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The Effect of Minimum Parking Requirements on the Housing Stock

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Abstract:

The cost of parking is in many cities subsidized and instead taken through housing prices, wages, taxes etc. The effects on other markets are principally well known, but the work on the area is limited. In this paper we study how parking norms affect the size of the housing stock. Our analysis is based on a model of the rental-, asset- and construction markets, the results are quality assured by interviews with market actors. Prices and profits are affected when constructors are forced through parking norms to build more parking spaces than the customers demand. This decreases the housing stock with 1.2 % and increases rents with 2.4 % in our example suburb Hägersten.

Keywords: Parking norms, housing market, construction

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Contents

1 INTRODUCTION

The cost of parking is in many cities subsidized and instead appears in housing prices, wages, taxes etc. House prices are affected when constructors are forced through parking norms to build more parking spaces than the customers demand, wages are affected when employers provide free parking, and taxes are affected when street parking fees are subsidized.

In this paper we study the effect of parking policy on the housing stock. This is done with a model made up by three markets:

- Rental market (where the supply and demand for space creates an equilibrium rent)
- Asset market (where the equilibrium rent gives a value of the housing stock).
- Construction market (where the value of the housing stock affects the amount of new construction)

This, together with a depreciation rate, gives the size of the housing stock. The model is based on DiPasqual and Wheaton (1992), but modified to allow for parking analyses. The model is applied to an area just outside Stockholm inner city (Hägersten), but the results are roughly generalizable to other inner suburbs. One main input to the model is the difference between the cost of building parking spaces and the willingness to pay for them.

Although the effects on other markets are principally well known, the work on the area is limited (especially empirical articles are scarce). We have not found any literature with an analytical model aimed at capturing the effects on the housing stock. The obvious alternative to ex ante modeling is to study the effects ex post. This is not possible on an aggregate level since there is too little variation in the explaining variable (parking norms). There are some studies that evaluate local natural experiments where parking norms in a block/neighborhood is removed. A major difficulty in these studies is to isolate the effect of parking norms, since several changes are done at the same time.

The main contribution of this paper is to model and analytically sort out the effects on the housing stock and the mechanisms underlying these effects. We roughly calibrate the model to a suburban area just outside Stockholm (Hägersten). We also provide some insights from a series of interviews conducted with market participants. Given the current debate on the housing shortage in the expanding regions in Sweden, this is an important and timely subject. Clearly, there are several underlying causes to the current situation on the housing market. However, one main cause is that there is, for various reasons, too little new construction entering the market. To the extent that parking norms hold back new construction, it is important to provide a better

understanding of why this is the case, and if there are reasons to change the parking policies.

In this paper, we focus only on consequences on the housing market from parking policies. We do not study work or visiting parking, even though these markets also are regulated through parking norms. Neither do we study flexible parking norms/mobility management. Firstly, because there are lots of variations of flexible parking norms, which means that this would have required a study of its own. Secondly, because the qualitative results of parking norms are the same since they increase the construction costs, making them flexible only makes the effects smaller.

The remaining paper is structured as follows; Chapter 2 provides background on pricing, supply, norms, costs and residents' willingness to pay for parking. The model is presented in chapter 3 and the results are given in chapter 4. The interviews with market actors (project development companies, long-term property owners, municipality representatives and brokers) are presented in chapter 5. Chapter 6 sums up the conclusions.

2 BACKGROUND ON PRICES, COSTS AND NORMS

2.1 Basic framework

Setting parking fees below market prices creates a free-riding problem for housing constructors, since they prefer to let their customers park on the subsidized street parking. The problem is that all housing constructors cannot free ride since the space for street parking is limited. The standard planning solution is to make constructors build parking spaces by parking norms. The juridical status of parking norms differs between countries, see Cost (2005) for an overview. However, the basic principle is the same; constructors must build a specified number of parking spaces per apartment, square meter of store area etc. Municipalities usually also regulate whether parking spaces may be built on the ground, or must be built in car parks or in garages. The situation is illustrated in figure 1 below.

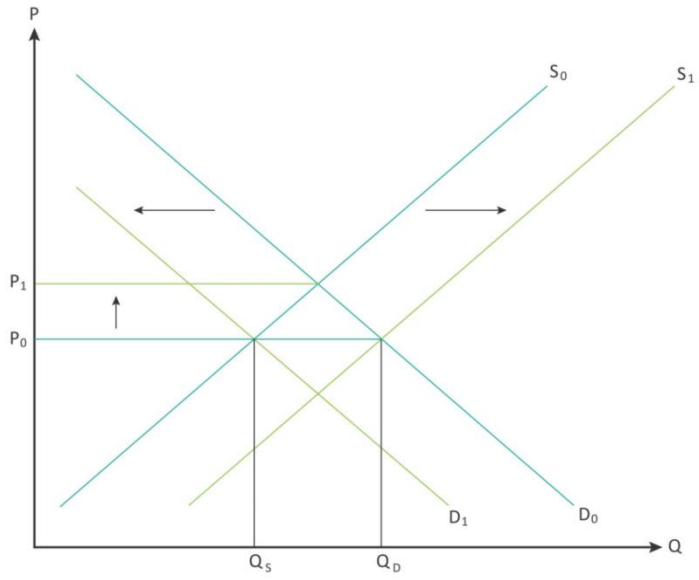

Figure 1. Illustration of excess demand on parking and possible solutions

In figure 1, D_0 and S_0 illustrate the initial demand and supply curves, respectively. Given the initial demand and supply, the market clearing price would be P_1. Setting a price for parking below the market clearing price P1, such as P_0, results in an excess demand of $Q_D - Q_S$. The fact that more customers are willing to park at price P_0 than there are parking space results in an efficiency loss. The obvious way of solving this would be to raise the price to P_1. Alternatively, one could introduce measures that shift the supply function to S_1 or the demand function to D_1.

While the price of street parking is decided at municipal level and affects all public streets, the supply policy instrument studied in this paper (parking norms) affects only new apartments. In the context of the figure above parking norms forces entrepreneurs to build Q_D amount of parking. Demand policies could either affect the demand from the people living in the new houses (usually referred to as flexible parking norms or mobility management) or the general demand for parking (fuel taxes, congestion charges etc.).

Meeting the demand at low or no price (Q_D) may affect the housing market in many ways (Shoup, 1997):

- The land use may lead to urban sprawl.
- Urban sprawl may lower land values.
- Fewer small apartments may be built (if the norm is set per apartment, constructors will avoid small apartments)
- The costs for parking spaces may increase housing prices.
- Constructors might abstain from some projects because of high costs of providing parking.

2.2 Price and supply of parking

The literature on supply of parking spaces is scarce, but there is more written on pricing of parking at a given supply. The early literature (Roth 1965) assumed that parking mainly is a private good and that the market for parking as well as the markets for substitute and complementary goods is mainly free from distortions. This leads to the first best-conclusion that parking should be priced at its marginal opportunity cost. An obvious second best argument is that congestion on roads indicates that road traffic in cities are underpriced, meaning that parking fees should be set higher to compensate for this (Glazer and Niskanen 1992, Verhof et al 1995, Arnott and Inci 2006 and 2010, Bonsall and Young 2010). Another argument for setting prices above marginal cost is the external effects of searching for a parking space. A common conclusion (Arnott and Rowse 1999, Arnott and Inci 2006) is that the price should be raised until search traffic almost ends. Introducing private parking houses makes the analysis more difficult. Calthorp and Proost (2005) argue that the price of street parking should be set equal to the price in private parking houses, since the latter is likely to be equal to marginal cost.

2.3 Parking norms, a background

The empirical background of minimum parking requirements is usually vague, most often it is based on peak demand (at no or low price) at similar areas without considering costs (Shoup, 1997).

In newer parking policies various factors that are supposed to affect the need for parking spaces and therefore could be taken into account for reducing the norm are listed. According to our interviews and studies of several parking policies it could be factors such as apartment size, accessibility to public

transport, specific target groups for the new building or accessibility to parking spaces on the street.

Most municipalities are gradually introducing more flexible parking norms. For major development projects, a review of the old parking norm is usually done. However, this can lead to different parking norms in different parts of an area being developed as a single project, dependent on the local plan relating to that particular site.

To see how parking norms in Sweden are actually set, we have studied the relation between parking norms and demand for parking for nineteen Swedish municipals with more than 50 000 inhabitants. This has been done by calculating the average number of cars per apartment in each municipality respectively. This is captured by the red bars in figure 2. These may be related to the parking norms applied by the different municipalities, which are illustrated by the blue bars in figure 2.

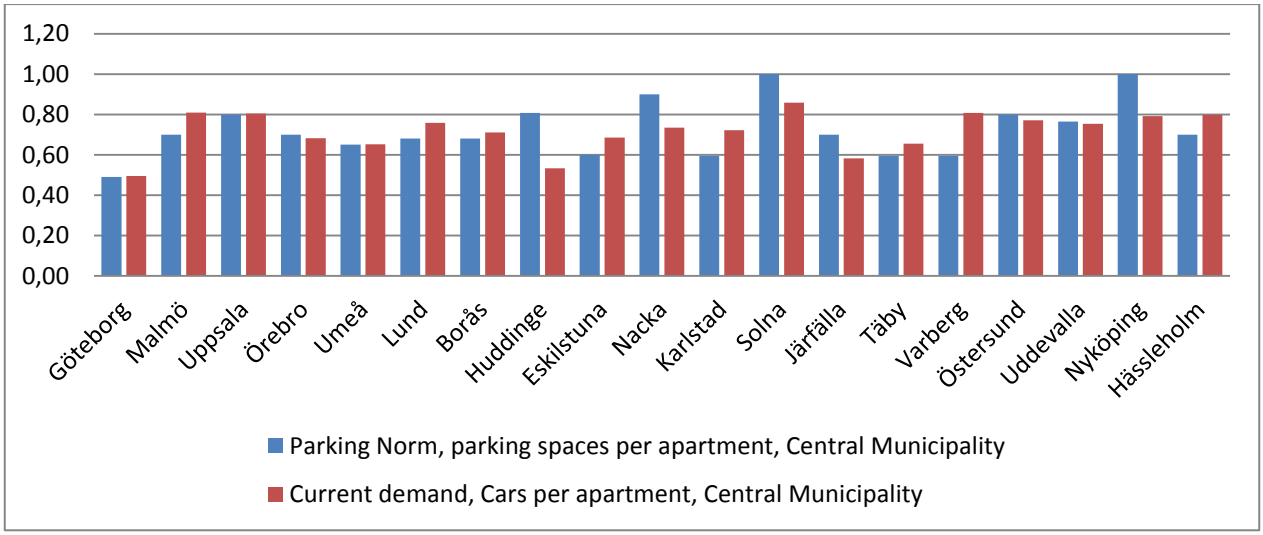

Figure 2. Parking norm and demand for parking in central parts of nineteen municipalities.

Parking norms are in these municipalities (with few exceptions) set for three zones - inner city, central areas and periphery areas (norms are from the respective municipalities parking policies). Generally, the demand for parking spaces is lower in more central areas. Figure 2 shows the parking norm in the most central parts of the nineteen municipalities. They are compared with an approximation of the current demand for parking in the same area (i.e. car ownership). In the parking policies the parking norms are either expressed as number of parking spaces per apartment or as parking spaces per 1000 sq. m residential area. Based on data from Statistics Sweden we have in the latter case we have assumed the average size of apartments to be 85 m^2 to calculate the number of parking spaces per apartment. Official statistics for average car ownership (number of cars per person) in the municipality has been used (SCB, 2013). For the central parts we have assumed the car ownership to be 85 % of the average for the municipality. We also assume that on average 1.8 persons live in each apartment.

Given these assumptions we have calculated the average number of cars per apartment. The result should not be analyzed per municipality, but rather be seen as a pattern. The average quota for these nineteen municipalities between parking norms (parking space per apartment) and the number of cars per apartment is 1.02 for central areas and 0.92 for the rest of the municipalities. This implies that project development companies are demanded to construct enough parking spaces on their property to cover the *total* demand for residential parking spaces in the central parts and almost the total demand in the rest of the municipalities. Since there are also other parking spaces available in many cases, for example in the streets, the total number of parking spaces that could be used for residential parking is on average larger than the current demand. This strongly suggests that the municipalities are trying to make the parking norms match the demand for parking.

2.4 The effect on housing of removing local parking norms

The literature on the effects on housing of parking norms consists of local natural experiments. Some studies have studied the effects on housing prices. Manville (2013) examined the effects of the ARO-plan (Adaptive Reuse Ordinance) in downtown Los Angeles. Designed to help convert vacant commercial and industrial buildings into housing, the ARO gave developers who owned qualifying buildings three specific zoning exemptions: an alternative life safety code, allowing developers to change the buildings' use (from commercial or industrial to residential) without variances and exempting the buildings from minimum parking requirements. Manville finds that the ARO-buildings are less likely to bundle parking and that they sell for a lower price. Jia and Wachs (1999) use hedonic regressions to show that housing without parking in San Francisco sold for 12% (about $40,000) less than housing with parking.

A classical text is Bertha (1964) which showed that implementing parking requirements in Oakland (CA) led to an 18% increase in construction costs, a 30% reduction in housing density, and a 33% reduction in land value. He further found that the requirement led developers to offer larger and more luxurious units.

Both Manville (2013) and McDonnell et al (2011) argue that complying with parking requirements is more onerous in denser areas since ground prices are higher. In this paper we argue that it is the difference between the cost of building parking spaces and the willingness to pay that matters (which is greater in the suburbs since on street parking often is free and available).

2.5 Costs and revenues for parking

According to our interviews with project developers and property owners it is not possible to cover the construction cost of parking spaces in garages with revenues from parking fees. In areas with higher parking fees (central areas) the construction costs for garages is in general higher, due to the complexity of

building in dense city environments. In areas where parking spaces are cheaper to establish (where ground parking is allowed) the price on the street is also lower or often zero. Also, parking spaces on the ground has a high opportunity cost because the land cannot be used for buildings which give higher returns.

Depending on type of parking space - on the ground, in car parks above ground or in a garage, the construction cost for parking spaces differs a lot. A parking space in a garage is at least twice or three times as expensive as a parking space in a parking house, which in turn is much more expensive than parking spaces directly on the ground (City of Malmö, 2010). In addition to the cost of the garage, the housing is often more expensive to build with a garage under or next to the building.

The total construction cost of parking spaces adds on to the total building cost for the new apartments. The parts not financed by the fee are accumulated in the rent on the apartments (for both car owners and non-car owners). The rough calculation presented in table 1 below shows that about half of the construction costs for a parking space in a garage (only one floor) are covered by the parking fee, the remainder is funded through increased rents on the apartments. This corresponds to approximately 700 – 1 500 SEK per square meter which represents about 5% of the apartment's value.[1] In less attractive areas the production cost will be about the same but the value of the apartments will be lower, providing parking a fraction of the apartment value higher than 5%.

Table 1. Parking cost financed by fee

	Production cost[2] per space (SEK)	Parking cost[3]/space and month (SEK)	Parking fee[4]/space and month (SEK)	Loss/ space and month (SEK)	Share of parking funded by fee	Production cost funded by fee (SEK)	Production cost per space financed by apartment[5] SEK per sq. m	
							P norm 1,0	P norm 0,5
Car park	120 000	1 500 - 2 000	500-1 000	1 000	50%	60 000	706	353
One story under yard	250 000	2 500 - 3 000	800 - 2000	1 500	50%	125 000	1 471	735

[1] Assuming an apartment value of 35 000 SEK per square meter, which we think is reasonable in the suburbs of Stockholm or in Gothenburg. Price statistics can be found at maklarstatistik.se.
[2] City of Malmö (2010)
[3] City of Malmö (2010)
[4] Assumptions by interviews with brokers, property owners, property developers and Stockholm parking
[5] Based on assumptions of a residential area of 85 m^2

3 OUR MODEL

In this section we discuss the functioning of the real estate market with emphasis on providing an analytical framework. This framework facilitates a structured way of studying how changes in parking policy may affect the housing market at large and housing construction in particular.

The Swedish residential market for apartment buildings is mainly composed by two different types of tenure. Firstly, there are rental apartments, where the residents rent their apartment by a private or public property owner. The rent paid for the apartment is not market rent but are set in negotiations between the tenant association and the property owner based on the apartment's standard, location, etc. In Sweden, this tenure is not linked to social housing. The other form of tenure is condominium, where the resident owns his apartment and can sell it on the open market. The members of the condominium association jointly own the property and the residents have a right to occupy a specific apartment.

3.1 A simple real estate valuation approach

A property's value is determined by the future cash flows it might generate. To assess the value of a commercial property, one typically uses a model that discounts the future cash flows that the property will generate. The principle is very simple, although in practice it can be complicated as it requires a lot of information and market knowledge to get the correct parameters in the model. A first step is to assess the future returns, the so-called net operating incomes. The revenue side of the net operating income consists of rents. On the expenditure side, we find e.g. operating costs, maintenance costs, and any property taxes and ground rents.

The choice of discount rate becomes central as a small variation in interest rates will have a major impact on the assessed value. The discount rate should reflect the return that the investor would receive if she invested in an alternative asset having the same risk exposure - that is, it should reflect the opportunity cost of capital. A property's value can thus be estimated by

$$MV = \sum_{k=1}^{n} \frac{NOI_k}{(1+r)^k} + \frac{SV}{(1+r)^n} \qquad (1)$$

Where MV denotes market value, NOI is the net operating income, the SV is the salvage value (i.e., the value of the property at the last year of the calculation), k is the year and n is the length of the period analyzed. The discount rate is denoted r and is assumed for simplicity to be constant over the period.

3.2 Parking and existing properties

From equation (1) we see which variables influence a property´s value that are also potentially affected by the design of the parking norm. First, the net operating income may be affected. As discussed above, parking norms may decrease the net operating income (for instance due to parking crowding out residential space and thereby decreasing aggregate rents) or increase it (for instance by resulting in less crowded streets, which increases demand for residing in the area). A parking norm may also influence the discount rate. This too may go in both directions, in particular depending on if the parking norm may influence the fluctuations of future net operating incomes, i.e., the risk. The salvage value is basically a function of net operating incomes occurring later than k years, so it will be affected in a similar way as the NOI and it is also affected by r.

3.3 Interacting markets

The simple story that follows from inspecting equation (1) does not capture all relevant variables. The reason is that (1) does not explicitly capture the fact that the rental market – on which the NOI is established – is not an isolated entity.

As properties differ from many other commodities, the real estate market is rather complex. However, it is possible to get a fairly good overview if one allows for a number of simplifications. A first step is to focus on a given market segment defined by a specific property type in a specific geographic area, e.g., residential apartment buildings in a Stockholm suburb. Within this framework, there are still a number of submarkets that interact. A classic example to illustrate this interaction is given by DiPasqual and Wheaton (1992). Their model, which often referred to as the four quadrant model, shows that the real estate market can be divided into three markets:

- The rental market, where supply and demand for space (residential or commercial) results in an equilibrium rent

- The asset market (or the real estate market), where agents trade in real estate, thus transforming the equilibrium rents into property values

- The construction market, where property values affect the amount of new construction

The model may be illustrated as in Figure 3.

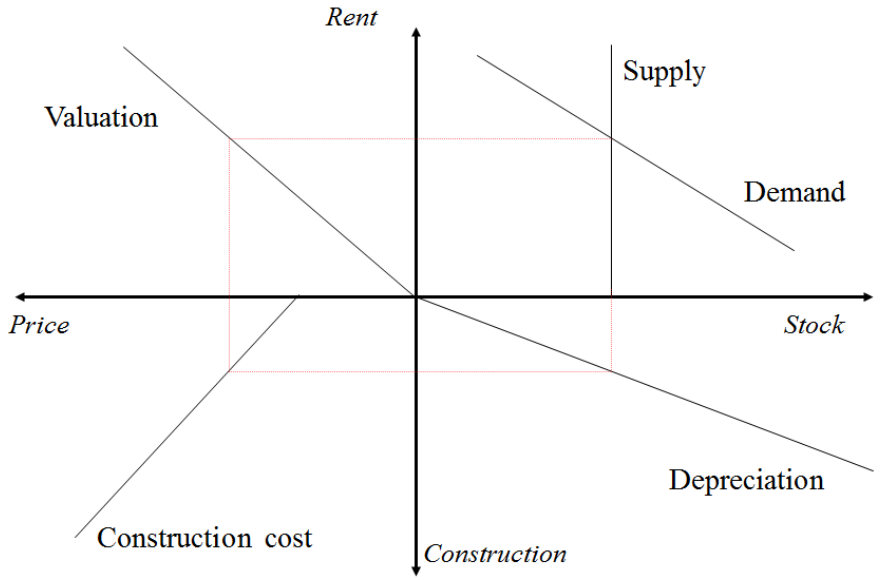

Figure 3, *The four quadrant model*

The first quadrant - in the northeast corner - captures the rental market. It is assumed that the equilibrium rent that arises is such as demand, at the equilibrium rent, exactly corresponds to the supply. Note that the supply in the short term is given and that the supply function therefore is completely vertical. As expected, the demand curve slopes downward. A larger supply thus results in a lower equilibrium rent.

The second quadrant - in the northwest corner - captures the asset (real estate) market. In principle, this quadrant consists of a simple valuation model that transforms the equilibrium rent arising on the rental market into a property value per square meter: the higher the rent, the higher the value.

In the third quadrant - in the southwest corner – we find the construction market. The quadrant consists simply of the construction market's supply function. The higher the price for which you can sell a newly constructed square meter, the more the construction market will produce. Note that there is a level of price per square meter which is such that new design becomes zero.

The fourth and last quadrant is a very simplified way to illustrate that part of the building stock becomes older and will therefore leave the market. It creates a balance between new construction and the properties leaving the resulting in an equilibrium stock level. If there is no new construction, in the long run the total supply on the market will be zero. This quadrant represents the model's crudest simplification as it reasonably should be dynamic - it takes time before the whole of the existing stock becomes obsolete - but the process is modeled as instantaneous.

The model assumes that the markets are in equilibrium. This is seen by noting that if one goes clockwise through the four quadrants you end up in a supply equal to what one began with. Thus, there are no forces pulling against either a higher or lower supply.

As an illustration, assume that there is a demand shock such that demand shifts outward, see Figure 4. In the rental market arises, given the initial supply, a substantial rent increase (upper dot-dashed line in Figure 2). If the rent increase would be permanent so would square meter prices increase significantly, which would be a signal to the construction market to increase construction. Finally, the overall supply increase dramatically, as illustrated by the dot-dashed line to the right in the first quadrant.

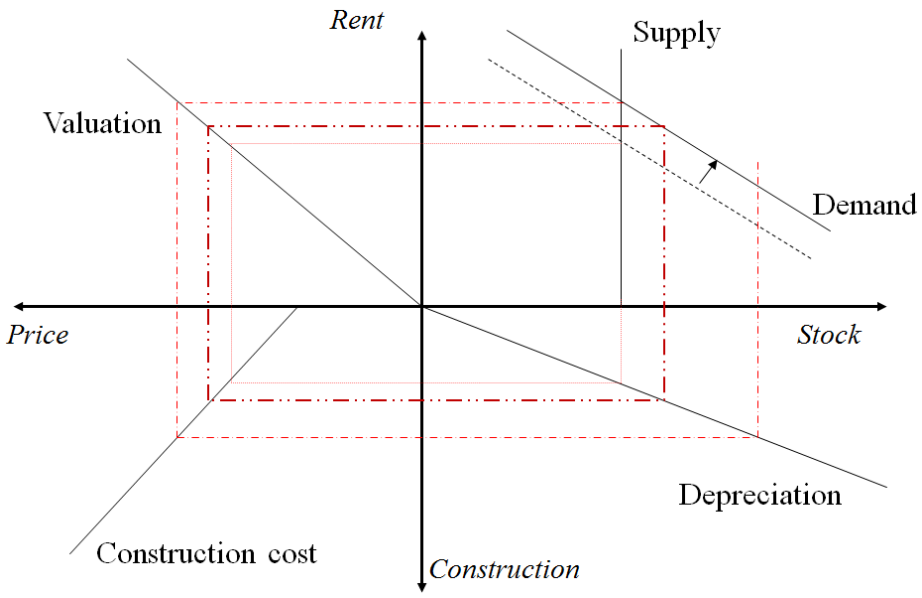

Figure 4, illustration of demand shock.

However, this cannot be an equilibrium. This is seen from that the equilibrium rent at the new supply (and the new higher demand) is lower than the original rent. Property values would then fall again, and thus the new construction. Instead, the equilibrium is illustrated by the dot-dot-dash line. This constitutes an equilibrium because it begins and ends at the same supply level. We can thus see that rents will rise as a result of the demand shock, but not (in the long run) to the high levels discussed above. Similarly, we see an increase in both prices and new construction. But in both cases they are held back by a supply increase in the market that dampens an excessive rent increase.

The similar exercise can be done for the changes on the real estate market, such as a change in the yield, and changes in the construction market, such as revised construction costs.

The amount of parking within a representative property could affect several of the markets in Figure 3. First, the rental market may be affected. We will discuss this in more detail below, but in short, the equilibrium rent (per square meter) may either rise or fall. It will clearly increase if more car parks mean that the offered amount of housing decreases. That is, if it is the case that a particular property can contain both parking and offices, but that both uses crowd out each other - then an increased demand for parking must displace residential

space. This results in a lower supply, which in turn leads to a higher equilibrium rent. This effect can be counteracted or enhanced by a demand effect. An increased amount of parking can lead to a sub-market becoming more attractive, which would be captured by the demand curve shifting outwards - something that affects the equilibrium rent in a positive direction. As discussed above, there may also be situations where an increased amount of parking will make the sub-market less attractive - in which case the demand is shifted downwards, which affects the equilibrium rent negatively.

Secondly, the asset market in quadrant two may be affected. The central feature in this quadrant is to transform an equilibrium rent (per square meter) into a property value (per square meter). This too will be returned to in more detail below. Here we content ourselves by noting that the risk of future returns is central to the property value. The risk affects the slope of the function in quadrant two. Risk is, in this context, variation around the future expected returns. In this simplified world, therefore variation around the future equilibrium rents. It may be that the availability of parking has a dampening effect on this variation (again, as measured by the rent per square meter) as they will serve as an option.

Thirdly, the construction market may be affected. An increased demand for parking will increase the cost of providing one square meter of living space. In the figure, this results in that the supply function in the third quadrant will move to the left. Thus, at a given square meter price there will be less new construction.

4 MODEL RESULTS

We will in this section illustrate the outcome of impacts shifts in parking policy may have on the different markets captured by the 4Q-model. Our aim is not to draw definitive conclusive results for a real life situation. Doing so would require substantially better data and a much more elaborate model. Even so, we roughly calibrate the model to an area just outside Stockholm inner city; Hägersten (the results are roughly generalizable to other inner suburbs). As noted above, residential rents in Sweden are regulated with the exception for the initial rent in new buildings. That is, rents for existing are not set to clear the market. We will return to this complication. To begin with we study the outcome of the model under an assumption of an unregulated market that freely responds to changes in supply and demand.

For new apartments, the rent may be, more or less, freely set. Consequently, the initial rent charged in new buildings mirrors the market rent rather well (given that rents in older buildings typically, at least in major urban areas, are below the market clearing level).

4.1 Calibrating the model

At the time of writing, the average rent charged in new apartments in Hägersten is around 1 700 SEK / m^2 and year. The total area of residential apartments, i.e., the stock, in Hägersten amounts to almost 1 800 000 m^2. For the purpose of this illustration, we thus assume that a rent equal to 1 700 is such that the entire stock of 1 800 000 m^2 is let and that there is no excess demand – i.e. there is no queue of potential tenants given the price.

The rent and stock constitute a point estimate. We need to specify a demand function that passes through that point. To keep the model simple, we apply a linear demand function. The intercept with the vertical axis thus corresponds to a hypothetical willingness to pay for the first square meter of area in this localization. This is clearly not an observable value, but it is more a question of assuming a reasonable value – we settle for 5 000 SEK / m^2 and year. This value is chosen because it yields a price elasticity at a rent of 1700 SEK / m^2 of approximately -0.5, which is in line with what is used by Boverket (2013).

The value per m^2 for residential buildings in Hägersten is around 23 000 SEK based on recent transactions. However, this value refers to older buildings. Arguably, the value of new buildings (which are of interest here due to the use of the rent in these buildings as an indicator of market rent) is higher. Taking our departure in a market rent of 1 700 SEK/m^2 and from this deducting operational expenses of 370 SEK/m^2 (www.varderingsdata.se), we reach a net operating income of 1 330 SEK/m^2. Applying a net capitalization rate of 4%, which is appropriate for residential apartment buildings in Hägersten (www.varderingdata.se), we arrive at a reasonable market value of around 33 000 SEK/m^2.

A value per m^2 of 33 000 given a rent of 1 700 requires a gross capitalization rate of 5.1%.

Turning to the construction of new building, we have that new construction in Hägersten – as an average over a few years – amounts to around 2% of the stock. From Boverket (2013), we have an estimate of the supply's price elasticity being somewhere in the range of 0.08-0.7. Assuming that the market in such an expansive is rather price sensitive, we calibrate the model such that the supply's price elasticity is just above 0.5. To achieve this using a linear supply function (together with a value per m^2 of 33 000 and a yearly supply around 2% of the stock) requires that the supply function intersects the value-axis at a negative and substantial value (-31 800). This is clearly not realistic. For instance, it implies that even if the price for which the construction companies may sell new residential housing would be zero, they would supply some 17 000 m^2 per annum. Thus, the supply curve in real life is obviously not linear. The main implication of this is that the model should not be used when trying to capture large changes. However, it should still perform reasonably well for small changes around the initial equilibrium.

For this to be an equilibrium requires a depreciation rate of approximately 2% per annum.

4.2 Simulations

Implementing the calibrations above yields a model that crudely captures the situation in Hägersten. We may now use the model to simulate the consequences of shocks that may relate to changes in parking policy. Even though the model is calibrated, we start by illustrating the changes in the short and long run to get an idea of the magnitude of the impacts from shocks on the demand, real estate market and the construction market. In a later section we will discuss the likely magnitudes in real life from parking policy changes on these markets.

A shock towards the demand
It may be that a change in parking policy will influence the demand for residential apartments. Table 2 shows the effect of an increase in demand. We model this as a 1% outward shift of the demand function's intercept with the quantity axis, i.e. the demand function flattens marginally, but given a fixed intercept with the rent axis.

Table 2. Short and long run impacts from a 1% shift in residential demand

	Initial	*Short run*	%	*Long run*	%
Rent	1700	1733	1.90%	1716	0.96%
Value	33333	33974	1.90%	33656	0.96%
Constr.	36185			36365	0.49%

From table 2 we see that an increase in demand will have a large impact on both rents and value in the short run. Both the rent and the value per m^2 increase by 1.90%. However, in the long run, the increased value will spur new

construction. This increases the stock, which pushes rents down again. Thus, in the long run, the impact on rents and value will be less; 0.96% higher than the initial states. In the new equilibrium, yearly construction has established on a new level that is 0.49% larger than in the initial equilibrium.

A shock towards the real estate market

Another possible consequence of a shift in parking policy is that it may influence the real estate market. For instance, it may be that investing in real estate subject to a more expansive parking policy is regarded as less risky as it would seem to be more flexible in regard to future changes in parking demand.

Table 3. Short and long run impacts of a -1% difference in gross capitalization rate

	Initial	*Short run*	*%*	*Long run*	*%*
Rent	1700	1700	0.00%	1691	-0.50%
Value	33333	33670	1.01%	33501	0.50%
Constr.	36185			36279	0.26%

As seen from table 3, a change on the real estate market also implies large differences in the short versus long run. In the short run, nothing happens on the rental market – as nothing happens with demand for residential apartments or with the stock. However, the change has a substantial impact on the real estate market in the short run. The value increases with 1.01%. As the increased value will result in more construction taking place, rents will decrease and real estate values will stabilize on a level above the initial but below the short run state. In the new equilibrium, annual new construction will be on a level 0.26% above the initial one.

A shock towards the construction sector

Finally, it seems highly likely that a policy shift towards more parking per m^2 constructed residential area will increase the cost of construction. From above, we have that constructing underground parking garage increases total construction costs with around 5%, so that is the number we shock the model with.

Table 4. Short and long run impacts of a 5% shift in construction supply function (marginal cost)

	Initial	*Short run*	*%*	*Long run*	*%*
Rent	1700	1700	0	1740	2,38%
Value	33333	33333	0	34126	2,38%
Constr.	36185			35742	-1,22%

From table 4 we see that, unsurprisingly, any difference in construction cost will have no impact on the rents or real estate values on the short run. However, as a higher construction cost will result in reduced construction, in the long run both rents and, consequently, real estate values will increase by 2.38%. The higher construction costs will lead to that the amount of newly constructed residential area will decrease by 1.22% compared to the initial state.

4.3 Rental regulation affects the result of parking norms

The numerical example shows us that a change in parking policy, that may result in shocks both on the market for residential space, the market for residential real estate and the construction market, will impact all these markets to various degrees. We also see that there may be substantial differences between what happens on the short run as compared to on the long run. Before we turn to a more qualitative discussion about what impact changes in parking policy may have on the different markets in a real life setting, let us discuss some other complications with going from the numerical example to the real life situation.

One such complication has already been touched upon, namely that the Swedish rental sector is regulated. Rents for residential apartments are not set on a free market. Rather, in expanding regions – which are also the regions where parking policy design may be of greater concern – actual rents are typically below the rent that would clear the market. Consequently, there is excess demand on the market. At a given price, there are more people willing to rent apartments than there are apartments available. From our perspective this implies that the rental sector will not respond as quickly or as much as the model suggests.

For example, consider a situation where the demand for rental apartments in a given market increases. The model suggests that this will result in higher rents, higher real estate values, more construction and an increased stock that will somewhat dampen the initial effect of the demand increase. If rents are regulated, neither of this will happen – or, depending on the regulation design – the process will be much slower. Rather, as rents cannot adapt, a longer queue will emerge.

Changes that occur on the real estate market or the construction market will still have an impact on the amount of new construction, but one major feature of how interacting markets work is to some extent short circuited as the rents cannot respond to the new stock level. In the Swedish case, we would expect that rents react to changes in, e.g., demand, but not the full extent as in a free market case and not as quick. That is, the rent regulation in Sweden will work as something of a filter that will dampen the effects described above.

As noted, a large share of the market for residential apartments in Sweden is catered for by condominiums. The market for these may be described by a similar framework as discussed above. The problem is that the demand and supply on the residential market will not result in a market rent in the same way as above. Even so, there will be a link between residential apartment demand and supply, the real estate market and the construction market and the basic insights from the model – including the key concepts of short versus long run effects – still apply.

5 INTERVIEWS WITH MARKET ACTORS

To further investigate the consequences of parking norms, we have conducted interviews with stakeholders on the relevant markets. The interviews primarily focus on the inner suburbs of major Swedish cities. These areas exhibit the greatest differences between the municipality's requirements for parking (primarily in garages) and the property owners' interest in providing garage. Free parking spaces in the streets compete with the expensive parking garage while the willingness to pay for housing is lower in the suburbs.

Our findings, from interviews with project developers, are that the parking norms are of significant importance for how many apartments can be built on a specific property. The number of parking spaces demanded from the municipality, and the number of apartments that they permits, is one of the first factor to be considered when analyzing the purchase of a property.

In the following, we highlight the major insights from the interviews grouped in accordance to the model presented above. That is, we start with issues related to the rental market. After this we turn to the real estate and construction market, respectively.

5.1 The rental market

The parking norm and the requirements for organizing parking spaces in garages or on the ground are normally the same for buildings with rental apartments or condominium apartments. The Swedish rental system enables a higher rent for newly built apartments during a period of 15 years. It is the case that access to parking allows a higher rent, but the increase is only marginal. The total level of rent that is accepted in the negotiations together with the higher production costs in general for rental apartments provides difficulties to produce rental units with adequate return. This problem is generally more pronounced in projects for rental apartments in central areas compared to projects with condominium apartments.

There are thus indications that the direct impact from parking, and hence possibly parking norms, on rent levels is small. Most tenants do not expect parking spaces on the property and are still willing to rent apartments. Developers of rental apartments and also the long-term property owners say they can consider building apartments without parking spaces. It is also the case that garages, in particular multiple story garages underground, are often perceived as unsafe places to visit for the car owners.

The brokers who have direct contact with the home buyers say that they can see some increased willingness to pay, since some buyers require that a parking space in, or adjacent to, the building must be available in order to buy an apartment. These customers are primarily older who sold their one-family house and families with small children. On the contrary project developers and brokers say that the apartments and parking spaces often are managed

separately (when an apartment is acquired, it is often not clear whether the apartment owner has the possibility to rent a parking space or not).

Even if there seems to be only small direct effects on rent levels, there are potential indirect effects affecting the rental market. These follow from that the parking norms changes the structure of the supply side on the rental market. For instance, interview answers suggest that parking norms affect where housing projects are realized. The cost of constructing parking in housing projects differs depending on construction factors such as terrain and ground conditions but also on the number of required spaces, if garages are required and what the competitive parking fees are in the area. The norms also influence what types of apartments are provided. Parking norms often prescribes a number of parking spaces per apartment. For the project developers this provides an incentive to build fewer but larger apartments. If it would be possible to add a few additional apartments, it will not be implemented because the additional construction costs of parking spaces become too high.

The interviews also confirm the general statements in Shoup's (1999) article. Parking norms in combination with low prices for street parking has the negative effect that fewer and more expensive apartments are being constructed. Transferring the cost from the parking market to the housing market also means transferring costs from car owners to non-car owners because costs that are not covered by revenues from letting out parking spaces is distributed evenly between the apartments.

5.2 The real estate market

Turning to the real estate market, our interviews with municipalities and project developers confirm the results from the model analysis. Free or cheap parking in the street means that it is not possible to charge the car owners the full cost of providing the parking spaces demanded by the municipalities. The cost is instead transferred to the housing costs, and thus property values. This leads in some cases to difficulties financing housing projects. Some projects will not be realized and other will be reduced, compared to a situation with less demanding parking norms.

One could argue for that parking lowers the value of apartments. The municipalities demand for parking spaces often lead up to that some parking spaces on the property are empty, especially if there are free or cheap parking on the street. Our interviews imply that this is not a negligible problem for project developers and property owners, since vacancies in the garages means lost revenues and higher housing costs, and thus an increased risk for the buyer. For security and practical reasons the problem with vacancies is not that easily solved by letting out parking spaces in garage to people not living in the house and of course the external demand is also depending on the availability and price of parking in the street instead. Some are willing to accept higher prices in garages for convenience or safety reasons, but not too much higher. In order to reduce the purchaser's risk for future vacancies in the acquisition the project

developer usually leaves a vacancy warranty of 2-5 years to the buyer (the property owner or the condominium).

Project developers see no direct increase in value from parking in the initial stage, when the project developers build the houses.

In interviews some pointed out that another disadvantage to building parking spaces is that the yard is becoming less attractive. Parking spaces on the ground is prepared with a hard surface instead of a garden. Even when the car park is below ground the outdoor environment is affected negatively as it worsens the conditions for plants and trees etc.

5.3 The construction market

The municipality regulates whether parking spaces can be built directly on the ground, or must be built in car parks or garages. A common regulation is to demand for parking spaces to be in garages in the central or densely inhabited parts of the municipality and to allow car parks or parking spaces directly on the ground in more peripheral areas. Garages for residential buildings are normally built in one story under the yard. Builders normally avoid building car parks in garages with more than one story under the ground, because these are much more expensive to build. The number of apartments possible to build is then calculated depending on how many parking spaces can be fitted into the garage.

In some cases the municipality takes responsibility for building the parking spaces, in exchange for a sum of money per parking space demanded by the parking norm. The municipality then undertakes to build the required parking spaces (often in a joint car park within some given maximum distance) when the parking spaces in the street are no longer enough. This method where the project developers can buy parking spaces is often cheaper for the developer than building their own garages.

Parking norms and requirements for underground parking gives, according to the interviewed stakeholders, that there are housing projects that are not implemented. The stakeholders who were interviewed stated examples of development rights for tenancy that was not built, partly because of the high cost of garage parking entails. For example, Helsingborgshem chose not to buy land in Maria Station, Helsingborg, partly because of the requirement of a garage. The interviewed project developer who develops rental units, basically never consider land purchases where the requirement involves parking in the garage.

The project developers or property owners believe that it is not possible to build the housing and parking spaces with the return on investment that the owner (private or public) require. This means that property owners prefer building rental apartments in locations where ground parking is possible, which is mainly outside the inner city or outside neighborhood center. Another consequence of the parking norms is that developers prefer to build larger

apartments than smaller because the larger requires fewer parking spaces per square foot apartment. Project developers' estimate that it is building rental apartments does not provide a sufficient profit margin. A reason for still constructing rental apartment is to respond to the municipalities in order to facilitate other, more profitable projects in the municipality. In order to build rental apartments the cost of purchasing the land often needs to be subsidized by the municipality. This follows from the parking standards being the same for rental apartments as condominium, and condominium is a business with higher margins. Thus, subsidizing the land for residential apartment projects is a way for the municipality to provide incentives for developers to conduct these projects rather than, only, condominiums.

Despite high parking standards the developers usually accept the conditions that municipalities require for selling land because there is a shortage of buildable land, and the demand for housing is high. The high willingness to pay for condominiums gives developers the ability to build and sell homes with desired returns.

6 CONCLUSIONS

It is important that municipalities are aware of the effects on the housing market when considering parking norms and pricing for street parking. According to our calculations parking norms increases the construction cost with 10 %, half of the increase can be financed by user fees. According to our interviews, the demand effects are ambiguous. Instead, parking norms largest effect on housing most likely comes through the construction market. According to our model simulation, the 5 % uncovered cost increase leads to a 1.2 % decrease in the housing stock and a 2.4 % increase in rents. The effects are calculated for Hägersten, but are roughly representative for other Swedish suburbs. Since the model simulation is based on a series of assumptions and simplifications, the simulations should not be interpreted as exact outvomes, but that parking norms has a significant effect on the size of the housing stock is a stable result.

Although a full pro-contra analysis or cost-benefit is beyond the scope of this paper, a few things could be mentioned. According to our interviews parking norms are really used as a second best-instrument instead of increasing parking fees, aiming at the same goals. An obvious welfare improvement would be to use the first best instrument, i.e. to raise parking fees. Meeting the demand at a low cost (for the car owner) leads to an overconsumption of car ownership, this would have been avoided if the market had been regulated with parking fees. An important point on parking norms is that they regulate construction of buildings, not the use of the buildings. By studying the amount of parking garages that had been remade to shops, offices etc. in Södermalm (a part of central Stockholm) (WSP, 2012) showed that parking norms has an approximate life span of 15-20 years in areas where parking spaces generates higher incomes in other uses.

A reasonable speculation is that parking norms are politically more pleasant since the costs for the public are not as obvious as for parking fees. Another motivation is probably that planners like to plan. There are obvious efficiency and environmental gains to be made by separating the housing and parking markets, but this might give planners a feeling of losing control.

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8 INTERVIEWEES

- David Hogell, Bjurfors, Malmö
- Anders Paulander, BoKlok
- Martin Johansson, BoKlok
- Mikael Augustsson, Fastighetsbyrån, Älvsjö/Skärholmen
- Anna Wiklund, Fastighetsbyrån, Farsta/Högdalen/Skogås
- Mikael Grans, Fastighetsbyrån, Solna
- Johan Berglund, Husman Hagberg, Malmö
- Per Björklind, Hyresgästföreningen Stockholm (The tenant association)
- Ewa Folkesson, MKB Fastighets AB
- Göran Eriksson, NCC
- Cecilia Önnevik, PEAB
- Joanna Berg, Riksbyggen
- Kerstin Ahlkvist, Trafikkontoret, Stockholm stad
- Erik Tedesjö, Trafikkontoret, Stockholm stad
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- Markus Henricson, WSP