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Transmission of Housing Bubbles among Industrial Sectors

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Highlights

1 We find a negatively significant correlation between housing or land prices and the Consumer Price Index (CPI) during China and Japan's bubble economy eras. This puzzling fact can be explained by the new theory presented in this paper.

2 Our theory models the impact of the housing bubble on housing-related and non-housing industrial sectors by combining the neoclassical general equilibrium with the input–output table.

3 Our theory proposes that housing bubbles increase investments and output prices in housing-related sectors (crowding-in effect) while simultaneously reducing both investments and output prices in non-housing sectors (crowding-out effect).

4 We provide new insights that illustrate why and how the housing bubble distorts the economy differentially in different industrial sectors.

Abstract

We find that housing bubbles are accompanied by sluggish demand in non-housing-related sectors both currently in China and previously in Japan. To explain this, we construct a theory to model the differential impact of housing bubbles on housing-related and non-housing-related industrial sectors by combining the neoclassical framework of general equilibrium with the input–output table. We also find that the housing bubble increases investments and output prices in housing-related sectors (crowding-in effect) while simultaneously reducing investments and output prices in non-housing-related sectors (crowding-out effect). Our theoretical findings could explain the negatively significant correlation between housing or land prices and the Consumer Price Index (CPI) during China and Japan's bubble economy eras. Hence, this paper provides new insights into why and how the housing bubble distorts the economy differentially, for different industrial sectors.

JEL: E22; R31; D57

Keywords: housing bubble, industrial sector, input–output table, overinvestment, underinvestment, crowding-in, crowding-out

1. Introduction

1.1 Bubbly housing demands accompanying sluggish non-housing demands.

No satisfactory theoretical explanation of why bubbly housing sectoral demands accompany sluggish non-housing sectoral demands has yet been advanced. As Figure 1 illustrates, this situation occurred in China between 2005 and 2020, when housing prices were significantly and negatively correlated (correlation coefficient = −0.5066 and p-value = 0.0452) with the Consumer Price Index (CPI). It also occurred in Japan between 1984 and 1987, as Figure 2 illustrates (correlation coefficient = −0.9306, p-value = 0.0694).[3] To the best of our knowledge, no studies to date have offered theoretical explanations for this from the industrial sectors' perspective, although Wan (2021) provides a theoretical explanation from the household side: oversaving as a result of speculation caused by housing bubbles provides financial resources for bubbly housing purchases by reducing non-housing-related consumption and decreasing demand in the non-housing industrial sector (Wan, 2021). This paper will provide new insights and link the household perspective with that of the industrial sectors by first combining the general equilibrium framework with input–output analysis and then clarifying how the housing bubble could increase investments in housing-related sectors (crowding-in effect) while simultaneously reducing investments in non-housing sectors

[3] See Wan (2018a) for details of the empirical results of housing bubbles in both China and Japan.

(crowding-out effect).

[Insert Figure 1 here.]

[Insert Figure 2 here.]

1.2 Housing bubble and investment in China, Japan, and the U.S.

Based on data pertaining to new vacant housing in Wan (2018c) and Williams et al. (2019) as well as direct input coefficients of the housing sector via the input–output table, Wan and Qiu (2020) identify overinvestments in China's housing-related sectors. Given the limited resources of the economy overall, this overinvestment (crowding-in effect) in housing-related sectors via the housing bubble should inevitably reduce the investment in non-housing sectors before inducing an underinvestment scenario (crowding-out effect) in sectors such as medical care and education, as Wan and Yin (2019) demonstrated empirically with respect to China.

As was the case with the stock and housing bubbles in Japan and the U.S. (Wan 2018a), the stock market bubble induced overinvestment in corporate physical assets in Japan (Chirinko and Shcaller 2001; Goyal and Yamada 2004) and in the U.S. (Chirinko and Shcaller 2011). Unfortunately, research into how the housing bubble induces overinvestment in some industrial sectors and underinvestment in others is lacking for both Japan and the U.S.,[4] despite the topic's importance for understanding the impact of the housing bubble on the macro and sectoral economies. We anticipate, therefore, that the present study will offer useful implications for these countries.

1.3 Contribution and structure of this research

We construct a theory that may be used to model the impact of a housing bubble on housing-related and non-housing sectors by combining the neoclassical model with the input–output table. We also find that housing bubbles increase the investments and prices of outputs in housing-related sectors (crowding-in effect) while simultaneously decreasing both investments and output prices in non-housing sectors (crowding-out effect). Our theoretical findings may explain the negative significant correlation between housing or land prices and CPI during China and Japan's bubble economy eras.

The remainder of the paper is organized as follows. Section 2 presents a model that may be used to analyze the unbalanced investments affected by housing bubbles by combining the neoclassical framework with input–output analysis. Section 3 analyzes

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[4] Ogawa (2011) reported that the concavity conditions of cost function were not satisfied for some Japanese manufacturing firms during the "bubble period'' in the 1980s, when land was used as a production input, and that the reason for this was that the great land demand was not only for production purposes but also for speculation. Speculative land demand or land investment of this nature could be regarded as overinvestment in land for corporate firms.

the crowding-in and crowding-out effects of housing bubbles and discusses the policy implications. Section 4 summarizes the conclusions.

2. The Model

2.1 Households

A representative household is assumed to obtain utility from two types of goods: housing C_h and other consumption goods, such as services (non-housing goods hereafter) C_c, as Figure 3 illustrates. The household faces the problem

$$maxU(C_c, C_h) = lnC_c + \gamma lnC_h \tag{1}$$

$$\text{s.t.} P_c C_c + P_h C_h = RK.$$

A household with the housing preference parameter $\gamma(> 0)$, as assumed in Bekiros (2020, Eq. (1)), chooses consumption C_c and C_h, subject to its budget with positive asset K, and the gross interest rate R(> 0). Under this setting, we find the optimal solutions for C_c and C_h, as follows:

$$P_c {C_c}^* = [(1+\gamma)]^{-1} RK, \tag{2}$$

$$P_h {C_h}^* = [(1+\gamma)]^{-1} \gamma RK. \tag{3}$$

It is obvious that a larger preference parameter (γ) on housing induces greater housing consumption (or purchase). The preference shock—that is, the sharp jump in γ—could be considered a type of housing bubble. The preference parameter (γ) here is essentially equivalent to the parameter (γ) of housing bubble growth in Wan (2018b; 2021).

[Insert Figure 3 here.]

2.2 Firms

Three types of firm exist: housing firms, housing material firms, and non-housing firms, as Figure 3 indicates. Each of these firms has as its objective profit maximization via the search for optimal investments based on the market principle, as argued by Jorgenson (1963) and Tobin (1969).

2.2.1 Housing sector

A linear production function with intermediary goods is assumed for the housing sector, as Figure 3 illustrates. The marginal productivity of capital is expressed by η_h (≥ 1) and includes the construction of required housing materials, such as steel. Following Leontief (1941) and Morishima (1958), the coefficient of direct input (S) of material to house (C_h) in the input–output table is measured by ξ_h (> 0). The material output and input costs are expressed by P_h and P_s, respectively. The firm rents capital K_h by paying interest rate R from the capital market. The firm behaves as a price taker. The profit function can thus be expressed as follows:

$$\pi^h(K_h) = P_h C_h - P_s S - R K_h \tag{4}$$

$$\text{s.t.}\, C_h = \eta_h K_h,$$

$$S = \xi_h C_h\,.$$

The zero-profit condition with respect to capital K_h is as follows:

$$\eta_h(P_h - P_s \xi_h) = R. \tag{5}$$

2.2.2 Material sector

The demand of the material sector, such as steel, as shown in Figure 3, can be written as

$$S = \xi_h C_h. \tag{6}$$

The output cost is expressed by P_s. The firm rents capital K_s by paying interest rate R from the capital market. The firm also behaves as a price taker. The firm has technology with decreasing marginal productivity and must pay fixed cost F ($\geqq 0$). To ensure profit maximization of a supply firm, the optimal capital stock is selected by solving the following problem:

$$\pi^s(K_s) = P_s S - R K_s - F \tag{7}$$

$$\text{s.t.}\, S = {K_s}^{\beta},$$

$$0 < \beta < 1,$$

F: fixed cost.

The fixed cost F is also used to ensure zero profit under a competitive market. The first order condition of Eq. (7) is expressed as

$$P_s \beta {K_s}^{\beta-1} = R. \tag{8}$$

The equilibrium condition of demand and supply for the material market should be

$$\xi_h C_h = {K_s}^{\beta}. \tag{9}$$

2.3 Non-housing sector

A linear production function without intermediary goods is also assumed for the non-housing goods sector, as shown in Figure 3. The marginal productivity of capital is expressed by η_c (≥ 1). The output cost is expressed by P_c. The firm also rents capital K_c by paying interest rate R from the capital market and behaves as a price taker. The profit function can be written as

$$\pi^c(K_c) = P_c C_c - R K_c, \tag{10}$$

$$\text{s.t.}\ C_c = \eta_c K_c.$$

The zero-profit condition with respect to capital K_c is as follows:

$$\eta_c = R. \tag{11}$$

3. Analysis of the economy

3.1 Equilibrium

For the entire economy shown in Figure 3, we summarize the necessary conditions of market equilibrium in all sectors as follows:

Household sector

$$C_c{}^* = [(1+\gamma)P_c]^{-1}RK, \tag{12}$$

$$C_h{}^* = [(1+\gamma)P_h]^{-1}\gamma RK. \tag{13}$$

Housing sector

$$C_h = \eta_h K_h, \tag{14}$$

$$\eta_h(p_h - p_s\xi_h) = R. \tag{15}$$

Material sector

$$S = \xi_h C_h, \tag{16}$$

$$P_s \beta K_s{}^{\beta-1} = R. \tag{17}$$

Non-housing sector

$$C_c = \eta_c K_c, \tag{18}$$

$$\eta_c = R. \tag{19}$$

Resource constraints

$$K_c + K_h + K_s = K. \tag{20}$$

We use nine equations (Equations (12)–(20)) to solve the nine endogenous variables ($P_h, P_s, P_c, K_h, K_s, K_c$, R, C_h, C_c). We obtain the following:

Proposition 1:

The economy has a unique equilibrium.

Proof: See Appendix.

The solution for housing prices is shown in Figure 4.

[Insert Figure 4 here.]

3.2 Transmission of housing preference shock among industrial sectors

To model the impact of the housing bubble on the entire economy, we assume that a household's preference on housing (γ) shows an increase. We then obtain

Proposition 2:

A positive shock on housing preference raises the housing price, housing demand, housing material demand and housing material price, housing investment and housing material investment (crowding-in effect) by simultaneously reducing both demand and investment in the non-housing goods sector (crowding-out effect).

Proof: See Appendix.

One implication of ***Proposition 2*** is that an increase in housing prices will induce an increase in the price of housing materials, such as steel, as noted by Wan and Qiu (2020), while simultaneously reducing the demand in non-housing sectors and inducing a decrease in non-housing goods, as shown in Figure 1 for China and in Figure 2 for Japan.

3.3 Policy implications

In accordance with ***Proposition 2***, the jump in housing preference could be considered the cause of the housing bubble, which should be excluded via policies, as demonstrated by Wan (2018b). Hence, the best policy would be for the government to prevent rapid increases in the households’ preference for housing induced by speculative motives.

For an economy with an existing housing bubble, as demonstrated by ***Proposition 2***, non-housing sectors, such as medical care and education, may be underinvested, as Wan and Yin (2019) have demonstrated. Hence, the prevention of housing bubbles may be expected to increase investment in the medical care and education sectors, in which are found the Chinese economy's most severe bottlenecks, owing to insufficient supplies.

However, the soft-landing policy detailed by Wan (2018b) should be implemented when a housing bubble exists, since overinvestment in the housing and housing material sectors, as per ***Proposition 2***, will depress corporate profits when the housing market is strictly regulated, and will then increase the banking sector's nonperforming loans (NPLs), as noted by Wan (2018c), and will cause the financial system's stability and efficiency to deteriorate.

4. Conclusions

We built a theory to model the impact of the housing bubble on housing-related and non-housing sectors by combining the neoclassical model with the input–output table. We found that the housing bubble raises the investments and prices of outputs in housing-related sectors (crowding-in effect) while simultaneously reducing investment and output prices in non-housing sectors (crowding-out effect). Our theoretical findings may explain the significant negative correlations between housing and land price and CPI during China and Japan's bubble economy eras. Hence, this paper provides new insights as to why and how the housing bubble distorts the economy differentially for different industrial sectors for current China and the past Japan. To prevent damage from the housing bubble, a bubble prevention policy is necessary since the housing bubble would destroy the balance of sectoral investments. Furthermore, a soft-landing policy is necessary because overinvestment in housing-related sectors caused by the housing bubble would cause the financial system's stability and efficiency to deteriorate if the housing market suffered a hard landing.

The labor market and the banking sector should be explicitly analyzed according to the framework presented here. Consequently, detailed empirical studies should be conducted with a focus on China and Japan as well as other countries that have experienced or are currently experiencing housing bubbles.

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Appendix:

Proof of ***Proposition 1***:

We set P_c^*= 1, then we obtain a nonlinear equation of P_h as follows,

$$P_h = \gamma\xi_h\eta_h\{K[f(P_h)]^{\frac{-\beta}{1-\beta}} - f(P_h) - 1\}, \quad \text{(A.1)}$$

$$\text{where } f(P_h) \equiv \frac{\beta(P_h\eta_h - \eta_c)}{\xi_h\eta_h\eta_c}. \quad \text{(A.2)}$$

As Figure 4 illustrates, the fixed point E is found as a unique solution P_h^* for housing prices when $\gamma\xi_h\eta_h = 1$ is assumed for simplicity.[5] Then, we further obtain the following:

$$P_s^* = \frac{(P_h^* - \eta_c/\eta_h)}{\xi_h}, \quad \text{(A.3)}$$

$$K_s^* = [\frac{\beta(P_h^*\eta_h - \eta_c)}{\xi_h\eta_h\eta_c}]^{\frac{1}{1-\beta}}, \quad \text{(A.4)}$$

$$K_h^* = \frac{1}{\xi_h\eta_h}K_s^{*\beta}, \quad \text{(A.5)}$$

$$K_c^* = K - K_s^* - K_h^*, \quad \text{(A.6)}$$

$$R^* = \eta_c, \quad \text{(A.7)}$$

$$C_c^* = [(1+\gamma)P_c^*]^{-1}R^*K, \quad \text{(A.8)}$$

$$C_h^* = [(1+\gamma)P_h^*]^{-1}\gamma R^*K. \quad \text{(A.9)}$$

Q.E.D.

5 Even when $\gamma\xi_h\eta_h \neq 1$ is assumed, the unique solution for P_h^* is assured. We also obtain a closed-form solution for P_h^* when β = 0.5 is assumed without assuming $\gamma\xi_h\eta_h = 1$. These results are available upon request.

Proof of ***Proposition 2***:

By differentiating $P_h{}^*$ in Eq. (A.1) with respect to γ, we obtain,

$$\frac{\partial P_h{}^*}{\partial \gamma} = \left[1 + \frac{\beta}{1-\beta}[Kf(P_h{}^*)]^{\frac{1}{1-\beta}} \frac{\partial f(P_h{}^*)}{\partial P_h{}^*} + \frac{\partial f(P_h{}^*)}{\partial P_h{}^*}\right]^{-1} \left[\xi_h \eta_h \{K[f(P_h{}^*)]^{\frac{-\beta}{1-\beta}} - f(P_h{}^*) - 1\}\right] > 0, \quad \text{(A.10)}$$

$$\frac{\partial P_s{}^*}{\partial \gamma} = \frac{\partial P_s{}^*}{\partial P_h{}^*}\frac{\partial P_h{}^*}{\partial \gamma} = \frac{1}{\xi_h}\frac{\partial P_h{}^*}{\partial \gamma} > 0, \quad \text{(A.11)}$$

$$\frac{\partial K_s{}^*}{\partial \gamma} = \frac{\partial K_s{}^*}{\partial P_h{}^*}\frac{\partial P_h{}^*}{\partial \gamma} > 0, \quad \text{(A.12)}$$

$$\frac{\partial K_h{}^*}{\partial \gamma} = \frac{\partial K_h{}^*}{\partial K_s{}^*}\frac{\partial K_s{}^*}{\partial \gamma} > 0, \quad \text{(A.13)}$$

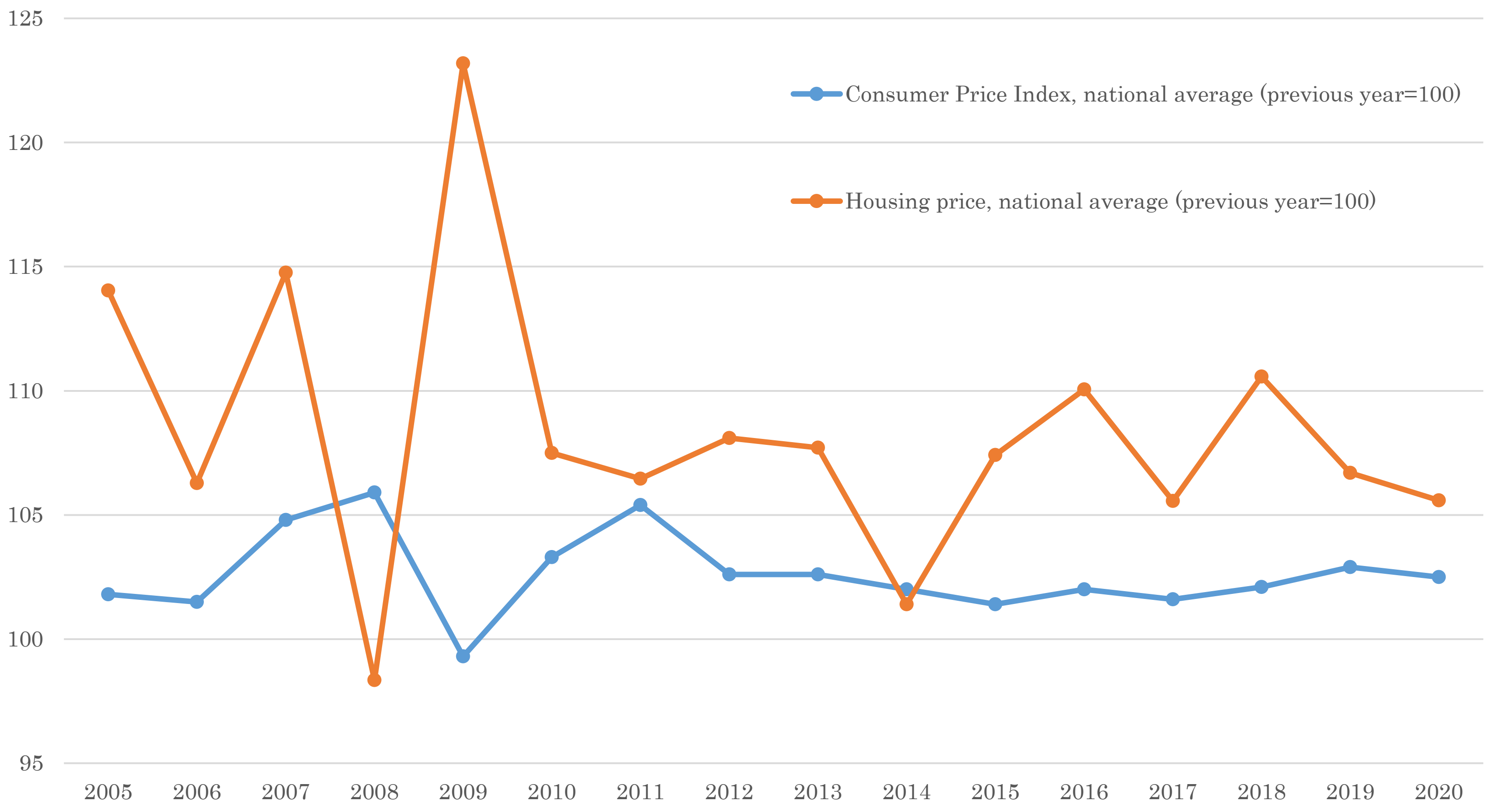
$$\frac{\partial K_c{}^*}{\partial \gamma} = -\frac{\partial K_s{}^*}{\partial \gamma} - \frac{\partial K_h{}^*}{\partial \gamma} < 0, \quad \text{(A.14)}$$

$$\frac{\partial C_h{}^*}{\partial \gamma} > 0, \quad \text{(A.15)}$$

$$\frac{\partial C_c{}^*}{\partial \gamma} < 0. \quad \text{(A.16)}$$

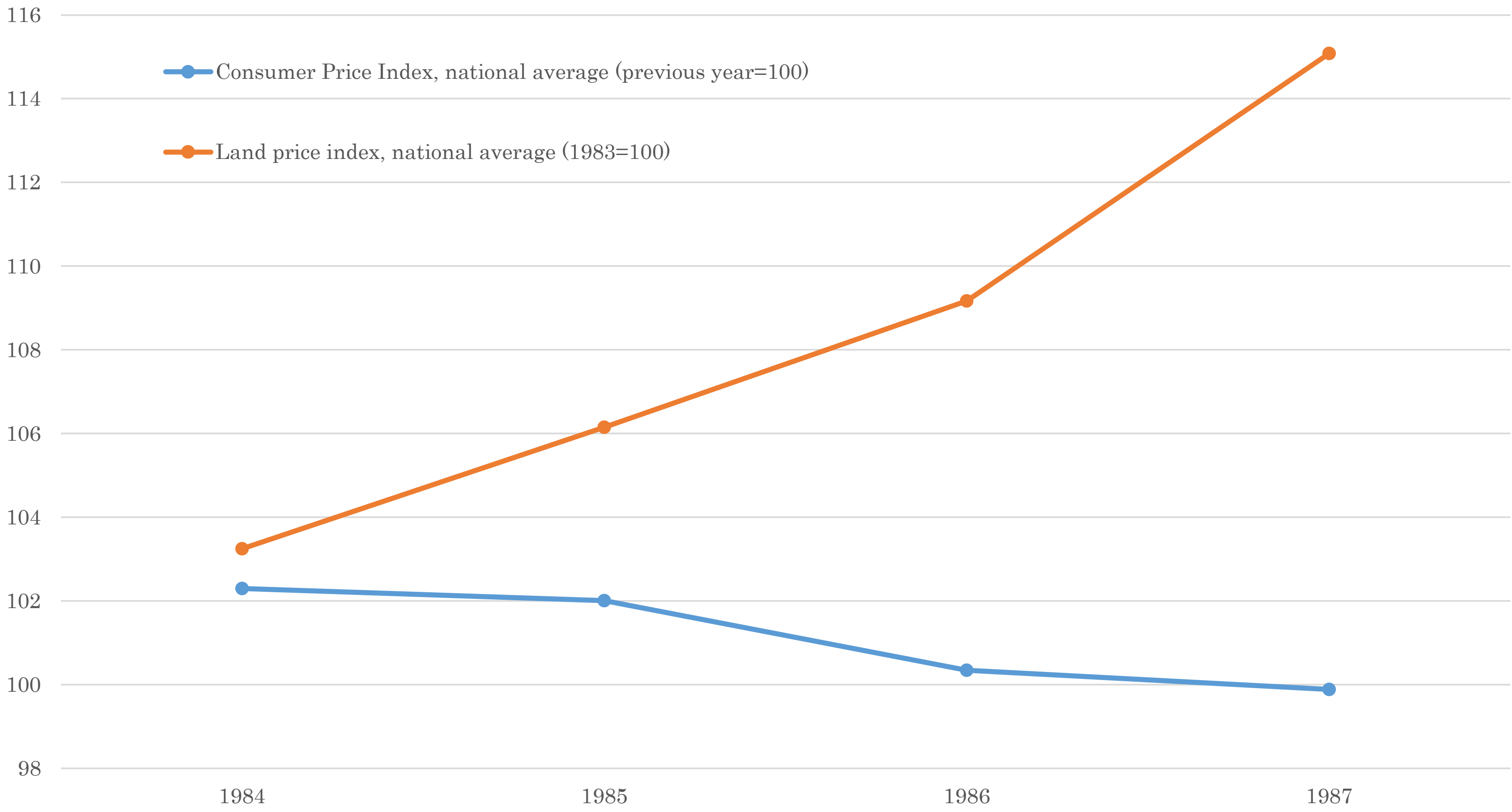
Q.E.D.

Figure 1: Housing prices and Consumer Price Index in China, 2005–2020



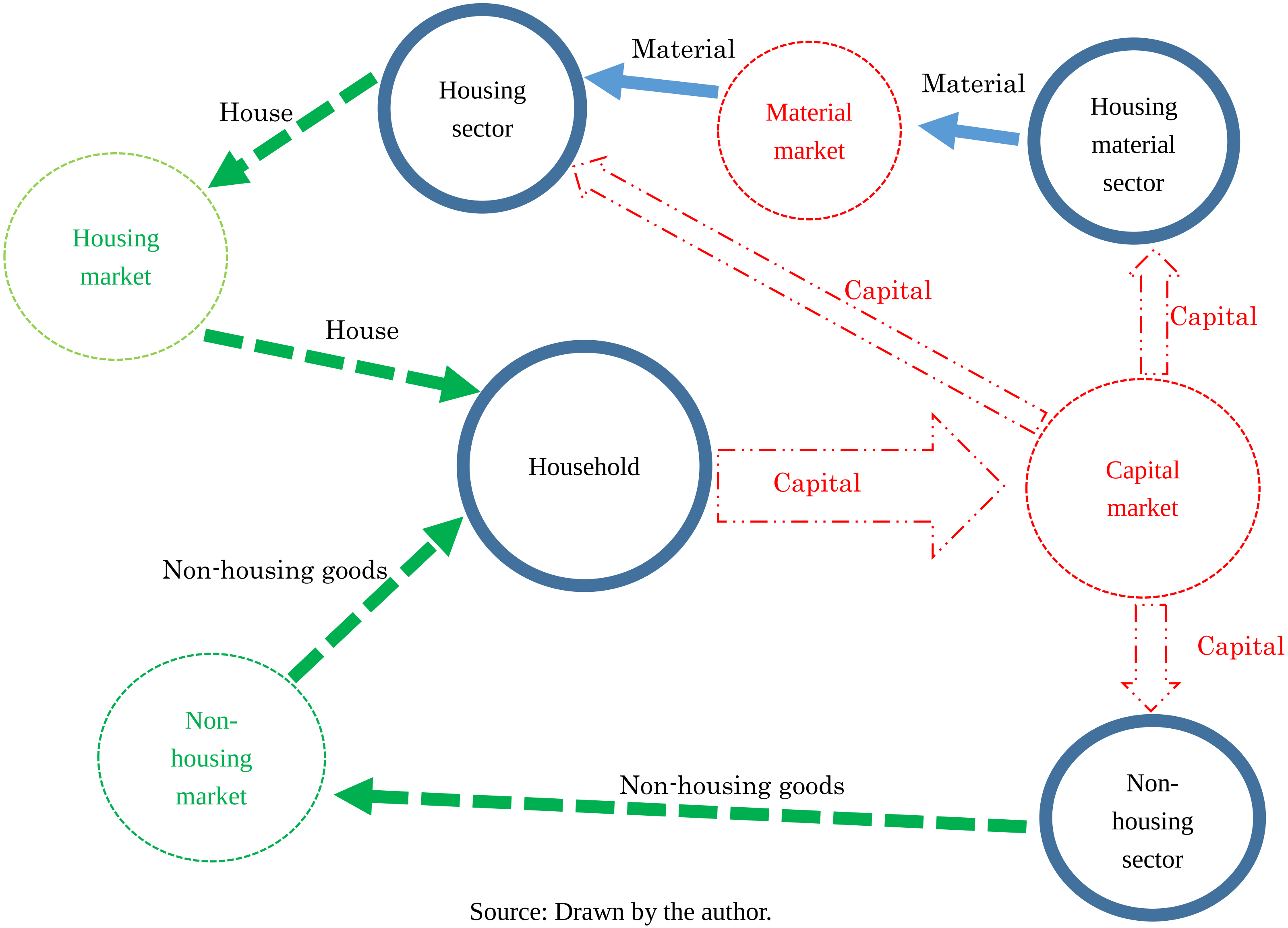
Source: Author's calculation based on China Statistical Yearbook 2020 and report by National Bureau of Statistics of China on Feb. 28, 2021.
http://www.stats.gov.cn/tjsj/zxfb/201802/t20180228_1585631.html

Figure 2: Land prices and Consumer Price Index in Japan, 1984–1987



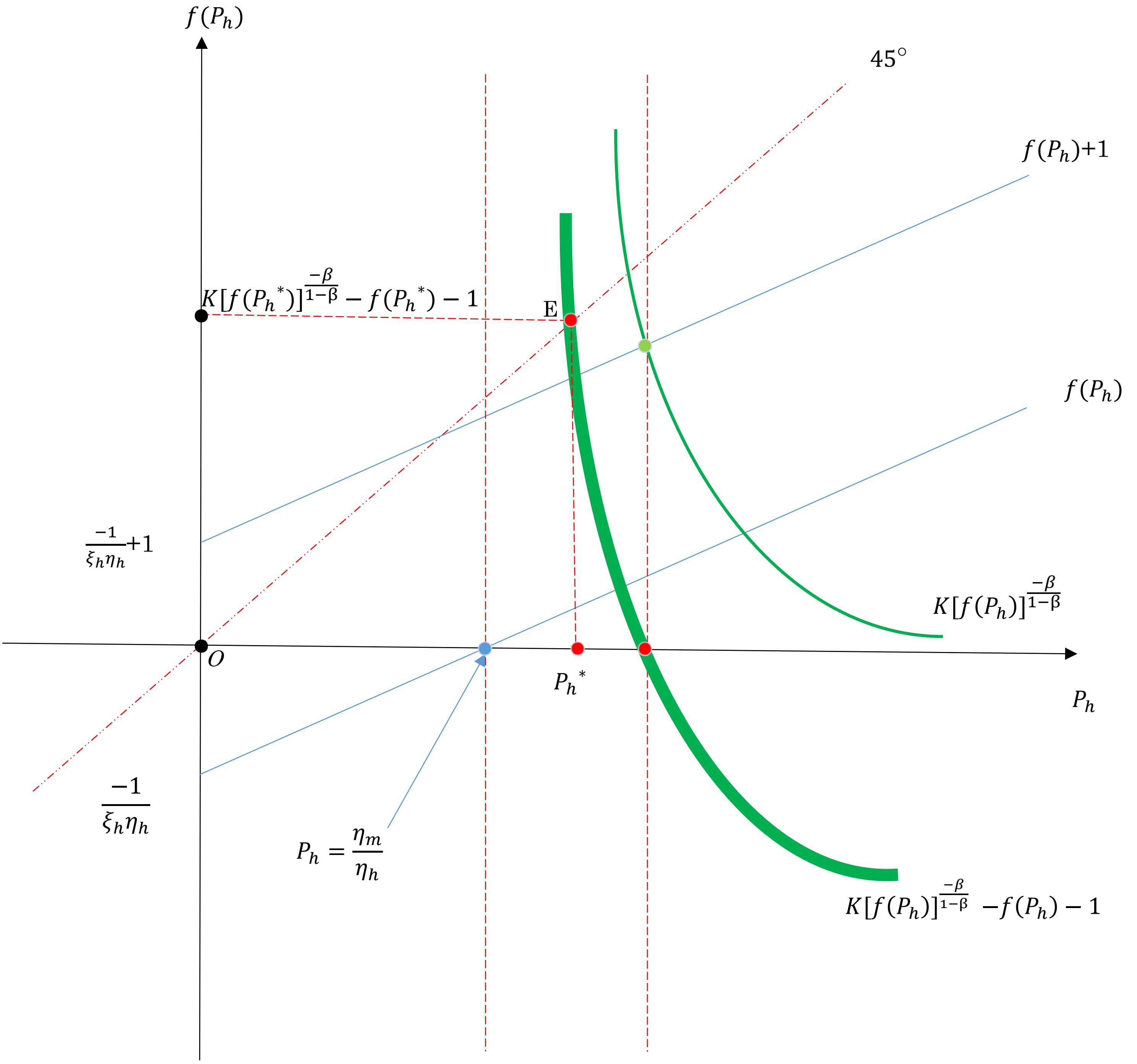
Source: Author's calculation based on historical statistics of Japan's economy by the Cabinet Office of Japan.
https://www5.cao.go.jp/j-j/wp/wp-je12/h10_data05.html

Figure 3: Transmission from housing bubble to investments in housing-related industries



Source: Drawn by the author.

Figure 4: Solution for the housing price



Source: Drawn by the author.