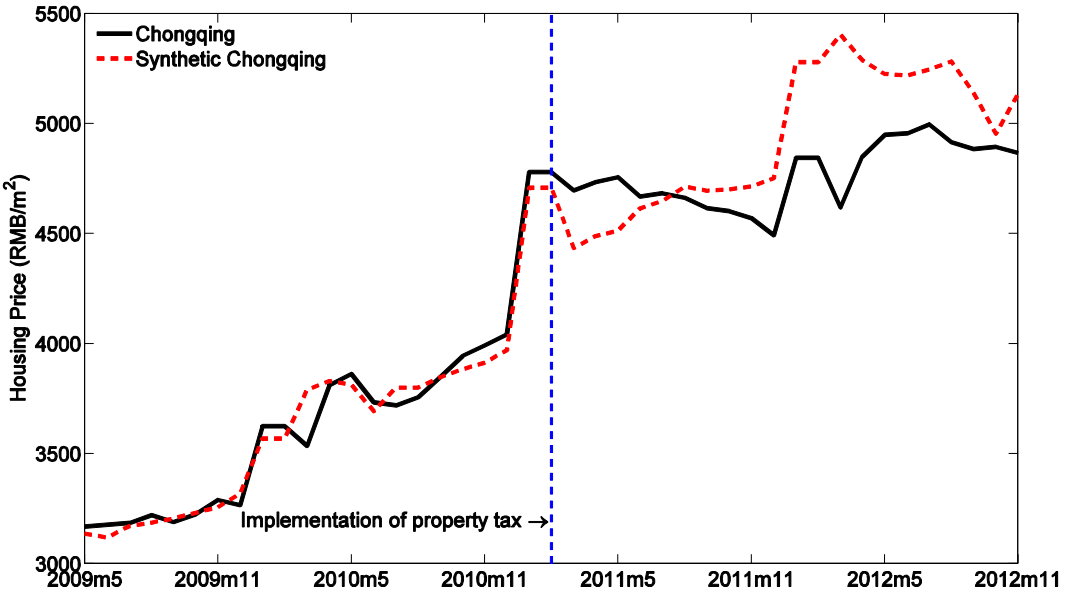

Figure 3. The housing price of Chongqing and synthetic Chongqing.

The solid line plots the actual housing price of Chongqing, while the dashed line plots the counterfactual evolution of the housing price had the property tax not been implemented in Chongqing.

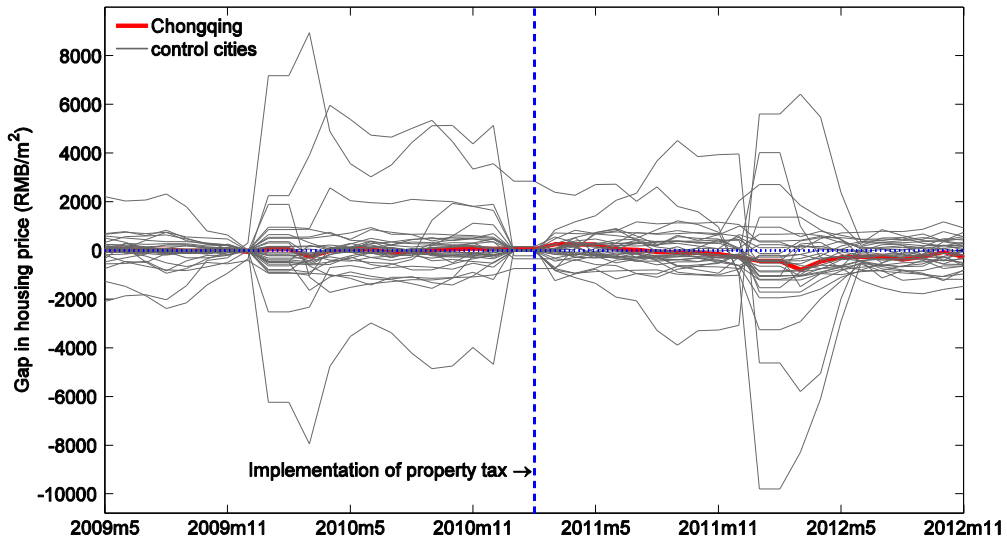

Figure 4. The housing price gap in Chongqing and placebo gaps in all 33 control cities.

The superimposed line plots the gap between the actual housing price in Chongqing and synthetic Chongqing; each of the grey line plots the placebo gap between the actual and counterfactual housing price of one of the control cities as if this city instead of Chongqing had implemented the property tax in January 2011.