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The housing price index and the number of housing units: a surprising co-movement in France

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Abstract

We examine the relationship between the evolution of the housing price index and the number of housing units from 1968 to 2015. Using a simultaneous equation framework, we find a positive relationship between housing supply and the housing price index. Our research suggests that there is an analogy between the Braess paradox and the housing problem. We find a positive income elasticity of demand as well as a positive price elasticity of demand that tends to zero.

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1 Introduction

The housing crisis has been a recurring subject in political debates in France since the middle of the 19th century. One of the major causes of the crisis has been high housing prices. For two decades, we have witnessed an alarming rise in housing prices. However, housing conditions have improved since then (Cahen, 1957; Jacquot, 2006; Bonvalet and Ogg, 2008). Despite the long-term improvements in housing conditions in France, this crisis is still underlined in several works. According to Fondation Abbé Pierre (2020), France faces rising housing prices that are making home ownership difficult for many households.

As pointed out by Jacquot (2011), rising prices and rents are often invoked to support the idea that the number of housing units is insufficient. In the same vein, when the current President of the Republic was interviewed by the Abbé Pierre Foundation during the presentation of the programs of the candidates for the 2017 presidential election, he proposed to increase the number of housing productions to bring down housing prices (Fondation Abbé Pierre, 2020).

Could the rise in housing prices in France be due to a housing shortage?
From Driant (2013), the national statistical data show that, between 1970 and 2006, the housing stock increased by more than 65%, whereas the country's population grew by only about 25%. In addition, based on the report published on the french-property[1] site, between 2010 and 2017, new housing construction averaged 370,000 per year, while the number of households increased on average by 240,000 per year. This means that during this period, there was a surplus of around 130,000 new housing units.

Hence, talking about a housing shortage or crisis in a country where conditions are improving would be paradoxical.

The main objective of this paper is to analyze the relationship between housing supply and the house price index. The interest of this work is threefold: (1) This work provides an answer to the question of whether more housing should be built in order to bring down housing prices. (2) Our approach has the advantage of using the house price index rather than the average house price. (3) We obtain results that are part of a macroeconomic debate, namely the effects of price and income on demand on the one hand and the effect of price on the supply of housing on the other.

The paper unfolds as follows: Stylized facts are presented in Section 2. A correlation analysis is done in Section 3. Section 4 presents the theoretical framework. In Section 5, we provide and explain the statistical data. In Section 6, we present empirical results and discuss them.

2 Stylized facts

Figure 1 represents the evolution of the total housing stock and the number of ordinary households over the period running from 1968 to 2015. The total housing stock approximates housing supply, and the number of ordinary households approximates housing demand. The slope of the total housing stock (supply) is higher than the slope of the number of households (demand). Thus, the housing supply is increasing faster than the housing needs. The gap between the two evolutions widens over time. Supply increasingly exceeds demand. Prices should decrease according to the conventional idea of consumer demand. However, the housing price index grew across the analyzed time period, as seen in Figure 2.

The use of the housing price index is of crucial importance here. Indeed, the houses built in 1960 are not the same in terms of quality as those built in 2015. If the quality (for example, living space, number of rooms, etc.) of the home increases, average prices could increase (Friggit, 2009). In order to make 2015 housing prices comparable to those of 1960, for example, the effect

[1] https://www.french-property.com/news/french_property_market/vacant_homes_new_housebuilding

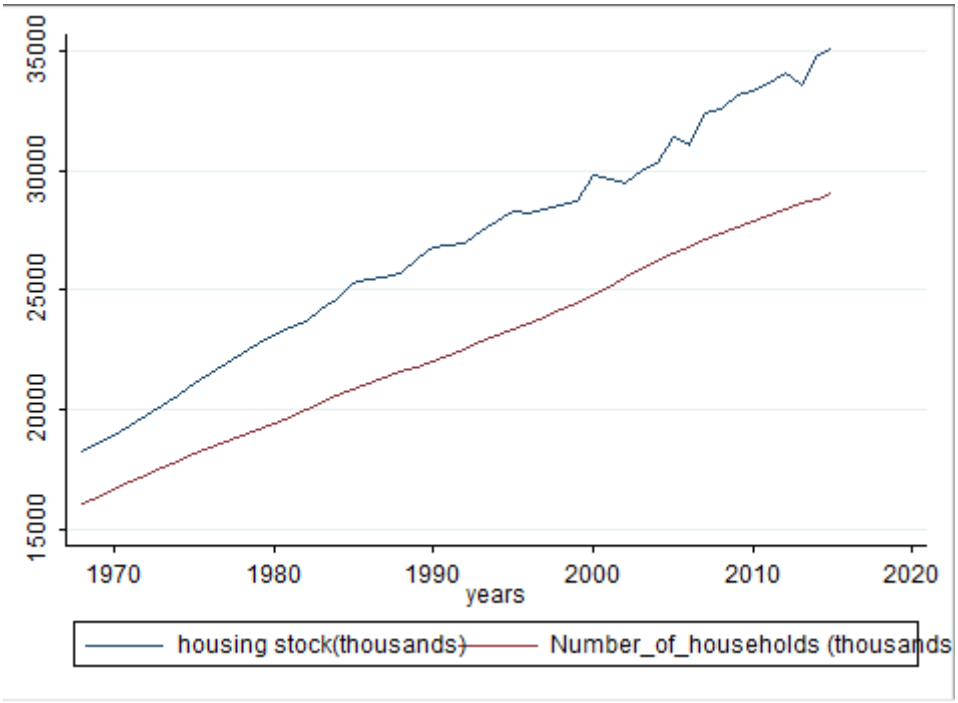

Figure 1: Evolution of housing supply and demand in France from 1968 to 2015

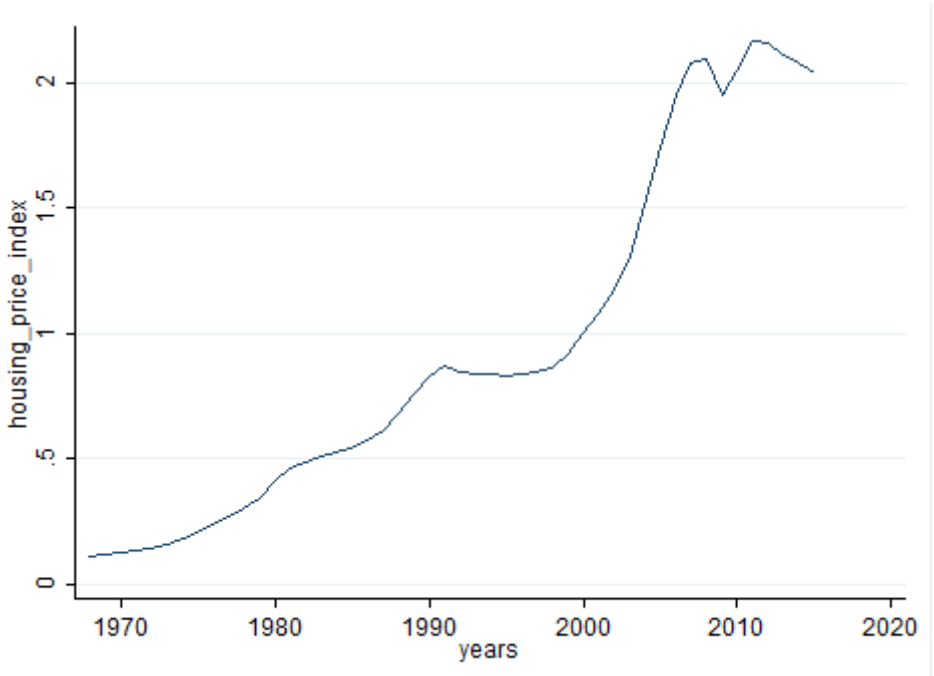

Figure 2: Housing price index

of quality should be taken into account. For this reason, the house price index has the effect of erasing the quality effect of the average price (Friggit, 2009). One of the most commonly used methods to construct the price index is the hedonic price method (HPM), which estimates prices based on the characteristics of housing (Herath and Maier, 2010). Usually, if the quality effect is taken into account, then the price index should not increase. But during the study period, this index increased. However, the change in the price index is not due to any improvement in the quality of new housing.

It is often believed that if prices go up, then there is a shortage, and the best way to lower

prices is to eliminate this shortage by making more offers. But it turns out that, in France, according to Jacquot (2011), there does not seem to be a housing shortage. Looking at Figure 1, this statement is verified: the offer exceeds the needs.

In summary, in the case of France, we simultaneously observe that the housing supply is increasing faster than the need and that the price index is growing. This case is surprising and deserves special attention.

3 Correlation analysis between the price index and housing supply

In order to analyze the correlation between housing supply and the house price index, we proceed as follows: In the first step, we regress the real price index and housing supply on the trend:

$$S = c_0 + c_1 t + \vartheta_1 \tag{1}$$

$$p = p_0 + p_1 t + \vartheta_2, \tag{2}$$

where S is the housing supply, p is the housing price index, and t is the trend. The trend variable allows us to capture the role of all factors likely to increase the price (for example, construction costs, land prices, etc.) and supply (for example, population growth, etc.) over time.

In the second step, we predict the error terms ϑ_1 and ϑ_2 and then analyze their correlations. The obtained correlation coefficient allows us to analyze the correlation between housing supply and price by removing the trend effects. The coefficient of correlation is positive (0.8337) and significant ($p - value < 0.001$).

In the next section, we analyze the causal links between supply and the house price index.

4 Theoritical framework

As in Chow and Niu (2015), we use a standard simultaneous equations model for housing supply and demand (e.g., Yobero, 2016, for review), in which we add a third equation to model the price.

Based on the work of Girouard et al. (2006) and André (2010), housing demand affects the price mainly through its following components: the real disposable income of households, inflation, population growth, mortgage interest rate, loan terms (monthly payment / income), and anticipations (ratio of the rent to the price of housing).

The minimum necessary housing is approximated by the number of households[2], which is defined as "minimum housing demand."

The supply of housing affects the price. The supply depends on housing prices and construction costs. The housing supply is the total housing stock. The housing stock is the existing housing in a given space on a given date. Regarding the prices, we use the housing price index for the reasons mentioned in the previous sections. The supply, demand, and price equations

[2]A household, in a statistical term, refers to all the occupants of the same dwelling without necessarily being linked by family ties. https://www.insee.fr/fr/metadonnees/definition/c1879

can be written as follows:

$$D = a_0 + a_1\, p + a_2\, inf + a_3\, y + a_4\, rate + \epsilon_1 \tag{3}$$
$$S = b_0 + b_1\, p + b_2\, inf + a_3 cc + \epsilon_2 \tag{4}$$
$$p = c_0 + c_1\, D + c_2\, S + c_3\, inf + c_4\, t + \epsilon_3\ , \tag{5}$$

where D denotes housing demand, y denotes the real disposable income, p denotes the real housing price index, cc denotes the real construction cost index, S denotes the housing supply, $rate$ denotes the long-term interest rate, inf denotes inflation, and t is the trend variable. We consider the logarithm of the variables.

Equations (3), (4), and (5) are three simultaneous equations where the quantity of demand, quantity of supply, and price are all endogenous variables. In this method, the parameters are estimated using a two-stage least squares approach (2SLS). In the first stage, we estimate the reduced-form equations for the endogenous variables as functions of the exogenous variables. In the second stage, we estimate the structural equations by substituting the first-stage regression estimates for the observed endogenous variables. The reduced-form equations are derived from solving the structural equations for the endogenous variables D, S, and p:

$$D = d_0 + d_1\, y + d_2\, inf + d_3\, cc + d_4\, rate + d_5\, t + \upsilon_1 \tag{6}$$
$$S = e_0 + e_1\, y + e_2\, inf + e_3\, cc + e_4\, rate + e_5\, t + \upsilon_2 \tag{7}$$
$$p = f_0 + f_1\, y + f_2\, inf + f_3\, cc + f_4\, rate + f_5\, t + \upsilon_3\ , \tag{8}$$

Denoting the predicted values of D of Equation (6) by $D^\star$, S of Equation (7) by $S^\star$ and p of Equation (8) by $p^\star$ in the second stage, we apply least squares to estimate the demand, supply and price equations (3), (4), and (5) by replacing D by $D^\star$, S by $S^\star$, and p by $p^\star$:

$$D = a_0 + a_1\, p^\star + a_2\, inf + a_3\, y + a_4\, rate + \epsilon_1 \tag{9}$$
$$S = b_0 + b_1\, p^\star + b_2\, inf + a_3 cc + \epsilon_2 \tag{10}$$
$$p = c_0 + c_1\, D^\star + c_2\, S^\star + c_3\, inf + c_4\, t + \epsilon_3\ . \tag{11}$$

5 Source and construction of data

All the data used are taken from the CGEDD[3] site, with the exception of the housing stock, which has been reconstructed.
We use the housing stock data from the 1968, 1975, 1982, 1985, 1988, 1990, 1992, 1996, 2000, and 2002 censuses and then reconstitute the data between the two censuses. The housing stock is equal to the number of housing units existing in the previous period, to which we add the construction of the current period minus the destruction of housing between the two periods. The housing stock data for the consecutive years from 2003 to 2015 were obtained directly from the INSEE website.

Regarding construction data per year, there are no published statistics. Thus, following Blanchet and Bonvalet (1985), and assuming an average completion time of one year, the number of housing units created each year is roughly estimated by the number of declarations made at the commencement of the construction of the preceding year. Furthermore, there are no statistics on housing destruction. We need to calculate it. As in Blanchet and Bonvalet (1985), let's assume they represent a constant share "d" of the housing stock each year. Referring to Blanchet and Bonvalet (1985), if $parc_t$ is the total number of housing units at the beginning of any year t and $const_t$ is the constructions during the same year, we have the approximate relation between the level of the stock at two censuses at dates t_1 and t_2:

[3] http://www.cgedd.developpement-durable.gouv.fr/prix-immobilier-evolution-a-long-terme-a1048.html

$$parc_{t_2} = parc_{t_1} + \sum_{t_1}^{t_2-1} const_t - d(t_2 - t_1)\frac{parc_{t_2} + parc_{t_1}}{2}$$

Knowing the estimated destruction values (see Table 1) for each period, we linearly interpolate the total number of housing units for the missing years.

years	Rate
1968-1975	47.28
1975-1982	40.25
1982-1984	-24.03
1985-1988	56.95
1988-1990	-92.62
1990-1992	-90.05
1992-1995	-58.90
1996-1999	40.48
2000-2002	160.57

Table 1: Rate of destruction of housing stock annually (in p. 10,000)

6 Regression results and discussion

Given the results of the reduced-form equations, the estimation of the structural equations is given in Table 2 . In the demand equation, the price elasticity of demand is positive and close to zero. As in De Lavergnée (1995), the price elasticity of housing is equal to 0.09[4]. The increase in price does not affect the demand for housing. Housing is an essential good[5]. The income elasticity of demand is positive and less than one. According to Ernst Engel's classification, accommodation is part of normal goods. As for the interest rate, the higher it is, the more the conditions for granting credit harden and the less demand is impacted.

In the supply equation, the impacts of housing prices and construction costs on housing supply are, respectively, positive and negative.

In the price equation, the effect of the supply on the price is positive. This means that the more the offer increases, the more the price increases. In other words, for a constant level of demand, when the supply of housing increases, prices increase. This result is paradoxical in classical theory. The theory would be that, facing stagnant demand, when the supply increases, the prices should decrease.

Following Jacquot (2011), given the evolution of the housing supply, the origin of the evolution of house prices seems to be found on the demand side. One might think that this is a cultural phenomenon in France that is affecting the demand for housing. Indeed, we note a phenomenon of supply that creates demand. In terms of parking spaces, for instance, the more spaces created, the more users will use them, and the more users, the more difficult it will be to find an open spot.

A greater number of housing units means more opportunities and choices. In observing this increase, people can see the possibility of becoming homeowners. There may be reasons why they want to change accommodations: More spacious accommodations, closer proximity to the workplace, etc. When the number of housing units increases, new opportunities for demand arise. House prices rise if demand increases and supply does not keep pace, all other

[4]De Lavergnée, 1995, p.208

[5]" Housing is an essential durable good for households ... " (Pirus, 2011, p.41)

	(1) Demand(D)	(2) supply(S)	(3) housing price index(p)
housing price index(p)	0.0892***	0.323***	
	(5.33)	(15.77)	
Inflation (Inf)	0.110***	0.144***	-1.305***
	(9.87)	(14.06)	(-8.16)
Real disposable income (y)	0.204***		
	(5.14)		
ln_taux	-0.0566***		
	(-13.95)		
Real construction cost index (CC)		-0.351***	
		(-5.24)	
Demand			2.624
			(0.94)
Supply			9.735***
			(4.92)
t			-0.0842***
			(-3.31)
_cons	8.547***	10.27***	-123.8***
	(31.99)	(2565.83)	(-5.28)
N	48	48	48
F	3806.5	2278.8	166.3
df_m	4	3	4
df_r	43	44	43
ar2			

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Second stage regressions

things being equal. Therefore, the increase in housing generates demand. When this demand is concentrated in a small number of housing units, the housing price index increases.

An illustration of the price dynamics within the framework of demand and supply

Dynamics of demand: For a constant level of housing supply, when the demand for housing increases, following the classical theory, we would expect prices to increase. This is what can be seen in Figure 3. This means that the demand has a positive impact on the price.

Supply dynamics: For a constant level of demand, when the supply of housing increases, prices are expected to decrease. This is what you see in Figure 4. The price has gone from 3 to 2. Compared to classical theory, the supply should have a negative impact on the price. However,

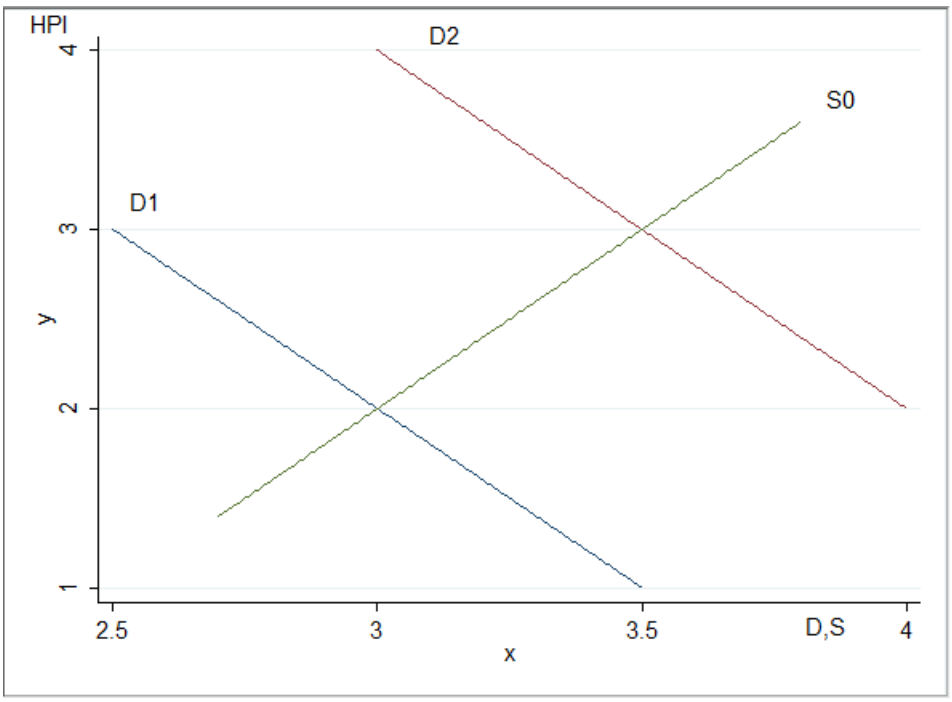

Figure 3: price dynamics within the demand framework

the result shows a positive impact of housing supply on the price, which is paradoxical. That is, price increases occur as supply expands. As illustrated in the housing sector, paradoxes like this one remind us of the Braess paradox.

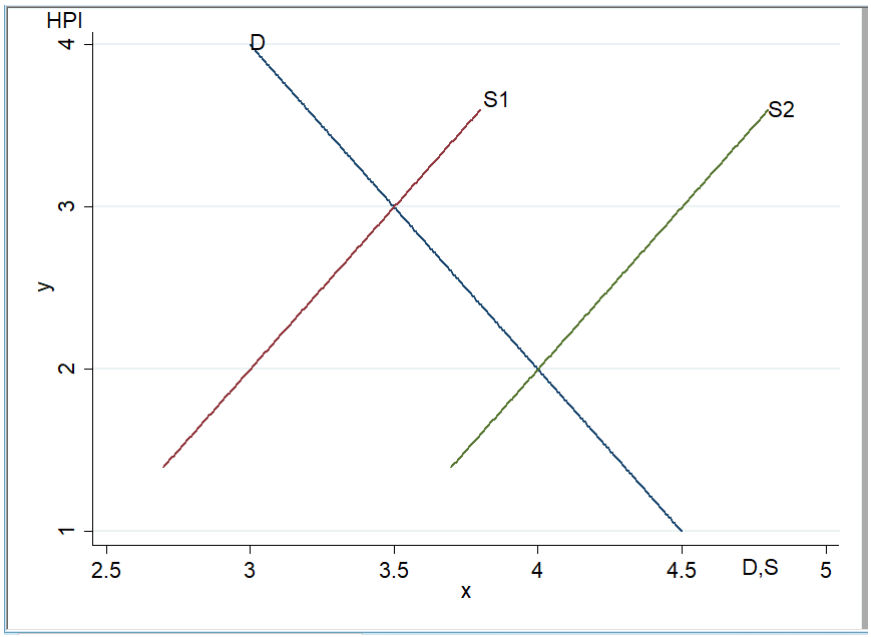

Figure 4: price dynamics within the supply framework

7 Conclusion

In this paper, we conducted an empirical analysis that allows us to conclude that in France, from 1968 to 2015, there was a positive effect between housing supply and the housing price

index and that housing is an indispensable good and is not an inferior good. As the number of housing units increases, prices increase as well. It is a paradox of classical theory. This reminds us of a paradox found in the literature regarding transportation, the Braess paradox. The idea is that the creation of a new road does not necessarily make traffic smoother but could slow it down instead. Future research could be concerned with the formal development of this analogy from the point of view of industrial organization through a hotelling model.

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