

Research Article

The Impact of Competition, Subsidies, and Taxes on Production and Construction Cost: The Case of the Swedish Housing Construction Market

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Few empirical studies focus on developing data and analyses on the factors that influence the decision making process of builders, developers and landlords. Interest subsidy, taxes, and competition are some of the factors that can influence the level of construction or production costs and ultimately the price of the housing units produced. Different subsidy schemes and value-added taxes (VAT) have been used as tools to increase housing construction in Sweden. However, their effect on costs of the housing stock has not been rigorously examined in the current housing supply literature. The aim of this paper is to investigate the relationship between production and construction cost and its determinants especially their relationship to different subsidy schemes and value-added taxes. In our econometric analysis, we utilize a quarterly panel data that covers 1975–2004. Our results suggest that there is a positive relationship between subsidies and construction cost and inverse relationship to value added taxes. This could explain why few companies within the housing construction industry raise the cost of production since these companies could manage to transfer some of the tax burden from themselves to the housing developers. Paper goes on to discuss common practices of construction companies that affects production costs.

1. Introduction

Housing is a commodity that occupies a large portion of household budgets in many developed countries and buying a single-family house or an apartment is the single most important investment a household does in life. Households in most of EU countries spend approximately one quarter of their income in housing expenses [1] while households in US spend one third of their income on housing [2]. Thus, housing provision is a central element in people's living standards and welfare as well as a major part of capitalist economies [3]. In Sweden, and elsewhere, different types of housing subsidies and housing allowances have been used in order to enhance housing demand and/or construction of housing (see, e.g., [4]).

Housing authority and other government agencies use construction price level as a tool to gauge appropriate policies toward the production level of affordable residential housing units. Our knowledge in determining house/apartment prices is rather good; however, our knowledge in estimating housing cost is deficient. Without superior knowledge of construction price and elasticity of supply of new housing construction, developers and contractors as well as public authorities could face a daunting challenge when trying to make prudent decisions about future projects and policies. DiPasquale [5] emphasizes the need to know more about the decision-making process of builders, investors, and landlords. He acknowledged that significant improvement in the time-series methods used to combine time-series analyses of housing supply does not resolve some counter-intuitive

findings such as the importance of market indicators and the irrelevance of construction costs. He suggested that the focus should be bringing new data to bear in the decision-making process related to housing supply.

One part of the housing construction subsidy system has been constructed as a subsidized interest rate to the developer, thus, increasing the demand from developers. The question here is “how successful have these policies been?” The Swedish housing construction subsidy system is no stranger to investigations from a variety of perspectives [4, 6]. However, instead of focusing on the effects of subsidies and taxes on housing prices, we look at its impact on construction costs.

Hence, the aim of the present analysis is to investigate the relationship between production and construction cost and its determinants. We are especially interested in the relationship with respect to different subsidy schemes that have been an important tool to increase housing construction in Sweden [4, 6]. Moreover, we are also interested in the relationship between value-added taxes (VAT) and construction cost since the tax reforms have impact on housing sector [7]. Sweden is a small country and the housing construction industry is characterized by a few number of firms. Investigating the impact of competition on construction costs could enlighten the possible outcome of this oligopoly power.

In spite of tangible progress in understanding the housing supply and determinants of new construction, few empirical studies focus on developing data and analyses of the factors that influence the decision making process of builders, developers, and landlords. Our main contribution is that we investigate this empirical question that has not been analyzed diligently so far with the exception of Gyourko and Saiz [2]. Moreover, we are using a unique panel data where we have detailed information, on an aggregated level, of construction and production cost. Furthermore, we have unique opportunity to investigate the effects of subsidies, taxes, and oligopoly power on housing construction and production cost.

The rest of the paper is organized as follows. Section 2 does a brief review of housing construction literature and Section 3 presents the theoretical and empirical framework. In Sections 4 and 5, the data, the empirical model, and results are presented and Section 6 summarizes and concludes the paper.

2. A Literature Review

The price of a new house is essentially comprised of the price of the structure which is elastically supplied in the long run and the price of land [8, 9]. There is extensive literature on the study of the effect of prices on housing supply. However, a good understanding of the determinants of new housing supply especially multifamily rental housing still seems to be hard to pin down [5]. Since Muth's [10] most cited econometric examination of the supply side of the US housing market, many more empirical studies based on either reduced-form estimation or supply structure approach have been carried out. These studies consider price and other

cost shifters as main determinants of new housing supply and often the focus is to estimate the price elasticity of supply.

From an economic theory perspective, Follain [8] states that if supply is less perfectly elastic, then the quantity of new construction is positively related to quantity and negatively related to the prices of inputs used to produce housing. Similarly, Green et al. [11] note that, in the absence of constraints on land supply, an increase of prices of materials and labor due to increased demand of new construction suggests that housing supply is not perfectly elastic. In the long-run equilibrium, price of newly constructed buildings (the physical structure) equals current construction costs [12]. Thus, construction prices are one of the main factors that does not only affect private sector investment of residential development but also play a big role in determining the level of profit that contractors and developers expected from construction projects. Gyourko and Saiz [2] used key drivers of construction cost variables such as local wages, unionization, topography and regulation in order to explain the heterogeneity in the cost of building across America.

Two issues that make the analysis of housing supply difficult are the quality dimension of housing units and location amenities [13], primarily the land aspect. With regard to the quality factor in housing supply, Rosenthal [12] states that the quality-adjusted price of newly constructed building is determined solely by current construction costs. In a comparative study between Britain and Sweden, Duncan [3] found that stable housing land market in Sweden eliminates any significant land development gains for the landowners and house builders. Sweden ends up with better quality and better distributed living environments while unearned income for landowners and builders is substantially removed [3]. Mayer and Somerville [9] studied the effect of land use regulation on housing supply and noted that constraints on supply result in higher house prices but so too does the capitalization of benefits that comes along with regulations.

Other factors that could influence construction price and ultimately housing supply are competition level in the housing market, government involvement in the housing production through subsidies and taxation policies, and interest rate. The level of supply for construction work is usually referred to in terms of intensity or degree of competition and consequently an increase of contractors causes decreases in price levels [14]. Ngai et al. [15] suggest that the likely number of competitors in the market and the degree of competition will depend on the market conditions. DiPasquale [5] concludes that tax treatment of investors in rental housing can have a significant impact on the level of new construction. Interest subsidy is not one of the direct input factors in the construction or production costs but its effect on costs and housing stocks has not been rigorously examined so far. On the specifications of supply-side, Topel and Rosen [16] included real interest rate as cost shifters in their housing investment study and found that housing starts respond to changes in both real rate of interest and expected inflation.

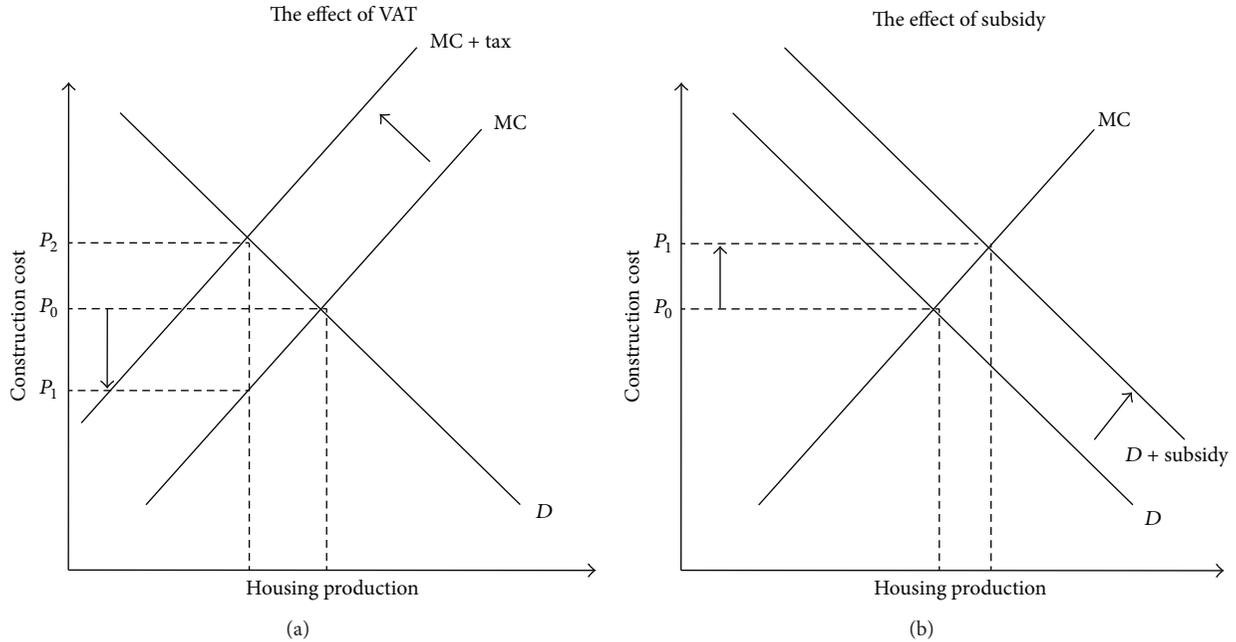


FIGURE 1: The effect of VAT and subsidy on construction costs.

3. The Theoretical and Empirical Framework

Our simple model is set up as follows and resembles Gyourko and Saiz [2] model. The demand from the developer is equal to

$$Q^D = \beta_0 - \beta_1 CC + \beta_2 I + \beta_3 S, \quad (1)$$

where CC is construction cost excluding VAT, I is income per capita, S is interest rate subsidies, and VAT is value-added tax. Higher construction cost is anticipated to reduce production and a higher income per capita from the households increases the demand. One part of the housing construction subsidy system used in Sweden is an interest rate subsidy to the developers. The expected effect is that it will increase the demand and the production of housing. Supply from the construction company is equal to

$$Q^S = \gamma_0 + \gamma_1 CC + \gamma_2 VAT. \quad (2)$$

The supply equation is of course equal to the marginal cost (MC). It will increase if the construction cost is higher and also VAT increases. In our empirical model we are also including the interest rate as a proxy for cost of capital. In equilibrium we get that

$$\beta_1 CC + \gamma_1 CC = (\beta_0 - \gamma_0) + \beta_2 I + \beta_3 S - \gamma_2 VAT, \quad (3)$$

and by collecting all terms, we obtain

$$CC = \frac{(\beta_0 - \gamma_0)}{(\beta_1 + \gamma_1)} + \frac{\beta_2}{(\beta_1 + \gamma_1)} I + \frac{\beta_3}{(\beta_1 + \gamma_1)} S - \frac{\gamma_2}{(\beta_1 + \gamma_1)} VAT. \quad (4)$$

Equation (4) is the equation that we estimate. It is the reduced form, where both demand and supply determinants

are included. In the empirical version of the above model, (4) is estimated in log form and all estimated parameters can be interpreted as elasticity. Income (as demand variable) is supposed to have a positive effect on construction cost. The interest subsidy is expected to have a positive effect on construction cost as developers with the subsidy demand more housing from the constructors. On the other hand, value-added tax will have an inverse relationship to construction cost. Higher VAT will reduce construction cost (excluding VAT) if the constructors can lay the tax burden on the consumer (in this case the developer). The two effects are shown in Figure 1.

In the above model it is assumed that perfect competition exists and that demand equal supply clears the market (equilibrium). However, that may not be the case. It has been shown by Bantekas [17] that the degree of monopoly/oligopoly power on the construction market may be substantial. Two effects are therefore anticipated. First, the tax burden will be on the developer, and hence, construction cost excluding VAT will not decrease, and second, the degree of monopoly/oligopoly power will increase the construction cost in general. In the empirical analysis, we are using Lerner index as a measure of monopoly/oligopoly power. Higher Lerner index values are assumed to have a positive effect on construction costs.

4. The Data

We analyze the case of Sweden over the period 1975–2004, a period during which Sweden went from a subsidy system without taxes to a system with no subsidies and value-added taxes. We use a panel data set consisting of 6 regions and 120 time periods (quarterly data). Thus the number of

TABLE 1: Definition of the data.

Name	Definition	Average	Standard deviation	Coefficient of variation (%)
Prodc	Production cost excl VAT, co-ops apartments, SEK/m ²	8793.26	4448.82	51
Conc	Construction. cost excl VAT, co-ops apartments, SEK/m ²	7419.83	3780.57	51
Inccap	Income per capita, SEK	76932.54	41071.56	53
Sub	Subsidized interest rate, %	5.01	2.90	58
VAT	Value-added tax, %	10.46	5.94	57
Stock	Housing stock, co-ops apartments	82969	55237	67
T-rate	Government Bonds 2 year	9.62	3.01	31
Lerner	Lerner index, monopoly/oligopoly power	12.39	1.65	13

TABLE 2: Descriptive statistics, average.

Year	Prodc	Conc	Sub	VAT	Stock	T rate	Lerner	Inccap
1975	1680	1351	5.10	3.02	67322	9.28	15.88	18705
1980	4172	3436	7.69	4.78	72871	11.90	12.69	31468
1985	6278	5312	8.68	5.62	78982	12.81	10.96	47522
1990	11155	9260	8.25	5.96	81749	14.27	9.27	85012
1995	11413	10076	4.05	16.78	87840	10.31	11.32	99505
2000	14852	12584	0.87	16.78	93383	5.91	13.11	126770
2004	15802	13611	0.52	16.78	105198	4.03	13.30	149096
Change	840%	907%	-90%	456%	56%	-57%	-16%	697%

observations is equal to 720. The regions are the metropolitan areas of Stockholm, Gothenburg, Malmö, and Norrköping-Linköping as well as the rest of the southern part of Sweden and the North of Sweden. The original data contained nominal cost figures and income per capita. Factor price indices and consumer price index (CPI) were used to calculate cost figures and income per capita in real terms, respectively. The variables utilized in this study are defined in Table 1.

Our main objective is to estimate (4), where both demand and supply variables are included. We use two different dependent variables. The first is the total production cost excluding VAT for co-ops apartments in Sweden. As an alternative, we also utilize construction excluding VAT for co-ops. The total production cost is on average 8800 SEK/m² while the construction cost amounts to 7400 SEK/m². The difference is attributed to the land cost. The variation over time and across region is substantial. The standard deviation is 51 percent of the average. As developers demand variables, we are using income per capita and subsidized interest rate. Both variables have a high coefficient of variation indicating that they might be of importance in explaining the variation in cost. Supply variables are cost of capital and value-added tax. We have also included the changes in housing stock as one explanatory variable. All three variables have a high coefficient of variation. Lerner index is used as a proxy for whether the market is a perfectly competitive one or not. However, Lerner index has the smallest variation in relation to the average, indicating it might not have any explanatory power to account for the variation in cost.

As indicated in Table 2, production cost and construction cost have increased by approximately 900 percent. That is more than the change in income per capita, which indicates that the price of new housing dwellings, as a portion of income, has increased. The subsidized interest rate has fallen from more than 8 percent at the end of the 1990s to less than 1 percent in 2004. At the same time the value-added tax on building material has increased from 6 percent to almost 17 percent. As the interest rate has fallen over the years, the difference between the subsidized interest rate and the market interest rate has varied less. The Lerner index gives the impression that the monopoly/oligopoly power decreased from 1975 to 1990 but began increasing again in 1995.

In Table 3 the correlation coefficient is exhibited. The correlation matrix indicates that production and construction cost are highly positively correlated to VAT and income per capita and negatively correlated to interest rate subsidy and the *T* rate. Moreover, subsidy and VAT are inversely related to each other; hence, the removal of the subsidy system occurred at the same time as when the government increased the value-added tax. The correlation is somewhat stronger for construction cost to all the independent variables than production cost.

Performing regression with nonstationary data produces spurious results. It is therefore important to pretest the data in the panel. We use the Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) panel unit root test (see [18, 19]) and a Dickey-Fuller test for the nonpanel data. The IPS test assumes that all series are nonstationary under the null hypothesis and relaxes

TABLE 3: Correlation coefficient.

	Prodc	Conc	Sub	VAT	Stock	Lerner	T rate	Inccap
Prodc	1.00							
Conc	0.99	1.00						
Sub	-0.68	-0.71	1.00					
VAT	0.81	0.82	-0.77	1.00				
Stock	0.28	0.28	-0.14	0.16	1.00			
Lerner	-0.30	-0.28	-0.38	-0.14	-0.03	1.00		
T rate	-0.58	-0.61	0.96	-0.68	-0.13	-0.48	1.00	
Inccap	0.94	0.94	-0.82	0.88	0.24	-0.18	-0.73	1.00

TABLE 4: Unit root test with ADF, LLS, and IPS (P values).

	ADF	LLS	IPS	Integrated of order
Prodc	0.234	0.025	0.012	0
Conc	0.139	0.001	0.000	0
Sub	0.996	—	—	1
VAT	0.607	—	—	1
Stock	1.000	1.000	1.000	1
Change stock	0.018	0.000	0.000	0
T rate	0.224	—	—	1
Lerner	0.940	—	—	0
Inccap	0.481	0.001	0.06	0

All variables have been transformed to natural logarithm form. Lag is equal to one. ADF has been estimated in one region (Stockholm).

the strong assumption about homogeneity in the LC test. The LLC test assumes that all series are stationary under the null hypothesis. Table 4 describes the result of these tests.

As our dependent variables are stationary, we are going to estimate the model in levels. However, as the ADF tests indicate that they are nonstationary, we will include a time trend as both cost variables seem to be even more trend-stationary. The results are not conclusive, but an overall result seems to suggest that our panel is integrated of order zero. It is problematic that series are integrated of an order greater than one, but it is more important that the error term is integrated of order zero, that is to say, that the included variables are cointegrated.

5. The Econometric Analysis

The econometric analysis has been performed in three steps. First, the benchmark models, where production cost is related to determinates such as subsidies and VAT, are estimated, second, we test whether temporal autocorrelation is present or not, and lastly we analyze the question of whether there is a difference between construction cost and production cost. Table 5 presents the estimates concerning the production cost model where subsidy, VAT, housing production, and interest rate as well as income per capita and Lerner index are used as determinants. The models have been estimated with OLS, IV approach (controlling for endogeneity), and Prais-Winsten regression (controlling for temporal autocorrelation), respectively.

It is obvious that we have a problem with temporal autocorrelation. The AR (1) test shows that error in one period can be highly explained by the error in the last one (P values close to 0.000 in Models 1–3). We have handled that in two different ways. First, we have estimated an AR (1) representation in the model (Model 4). It seems to be rather effective in that the AR (1) test indicates no temporal autocorrelation. Second, we have estimated a Prais-Winsten model in order to mitigate the problem (Model 5). Once again, it seems to reduce the problem as Durbin-Watson statistics increases from 0.9 to 2.2, hence, no temporal autocorrelation. Models 3–5 all try to handle the problem of endogeneity. It is always a problem to find valid instruments. We have used socioeconomic variables such as overall unemployment (in our case not correlated with cost) and demographics (as also [2] used). The Hansen test is a test of overidentifying restrictions and our result seems to indicate that our instruments are valid.

The results appear to be quite robust. Subsidy seems to have the anticipated positive effect in all models where time trend and fixed regional effects are included. The effect of VAT is negative as assumed, but the magnitude varies substantially between the models. In the two models where we corrected for temporal autocorrelation and endogeneity (Models 4 and 5), the VAT effect seems to be in the intervals 0.1 and 0.2, which indicates that production cost excluding VAT will fall marginally. The reason is that the supply is elastic and/or the demand is inelastic. Hence, the construction industry has a very little tax burden when it comes to value-added tax on building material. Most of the tax burden can be transferred to the housing developer who can transfer it to the final consumer (that is to say, the households). Another reason can be that the construction industry is dominated by a small number of companies and that they can take advantage of their monopoly/oligopoly power.

Periods and regions with higher income per capita and therefore more production of housing have higher production cost, everything else equal. As expected, it is also observed that the cost increases when interest rate is higher.

In Table 6, the econometric result concerning the construction cost models is presented. Models 6 to 8 use construction cost excluding VAT as the dependent variable. All models include fixed regional effects and are estimated with the IV approach. In Models 7 and 8 we control for the problem with temporal autocorrelation. Model 9 is a seemingly unrelated regression (SUR) combined with an IV-approach (three-stage regression). The same independent

TABLE 5: OLS, fixed effect, and IV estimates (production cost).

	Model 1	Model 2	Model 3	Model 4	Model 5
Sub	0.0021 (0.07)	0.1767 (5.10)	0.2646 (6.12)	0.1109 (3.54)	0.1330 (2.87)
VAT	-0.0608 (-3.95)	-0.1613 (-10.97)	-0.2242 (9.33)	-0.1180 (-5.35)	-0.2128 (-6.06)
Change stock	6.4021 (4.79)	11.3880 (7.30)	34.4833 (6.39)	15.3477 (3.62)	36.9840 (8.90)
Inccap	1.0243 (39.80)	0.5390 (7.94)	0.5968 (6.96)	0.3306 (4.80)	1.1341 (8.90)
<i>T</i> rate	0.1328 (2.02)	0.1807 (2.87)	0.2121 (2.89)	0.0793 (1.60)	0.1933 (2.98)
Lerner	-0.3885 (-5.08)	-0.0367 (-0.47)	0.3812 (2.78)	0.1578 (1.63)	0.3097 (1.86)
Time trend	—	0.0151 (8.70)	0.0177 (7.89)	0.0069 (3.72)	0.0049 (1.61)
AR (1)	—	—	—	0.5343 (13.16)	—
Constant	-1.9137 (-3.95)	-13.8627 (2.68)	-1.1824 (-1.19)	-18.7148 (-2.15)	-5.9174 (-4.17)
<i>R</i> square	0.9539	0.9620	0.9479	0.9730	0.9153
Hansen <i>J</i> statistics (<i>P</i> value)	—	—	0.0461	0.3190	—
LLC (<i>P</i> value)	0.027	0.004	0.000	0.000	0.001
IPS (<i>P</i> value)	0.022	0.001	0.000	0.000	0.000
AR (1) test (<i>P</i> value)	0.000	0.000	0.000	0.565	—
Durbin Watson (original)	—	—	—	—	0.949
Durbin Watson (transformed)	—	—	—	—	2.201
Method	OLS	OLS	IV	IV	IV/Prais-Winsten
Fixed regional effect	No	Yes	Yes	Yes	Yes

All variables are in natural logarithm form. *t* values are presented within brackets. Instruments used: unemployment and demographic variables. Dependent variable: total construction cost excl. VAT.

TABLE 6: Production cost versus construction cost.

	Model 6 Construction cost	Model 7 Construction cost	Model 8 Construction cost	Model 9 Construction cost	Production cost
Sub	0.3025 (7.57)	0.1298 (3.19)	0.1786 (3.90)	0.1281 (5.05)	0.1041 (4.05)
VAT	-0.2582 (-11.32)	-0.1325 (-6.54)	-0.2323 (-6.70)	-0.1312 (-7.30)	-0.1136 (-6.25)
Change stock	29.9166 (6.10)	13.1731 (3.16)	32.7823 (4.85)	14.5347 (4.97)	16.2088 (5.38)
Inccap	0.3607 (4.44)	0.1981 (3.61)	0.8994 (7.13)	0.1940 (3.20)	0.3057 (4.89)
<i>T</i> rate	0.2606 (3.84)	0.1102 (1.88)	0.1983 (3.10)	0.1040 (2.31)	0.0672 (1.46)
Lerner	0.4610 (3.58)	0.2092 (1.98)	0.3342 (2.03)	0.2370 (2.93)	0.1885 (2.29)
Time trend	0.0242 (11.45)	0.0103 (4.89)	0.0109 (3.66)	0.0097 (6.16)	0.0059 (3.78)
AR (1)	—	0.5440 (12.82)	—	0.5779 (27.15)	0.6005 (27.75)
Constant	0.4502 (0.48)	-0.1106 (-0.18)	-4.0122 (-2.86)	—	-1.2514 (-1.8)
<i>R</i> square	0.9544	0.9756	0.9165	0.9775	0.9756
Method	IV	IV	IV-Prais	Three-stage	
Fixed regional effect	Yes	Yes	Yes	Yes	

All variables are in natural logarithm form. *t* values are presented within brackets. Instruments used: unemployment and demographic variables. Dependent variable: total construction cost and production cost excl. VAT.

variables are used in both equations but the dependent variable differs.

The overall results appear to indicate that subsidized interest rate has a larger impact on the construction cost than on the total production cost. That suggests that subsidy is to a larger degree capitalized into the cost of building material than to land cost. The effect of changes in value-added taxes seems to be of the same magnitude. Moreover, income per capita has a larger impact on production cost than on construction cost and the opposite is true when it comes to interest rate and competition. Low competition in the housing construction industry increases construction cost more than total production cost indicating that the low competition does not have any (or small) impact on land cost.

6. Conclusion

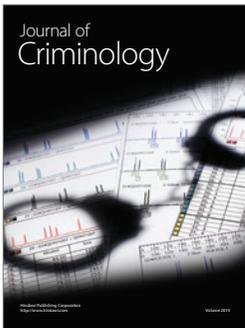
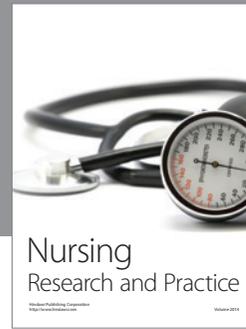
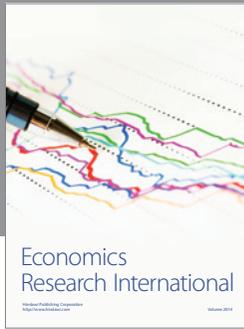
The determinants of the housing production cost have not been widely analyzed. This paper tries to overcome this lack of knowledge by studying the relationship between production and construction cost and its determinants such as interest rate, income per capita, and housing production as well as more policy oriented instruments such as changes in housing construction subsidies and changes in value-added taxes. We also analyzed the competitiveness within the construction industry and its impact on construction cost.

The overall results indicate, as anticipated, that interest rate subsidies to the housing developers increase the production cost. The results suggest that there is a positive relationship between subsidies and construction cost (excluding VAT) and an inverse relationship to value-added taxes. Thus, subsidies increase the housing cost and value-added tax decreases the construction cost that the constructor receives.

However, our results indicate that the constructors can transfer much of the tax burden to the developers (and maybe eventually to the final consumer of the house). Moreover, few companies within the housing construction industry raise, in general, the cost of production. The production cost was almost 10 percent higher in 1975 compared to a situation without subsidies, everything else equal. Moreover, value-added taxes decrease production prices excluding VAT; hence, the construction industry manages to transfer some of the tax burden from themselves to the housing developers. The reason could be that the developers are rather cost inelastic and/or that the construction industry monopoly/oligopoly power is quite strong. For instance, the result shows that if Lerner index increases by one percent, production cost increase by 0.2 percent; that is, the production cost in 2004 was more than 8 percent higher than that in 1985, everything else equal.

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