The Planning Process
And
The Elasticity of Housing Supply

-A Theoretical Study of the Effects a Shorter Planning Process Will Have on The Supply of New Dwellings in Stockholm

MARTIN NILSSON-ÖST

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The planning process and the elasticity of supply

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Martin Nilsson-Öst

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KTH Industrial Engineering and Management
SE-100 44 STOCKHOLM

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Martin Nilsson-Öst

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Examiner
Kristina Nyström
Supervisor
Hans Lind

Abstract

This thesis will investigate the potential that a reduction of the duration of the municipality planning process will increase the production level of new dwellings in the Stockholm region. The planning processes are significantly longer in Sweden than in comparable countries, which could leave potential for a quite dramatic cut. The planning process will be quantified with a net present value approach which will help the thesis overcome some of the problems previous research have had in having reliable estimations of the costs a firm faces in the initial stages of a real estate project. The thesis finds that the more elastic the land market supply is the larger will the rightward shift be of the housing market supply function. However, this paper challenges some previous research that determines the elasticity of housing supply to be elastic, due to the events in the early 90´s it is likely that there have been systematic changes in the housing market characteristics, however further research is needed in this area of studies. The thesis finding are in line with previous research that if the elasticity of supply is smaller than infinity and the positive supply shock does not affect the demand side of the market, a rational market response would be to increase the quantity supply.

Key-words
Housing Supply, planning processes by the municipality, land use restrictions, elasticity of supply, net present value, positive supply shock.
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1 Introduction

1.1 Background

At the moment a debate is running in Sweden about the low level of activity in the construction market of new housing that is, the supply of new dwellings. The debate is certainly not a new one; it has continued/evolved over the past half century. Starting at the end of World War II Sweden has had problems coordinating the markets to take care of the housing supply. The period up until the 1990’s was characterized by vast public subsidiaries towards the housing industry, then in the beginning of the 90’s came an economic turmoil that hit Sweden and in its backlashes the subsidiaries towards the construction sector was phased out (Lundström and Lind, 2007) and (Lind, 2003).

However, the supply of new dwellings has not reached the same levels since - arguably for good reasons, based on the factors that were driving the construction up until then. In the last decade however a shortage of residential buildings once again has emerged and especially in the large cities the situation has become critical with Stockholm as the dominating example (Swedish Construction Federation, 2014) and (Lind, 2003).

From an economists or policy makers point of view, it is obvious why a “shortage”1 in the housing supply is an important problem to solve. If people have trouble to find a place to live in a region where a great fraction of new jobs are created mismatches will occur that puts constraints on the potential growth rates of the whole economy and even more troublesome, it generates unnecessary suffering and a welfare loss for the inhabitants. (Boverket, 2013)

In a report from Boverket2 and an additional report from the Swedish construction Federation, numbers show that Sweden has initiated significantly fewer dwellings that the other Nordic countries in the last decade (Boverket, 2012) and (Sveriges Byggindustrier, 2013). This in a time period were Sweden and Stockholm has faced a positive trend in housing prices and have seen strong net migration tells the story that something is holding back the supply of new dwellings in Stockholm and Sweden (ibid.). Over the years many potential constraints to the supply has been debated, and is still being debated.

The debates have covered: high construction costs, price ceilings in the rental market, lack of competition among construction firms, taxation issues, zoning constraints and the long planning processes needed to start new real estate projects. (Mattson-Linnala et al, 2013)

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1 In a market with no direct restriction upon it, as is the case for the non-rental housing market in Sweden, there can be no shortage as supply equals demand.
2 The Swedish authority for Urban Planning and Construction and Housing.
All of the subjects mentioned do impact the overall functionality of the construction market and thus the market framework of supply and/or demand. The debate is therefore good in nature since reforms in all of these subjects are needed in order to see a more efficient housing market in general. This, in turn, is essential in order for Sweden to achieve a better functioning market for housing and furthermore break the constraints on the economic growth the housing market currently puts on Sweden.

This thesis will choose to cover the problem that arises from having long planning processes when staring a new dwelling project. Sweden, in comparison to many other developed countries, faces long planning processes. For example, a typical planning process by the authorities in Germany takes only 4 months compared to the 2,5 years a similar process consumes in the Stockholm region. It is this observation that has initiated the public debate of the potential problem that comes along with time-consuming planning by local authorities. (NCC, 2012) and (Lagheim and Lindh, 2013)

The research frontier in housing supply at the moment is also emphasizing on the importance of land use policies when making the housing market adapt/react to an external shock (Murphy, 2010). With these facts in mind it is interesting to bring further insight to the Swedish housing supply and thus what can be expected if our planning processes in fact had the same duration as the German ones.

In the current debate the Swedish housing minister, Stefan Attefall, have put himself to a mission to get rid of the bottlenecks in the planning process in order for the construction to take off. It seems that the causality is taken for granted, that is:
- If just the planning processes were shorter the production or the supply of new dwellings would increase. (SvD, E-link)

That is a quite naïve position to take, in order to draw that conclusion the market/-s involved has to be thoroughly analysed, not just the housing market itself but the analysis also has to involve the market for land. Building on the framework worked out by Lind (2014) but with introducing a new/different way to find max land price, and introducing an other assumption that the extra gains will not just fall into the hands of the end customers but also the construction firm itself. This thesis, by analysing the elasticity of supply on the market for land and the housing market, could develop a solid argument and give further insight under which market assumptions the intended effect, of shorter planning processes, actually will be the case.
1.2 Research questions

What is the effect of shorter planning processes by the municipality on the supply of new dwellings in a city like Stockholm in terms of market output, market prices and input prices?

Will a shorter planning process by local authorities make room for an increased production level in the real estate sector?

Will the existing structure of the real estate sector in Stockholm allow for an increased level of construction? Or will the gains end up in increased margins for the actors in said market/-s?

1.3 Aim of study

The purpose of this paper is to create an understanding of the relationships involved in the construction sector. These relationships between actors are crucial in order to answer the research question stated above. There is no clear one-way relationship between a shorter planning process and a higher activity in the construction market; this paper is not implying that such one direction causality exists.

However, by analysing the elasticities of both supply and demand such an outcome could be the case. By making the rather radical assumption that the planning processes in Sweden could be downsized to the duration they currently have in Germany this thesis will analyse the effect such a large external shock could have on the level of activity in the Swedish construction sector, and thus try to bring further insight on this issue. This paper will make a thorough investigation of the latest research and how the results in these papers would affect the Swedish construction market. At the moment the study of Swedish housing supply is rather thin and in the studies found Sweden is just one piece of a larger studies in longitudinal data series of how elasticity of supply vary between countries, e.g. Sánchez and Johansson (2011). This is a gap this thesis will try to, at least partly, fill. As will be presented in chapter 3.0, theoretical framework, previous researchers have had problems quantify the gains/extra costs attributed to the planning process and to correctly include it in an econometrical model of housing supply. From Lind (2014) this thesis will create a dynamic model in order to analyse the relationships between planning process duration, elasticity of supply on the housing market and, input prices, and constructor revenues.

This model will allow for a deeper understanding of the internal relationships in the housing market thus push the research frontier forward and help policy makers adopt the right policies, or at least start reforming housing markets in the right end. Even though this thesis, later on, will take an example from the Stockholm market the dynamics presented will hold for any housing market thus making the insights presented possible to apply on housing markets outside of
Sweden as well. Thus the findings of this thesis can be regarded as a compliment to the previous econometrical research that has elaborated the correlations between land restrictions and planning process duration and the responsiveness of market output. This thesis will contribute with a quantitative estimate of the costs incurred in the initial stage of a construction project that the research presented in chapter 3.0 have had trouble getting a good estimate of.

1.4 Limitations

First of all the thesis will not in spend much time talking about the demand side of the construction market, and its elasticities, instead this function will be regarded as exogenous. As we all know the demand side is half of the market but the reasons for choosing this approach is that this thesis is focused on the planning process and the policy that affects this issue are unlikely to affect the demand side of the market and thus can be left as an exogenous factor (Paciorek, 2012). Also there are many papers written in this subject and this paper have nothing more to add to that discussion. Furthermore this approach is confirmed and backed up by study made by Glaeser and Gyourko (Glaeser and Gyourko, 2003).

As of recently a debate of the suggested poor productivity increases in the construction market have developed, that is the construction cost index has increased at a greater pace than overall costs, CPI, in the OECD area. Although being an interesting debate this thesis will not focus on what fraction of a price is actual costs of production and what fraction is a mark-up or profit. The reason is simple; those two parameters are hard to separate from each other and furthermore are irrelevant from a consumer perspective, what matters for a consumer is the market price not how the market combines prices and individual inputs of production. A relating subject to the previous one is worth mention, namely the efficiency of production or the construction time, in this thesis this time is held constant, thus it is assumed that all firms participating in this market - under given policies and regulations- is working efficiently. Without this assumption much of the analysis would fall apart since one then have to a priori assume inefficiencies in the production function and that better, more economically efficient, technologies are neglected by the industry.

Restrictions in land use do of course have some benefits to the society, with strict planning the inhabitants of the specific community have been provided with great tools that preserves their current local environment, which they in their turn based their housing investment decision a few time periods back, and any potential new projects will affect the price on incumbent families homes and also may change the “attractiveness“ of the local area. These effect will not be discussed further in this paper since it is assumed that the overall gain to the society will be greater than the suffering the incumbents will face thus making the policy shift Pareto efficient.

3 Interested readers can contact me for suggestions on well cited papers on housing demand
When this paper talk about low elasticity of market supply in the housing market that implies a steep supply curve, that is, a given change in P leads to a small change in Q. From a problem formulation that is based on a “shortage” of housing in a region that clearly is problematic. However the opposite which is a elastic supply curve is also problematic since resources in such a situation is more likely to get misallocated into housing, overbuilding, and thus creates false market signals to the population where to settle down (Glaeser et al. 2008). However from the background it should be clear that Stockholm at the moment does not suffer from overbuilding and thus this aspect of housing supply will not be covered in this paper but potential readers should be aware of the flip side of the discussion developed in this paper.

1.5 Structure

The structure of this thesis goes as follows, after the next section where some limitations is made in order to keep the thesis focused, section 2 will be devoted to the methodology, this section will discuss that by combining the framework in the paper by Lind (2014) and the empirical findings of previous researches both in the US and multinational studies a deeper understanding of the housing supply in Sweden could be made and thus make this paper able to answer research questions stated in 1.2. In chapter 3 this paper will present some findings of other researchers in this area of study. These finding will be of great value when later on the model is worked out and when the results are analysed. This is because this thesis will lack an empirical section of its own such estimates and findings have to be brought in from outside. Combined with the previous research this thesis will develop a theoretical framework, which will combine findings and model specifications from previous research with microeconomic theories and theories of business strategy.

With this done a two-staged model could be developed and be the tool by which the research question could be answered. The model will be two staged in that sense that the first stage will quantitify the external shock and the second part will use the microeconomic theories combined with the previous research to set up the market structure or environment in which the efficiency gain should be allocated where the dynamics can be captured in a partially equilibrium model. Based on that framework the dynamics of the model can be understood when the elasticity of supply alters. Next chapter 6 will introduce the reader to a specific project from which the gains will be calculated the results derived and the model applied to, this chapter will thus bring the different pieces developed in the paper so far together and generate a solid ground onto the subsequent analysis could be made.

Chapter 7 will analyse and discuss the dynamics of the model in the context of the specific market characteristics observed in Stockholm. This section will also merge the findings of other researchers presented in chapter 3 with the findings of this paper and thereby be able to present an answer to the research question.
stated in the beginning of this paper. Furthermore the chapter will problematize the assumptions made about the elasticity of supply, exogenous and constant demand, these assumptions will be discussed and how realistic the various assumptions are and what the effects would be if they were to be relaxed. The paper will wrap up in a conclusion and suggestions on potential further research.
2 Methodology

In this chapter the methodology will be presented and also how the data used in the empirical examples presented in chapter 6 was collected. The chapter will then continue to discuss the validity and reliability of the data collected and ends up in a discussion about potential drawbacks of the framework used in this paper.

2.1 Theory development

The first part of the research question can be sufficiently answered by using the framework put in place by Lind (2014) and examinations of the partial equilibrium model derived later on. Thus the net present value calculation will be the means by which the external supply shock will be quantified which then could be put into a market framework that in turn will help the author to determine the dynamics of the housing market and thereby lay the foundation for a valid answer to the first research question. The approach used will also serve as a compliment to the econometric results derived in this field of study some of which will be presented in chapter 3, this thesis will also use the findings in those papers in order to sufficiently answer the second part of the research question.

By applying the model to the mean data, which have been collected and revised in collaboration business insights (Veidekke Bostad) and renowned academics, (Hans Lind) and official statistics (Statistics Sweden) and (Swedish Construction Federation). In order to correctly estimate the size of the freed resources reliable data on project duration, costs, revenues and discount rates have to be collected. Putting these parameters into a net present value formula and evaluate the numbers and assumptions made will generate the robust value needed. From those estimates an empirical example will be used to concretize the model and increase the understanding of how the market dynamics works on the housing- and land market. With a robust quantitative (positive) number derived the thesis can proceed to analyse the total sector to which the economic gains will be available. As the hypothesis is stated a reduction in the planning process will lead to a higher level of construction activity.

In order to confirm the research question a theoretical economic partial equilibrium model has to be developed. Such a model can be derived using theories and assumptions made by previous researchers in this area of study and then apply these to the Swedish market conditions. However, a positive external shock will only satisfy the hypothesis if some of it transfers into an increased activity on the construction market i.e. increased production of condominiums. In order for that to occur the market supply cannot be totally inelastic.

Hence the parameter of ultimate interest for these examinations will be the elasticity of supply, by examining the elasticity of supply, $\varepsilon_s$, this paper will try to resolve how much of the initial shock will transfer as a change in price and how much will end up as a change in quantity supplied. By creating an understanding of the dynamics of the $\varepsilon_s$ the second part of the research question
can be fulfilled and the aim of the study, to generate a deeper understanding of the market characteristics in the construction market and how an external positive supply shock will affect the market, can be reached. This will also mean investigating how and if the supply shock itself will alter the supply curve, that is will a shorter planning process have effects on the housing market elasticity of supply.

To be able to receive reliable estimations of the elasticity of supply and increase the validity of the results a thorough investigation of the previous research made in this area of research has to be made. This will include the input market of land since that market, because of its characteristics and lack of substitutes to a great extent will determine the allocation of the economic gains created from the exogenous supply shock. Without a larger supply of inputs - i.e. land - higher returns on investments (ROI) generated by the larger NPV will just lead to a situation where the inputs gets more expensive when there is a higher demand for them.

This framework will allow the thesis to answer the main research question stated in section 1.2 and also the sub-questions that are focused on the market dynamics and the important role it plays in order to determine where the post shock equilibrium are likely to take place.

2.2 Reliability of data and validity of results

The size of the cash flows used in the first stage of the model developed in chapter 5.0, the NPV calculations, are personal mean estimates of the initial cost, land cost, construction cost and revenue. In order to validate the data private actor in the construction market in Stockholm, Veidekke bostad, has confirmed that the estimates are within reason. In order to further validate the numbers the author has been in contact with a well-cited academic in the area of housing economics, Hans Lind. Boverket in a report from 2014 derives at somewhat the same the relative sizes of the different costs incorporated in a housing project (Boverket, 2014b). The 5% decrease made in construction costs after the planning process is reduced is based on the paper written by Lind in 2014 where a variation of such a discount is used. However, the quantitative results in this section will rely on the accuracy of these estimates, or at least the relative size between them.

That said, the author hereby emphasize that the purpose of this thesis in not to quantify the true economic gain in reducing municipality planning process in the Stockholm area per se but rather to widen the public debate to include the correlation/causality problem of a reduction of the Swedish planning processes. Thus in this paper the calculations is the means that assists the author to

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4 Of course the specific values are company secrets so the estimates are suggestions which then has been confirmed to be “within reason” to the true values.
estimate the initial shock in the construction market from which the market analysis then can derive.

Continue to the other parameters included in the NPV calculations. As was stated before - prices used in this project will be assumed to follow the inflation and thus are in real terms. This also means that a real interest rate is being used more specific the real annual discount rate used will be 5%\(^5\) (equal to a nominal yield of 7%). This interest rate is chosen taking into account the low interest environment of today that shows no intention to be revised upwards dramatically in the near future due to the current regimes of both the Swedish central bank and the large international central banks (Sveriges Riksbank, 2014). The typical project is also considered to be of limited risks i.e. a condominium building in a semi-attractive/-central area in the expansive Stockholm region.

The estimations of the planning processes in Sweden and Germany have been collected from mean estimates made by Stadsbyggnadsbenchen in the case of Sweden and NCC for the German mean estimates (Lagheim and Lindh, 2013) and (NCC, 2012). The estimate of the construction time, 12 months, is a standard estimate used by previous researchers e.g. Lind (2014).

### 2.3 Drawbacks of the NPV-model

As was discussed in the previous section my results presented in chapter 6 will rely on the significance of the parameter estimates presented above. However, the absolute size of the cash flows are not crucial for the results but rather the relative size of them, and to a report from Boverket where they have collected and analysed data from Statistics Sweden supports the relative sizes used in this thesis (Boverket, 2014b). Another shortcoming is that this thesis, as in Lind (2014) will not estimate a elasticity of supply of its own, but rather find corner solutions and then elaborate with exogenous estimates of \(\varepsilon\) in order to find the dynamics of the role planning processes have in determining the yearly increase in market output on the housing market. But if combining the results and conclusions with reliable local estimates of \(\varepsilon\) received from econometrical models a solid foundation for balanced housing policies by authorities is made. Lind (2014) is making an assumption that all efficiency gains is allocated to the customers in the housing market, showed in a decrease of the market price, this thesis however will make another assumption that the gains are divided between the construction firms and the end customers, the revenue term in eq. 2 is kept constant in my scenario and in Lind (2014) the NPV is kept constant. The thesis will come back to discuss the implication in this assumption in chapter 7.

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\(^5\) 5 % annual yield = \((1,05^{(1/12)}) - 1\ = 0,407\%\) in monthly yield
3 Theoretical framework and previous research

This paper seeks to increase the understanding of the effects a shorter planning process will have on the Swedish construction market. The framework from which such an analysis is going to be made will rest on the conclusions and insights made from previous research in the area of housing supply. Thus this chapter will cumulatively develop such a framework while the findings of previous researchers are presented.

There has been numerous papers written about the housing market but until recently most of them has focused on the demand side of the market e.g. Sinai (2012), Walden (1988) and DiPasquale and Wheaton, (1994). However in the last decades some important steps have been taken that explains the characteristics of the market supply as well in establishing fundamentals in the relationship between price and quantity supplied, some of which will present in this section. A majority of the previous research have been made on the American market due to the simplicity and more straightforward approach to compare the results between states in the US, compared to the inter-nation studies done by the OECD, there are more variables not being constant when making comparisons between sovereign nations thus making the validity of the estimates lower. Despite these shortcomings this section will also include a study made by the OECD, because its tries to estimate the constraints planning and land use regulation puts on the Swedish construction market. Finally some papers focusing entirely on the Swedish housing and construction market will be presented.

3.1 Housing market

3.1.1 Housing demand

Even though the demand function of housing will be exogenous in this paper and thus will be held constant a short description of its characteristics and the parameters it consists of are in place. The assumption that the demand can be viewed as exogenous is valid since there is no clear theoretical relationship between a reduction in production costs and the market demand (Paciorek, 2012).

Ultimately the demand for housing is determined by the income level of the households, and the cost of housing facing those customers e.g. interest rates, taxation, depreciation and capital gains. Another parameter of interest is demographics, that is the fraction of the population that can purchase a home and how many persons the typical household contains (DiPasquale and Wheaton, 1994), the latter parameter is assumed to be constant over the foreseeable future but can alter over time, which have occurred in Stockholm over the last decades (Gölin, 2011). These parameters transfer into a total
demand and given the number of dwellings available (the stock of dwellings), which is fixed in a given time period, assuming it takes one period to produce new dwellings. Thus market price at time $t$ can only be set if the current rental price for dwellings shifts. These assumptions aggregates into a demand curve for dwellings that in all $t_i$ is negatively sloped.

### 3.1.2 Housing supply

Case and Shiller write one of the first papers written in the subject of interest for this thesis in 1989. That paper stated that the presence of transaction costs, combined with the difficulties of short-selling the product (i.e. dwellings), will allow the price of housing to diverge from equilibrium. Observed in the great volatility of housing prices, from the “true” price derived from fundamentals. Case and Shiller used data from houses sold several times over the time period observed, and applied a three-step GLS model. They found that a shock in the city-level price index was transferred into the next periods, which were not explained by market (demand side) fundamentals, these findings were used to support their theory of pricing bubbles, and the frequency in which they seem to occur, in the housing market (Case & Shiller, 1989). Transferring their findings to this thesis they found out that price is the variable that equilibrates the housing market, making it fluctuate a lot over time without any response in supplied quantity, that is a hint that market supply is quite inelastic.

As an extension of these arguments DiPasquale and Wheaton in their paper they recognized that housing passes characteristics of both an investment and a consumption good a fact that has implications in the consumers preferences in how to optimize their bundle of goods consumed under a budget restriction. Housing characteristics such as a long production time and a low rate of depreciation makes the stock of housing adjust slowly to changes in demand, this has the implication that in order for the market to clear, as it ultimately has to, the price is the parameter that catalyses any market shock in the short run. The individual consumer is also constrained by search- and transaction costs that makes it hard for the consumers to quickly adjust their consumption of housing after new information is incorporated in the market price. This, DiPasquale and Wheaton argue, have the natural effect that the supply curve becomes rather steep - a given price increase will not change the market supply all that much.

In a paper by Paciorek (2012) a simple model of the market supply is developed. The model states that if the aggregated supply of dwellings is fixed at a given time period and constructing new dwellings takes one period the price on which developers base their investment decisions is the expected price one period ahead, $E(P_{t+1})$ and furthermore the profit made from the last house produced must equal zero, that is $C(L_t)= E(P_{t+1})$ if not the market will not be in steady state (Paciorek, 2012). In this kind of model long planning process will force developers to forecast further into the future, $E(P_{t+1})$, which makes the estimate more unreliable leading to a less responsive supply function to a given demand.

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6 $P_{t+1} = C_t + H_t + N_{t+1}$, where $P$ is the price house $t$ sold for at time $t$, $C$ is a citywide price level, $H$ is a random walk parameter and $N$ is the error-term (iid-distributed)
shock. Another way of phrasing the same thing is that price/rental cost in time $t$ will be less correlated with the expected price in time $t+1$. Making the supply function steeper and the return to long-run equilibrium (steady prices) is slower (ibid).

As this simple supply framework states some fundamentals of the housing market makes the market supply relatively inelastic compared to other markets, but in order to make this analysis complete this paper has to determine where the lack of flexibility derives from. Based on the econometrical studies in Paciorek (2012) and Glaeser (2003) a great fraction of the price volatility of housing can be explained by the restrictions man has put on land use, as will be presented later in this chapter.

Economic theory states that unlike other markets, that require capital and labour as inputs in their production functions, construction also requires the land on which the dwelling is built. Land is in some sense fixed in supply, not meaning that it is scarce in absolute terms. But some land lots are in fact more desirable than others from an developers perspective, and since the land owner and the developer (of a multi-apartment building) rarely is the same person. The strong heterogeneity between different units of land creates transaction costs that reduce the liquidity in the construction market that partly explains the troubles of short selling that was covered by Case and Shiller (1989). This in exemplified by the notation that the landowner and the developer in the majority of the real estate development projects in Stockholm is not the same agent, in Stockholm municipality about 70% of the land is owned by the municipality itself (Caesar et al, 2013).

The land market per se does not have a marginal cost which determine its market price instead the market price is determined by opportunity costs and theories of economic rent (Varian, 2006), the theories states that the agent who can extract the most value from a given piece of land have the highest valuation of any specific land lot and thus market forces will act and give that agent the land lot in exchange for his valuation/price.

This theory assumes a perfectly competitive market, which among other things implies perfect information and no transaction costs, a situation where supply is totally elastic or horizontal. Although such conditions never fully can be fulfilled it will serve as an “extreme” outcome and thus can be used as a limit from which the analysis can be based upon. At the other “extreme” land supply would be perfectly inelastic, i.e. a vertical supply curve. In such a situation due to the fixed amount of land, in absolute terms, all land is currently allocated at its best use and no matter how high real estate developers value a certain land lot current owner will value it higher and thus no more land will be devoted to housing, and an external positive shock in demand would be reflected by a increase in house prices. This situation is unrealistic but like the previous example will serve as a limit upon which the analysis to come can be based.
3.2 Origin of the supply restrictions

The limits on the elasticity of supply can according to Glaeser and co-authors (Glaeser and Gyourko 2003) and (Glaeser, Gyourko and Saiz 2008) be derived from constraints of potential land onto which new buildings can be developed. In the 2003 paper Glaeser and Gyourko wrote they based their model on the findings of Case and Shiller (1989) made about housing bubble theories, what Case and Schiller did was that they shifted the focus to constraints on the supply side in order to fully understand the great volatilities of house prices observed.

Together with two other economists, Joseph Gyourko and Albert Saiz, Glaeser published a paper in 2008 in which they concluded, like Case and Shiller (1989), that fundamentals does not explain all the observed variation in housing prices. Thus, they argue, some of the theories developed in financial economics about over optimism and bubbles can be applied to the housing market (Glaeser et al., 2008). However they argue that bubbles, i.e. sharp price increases not explained by market fundamentals, are more likely to exist in a situation where the supply is fixed or strictly constrained that is local markets where the supply function is vertical or very steep. Glaeser et al, (2008) captured the land restrictions by an index called: Wharton Residential Land Use Regulation Index, WRLURI\(^7\), which among other things included a survey answered by municipality officials, measures of financial constraints and other zoning regulation.

They argue that unlike other asset markets where the supply was assumed to be fixed or controlled by authorities, i.e. exogenous, the supply of housing like DiPasquale and Wheaton (1994) have argued is constrained by lags in production and through land use regulations but not fixed - there is new objects added to the market at any time period. Thus they developed a model where housing supply was made endogenous, new housing is continuously supplied to the market in response to price increases, they then concluded that house prices should increase more during bubbles - an exogenous demand shock - in places where the supply is more inelastic and in those areas it should be more common to find a longer duration of the price increases. Regions with more elastic supply however would not see continuous price increases due to the response in supply, hence, they argue, the latter regions could avoid price bubble in housing altogether. (Glaeser et al, 2008)

\(^7\) Developed by Joseph Gyourko, Albert Saiz, and Anita Summers (2006). The WRLURI index combines a series of indexes of construction input factors that origins from legislation in land use to aggregate into a single measure of regulatory constraints on real estate development that allows area to be ranked by their degree of control over the land use environment.
3.2.1 Zoning restrictions and delays

Glaeser and Gyourko (2003) made an approach to find out from where in the supply the non-fundamental fluctuations origin. They argue that a high price on dwellings must origin from a high demand for dwellings itself but also from restrictions in supply. Furthermore they argue that studies have shown that the elasticity of houses, cost of capital and labour, is almost perfectly elastic so the restrictions must come from a third input namely restrictions in land itself.

Glaeser and Gyourko (2003) states two hypotheses which both states that the origin was the limited supply of land. However the two hypotheses differed in how land constrained the supply of new dwellings. Their first hypothesis states that land per se around a city is limited and thus creates constrain on construction. In the second hypothesis they state that land is actually fairly abundant but man made regulation or zoning restrictions limits land use and is responsible for the inelastic supply of houses.

Glaeser and Gyourko (2003) divides the US into three different regions\(^8\). In regions with no growing income, with or without land use restrictions, they find that fundamentals (price equals marginal cost) explained most of the observed variation in price. However in region 2 and 3, which are growing states with or without strict land use regulations they found that states that had imposed more strict regulation in land use also had seen prices diverged from the marginal cost.

\[
\frac{\partial p(L,B)}{\partial B} = \frac{dp}{dB}L + \frac{dT}{dB} \tag{Eq.1}
\]

Equation 1 states that the derivative of the price of a house\(^9\) with respect to specific local amenities will tell the relative importance of the price of land itself \((p)\) and the zoning policy \((T)\). The authors also performed a survey where the time for a developer to receive a building permit was asked and coded into five categories (time intervals)\(^10\). After performing econometric testing they leaned against the latter hypothesis to be of most importance in explaining the variations in price of a house with given characteristics, i.e. the term including the zoning regulation-term, \((\frac{dT}{dB})\), is far larger than the term including land price, \((\frac{dp}{dB}L)\). From the regression of the survey results they concluded that an increase of one unit in the time it takes of receiving a building permit would

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\(^8\) Non-growth, growing - but with limited zoning restrictions and a third region which contained growing states that also possessed greater restrictions in land use.

\(^9\) The price of a home containing L units of land is a function of: construction costs \((K)\), Zoning & restriction \((T)\), and local amenities \((B)\). However is assumed to be location independent, which gives that the derivative will tell the relative importance of land itself \((p)\) and the regulatory effect \((T)\)

\(^10\) 1: \(<3\) months, 2: \(3\) months \(< x \) \(< 6\) months, 3: \(7\) months \(< x \) \(< 12\) months, 4: \(1\) year \(< x \) \(< 2\) years, 5: \(x > 2\) years
increase price increase by 7$/sq. foot.

In a paper from 2005, the same authors further investigated the impact of zoning and/or land use restriction in housing prices and the supply of housing (Glaeser and Gyourko, 2005). This paper, in line with their 2003 findings, introduced a kinked supply curve where the supply was elastic in regions facing economic growth and where P > MC but they also stated that restriction in land use will make the supply curve less elastic. Another interesting finding is that in contraction regions P<MC due to the argument of low depreciation-rate of dwellings, first put forward by DiPasquale and Wheaton (1994), new housing investment is highly elastic but the stock of housing is inelastic in price.

Paciorek (2012) by using supply variable of density\textsuperscript{11} and a updated version of the WRLURI index used in Glaeser et al, 2008 captures the relative stiffness in the land use. With the density parameter, the WRLURI and a third factor that could capture land use restrictions, namely, the delays of getting a permit. The third factor is measured with the Approval Delay Index (ADI) where the delays was sorted out and made an explanatory variable of its own, Paciorek (2012) states that the index may well underestimate the total delays since the process may start long before the official inquiry was sent to authorities.

The density variable/ratio should capture the degree to which an area(city is developed, if cost rises as the metropolitan are “filled up” (due to available land gets more expensive or that the outside option gets more valuable). However, since most regions (included in the study) the stock of housing is 5% of total land and the shifts are likely to be gradually - the flow of new housing is small relative to the stock of housing. Most of the rapid changes in housing investments captured will be attributed to price (Paciorek, 2012). However the density effect will be important to include when observing housing market characteristics over a long time period. The index of land use control excluding the permit delay index will capture cost shifting factors imposed by local governments (other than permit delays) e.g. density restrictions and open space requirements. The delay variable will correspond to an increase in the time between initiating a project until the projects gets a building permit thus making the correlation between Pt,j and E(P_{t+1,j}) lower and increase the forecast error. Both these variables will cause costs to rise faster in regulated areas as housing investments increases (ibid.).\textsuperscript{12}

Paciorek finds that a city with average delays in permits and other restrictions will have and elasticity of supply of 1.72, while a one standard deviation increase in delays and other regulation will decrease $\varepsilon_s$ by 0.37 and 0.15 respectively (ibid.) while an increase of investments by 1 percent increases MC by 0.34 and a one standard deviation increase in delays and other regulation increases this effect by 0.07 and 0.03 percent respectively. Another finding is that the

\textsuperscript{11} The density measure used is the same as was used in Glaeser, Gyourko and Saiz (2008) which is the amount of buildable land in a radius from the region economic centre subtracted areas >15% slope and the divided by the number of housing units in Manhattan (an area with especially high density in housing and thus a good benchmark for when a area is considered “filled up” (Paciorek, 2012, p.16-17))

\textsuperscript{12} The indices are standardized to have a mean of 0 and a standard deviation of 1 (Paciorek, 2012, p.29).
magnitude of the density parameter seems to be decreasing in delays but at the same time have a larger increase (relative to delays) in other forms of regulation, i.e. the WRLURI index excluding the sub-index of delays. This leads to the result that cities seem to “fill up” more quickly when the regulatory pressure is high, but if there is only a long bureaucratic procedures (long delays to receive a permit) this is not enough to constrain new housing supply. A city with substantially longer delays such as San Francisco (six months above mean) will double the price level for each 14 percent increase in new housing investments and in a highly regulated city like Boston housing regulation alone (both indices combined) will explain 1/10 of the total house price. In equilibrium households are not prepared to buy at such high price levels, which reflects, in a lower investment in such regions (ibid.).

One final quantitative finding in Paciorek (2012) is that as investment increases by sample average, cities with higher regulation either via delays or other regulation have substantially higher marginal costs on housing (8% vs. 11%). But due to higher prices to begin with in the regulated areas the real dollar value of this increase is tremendous. E.g. a city with elastic supply like Atlanta (εs=2,4) the increase in new housing investments corresponds to 13,000 USD but for highly regulated cities like New York (εs=1,7) or San Francisco (εs=1,7) the 11 percent increase corresponds to 26,000 and 52,000 USD respectively in prices for housing. The natural response of landowners and developers facing these higher marginal costs is to reduce their “investments increases” responding to demand-driven price increases like demographic changes, population growth and/or migration (ibid).

Paciorek’s paper (2012) uses panel data analysis with a dynamic model (AR1 process) by using site-specific variables the model controls for heterogeneity in land use strictness polices making a cross country estimate of market supply possible. The paper finds out that when the marginal cost is higher or the duration of building permits is longer supply gets more inelastic and the investment response (the error correction) is lessened, which makes the return to the steady state longer. Although land use regulation is complex institutions his paper argues that much of the difference in volatility of house prices between highly regulated and more unregulated cities can be explained by observed regulation policies, assuming no inter-city migration and identical demand shock.

Glaeser and Gyourko (2003) also lean in this direction that the constraints in residential development is explained not by the scarcity of buildable land surrounding a city but rather to the zoning restriction out on the land by public policies. Furthermore Glaeser et al. (2008) study the elasticity of supply and to which extent it can be traced back to availability of buildable land they used the same index as Paciorek (WRLURI) used a few years later. However their study also used a geographical satellite pictures and a software that calculated the fraction of land within a 50km radius from the centre of a metropolitan area with

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13 However, this effect is partly from the fact that a city like Boston, because of the high housing regulation in the fist place, has higher house prices.
<15 degree slope\textsuperscript{14} and adding any potential oceans and rivers. This value will be used as a proxy of land use limitations. Their study found that this geographical proxy and the WRLURI-index were strongly correlated (negatively) and thus the answers were similar and both confirmed that the variations in the price volatility observed between different metropolitan areas in the US can be explained by restrictions in land use (geographical or policy).

Paciorek (2012) estimates a supply function for American cities, one of the parameters included in his model is the regulation of land use. From the results a comparison between two regions (San Francisco and Atlanta) confirmed the theory in Glaeser and Gyourko (2003) that regulating land use (ceteris paribus) will increase the price of housing. Paciorek (2012) also includes the market power landowners possess by making the supply of land rely on the landowners willingness to sell/develop a given parcel, thus introducing expectations about future prices to capture the long production time when producing dwellings. Thus the model basically dwindles down to a microeconomic optimization problem, where landowners optimize their investment decisions based on construction costs, expectations of future price and local regulation of land use.

\subsection{3.2.2 Time optimizing and pro cyclical costs}

Like Paciorek (2012), Murphy (2010) develops a dynamic model (AR1) where he focuses more on micro-foundations and individual parcel-owners profit optimizing decisions, the timing, when to develop a real estate. The study takes place in the San Francisco bay area, an area facing high regulatory constraints on land use, and only contained construction of single-family houses.

In the model Murphy (2010) regress the observed sales price against the size of the house and the land lot and a dummy variable indicating if the house is a first time sale or not. He finds out two interesting facts. First, not surprisingly, he finds evidence for strong heterogeneity both across municipalities and time. More interestingly though, is that he finds a decreasing importance of house size in determine the house price. For example; although the price of a house increased by 50\% over the years the marginal cost of an additional square foot of housing was roughly the same, which made him think that the value of buildable parcels is a dominant factor in determine the market price for housing (Murphy, 2010).

Murphy (2010) also highlights the importance of costs, more specifically; the expectations of pro-cyclical costs\textsuperscript{15}, in determine the activity on the construction market. Without the expectations of pro-cyclical costs, developers only focusing

\textsuperscript{14} Land which have a slope greater than 15 degrees are very hard to build upon (Glaeser et al. 2008 p.22)

\textsuperscript{15} Pro-cyclical costs: Costs follow the cyclical pattern - the fluctuations of economic growth. This means that the costs will be high I periods of high economic activity and low in periods of low economic activity
on price, a model would predict the volatility in produced units ($Q_S$) too high. Hence the presence of pro-cyclical cost patterns makes the industry supply more volatile regarding market prices on the finished product than would be the case if landowners did not have adaptive expectations. Murphy's longitudinal model used fixed effects framework and comparing this coefficient across regions, in a cross sectional dimension, will capture the physical costs that do not vary with house size. And thus, given that constructions costs is fixed across regions, these fixed effects will capture the variation in costs that derives from variation in regulation between the regions in the study. Murphy (2010) then regress (OLS) these fixed effects on demographic and housing characteristics to see what factors explain this observed variation in housing regulation. Murphy finds that this regulatory factor is higher in areas where house prices are high and in areas where the houses are older. Murphy also finds that the regulation effect is higher in areas where average income level is lower and in areas where the fraction of home ownership is high (Murphy, 2010). These findings would imply that the existing residents in an area are in fact blocking development and decreasing the elasticity of supply on the housing market and thereby increase the price level on already developed houses. Murphy (2010) emphasises that these regressions are in fact more suggestive than tests for whether incumbent households in fact are blocking new development.

Murphy (2010), also observes how the regulatory costs vary over time, he finds (like in the case of the variable costs) that the fixed effects are pro-cyclical, and that this could be explained with the fact that either contractors in boom periods are harder/more expensive to hire, or that the fixed effects parameter captures the probability that a parcel will not be granted a permit, and this probability is likely to be higher in periods where the demand for permits is high. This implies that more restrictions besides increasing overall price of housing also makes prices more pro-cyclical but decreases production volatility, if parcel owners are forward-looking with respect to prices they try to delay construction until a peak in prices.

### 3.3 Time series models

An OECD report published in 2011 "The price responsiveness of housing supply in OECD countries" written by Sánchez and Johansson made cross country comparisons of the elasticity of supply (long-run and short-run) using data

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16 If physical and regulatory costs are positively correlated the construction cost difference in the fixed cost parameter can be interpreted as the upper bounds on the difference in regulation across regions in the San Francisco-bay area.

17 Murphy emphasize that these findings are suggestive and he mentions that the regions are large so they will inhibit considerable heterogeneity in region characteristics and construction level within each region

18 This probability will vary across regions

19 This thesis will address the long-run elasticity exclusively throughout this paper, since it determines the long-run relationship between price increases and the latter response of the construction market whether the short-run elasticity measures the yearly error correction towards the long run equilibrium or trend.
between 1980’s and the mid 2000’s (varying substantially between countries) in which they found that in markets that suffered from constraints from zoning the adjustment to clear the market has to be made by the market price rather than quantity supplied resulting in a more inelastic supply curve. Sánchez and Johansson (2011), also find that the speed in which new investments close the gap to equilibrium lies within the interval 20 - 100% of the gap within one year - i.e. the short run elasticity. An unresponsive elasticity of supply, they argue, increases the volatility of housing prices due to demand shocks and thus also influences the consumption habits and residential investments.

The long-run elasticity of supply was estimated separately for the 21 countries, with a similar approach (error correction framework) that was conducted by Wheaton et al. (2014), see below. The data according to this OECD report suggest the elasticity of supply in the Nordic countries including Sweden is argued to be quite high ($\varepsilon_s=1.38$) compared to other countries included. For example Germany has a $\varepsilon_s=0.43$ and Switzerland $\varepsilon_s$ is estimated even lower at 0.15 this would imply that in a response to a demand shock housing output would increase more in relation to prices in Sweden (Sánchez & Johansson, 2011). Although the model of the OECD report like the model used by Wheaton et al, 2014, does not contain a variable for land restrictions Sánchez and Johansson (2011) present suggestive evidence that cumbersome planning regulation are associated with a smaller elasticity of supply. For example the paper lets the reader know that a simple correlation matrix show that the elasticity of supply is lower in countries that are more densely populated, a similar correlation is found on the city level in the US by Green et al. (2005) a study that the authors of this OECD report also refer to. Furthermore the study also presents a correlation between housing supply responsiveness and the number of days is takes to receive a building permit in the countries included in the study and they see that a longer duration is accompanied with a lower responsiveness. An index including US cities developed by Malpezzi (1996) shows the same result.

Wheaton, Chervacidze and Nechayev (2014) have raised another potential problem with the longitudinal models used in previous research namely the lack of tests to confirm that the time series in fact follow stationary process. Their study takes on a different approach since they use a time series set up for 68 different metropolitan areas starting from 1980 and then comparing the results between the individual regressions instead of using a panel data model where all regions are within the same model.

Wheaton et al (2014) find that the time series used (quarterly prices and building permits) are not stationary in level form but in first difference. However they found that the series combined showed a pattern of co-integration and thus an Error correction model could be applied to the dataset and thus both a long-term (10 years) and a short-term elasticity of supply could be scattered for the 68 regions. Wheaton et al (2014) found that the land use restrictions, whether  

\footnote{Data is collected from the World banks Doing Business (2009) indicators, and the delay to receive a permit is based on the time, costs and number of procedures to receive a permit for a warehouse in the largest economic region (in Sweden - Stockholm)
they were the index measuring land use restrictions, WRLURI, or the geographical constraints developed by Saiz and used in his paper with Glaeser and Gyourko in 2008. They, to a large extent, explained the observed fluctuations in house prices across the cities. By comparing the estimated elasticities the authors can reject that the elasticity of supply is scale dependent, if the city framework is mono-centric, that is a larger city is not correlated with a lower elasticity of supply.

Lind (2003) published a report about the Swedish housing market. The report show large price fluctuations on the Swedish market in the time period between 1985-2002 a period that also contained large swings in the activity on the construction market, great variation in the quantity supplied. However, at the end of that time period the great increase in prices for dwellings has not been followed by an increase in quantity supplied. Lind (2003) then isolates and highlights the parameters that according to him and his previous research determines the supply side of the housing market: the availability of buildable land, public regulations/bureaucratic processes and the market structure of the construction sector. Lind argues that the equilibrium on the market is a state in which different flows cancel each other out; investment in new buildings that makes the housing stock larger is exactly met by the increased demand from a growing population etc. Lind, 2003, then argues that on a well-functioned market the flexibility of the supply should be high, an argument also made by Glaeser and Gyourko in their paper from 2005.

### 3.4 Planning process costs with a NPV approach

The research presented so far has contributed land use regulations to explain a great deal of the observed variations in price volatility in different regions. However, it is hard to quantify land regulation, which some of the authors also mention in their work, however Lind (2014) has developed a framework where the profits of a typical project is calculated using a net present value (NPV) approach. In such a model the land restrictions and the value of the land use policies is reflected by a longer total duration of a project. This approach will overcome many of the problems previous researchers had had in collecting good/reliable estimates of the extra planning costs land use restrictions puts on a housing project and the quantitative gain is estimated by keeping the NPV constant as $t$ is reduced. Lind (2014) then goes on and tests the robustness of the results, the potential price reduction, by varying the discount rate and the different future cash flows.

Lind (2014) find that revenue is positively correlated with efficiency gains, a larger revenue cash flow will occur in a closer future thus making the efficiency gains larger. If costs were to be larger it would have a positive impact on the size of the efficiency gains, due to the fact that the more resources already put in to a project, the more will the gain be if the project could be finished earlier. If interest is higher the gains by the reduction of a shorter planning process are proportional to the increase of the discount rate. If the return on investments
were to be reduced due to the reduction of project duration, the revenue - market price today- has to be reduced in order for the NPV to be fixed.

3.5 Problems of interpreting equilibrium estimates

An important problem that the literature has highlighted is the endogeneity problem that derives from the fact that prices are set in equilibrium and thus the error terms of the supply-curve will be correlated with the error term of the demand curve. This will result that a given external shock in supply will also shift the demand and vice versa, making the coefficient estimates, the elasticities, biased. If the endogeneity problem is considered to be severe, as these papers do suggest, taking instrument variables - which is done for in market demand variables, will solve the problem of endogenous variables (Cameron and Trivedi, 2010). From theory we know that a good instrument is correlated with the endogenous explanatory variable but not with the error term. However, if the correlation between the instrumental- and the endogenous variable is not the best this will cause the standard deviations of the instrumented variable to increase, thus making the overall estimate more inaccurate. (ibid.)

This is problematic for this thesis since it will need a good estimate of the elasticity of supply and larger standard deviations are equivalent with a larger interval in which the true value can be found, which make a model based on mean calculations more inaccurate.

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21 For example: Glaeser & Gyourko (2003), Paciorek (2012) and Murphy (2010).
4 Development of housing supply

This chapter will contain historical data/time series of how prices and market output has developed over the years. The chapter will start by presenting data from the Nordic counties and the zoom in into first the Swedish market and then finally the local Stockholm housing market.

4.1 Housing market in the Nordic countries

Figure 1 presents time series of apartments initiated per 1000 inhabitants in the Nordic countries (Boverket, 2014a). Looking at figure 1, it is clear that Sweden has initiated fewer apartments per thousand inhabitants than other comparable countries, except Denmark after the great recession and that the time series shows no tendency to increase. Boverket (2014a) makes one distinct observation is that in 2012 the housing investments as a fraction to GDP were twice as high in Finland compared to Sweden but Finland has also seen a larger increase in real house prices, 215 compared to 170 in a index where 1980 is the base year. Boverket finds that Sweden initiate fewer apartments per each new inhabitant as well (ibid.).

Boverket (ibid.), in their report of the situation in the Nordic housing markets concludes that the housing investments were on high levels in the 80’s, even in an international context, with a peak just before the crisis in the early 90’s. During this time the prices of dwellings were quite stable in real terms, a time period where Sweden suffered from a high inflationary environment, the prices didn’t seem to take off until the late 90’s, some years after the Swedish economy had started to recover from the turmoil. However, the difference from the pre-crisis environment on the Swedish housing market is that the quantity supply has not responded to the price increases at the same magnitude it commonly did the time before 1990.

Figure 1 - Number of initiated apartments* per 1000 inhabitants in the Nordics 2000-2012

*The foundation of the dwelling is finished, and single-family homes are excluded (Source: Boverket, 2014a)
4.2 Swedish housing market

Figure 2 confirms the method of measuring the planning process by the delays in receiving a permit used in previous research, e.g. Paciorek (2012) and Sánchez and Johansson (2011) the two series are clearly following the same pattern which makes permits a good proxy for new housing investments in the Swedish market for multi-apartment buildings.

Figure 2 - Initiated multi-apartment houses* and multi-apartment permits granted

*The foundation of the dwelling is finished, and single-family homes are excluded

** Multi apartment houses

(Source: Swedish construction Federation)

Looking at figure 3 below one can confirm the observations of e.g. Murphy (2010) and DiPasquale and Wheaton (1994) that investment in housing is procyclical. The change in initiated dwellings, or put differently, the change of the flow of dwellings according to the pink line in figure 3, clearly follows the swings in GDP growth, represented by the blue columns in figure 3.

Figure 3 - GDP and started housing projects*

*The foundation of the dwelling is finished, and single-family homes are not excluded

(Source: Swedish construction Federation)

In Boverket (2014a), some characteristics of the development of the housing market in Sweden can be made. Looking at figure 4, one can conclude that real
housing prices in Sweden has increased dramatically after the Swedish economy recovered from the economic crisis in the mid 1990’s, but the same report finds that the housing investments in Sweden has hovered on constantly lower levels after than before the crises in the early 1990’s, this observation is confirmed by figure 5 and 6 below plotting the housing investments for Sweden and number of apartments initiated in Stockholm County from 1997-2013 respectively. (Note: figure 5 starts in the period of economic recovery.)

Figure 4 - Price development (left), and development of initiated dwellings per 1000 inhabitant (right)

Figure 5 - Housing investments*, new projects** (2012 prices, in Billion SEK)

*The foundation of the dwelling is finished, and single-family homes are not excluded
** Time series is adjusted for renovation projects
(Source: Swedish construction Federation)
Figure 6 - Started apartments* in Stockholm County

*The foundation is of the dwelling is finished, and single-family homes are excluded (Source: Swedish construction Federation)

Figure 5 show that housing investments has starting to increase from a low level after the crises in the 90’s and the increased constantly until the great resection in 2007. Figure 6, although starting later in time, also plots a positive trend, the number of initiated apartments in Sweden’s largest economical region, Stockholm, is catching up from low levels. According to Boverket (2014a), the housing investments decreased dramatically in the beginning of the 1990’s in the backlashes of the financial crisis, decreased by 70 percent. Investments then increased slowly but steady until it started to decrease in 2007 due to the removal of (the last) governmental subsidies. Figure 5 confirms the observation made by Boverket (ibid). Boverket makes another important remark that in 2011 and 2012 rebuilding of the existent stock incorporated approximately 50 percent of total investments22 (ibid.).

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5 Theoretical models of market effects

This section will start by creating a model by which the initial external shock can be estimated and quantified. By using the net present value (NPV) approach used by Lind (2014) such a estimates can be quantified. Next section using the NPV estimations of the different costs and the revenue of a typical project and apply them into a simple supply and demand framework modelling the land market and later the housing market find the post shock market equilibriums. In this first step the extreme points will be predicted. In the third section of this chapter, the model will apply the findings made by other researchers in order to find some dynamics in the model and thus develop an understanding for how the characteristics of the land market translates into the housing market, and how this will make the end result differ when the model framework is affected by a positive supply shock.

5.1 Net Present Value estimation

One conclusion of the previous chapter is that many researchers have found a clear relationship between housing supply elasticity and the volatility in housing prices. They also all confirm that the land use regulation is complex and thus hard to quantify, and most of the studies presented in section 3 the land restriction proxies are made in the US except the data of duration to receive a buildings permit from the World Bank data base used in OECD studies e.g. Sánchez and Johansson (2011). However Lind (2014) by doing net present value calculations implicitly receive a value of the planning process, which from a developers perspective is a fair estimation of the extra costs extensive planning puts on a project.

Building on Lind’s (2014) framework the size of the future costs and revenues is kept fixed and predetermined. This allows any private developer to calculate the net present value (NPV) of a given project. If then the duration of the annuity is made shorter, the time needed for the municipality to legally confirm the land use is shorted. The NPV will now grow (both) because the future cash flows, construction costs and project revenue, is received earlier and thus gets deducted by a smaller discount factor and through a shorter duration of the annuity and hence fewer monthly negative cash flows needed to keep the process alive. One important assumption to make is that this model assumes that the municipality confirms all initiatives made by any private developer, and all potential appeals made by any affected party is going to be rejected in court. Finally the model assumes that the property being developed is building containing only condominiums, the apartment building is sold to the housing association when finished.23

23 The latter assumption is not critical for the overall model but it simplifies the NPV calculations, if the project contains rental apartments praxis is that the developer also stays and do the maintenance work etc. Furthermore the revenue would take the form of an annuity with the duration of the expected lifetime of the dwelling.
Without these assumptions it is not certain that a project gets completed thus making the model redundant.\textsuperscript{24}

Before mapping out the NPV-framework some basic assumptions of the new construction project could be appropriate. This thesis will assume the house being developed is a multi-apartment house (of condominiums) within an already existent area where people live, i.e. the new property will densify the area in which it is built, the area is assumed to be a typical suburban location of Stockholm possessing average characteristics e.g. commuting time, safety, parks and recreation areas etc. Furthermore, the prices used in all variables will reflect living area costs, making them marginal costs. Note that this model will thus lack a fixed cost parameter and thereby simplify the calculations in the next section. Living area costs is defined as costs per square meter after the costs of hallways, stairwells\textsuperscript{25}, and other common areas not able to sell or rent out has been added to the price.\textsuperscript{26} This makes sense since it is this price the typical customer faces. A fact that is important to mention is that since this is a condominium property, a fraction of the actual cost of building will be renegotiated as debt attached to the condominium association, and all the members of the association together vouches this debt. From a condominium buyer’s perspective included in the price of the apartment is the personal stake in the debt hold by the condominium associations, however after the last apartment in the new dwelling is sold the project disappears from the developers books.

In order to visualize this figure 7 is a time line containing all the cash flows during the project life time where \( T=0 \) is the day when the first planning hour is debited to the project thus the sum (annuity) of the small cash flows will be an estimate of the quantitative costs derived from a planning process. The \( T \) indicates months passing by until the object is sold to the condominium association (cash flow \( C \)). At time \( B \) the real construction is initiated and thus the construction costs and the land costs is paid for.

\textsuperscript{24} By easing this assumption a developer will not pursue a project where the probability that a project will make it through court is low, transferring recourses to other projects. If then the project is approved in court once again the developer has to transfer recourses, this will make the efficiency of the industry lower showing in higher overall production costs.

\textsuperscript{25} A garage could be added but this particular apartment building will be attached with parking lots instead.

\textsuperscript{26} After the correction in sellable housing area a fraction of 0,78\% of the total area is apartments. That is an industry standard used when producing new multi apartment buildings in Sweden.
A decision to develop a new multi-apartment building, from a firm’s perspective can be seen as a series of cash flows, where the ultimate decision of initiating depends on whether the net present value of those cash flows is positive. The cash flows included would be the purchase of land, the actual costs of constructing the new dwelling, the revenue flow at the end. However, in the beginning there will be a series of negative cash flows, e.g. costs containing the consulting hours put into planning the project. Figure 7, above, presents the exact timeline when the different cash flows fall out as the planning process looks today in Stockholm and will be used to compute the NPV and further on the potential economic gains of a shorter planning process. Looking at figure 7 three different types of cash flows can be distinguished, at the beginning at T=0 until T=30 is the annuity, one larger at T=30 which contains the construction cost and land costs and finally one positive cash flow at 42 months after the project is initiated, the project revenue.

Starting from the back, at T=42 (C) months after a firm initiates a property development project it receives the revenue generated by the project, this is equivalent with the term E (P_{t+1}) in Paciorek (2012) following this argument the time between cash flow B, the construction costs, and the positive cash flow C is the construction time, the time it takes for a firm to build a multi-apartment house. That time will not be affected when the authorities shortens their planning process instead as mentioned in section 1.4 limitations the efficiency of how firms produce their output will not be covered in this paper, thus the assumption - given the regulation and taxation from the government all firms are producing at their the most efficient level, i.e. they are profit maximizers.

Cash flow B consists the actual/direct construction costs - more specific it consists of all of the construction costs facing the developer during the project, e.g. costs from actual construction; subcontractors, financing costs, marketing, logistics etc. This model will make an assumption that by shortening the
planning process the construction costs can be reduced. The argument is: as the annuity is a negotiation between the local authorities and a private developer where the local authorities through these negotiations puts constraints on the private developer how to construct the dwelling, it seems reasonable that the techniques and materials suggested in the beginning was cheaper and/or more familiar to the developer than the materials and techniques used in the final plan. This effect will be included in the model by a reduction of the construction cost by 5% when the planning process is reduced. 

Cash flow (B) will also contain the purchase of land needed for the development of the intended multi-apartment house, as previous research has emphasized the importance of land when explaining the housing market elasticity of supply e.g. Glaeser and Gyourko (2003), this thesis will develop the role land plays in this model in the next sections.

In this model the first cash flow/series of cash flows, (A), is more theoretical. It consists of all the planning, lobbying that leads up to the point where the municipality accepts the firms suggestion on how to use a specific piece of land, the time period thus contains the progressive compliments made to the original plan in order to the final approval. To specify each annuity cash flow will include working/planning hours by architects, consultants and administrators and logistic planning etc. since these are assumed to be constant over the initial phase of the project it can be summarized as an annuity cash flow.

$T=0$ is the time there the first hour of consultancy is accounted for and thereby making the specific project appear in the company books. Furthermore it seems fair to assume that the authorities does not make the process longer than necessary, after all it brings costs over their organisation as well, hence any given month at this stage of the project the firm has to update its drawings and proposal in order to get approval from the local authorities - given the market characteristics local governments are profit maximizers. It seems fair that these costs for keeping the process alive is distributed equal over the time hence this first cash flow can be seen as a annuity with the same duration as the mean planning process.

Making the planning process shorter, to equal the mean of German planning, will affect the total costs of a construction project in dwellings in two ways. First the effect on the net present value of the project by cutting time will lead to a situation where both the revenue and the cost cash flows fall out in a nearer future, thus making them bigger and less uncertain. Thereby reduce the market risk and thus create cost savings for a private developer. Second shorter planning processes will reduce the annuity term of eq. 2 below, since it now will contain fewer individual payments thereby less recourses has to be devoted to architects and various consultants and planning personnel, also the construction

\[ T=0 \]

\[ \text{annuity cash flow.} \]

\[ \text{first fraction of the time the plan spends passing the legal system, that is individual stake holders will have a say in a project affecting their surroundings. But that process is overlooked in this thesis, with the assumption that local governments only approves legit projects.} \]

\[ 27 \text{ After discussions with business insights and academic experts a reduction of 5% is legit and probably in the lower range of potential gains. Lind (2014) uses an estimate of 160 SEK/ living area.} \]

\[ 28 \text{ A third fraction of the time the plan spends passing the legal system, that is individual stake holders will have a say in a project affecting their surroundings. But that process is overlooked in this thesis, with the assumption that local governments only approves legit projects.} \]
costs will be reduced as stated above. In this framework the planning process will be shortened to meet the mean time the same process takes in Germany namely 4 months (NCC, 2012). According to Stadsbyggnadsbenchen the average planning process is 2,5 years or 30 months for a project in the Stockholm region - which is the estimate used in this thesis (Lagheim and Lindh, 2013). By reducing the planning process to consist of only four months instead of 30 (the German situation) the cash flows will fall out in a closer future; the annuity now consists on only 4 cash flows and thus will decrease substantially, the construction and land costs now occurs after 4 months and the revenue is now received 16 months after the project is first being suggested to the local authorities.

The thesis will not cover how such a dramatic abbreviation will be done, but just notice that the process is handled more effectively in a country that share many characteristics with Sweden - A north European OECD-, EU-member. Thus a large cut in the Swedish handling times should be possible.

\[
NPV = \frac{Revenue}{(1 + r)^t} - \left(\text{monthly fixed costs} \times \frac{1 - (1 + r)^{-t}}{r} + \frac{\text{Land cost}}{(1 + r)^{t_1}} + \frac{\text{Construction cost}}{(1 + r)^{t_2}}\right) \\
\text{(Eq. 2)}
\]

The framework presented above is summarized eq.2, where \( t \) is the time (in months) counted from when the project was initiated. \( r \) is the monthly real interest rate, prices are assumed to follow the inflation thus the same numbers can be used regardless in what time period they occur. The NPV function is equal to a profit function in microeconomics, this gives that the revenue term is the market demand for housing and the term within the parenthesis in eq.2 will be the cost function (eq.3) below. If both prices and quantities are to be stated in percent, that is, the pre supply shock equilibrium was 1 to 1. A transformation of eq.3 is necessary. The demand for houses is constant, 1, in eq.2. This implies, by examine the first term in eq.2, in order for the present value of the revenue to remain constant as \( t \) is reduced, assuming \( r \) is constant, the real present day price has to decrease. In Lind (2014) the left hand side (NPV) is kept constant meaning all efficiency gains is allocated as a lower market price, this model however is assuming as was mentioned that the revenue is constant. For explicitly this implies that some gains are allocated as extra profits for constructors, the NPV increase, and some are allocated as a lower market price.

\[\text{[29It could be argued that shortening the planning process will also reduce the market risk a developer faces thus lowering the cost of capital and the required rate of return which leads to a lower discount rate are to be used after the supply shock, this paper however will overlook this potential effect.}\]

\[\text{[30A Conglomeration of eight municipalities within Stockholm County, containing Haninge-, Huddinge-, Nacka-, Sollentuna-, Stockholm-, Södertälje-, Täby-, Upplands Väsby municipalities}\]

\[\text{[31This assumption will be discussed in section 7}\]
\[ TC(Q) = Q_{\text{initial}} \left( P_{\text{initial}} \cdot \frac{1 - (1+r)^{-t}}{r} \right) + Q_{\text{land}} \left( P_{\text{land}} \cdot \frac{1}{(1+r)^t} \right) + Q_{\text{construction}} \left( P_{\text{construction}} \cdot \frac{1}{(1+r)^t} \right) \]

(Eq. 3)

5.2 Partial equilibrium

After establishing how the various costs and revenues will be calculated, which was done in the previous section this section will continue and apply these in a supply and demand framework, the section will start to find the corner solutions a external supply shock to the housing market can have.

Leaning on the works of Glaeser and Gyourko (2003), Sánchez and Johansson (2011) and other researchers presented in section 3.0 most of the inelastic supply of dwellings could be traced back to the scarcity of land on which new buildings can be built. Where elasticity is defined as the effect a given change in price have on the market output (Q) (Varian, 2006). Thus this thesis will assume that the marginal cost of capital and labour is constant. Furthermore research leans to the conclusion that land per se is not scarce\(^{32}\) but that the scarcity derives from “man made” regulations of land use in the form of density restrictions, minimum land lots, height control or areas devoted for special purposes or in other aspects not suitable for housing. Thereby this thesis will now continue to picture the market for land in Sweden and make the extreme assumptions that the supply for some reason is perfectly elastic or perfectly inelastic. This section will later investigate what effects these findings will have on market of interest in this thesis - the housing market of Stockholm.

5.2.1 Land market

In order to fully understand the implications a shorter planning process/the German scenario would have on the construction market in Sweden the land market has to be pictured, and the dynamics of the interactions between the market for land and the final output i.e. the housing market has to be examined. Figure 8 visualises the extreme assumptions of the elasticity of supply in the land market, vertical (\(\varepsilon_s=0\)) and a horizontal (\(\varepsilon_s= \infty\)) supply function such market outcomes.

\(^{32}\)Glaeser et al (2008), Paciorek (2012) control for this effect by control for lakes, oceans and very steep topography not suited for real estate development surrounding the areas of study.
Figure 8 helps to get an illustrative picture of the corner solutions derived above. Starting from the equilibrium point A the external shock shifts the demand curve outwards from $D_0$ to $D_1$. Positive demand shock on the land market will be transferred from a reduction in total cost of production in the condominium market, thus construction firms will demand more factor inputs in order to increase new investment in housing and thereby increase the demand for land. Depending on the assumptions of the elasticity of supply (on the land market) the new market equilibrium will occur somewhere between the corner solution B (totally elastic supply) and C (totally inelastic supply) on the new demand curve ($D_1$).

First now consider that the supply of the land market is totally inelastic, that is all buildable land is already developed and no more can be created, due to unwillingness to sell by the current owner or complete land use regulation. In such a situation the only effect the external effect will have on the housing market is an increase of the price of the input variable land, resulting in a reallocation of the input prices but keeping the output fixed, as shown by point C in figure 8.

Now consider the other extreme outcome where $\varepsilon_s$ is $\infty$. In such a situation all new economic value created by the more efficient planning process will be devoted to increase the existing stock of dwellings. This mean that no input variables will increase in price and thus the supply curve will be horizontal and the new market equilibrium will be point B in figure 8.

To find these points in figure 8 eq. 2 could be used, since we know all the parameter costs, revenues, timing and the discount rate one can calculate a NPV for both situations. If land was to be $\varepsilon_s=0$ by putting the NPV of the Swedish scenario into the German equation and solve for land, holding the revenue term
constant\textsuperscript{33}, we will find the price the developers are now ready to pay for land, since the NPV is constant the firms will make the same profits, take the same risks etc. and thus produce the same amount of output. This then gives point C in figure 8, but in order to find point B one assumption of the slope of the demand function for land has to be made. This thesis will assume an $\varepsilon_d$ of -0.5 and that this elasticity is constant, this value is widely used in previous research\textsuperscript{34} making it a reasonable proxy in this paper as well. By applying the Q and P values from point C into a formula of a linear function (eq. 4) first the intercept can be found.

\[ P_d = \varepsilon_d \times Q_d + \text{intercept}_d \]  

(Eq. 4)

Knowing the intercept there is just one unknown variable ($Q_1$) in point B in figure 8, thus putting in these values in eq. 4 we will find the new quantity that equilibrates the model.

5.2.2 Housing market

Further, these corner solutions in the land market will change the outcome in the ultimate market of interest, namely the housing market. When putting the shorter planning processes into a supply and demand structure for the housing market the supply curve, by reducing the production costs i.e. marginal costs, will shift to the right.

Some assumptions about the housing market in Stockholm are, other inputs needed to develop a house, capital and labour will have a marginal cost of production equal to 0, that is, the slope of the MC-curve in this model will solely depend on the MC of the inputs in the NPV framework developed in the previous section. Another assumption is that the housing market demand elasticity in present value terms\textsuperscript{35} is $\infty$ - i.e. horizontal - this gives that the market demand is infinite at the market price $P_0$ and otherwise undefined. In absolute terms the latter assumption is unrealistic, however in a housing market like Stockholm which a large amount of excess demand at the current market price this assumption is plausible. Further on in a micro economic perspective this implies that any firm can sell another apartment for the same price. Finally the model assumes that all houses produced are homogenous in all aspects, such as location and other quality aspects. Figure 9 pictures this framework.

\textsuperscript{33} This is because the elasticity of housing demand is 0 in my model, this model does not allow for it to be separated from zero. If not 0 the housing market demand, due to the initial supply shock, would shift to the right.

\textsuperscript{34} According to empirical research on the market demand in housing (Sinai 2008) most studies predict that the price elasticity of demand is -0.5 e.g. Hanusheck & Quigley (1980) supports this estimate. An estimate in this region is used in papers from Meyerson et al. (1990) and Sörensen (2013)

\textsuperscript{35} If r is constant that implies that the real price/ living area has to fall.
The starting point in the housing market, that is, the revenue, costs and profits facing the housing market before the positive supply shock is in point F in figure 9 is a situation where total market output is $Q_0$ the Demand or revenue ($D_0$) reveals the market price $P_0$ and the production costs ($PC$) when producing $Q_0$ is $PC_0$. This makes the initial profit (NPV) of market actors will be the rectangle $A,B,F,G$ - this is the situation corresponding to point A in figure 8 of the Land market where total market output is $Q_0$. As firms at the beginning are making profits (a positive NPV) and thus $P>MPC$ we have a deadweight loss in the initial equilibrium, the area $B,C,F$, this is because as previous research has suggested housing development decisions are based on $E(P_{t+1})$ and not $P_{t=0}$ which will make the optimum investment decision be at a Tobins $q^{36} > 1$ by a margin.

The external supply shock is visualised by the rightward shift of the MC-curve from $MC_0$ to $MC_1$ due to the lower production costs $PC_1$ (the annuity term and the $5\%$ decrease of construction cost), making the market equilibrium go from point F to point I in figure 9 above. If the elasticity of supply on the land market is totally elastic ($\varepsilon_s=\infty$), the initial positive external supply shock will shift MC to the right from $MC_0$ to $MC_1$. This will make the market equilibrium shift to point I. The lower production costs will make it rational for market participants to increase their output to $Q_1$, which corresponds to point B in figure 8. Note that the market price for land is constant as figure 8 shows but the reduction in production costs derived from the other two cost components in eq. 2. Due to the reduction in production costs and the additional output produced the NPV/profits have also increased, the profit has grown to the area $A,D,I,H$. The deadweight loss is still present, the fundamentals that explains them has not changed, the deadweight loss after the shock is the area $D,E,I$.

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36 Tobins $q$ states that an investment is made only if the price of the final product is larger than the production cost, $P/TC > 1$
If the $\varepsilon_s$ of land on the other hand is 0, and the land market supply curve thus is vertical supply since the quantity of land is fixed the output produced in the condominium market cannot grow because of the constraint in the land market point C in figure 8. The effect and the result on the housing market will be that the original shift of the supply curve in the condominium market will shift back to the same point as before the planning process were reduced. This is because the reduction of the initial- and construction cost variables will be exactly offset by an increase in the market price for a specific land lot. Rearranging eq. 2 and solve for land cost, using original values of NPV and revenue the “post supply shock” values for initial cost and construction cost and solve for Land cost reveals that the production cost will remain constant. Thus all that has happened in this situation is that the additional resources created by the efficiency improvement has allocated as a higher market price for land keeping market profits (NPV) and output unaffected.

It is important to stress at this point that the model used assumes that the shock itself does not affect the elasticity of supply in either direction on the condominium market. This thesis assumes that the external shock just reduces the time needed to revise and confirm development plans by the local authorities and in the process reduced some costs. The thesis will also assume that the supply shock will not affect the demand function; this too is reasonable since there is no clear correlation between the variables included in the demand function, such as income, demographics etc. and the cost variable in the supply (Paciorek, 2012). One more assumption is that the demand for dwellings is infinite, pictured in figure 9 by a horizontal demand function ($D_0$). This fact is not realistic, but in a region with net migration surplus the demand for dwellings is high and in a city like Stockholm where land supply is controlled by the local authorities production of new dwellings will be reluctant to respond on high demand (Glaeser and Gyourko (2003) and Glaeser et al. (2008)).

5.3 Market dynamics

As has been noted from the previous section the outcome of the positive supply shock is very different depending on the actual elasticity of supply on the housing market of interest. However the elasticity of supply is unlikely to be either infinite or 0, based on the estimates of the long-run elasticity of supply made by previous research e.g. Sánchez and Johansson (2011), Murphy (2010) and DiPasquale and Wheaton (1994). However the “true” equilibrium is likely to be found somewhere in-between points B and C on the demand function in figure 8 derived in section 5.2.1.

Once again the thesis will start examine the dynamics on the land market. When elasticity of supply in the land market was zero, the observation in section 5.2.1 was that the resources that were freed by the efficiency improvement were exclusively allocated to a higher market price for land thus making housing output remain constant. On the other hand when the elasticity of supply was...
infinite, land prices remained constant and the full potential of the efficiency improvement was captured and supplied quantity increased to $Q_1$. This then suggests that the closer the $\varepsilon_s$ gets to 0 the more recourses will be devoted to higher land prices and less will be allocated to increasing market output. And as $\varepsilon_s$ gets closer to $\infty$ the inverse will be true, small increase in land prices and large increase of quantity supplied.

Moreover it was found in the previous section (5.2.2) that the effects of the supply shock on the housing market were dependent on the elasticity of supply of land. If $\varepsilon_s$ is zero due to the incapability of increasing the supply of land the equilibrium output quantity of new dwellings remained constant. If then $\varepsilon_s=\infty$ the output increased to $Q_1$ in figure 8. This suggests that the higher the elasticity of supply is on the land market the larger will the rightward shift be of the MC-curve be in figure 9. In line with this finding the literature in this subject states, presented in section 3.0, that if $\varepsilon_s$ of land is $\neq$ 0 a large enough increase in the price of condominiums will result in more parcel owners are willing to sell, or by themselves change the production activity of a non-condominium land lot, and develop new dwellings on that parcel (Murphy, 2010) and (Paciorek, 2012). This gives that the closer the elasticity of supply in the land market is to perfectly inelastic the smaller will the outward shift be of the supply curve on the housing market due to the small amount of additional land that will be offered by current landowners to new housing investments - thereby the largest shift will occur if the elasticity of supply on the land market is $\infty$ and the market is perfectly competitive.

In section 5.2.1 eq. 4 presented the linear demand function pictured in figure 7. if equation 5, the supply function of land, is substituted into eq. 4 we will find the market equilibrium when $\varepsilon_s$ is within the interval $\infty > \varepsilon_s > 0$.

$$P_s = \varepsilon_s * Q_s + \text{intercept}_s$$

(Eq. 5)

If prices and quantities are quoted in percent, that is, in figure 7: $P_0 = 1$ and $Q_0 = 1$ the intercept term can be found, given a certain $\varepsilon_s$. This leaves a two system equation system with two unknown parameters - $Q$ and $P$. In the market place prices and quantities are set in equilibrium making $Q_s=Q_d$ and $P_s=P_d$, thus eq. 5 substituted into eq. 4 and the equation can be solved for $Q$ (eq.6).

$$Q_{eq.} = \frac{(\text{intercept}_d-\text{intercept}_s)}{(\varepsilon_s-\varepsilon_d)}$$

(Eq.6)

This number can than be put into either one of eq. 4 or eq. 5 to find the equilibrium market price for land, where $\varepsilon_s$ is externally given. Using the estimate of $Q$ received from eq. 6 the rightward shift of the marginal cost-curve of the housing market can be derived. Finally the estimation of the land market price that equilibrates the land market for that $\varepsilon_s$ can be put into the equation 7 to derive the new profit/NPV, and the new project cost.
\[ NPV = P_0 - [\text{initial cost} \times \beta_{\text{initial}} + (\text{construction cost} \times \beta_{\text{const.}}) + \text{land cost}_{\text{neweq}} \times \beta_{\text{land}}] \]  
(Eq. 7)

Where land cost in equilibrium is derived from eq. 4 or eq. 5.

where \( \beta_{\text{ini}} = \left( \frac{1 - (1 + r)^{-t_i} \times P_{\text{initial}}}{\text{Total Cost}} \right) \)

where \( \beta_{\text{const}} = \left( \frac{1}{(1 + r)^{t_i} \times P_{\text{construction}}}{\text{Total cost}} \right) \) or \( \left( \frac{(1 - 0.05) \times P_{\text{construction}}}{(1 + r)^{t_i} \times \text{Total cost}} \right) \)

where \( \beta_{\text{land}} = \left( \frac{1}{(1 + r)^{t_i} \times P_{\text{land}}}{\text{Total cost}} \right) \)
6 Results

The thesis is now ready to implement the model derived in the previous chapter on a typical housing project in the Stockholm region. This chapter will follow the same structure as the previous section thus starting with the NPV calculations based on Lind (2014) framework, then continue to derive the extreme points on the land market which in turn will give the interval, rightward shift, of the marginal cost function. Finally this chapter will derive various market equilibriums where $\varepsilon_s$ is $0 < \varepsilon_s < \infty$, in order to increase the understanding of the dynamics of the model derived in the previous chapter.

6.1 Presentation of data

Due to the importance of the validity of the results derived in this section this thesis will start this chapter in a brief discussion of how the various numbers were collected and or estimated.

As was mentioned in section 2.2 the data was collected and revised in collaboration with prominent academics and business insights, and later the relative sizes was confirmed in a report from Boverket were they compared the relative size of the actual construction costs (approximately 40 percent of total costs) and the developer costs, which include the initial cost and the land costs, to an approximate of 60 percent of total costs (Boverket, 2014b).

That said, the author hereby emphasize, once again, that the purpose of this thesis in not to quantify the true economic gain in reducing municipality planning process in the Stockholm area per se but rather to widen the public debate to include the correlation/causality problem of a reduction of the Swedish planning processes. And to develop a compliment to the econometrical models already existing but that has drawbacks in their quantitative estimations of the costs incurred in the planning process for a private developer. Below are the estimates of the initial costs, land costs, construction costs and the revenue used as the pre-shock prices that equilibrates the Stockholm housing market.

A, (initial cost): 250 SEK/ M² living area & month of planning
B, (land): 10 000 SEK /M² living area
B, (construction): 25 000 SEK /M² living area
C, (revenue): 50 000 SEK /M² living area

The other parameters included in a NPV calculation are the interest rate ($r$) since prices used in this project will be assumed to follow the inflation and thus are in real terms means that a real interest rate is used in the calculations, the real annual discount rate used will be $5\%^{37}$ (equal to a nominal yield of $7\%$). The typical project, as was mentioned in chapter 2.0 methodology, is considered to be

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37 5 % annual yield = $1.05^n(1/12)) - 1 = 0.407\%$ in monthly yield
of limited risks i.e. a condominium building in a semi-attractive/-central area in the expansive Stockholm region. The estimations of the planning processes in Sweden and Germany have been collected from mean estimates made by Stadsbyggnadsbenchen in the case of Sweden and NCC for the German mean estimates (Lagheim and Lindh, 2013) and (NCC, 2012). The estimate of the construction time, 12 months, is a standard estimate used by previous researchers e.g. Lind, 2014.

6.2 An empirical example - The Stockholm housing market

6.2.1 Net Present value calculations

Putting the variable and parameter estimates presented above in eq. 2 from chapter 5.1 and using the monthly interest rate of 0,0407% will give the values in the first column in table 1. By the reducing the planning process to, consist of only, 4 months instead of 30 (the German situation) the cash flows will fall out in a closer future; annuity now consists on only 4 cash flows, the construction cost and land costs now occurs after 4 months and the revenue is now received 16 months after the project is first being suggested to the local authorities. However as was discussed before the market price for new dwellings is undefined unless the present value of it is the same as before the planning process duration was reduced, which implies a reduction of the real price. $\varepsilon_d$ of the housing market is 0. These values are presented in the second column of table 1 where column 2 indicated the extreme case where $\varepsilon_s = \infty$.

Table 1. NPV-estimates

<table>
<thead>
<tr>
<th></th>
<th>NPV (Swedish duration)</th>
<th>NPV (German Duration)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annuity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial cost</td>
<td>7046</td>
<td>990</td>
</tr>
<tr>
<td>Present value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land</td>
<td>8852</td>
<td>9839</td>
</tr>
<tr>
<td>Construction Costs</td>
<td>22129</td>
<td>23367</td>
</tr>
<tr>
<td>Revenue</td>
<td>42151</td>
<td>42151</td>
</tr>
<tr>
<td>NPV</td>
<td>4124</td>
<td>7956</td>
</tr>
<tr>
<td>change in NPV</td>
<td>3832</td>
<td></td>
</tr>
<tr>
<td>In %</td>
<td>92.9</td>
<td></td>
</tr>
<tr>
<td>Project Cost (PC)</td>
<td>38027</td>
<td>34195</td>
</tr>
<tr>
<td>PC as % of R</td>
<td>90,2</td>
<td>81,1</td>
</tr>
</tbody>
</table>

38 Recall that the construction costs is reduced by 5%
From table 1 one can observe that the annuity cash flow gets dramatically smaller as most of its within cash flows are removed in the German scenario. The other cash flows grows in size as they now occur in a closer future, more precise 26 months sooner compared to the original Swedish scenario the project cost has thereby decreased, from PC$_0$ to PC$_1$ in figure 9. Due to this the NPV grows significantly, from the area A,B,F,G to the area A,D,I,H in figure 9, by approximately 90 percent (92,9) according to calculations presented in table 1. From table 1 one can also observe that most of the growth of the NPV is due to the shortened planning process, a firm now have to make fewer improvements to the original plan for it to be approved by the local government.

### 6.2.2 Finding corner solutions

After establishing these ground values this section can start examine the land market in Stockholm to find the extreme values, $\varepsilon_s$ is $\infty$ or 0, which are associated with the estimated values from the previous section. Recall from chapter 5.2.1 that by applying the post shock values while holding NPV and revenue constant to eq. 2 and solve for land will give this new equilibrium in the land market, hence the second column values of table 1 (except NPV) are put into eq. 2 along with the first column estimate of the NPV, these estimates is shown by table 2. Next step is to find the point corresponding to point B in figure 7. By putting the percentage increase of P into and the corresponding Q estimate into eq. 4 the intercept of D$_1$ in figure 8 can be estimated, recall that $\varepsilon_d$ is -0,5. Knowing the intercept and the quantity that equilibrates the land market for $\varepsilon_s$ = 0 can be found by using eq. 4 again and solve for Q this time. These results too are presented in table 2.

This will give us the corner solutions on the land market, and based on previous research that input market ultimately decides output on the market of interest the market for condominiums.

<table>
<thead>
<tr>
<th>Table 2. Partial equilibrium estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Land price</td>
</tr>
<tr>
<td>Increase in %</td>
</tr>
<tr>
<td>Intercept (D1), in %</td>
</tr>
<tr>
<td>Increase in Q (%)</td>
</tr>
<tr>
<td>PC as % of R e s=0</td>
</tr>
</tbody>
</table>

Interpreting the results from table 2 it is found that if the elasticity of supply in the land market is zero the positive supply shock will make land prices in Stockholm to increase by approximately 85 percent (86,7) leaving output supplied unaffected. If the $\varepsilon_s$ is $\infty$ the quantity supplied on the land market will increase by around 170 percent (173,4). For the housing market in Stockholm this implies that if $\varepsilon_s$ is estimated to be infinite the market output, the supply of land will increase by 170 percent, it also implies that market profits will increase by around 90% (92,9). Last table 1 and 2 together states that when $\varepsilon_s$= $\infty$ on the
land market the production costs is reduced by approximately 10 percentage points (9,1) due to the reduction in production costs.

### 6.2.3 Model Dynamics

So far the thesis has found the interval in which the true equilibrium of the Stockholm land market market can be found. The point corresponding to point C in figure 8 quantity supplied is 1 and the land price has increased to be 1,87. The partial equilibrium corresponding to point B land price remains unchanged at 1 but the supply of land increases to 2,73.

In order to find the actual land market equilibrium the elasticity of supply has to be found. This is an estimation we cannot get from the data since it is just a point estimate of the supply curve at prices and quantity equal 1. However, previous research has tried to scatter this elasticity of supply. Researcher states that the elasticity of supply found in the housing market almost exclusively can be traced back to constraints in the land market (Glaeser and Gyourko, 2003). This implies that the marginal cost for initial cost and construction cost are 0.

This thesis will now use some of the estimations from OECD written by Sánchez and Johansson (2011). From Sánchez and Johansson (ibid.), five different elasticities of supply (long-run) are chosen due to their variation, the decision to include their estimate of \( \varepsilon_s \) of Sweden and Germany seems obvious, the decision to include Switzerland, Finland and USA is because they capture the most inelastic, close to unit elastic and most elastic estimates, in that order, in the OECD study. Using these estimates of \( \varepsilon_s \) in eq.5 will give the intercept parameter and then substitute eq.5 into eq.4 will give the new equilibrium conditions in the Swedish land market, given \( \varepsilon_s \), presented in table 3.

#### Table 3. Land market equilibrium

<table>
<thead>
<tr>
<th>( \varepsilon_s ) *</th>
<th>Switzerland</th>
<th>Germany</th>
<th>Finland</th>
<th>Sweden</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, ( \varepsilon_s )</td>
<td>0,146</td>
<td>0,428</td>
<td>0,988</td>
<td>1,381</td>
<td>2,012</td>
</tr>
<tr>
<td>Equilibrium Q</td>
<td>-5,849</td>
<td>-1,336</td>
<td>-0,012</td>
<td>0,276</td>
<td>0,503</td>
</tr>
<tr>
<td>Equilibrium P</td>
<td>1,053</td>
<td>1,137</td>
<td>1,258</td>
<td>1,318</td>
<td>1,391</td>
</tr>
<tr>
<td>PC, %</td>
<td>1,363</td>
<td>1,321</td>
<td>1,261</td>
<td>1,230</td>
<td>1,194</td>
</tr>
</tbody>
</table>

*Long-run \( \varepsilon_s \) estimates from Sánchez and Johansson (2011), presented in table 3, are inversed when doing the calculations behind the results presented in row 2 of table 3.

From table 3 where estimates of equilibrium on the land market based on various \( \varepsilon_s \) it is observed that as the elasticity decreases more recourses, that was

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40 Japan is also estimated to have a \( \varepsilon_s \) close to 1 but as a country Finland is more comparable. Since cross-country studies as this one assumes ceteris paribus, it is assumed that the bias between estimates is smaller between Sweden and Finland than between Sweden and Japan.
freed by the reduction in duration of the planning process, are allocated to current parcel owners showed by the negative trend in $P$ (as $\varepsilon_s$ increases). This also gives that as the elasticity of supply increases recourses are transferred from parcel owners to firms and customers as $Q_s$ of land increases. However the ultimate interest for this paper is to see how these variations in $\varepsilon_s$ alter the equilibrium on the housing market of Stockholm.

### Table 4. Housing market equilibrium

<table>
<thead>
<tr>
<th></th>
<th>Pre shock</th>
<th>Switzerland</th>
<th>Germany</th>
<th>Finland</th>
<th>Sweden</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land cost</td>
<td>10000</td>
<td>13629</td>
<td>13208</td>
<td>12606</td>
<td>12303</td>
<td>11940</td>
</tr>
<tr>
<td>Project cost</td>
<td>38027</td>
<td>37766</td>
<td>37351</td>
<td>367560</td>
<td>36462</td>
<td>36104</td>
</tr>
<tr>
<td>$\beta_{\text{initial}}$</td>
<td>0,185</td>
<td>0,026</td>
<td>0,027</td>
<td>0,027</td>
<td>0,027</td>
<td>0,027</td>
</tr>
<tr>
<td>$\beta_{\text{construction}}$</td>
<td>0,582</td>
<td>0,619</td>
<td>0,626</td>
<td>0,636</td>
<td>0,641</td>
<td>0,647</td>
</tr>
<tr>
<td>$\beta_{\text{land}}$</td>
<td>0,233</td>
<td>0,355</td>
<td>0,348</td>
<td>0,337</td>
<td>0,332</td>
<td>0,325</td>
</tr>
<tr>
<td>Project Cost/Revenue</td>
<td>0,902</td>
<td>0,896</td>
<td>0,886</td>
<td>0,872</td>
<td>0,865</td>
<td>0,857</td>
</tr>
<tr>
<td>PC change,</td>
<td>-0,007</td>
<td>-0,018</td>
<td>-0,033</td>
<td>-0,041</td>
<td>-0,051</td>
<td></td>
</tr>
<tr>
<td>NPV</td>
<td>4123,712</td>
<td>4384,983</td>
<td>4799,682</td>
<td>5391,137</td>
<td>5689,215</td>
<td>6046,606</td>
</tr>
<tr>
<td>NPV increase</td>
<td>0,0634</td>
<td>0,1639</td>
<td>0,3074</td>
<td>0,3796</td>
<td>0,4663</td>
<td></td>
</tr>
</tbody>
</table>

Turning to the housing market of Stockholm, Figure 9, the project costs, NPVs corresponding to each equilibrium on the land market are presented in Table 4, column 2-6. The first column contains the estimations of the initial market equilibrium on the Stockholm housing market - the pre shock situation. The numbers in rows 3, 5-7 are stated as fractions of the revenue thus row 5-7 contains the relative size of the different variables included in the cost function. As can be seen in Table 4. The relative importance on the three input variables changes in post shock equilibriums, first after the shock the relative importance of all input variables increases as the total costs have been reduced in all scenarios, column 7. But as was mentioned in section 5,2 the restrictions in housing supply is traced back to restrictions in the land market. Thus it was assumed in this paper that the other input variables in the cost function had a constant marginal cost. Due to this their importance/relative size grows when the planning process duration is reduced, and a smaller elasticity make this importance larger. The relative importance of land however, also increases due to the rightward shift in market supply but a larger elasticity of supply will decreases the relative importance of land. However, notice that total project costs as a fraction of the constant market revenue decreases as $\varepsilon_s$ increases. This is because as a larger elasticity of supply increases the supply of developable land more than a small $\varepsilon_s$ does. Efficiency gains will, as have been stated before, to a larger extent be devoted to quantity increases of produced dwellings with a large elasticity vis-à-vis a situation when the elasticity is small.

This naturally gives that the initial shock increases the profits of the producers of new dwellings, the NPV increases, but the closer $\varepsilon_s$ is to zero the smaller that
increase will be. Due to the fact that in such a situation the efficiency gains will be allocated to higher prices for a given land lot - the “extra profits” is allocated to current landowners instead of construction firms. If the assumption of constant demand was to be relaxed, as in Lind (2014) where the extra gains are transferred as lower market prices. And the housing is assumed to be a normal good and the demand function in figure 9 thereby has a negative slope, the more elastic the housing supply is the more will the external shock reduce the market price for new dwellings, ceteris paribus! From these results it can be concluded that the more inelastic the housing supply is the smaller will the rightward shift be of the marginal cost-curve in figure 9.
7 Analysis

In this section the paper will analyse the dynamics developed in the previous chapter, and then continue to discuss how the findings made by other researchers presented in section 3.0 affect the model.

7.1 Discussion of the results

From the results and observations of the model dynamics developed in the previous chapter the thesis in this chapter can make a prediction of what the potential effect will be if the Swedish planning processes were to be shortened. From the results in the previous section some characteristics of the importance the elasticity of supply have on the post shock equilibrium on the housing market. Graph 1 plots these outcomes; the post equilibrium increase of housing quantity (x-axis) is dependent on the elasticity of supply (right y-axis). Where the left y-axis shows the deviation from pre-shock equilibrium in percentage. On the next page figure 8 and 9 from chapter 5.0 are presented again in order for the reader to get an easy overview of the model presented in the previous chapters.

Graph 1 - Dynamics of the housing market
From graph 1 the observation from the previous chapter is clear that when the elasticity of supply is zero the price of land is at its peak and no additional construction is made, but as the elasticity increases the price of land decreases allowing for the marginal cost curve in figure 9 to shift rightwards and thus increasing the quantity response in production. Graph 1 also shows that as $\varepsilon_s$ increases the production of new dwellings, the rightward shift in figure 9, increases in an exponential rate up until unit elasticity and then start to decrease, meaning that the marginal effect on new construction of a change in the elasticity of housing supply is small in the region around unit elasticity and the marginal gain, in increased quantity, is larger the closer a market is to the partial solutions B or C in figure 8. Another observation is that as the elasticity of supply increases from zero the mark-up of the construction firms increases, shown by the difference between the purple and red line in graph 1, due to this there is a negative relationship between the housing elasticity of supply and NPV/profits.

The new equilibrium is unlikely to take place at the corner solutions derived in the previous chapter, that is, in the beginning or end of the curves in graph 1 due to the fact that the elasticity of supply in the land market is not zero nor is it infinite as these points earlier derived do suggest. The validity of that conclusion is derived from the low probability that in a given time period no landowner will sell their land lot at any price, or for that matter that all parcels will be put on the market at the current market price.

What would be the implication on the result if the assumption of a constant market price for dwellings were proven not to hold, that is, in a scenario more like the one assumed by Lind (2014)?

Given the assumption that housing is a normal good and thus have a negatively sloped demand with respect to price an external positive supply shock will cause the market price to decrease. And as the paper has found that the closer the $\varepsilon_s$ is to infinity the larger will the rightward shift of the MC-curve in figure 9 be still holds when the demand is negatively sloped. But the larger, in absolute terms,
the elasticity of demand is the smaller will the positive effect on produced quantity be for any given elasticity of supply. However, if the construction market is competitive construction firms will not be able to increase their mark up thus making the NPV curve in graph 1 constant at 1 (left axis). And the revenue curve, the market demand, will decrease at the same rate as the green curve in graph 1, the project cost/revenue-curve. This then gives a chance to answer the first part of the research question stated in the beginning of this thesis. A shorter planning process will make room for a quantity increase if the elasticity of supply is ≠ 0.

How will the results be affected if the cost- and revenue variables estimations are biased?

The dynamics of the model and the inter-variable relationships are not dependent of the estimations made of the of cash flows, interest rates and planning duration and will have the same characteristics as have been plotted in graph 1. However, what will be affected is the magnitudes of the their interdependence. Meaning the smaller the initial costs are relative to the other cost parameters, either due to a small t or a small negative monthly cash flow, the smaller will the rightward shift of the demand function in figure 8 be - i.e. the exogenous shock will be smaller.

7.2 Shorter planning processes alter the $\varepsilon_s$

The model assumes that the shock itself does not affect the elasticity of supply in either direction on the condominium market, all the shock has done is to reduce the time needed to revise and confirm development plans by the local authorities, shown in this model by the rightward shift of the supply function. But the slope of the supply function is unaffected. If this assumption does not hold the result will differ as illustrated by figure 10.
As can be seen in figure 10 a given rightward shift in the supply will lead to
different post shock equilibrium if shorter planning processes itself will affect
the elasticity of supply, one extreme outcome is that the shock will lead to
increased prices and a lower rate of condominium production, red curve, if
shorter planning processes will decreases $\varepsilon_s$ enough. To develop a understanding
of this effect the thesis will turn to previous research for an answer on which
direction shorter planning could effect the $\varepsilon_s$ in the housing market, and if there
is an effect at all.

### 7.2.1 Land restrictions

Leaning on the works of Glaeser and Gyourko (2003), Sánchez and Johansson
(2011) and other researchers presented in section 3.0 most of the inelastic
supply of dwellings could be traced back to the scarcity of land on which new
buildings can be built. Furthermore research leans to the conclusion that land
per se is not scarce\textsuperscript{41} but that the scarcity derives from “man made” regulations
of land use in the form of density restrictions, minimum land lots, height control
or areas devoted for special purposes or in other aspects not suitable for housing
- that is these parameters partly determines the elasticity of housing supply.
Furthermore, previous studies suggest that supply restrictions in the housing
market come in the form of either natural constraints or publicly decided
constraints. Models capturing the natural constraints on land use developed by
Gyourko et al. (2006), and later used in Glaeser et al. (2008) and in Paciorek
(2012) calculated the buildable land within a radius from a city centre. Such a
number for Stockholm will be subtracted with all of the water that lies within
such an imagery radius thus limiting potential land use, but as both Glaeser
(2003) and Paciorek (2012) states the natural effect of land availability is limited
and can be neglected since they tend to change very slowly over time (Paciorek,
2012). This is an important finding since it declares that the housing market
elasticity of supply is not zero! Local markets policy makers, new public policies,
can alter the steepness of the supply function - if such a scenario is to be
preferred.

However studies, e.g. Murphy (2010), and Glaeser et al. (2008), find that man
made restrictions increases the elasticity of housing supply, such restrictions is
hard to quantify as previous research dictates. Stockholm, as other cities, have
some land use restrictions worth mentioning, such as a standard height that
houses in the centre cannot normally differ from, laws and recommendations of
open area requirements, automotive parking requirements, noise restrictions
etc.

In a Study conducted by Tyréns\textsuperscript{42}, on the behalf of Stockholm Chamber of Commerce\textsuperscript{43} (2014), an estimation of how much of undeveloped land that where
not affected by any restrictions in Stockholm. By using the definitions of an

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\textsuperscript{41} Glaeser 2003, Paciorek 2012 control for this effect by control for lakes, oceans and very step
topography not suited for real estate development surrounding the areas of study.

\textsuperscript{42} Swedish urban planning consultancy: http://www.tyrens.se/en

\textsuperscript{43} An association of the local enterprise: http://english.chamber.se
urban area and periurban countryside used by Statistics Sweden\textsuperscript{44} the data used in the study was collected using GIS-files\textsuperscript{45} from various institutions (such as The National Heritage Board, County Board and Department of Agriculture), some estimates was made by the team itself such as shoreline protection and suggested national parks (ibid.). The study suggests that there are regulatory constraints on a large fraction of the land in Stockholm County (Chamber of commerce, 2014). This thesis will not predict the specific implementation of these restrictions on new construction and relative importance of the regulations, but rather use the findings made by Tyréns to state that there is land use regulation in the Stockholm area which - ceteris paribus- will have the potential to decrease the elasticity of the housing supply in Stockholm compared to a similar city without these regulation.

Murphy (2010) as mentioned in chapter 3.0 made another interesting findings of the implications of “man made” land use legislation. Murphy (ibid.) finds that the costs that do not vary with house size, i.e. various land use restriction costs, is pro-cyclical making them higher in boom periods than in times when the economic activity is low. A strong positive net migration, as is the case for the Stockholm region, would imply that these costs/restrictions is currently at a high level. Murphy (2010) also predicts that the presence of these fixed costs and the pro-cyclical pattern they show will lead to a smaller elasticity of supply, that is, new housing production becomes stabilized and thus tend to respond less on price signals.

In Boverket (2014a), where they investigate the trends of house prices and production of new dwellings in the Nordic countries, find a pattern where the flow of new housing output in Sweden after the economic crises in the 90’s is relatively stable compared to the other countries included in the study, Norway excluded at the same time as prices have showed a positive trend. This is interesting, as it would imply that the elasticity of supply in Sweden has shifted to be more inelastic in the last 20 years. These restrictions will have a negative effect on local housing elasticity of supply. However, the positive external supply shock - dramatically reduced planning processes - is very unlikely to alter these “man made” land use restrictions, and thus can be neglected when analysing the effect shorter planning processes will have on the volatility of the supplied quantity of new dwellings.

7.2.2 Project duration

As DiPasquale and Wheaton (1994), Case and Shiller (1989) and Glaeser and Gyourko (2003) housing supply in Sweden is not fixed as Figure 1-6 in chapter 4.0 explains, but as DiPasquale and Wheaton (1994) dictates production of new housing is time consuming, more so in Sweden than in Germany, and existing

\textsuperscript{44} Urban area: An agglomeration of at least 200 houses where the minimum distances between units are 200 meters.

\textsuperscript{45} Geographical Information System
housing stock has low depreciation thus a long life time, this makes \( E(P_{t+1}) \) more uncertain and the price elasticity lower. This gives that prices has to increase more in order for developers to be prepared to take on the risk that lays in a new housing project. As DiPasquale and Wheaton (ibid.) concludes this will make the housing market more inelastic in supply than the typical market. Housing elasticity is reduced the more fixed the housing supply gets which is confirmed by the previous research presented in section 3, whether they talk in terms of pricing bubbles or in terms of house prices. Glaeser and Gyourko (2005) concludes that high house prices must derive from a high demand for housing, but can also differ from variation in supply restrictions between area A and area B.

Stockholm has faced, and still faces strong positive net migration and increasing population (Blume et al, 2013), thereby the first criteria of sharp price increases made by Glaeser and Gyourko (2005) is fulfilled, the strong net migration to the Stockholm region will explain some of the price increases observed in Stockholm (Boverket, 2014a). The findings made by Case and Shiller (1989), DiPasquale and Wheaton (1994) and Glaeaser and Gyourko (2003) finds negative correlation between total project duration and the elasticity of supply - markets with more elastic housing supply have shorter total project durations (ceteris paribus).

7.2.3 Delays

Another parameter of interest in housing restriction used by earlier studies is delays, which lies in the core of this thesis. It is suggested by previous research e.g. Sánchez and Johansson (2011), (Paciorek, 2012), that longer delays correlates with higher house prices, thus further decreasing the elasticity of supply. However, Paciorek (2012) suggest that duration alone do not affect the elasticity of supply, that is, duration to receive a permit is a control variable for the transparency and how well constructed the regulatory system of land use is. Sánchez and Johansson (2011) support this finding when they state: “But, government policies can also have a bearing for housing supply. For instance, land-use and planning policies are intended to reduce negative externalities that can be associated with new housing construction, but if they are poorly designed they may also restrict supply responsiveness.” (Sánchez and Johansson, 2011, p. 22).

Since the duration of the planning process is long in Sweden around 30 months this suggests that the elasticity of supply in Sweden, all else equal, should be lower than in a comparable country, it also suggests that after shortening the planning process from 30 to 4 months the supply curve, if anything, should rotate clock-wise, thus becoming more elastic. Paciorek (2012) does also point on the fact that it is hard to correctly measure the planning process duration since the planning is likely to start before the actual application is sent in to the local government.
7.2.4 Stockholm housing market implications

The findings of previous research, although made in other housing markets, do suggest that the effect of shorter planning processes and thus shorter project duration, if any, will increase the elasticity of supply thus make the quantity gains, increases in Q, larger than the exact same shock will have if the elasticity is unaffected. This also implies that the situation where the elasticity of supply will decrease, and in extreme cases make the effect of shorter planning processes increase market price and decrease the market production of new dwellings, can be seen as unlikely but not completely ruled out. Because, the more inelastic the supply is the smaller anti-clockwise rotation is needed in order for such a situation to occur.

7.3 Stockholm housing market, elastic or inelastic

From graph 1 a distinction can be made in the elasticity curve between points at the left half of the elasticity curve, where \( \varepsilon_s > 1 \), and values on the right half where \( \varepsilon_s < 1 \). In the latter case \( \Delta Q \) will be larger than \( \Delta P \) with respect to a given external shock in supply, the inverse is true if \( \varepsilon_s > 1 \). Thus is would be of interest to know if the housing supply in Stockholm is elastic or inelastic at the moment, in order to decide whether a external shock on the housing market where to have a larger relative impact (%), in absolute terms, on market prices (P) or produced quantity (Qs).

In the report from the OECD, by Sánchez and Johansson (2011) an estimate of the elasticity of supply (long-run) for Sweden was made, within an error correction framework. The paper found that within their sample of OECD-countries the elasticity of supply for Sweden was rather elastic, 0.724, which in fact was the second most elastic supply in the sample after the US. Sánchez and Johansson (2011) also conclude that density and permit delays have negative effect on housing supply, which is in line with other papers where is this area. As was mentioned in chapter 3.0 the OECD study made by Sánchez and Johansson (2011) covers a long period of time - starting in the 80´s and runs up until the early 2010´s. And as Boverket (2014a) states that there are signs of a systematic shift in the development of both house prices and the corresponding response by market supply in Sweden during this time period (1980-2010) coinciding with the economic crises. This then, makes the thesis question the truthfulness of the estimate of the long-run elasticity of supply made by Sánchez and Johansson (2011) and how applicable that estimate is on the current Swedish housing market conditions!

The data on delays used by Sánchez and Johansson (2011) is substantially lower than the measure used in this paper (60-70 days compared to 30 months), the explanation is their usage of the World Banks: Doing Business index, which is calculated using a standardized warehouse. This is obviously preferable when making a cross-country analysis where quality-parameters have to be controlled for; a warehouse is a more standardized product. However, this clearly under
estimates the delay factor for housing construction in Sweden and Stockholm since warehouses in general are built in the outskirts and industry areas of a city where appeals are less likely to be submitted.

Another drawback of the OECD cross-country report is that it does not control for individual fixed effects, as longitudinal models do, or regulation/policy shifts in their data. Since the time period investigated is fairly long (mid-1980’s to mid/late 2000’s depending on the country) it is likely that systematic shifts in regulation has occurred, but once again controlling for such parameters limits the comparability of the cross-country investigation. This said, from Lind (2003) it is observed that the period up until 2003 have faced great price volatility on the Swedish market however he notes that the last part of the time period new supply has stabilized on low levels (in historical terms) a observation that is confirmed in Boverket (2014a) and Blume et al. (2013), thus an argument can be made that a systematic shift has occurred in Sweden.

The time period studied by Sánchez and Johansson (2011) covers this time period, and since the economic crisis in the 1990’s, a “local” crisis concentrated to Sweden (and the Nordics) not affecting other OECD-countries dramatically it is not controlled for. In the backlashes of the crises in the early 1990’s the Swedish government took its hand of the housing market in terms of direct subsidies to construction and new investment these policy shifts by the Swedish government is likely to affect the housing supply since private investors now have to bear a greater risk when investing in new housing (Lind, 2003). Not incorporating this effect in the model is likely to overestimate the coefficient of long-run error correction, i.e. predicting a larger elasticity of supply for Sweden. The time up until right after the crises price swings in the Swedish market were well responded by shifts in produced quantity Boverket (2014a), Blume et al., (2013) and Sánchez and Johansson, (2011).

Furthermore from figures 4-6 in chapter 4 it is observed that construction has been fairly stable since the beginning of the century, in a historical perspective, with low investments per thousand inhabitants (figure 1) and low overall investments (figure 5). The strong correlation of housing investments and the economical fluctuations showed in figure 3 supports Murphy’s (2010) theory of pro-cyclical fixed effects, derived from land use regulation, that increases the elasticity of supply. A cyclical pattern of fixed effects costs, first discovered by Murphy (ibid.), or “developer costs” as Boverket chose to address them is confirmed in a report by Boverket (Boverket, 2014b). The co-movements of the two data series in figure 3 indicate the presence of such costs in the Swedish housing market. Based on these observations, a good prediction of the elasticity of supply in Sweden at the moment should be lower than 1.381 which would imply an inelastic market supply. This would have the effect that a positive external supply shock with the characteristics explained throughout this paper

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46 There still exists subsidies for housing consumption and renovation (Lind, H., Lundstöm, S., 2007), (Lind, 2003)
47 1.381 is the suggested estimate of the long-run elasticity of supply for Sweden in Sánchez and Johansson (2011)
would increase land prices relatively more that it would increase production of dwellings in a city like Stockholm. Thus, based on the data used in this thesis, an answer to the research question could be: A reduction of the mean duration of the Swedish planning processes to a German standard will cause the market equilibrium to shift. In general it could be said that if the elasticity of supply in the land market does not equal zero the effects will be a increase of the quantity produced in the housing market, this increase will be larger the closer the elasticity of supply in the local housing market is to zero. However, it is crucial to mention that these findings relies on the assumption that elasticity of supply in the land market is ≠0 and that the positive external supply shock will not cause a decrease of the εs large enough to offset the rightward shift of the supply function. The results will also depend on the assumption that the construction market is competitive and the producers are rational in that sense that they will not keep undeveloped land on their books as speculation in future prices etc.

The findings also highly depends on the assumption that the market demand is exogenous, that is that shorter planning processes do not affect any variables included in the demand function for housing, not just the flow of housing but the demand for the entire stock of condominiums and its substitutes. But in situations where these assumptions hold shorter planning processes will cause rational firms to increase their production of dwellings. That is - in any market including Stockholm, the new equilibrium, given the assumptions stated earlier, would occur in a situation where both supplied quantity of housing and land prices have increased.
8 Conclusions and suggestions for further research

In this chapter the research findings will be presented into conclusions what effect shorter planning processes will have on the housing production. The chapter will in the end present some suggestions for further research.

8.1 A new situation for the housing market in Sweden/Stockholm?

This thesis seeks to find what the implications of dramatically reduced planning processes would be of the flow of new dwellings to the existing stock. The background to the interest in these questions is that the city of Stockholm has faced sharp price increases but no clear response in output in the last decade. This has had complications for the inhabitants of the growing region (persons as well as firms) when job opportunities have to be turned down when not finding a suitable place to live.

Much of the public debate has focused on the problems that long planning processes brings and that the legislation in these matters have to be liberalised in order for the construction to take off. This thesis have focused on the dynamics of the construction market and the important role that the elasticity of supply plays in determine the results of such an external effect, and whether the outcome is so straight forward that a shorter planning process per se will imply higher levels of production in the construction market.

The research question is to investigate first: what the implications of shorter planning processes would be in a city with the characteristics of Stockholm, and later whether those characteristics would allow the produced quantity of dwellings to increase with respect to such an external shock to market supply?

Previous studies suggest that in order to determine the housing supply quantity increases as a response of a price increase the market for land has to be thoroughly investigated and included in the analysis due to the constraints land market supply puts on the housing market (Glaeser and Gourko, 2003). From previous research it is also concluded that supply constraints is hard to measure correctly but it is observed that the volatility in prices varies substantially between regions and the supply constrains, as it is measured, will explain a great fraction of the observed difference in house price fluctuations (Paciorek, 2012), (Glaeser, et al, 2008) and (Sánchez and Johansson, 2011)

Lind (2014) developed a model where the planning cost is captured by a net present value calculation approach. This framework was used to estimate a quantitative difference between a long and short duration, and to overcome the problems previous research have had in correctly estimate the costs of planning.

In order to find the interval in which the post shock housing market equilibrium is to be expected the extreme values, based on assumptions on the elasticity of supply on the land market, have to be found. From that framework it is clear that
In situations where land market elasticity of supply is totally elastic the rightward shift of the supply function will be maximized and if elasticity of supply were to be totally inelastic the rightward shift will be minimized, in fact the supply function will stay put.

It is found that a given shock would have a larger impact on the housing market quantity supply the closer the elasticity of supply is to infinity. From this comes that the exact opposite is true for the effect a given shock has on land prices.

The ultimate results derived in this paper are dependent on the assumptions that the supply shock itself does not cause the elasticity to alter. However, since this thesis does not estimate an elasticity of supply of its own, for the local market in Stockholm, the potential effects that might validate the assumption have been collected through a literature review on previous econometrical papers that deals with these kinds of questions. From those it can be concluded that the duration of the planning process will have an effect on the housing market elasticity. Paciorek (2012) finds that a longer project duration will cause the correlation between \( P \) and \( E(P_{t+1}) \) to be lower thus making future prices harder to predict. Which, in turn, will cause quantity increases in production, of new houses, not to respond as good to changes in prices today thus decreasing the elasticity of supply. This then would imply that the policy shift suggested in this thesis will cause the supply curve to be “flatter” thus making the estimation in this paper negatively biased. Furthermore research has suggested that permit delays, if anything, will reduce the responsiveness of quantity supply with respect to price fluctuations Paciorek, (2012), Murphy, (2010) and Sánchez and Johansson, (2011). This too would imply that the policy shift would make the supply more elastic.

However, given the assumptions made about exogenous demand, the thesis points to that unless the land market elasticity of supply is zero, and the policy shift will not cause the housing market elasticity of supply to decrease, reduced planning processes should be followed by a positive response in equilibrium quantity supply, but that the effect will be larger the more elastic supply is and the less elastic housing demand is.

The exact impact of shorter planning processes on the Stockholm market this thesis is unable to give, since it lack a estimation of the housing supply in Stockholm/Sweden of its own. However, different sources gives different predictions of said elasticity, i.e. larger or smaller than 1, due to the to the time period they have chose to include in their sample. Arguments of both an elastic and inelastic supply have been made (Sánchez and Johansson, 2011), and (Boverket, 2014a) but the findings that emphasise on a elastic supply for Sweden does not control for the crisis in the early 90’s which brought systematic shifts along with it, which make this paper lean on that the elasticity of supply in Stockholm is inelastic \( (\varepsilon<1) \). Either way more studies in this area of studies, which focuses on the Swedish housing supply, in highly recommended.

Regardless the pre-equilibrium elasticity of supply in Stockholm the effect of shorter planning processes are not likely not have a negative impact of the production level in the housing market. The debate is rather what the true size of
such an effect will be, and whether the shift will be substantial enough to actually change investment decisions of developers.

8.2 Final remarks and suggestions on future research

A remark on the results is that it could be argued that a more responsive housing market supply may not be for the better, due to problems of overdevelopment of certain areas. Potential problems with excess supply and problems with market prices giving wrong signals to market participants is higher in markets with a more sensitive supply function. These negative effects a more elastic supply will incur are not discussed in this paper but such a discussion is highly recommended if policy makers finds the long duration of the Swedish planning processes to be a problem for the society.

An interesting continuation of this study would be to build on the framework of Sánchez and Johansson (2011) but not necessarily make a cross-country study but rather control the time series for potential systematic shifts and thereby increase the understanding of the elasticity of supply in the housing market for Sweden. Another interesting study would be to take on a similar approach as Paciorek (2012) but apply it in a European context, however this approach would face huge problems in collecting reliable data for an index of land use regulation in order to make the variables included somewhat comparable in the cross section dimension.
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Johan Deremar (editor); johan.deremar@bygg.org, 08-6985849

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