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ECONOMIC GROWTH AND HOUSING SUPPLY RESPONSE: IMPLICATIONS FOR HOUSING PRICE BEHAVIOR

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Economic Growth and Housing Supply Response: Implications for Housing Price Behavior

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INTRODUCTION

The Puget Sound region, like many urban regions in the U.S., experiences periods of housing price escalation associated with growth in the local economy. As local agencies strive to achieve the housing goals established under growth management, the role of supply in price appreciation is not fully understood by many who are concerned about housing price and rent increases. Efforts are underway in some jurisdictions to re-evaluate the regulatory process in order to eliminate government actions that add unnecessary cost and delay. While these steps are useful, of far greater impact on housing prices is the timing of simple supply and demand effects. Market imbalance, sometimes long-standing, occurs when employment and population, and hence demand, surge while supply grows slowly or remains constant.

This market imbalance contributes to cyclical price effects. In the marketplace, land developers and builders watch for certain signs in the economy or the local housing market that portend a sustained increase in demand. If land developers believe that demand is increasing or soon will, they will submit site plans for review in order to have developable land to sell. Likewise, the builder acquires land, researches and designs a product, receives the necessary government entitlements and financing, and builds and delivers the product to market. This "market lead time" or "supply lag" can take one to five years or more depending on where in the U.S. a builder operates. The longer the supply lags, the more extreme and long-lasting the price spike.

Nonetheless, the roles of job creation, increased wage levels (changes in buying power in the marketplace), and new units reaching the market have not been related, in a predictive model, to the rate of housing price change. Empirically estimating the market process that determines the rate of housing price change allows us to better understand the housing delivery system and the effects of supply lags.

In this report, we use an econometric model – the Seattle model – to measure the most important housing market interrelationships. The Model measures how employment, income, housing prices and rents, lot filings, lot approvals, and new construction are related over time. This model yields projections of future housing prices, rents, and construction, and permits projection of the effects of "shocks," such as the employment growth that is currently occurring, on housing prices, rents, and new construction. Emphasis is placed on measuring the effects of land development and construction delivery lags on housing prices

and rents. A central use of the Model is to predict what would happen if these lags were shortened, increasing housing production early in a boom and heading off the cyclical price spirals that are driven by job creation. The Model applies to King County and is based on semi-annual historical County data.

Due to market lead-time, including local regulatory processing, housing supply responds slowly to increases in demand. Gaining approval for an application to create lots for single-family home construction, for example, can take two to four years. The time it takes to receive a building permit varies widely depending on project size, complexity, and site constraints. Once a permit is received, construction of a home can take 6 to 8 months. Multifamily housing can be constructed more quickly because the lot creation process can be bypassed.

This relationship between demand, supply, and prices is structural; it occurs in all housing markets. While housing supply can never grow immediately to meet rapidly increasing demand, the ability to adjust to greater demand differs considerably from one metropolitan area to another. The Seattle area falls near the slow end of the spectrum.

Another important factor is the global market, which drives changes in local housing demand. Local employers such as Microsoft and Boeing sell products in a global marketplace. Shifts in demand for their products increase the demand for labor, which will increase demand for housing and therefore housing prices. Because of the nature of the external forces involved, anticipating changes in employment can be difficult, but is increasingly essential. The Model is a new tool for analyzing the impact of development lags on housing supply and price during times of economic expansion. Our aim is to help growth-sensitive regions like the Pacific Northwest cope with their new role in the global market environment.

Our simulations demonstrate that more rapid construction during a boom period results in less upward pressure on housing prices, and ultimately, more housing built. A moderate reduction in the imbalance between employment growth and housing stock growth can substantially reduce cyclical fluctuations in housing prices. While acceleration of the building permit and construction process can be of modest help, most of the gain must come from shortening the land development process and ensuring that an adequate flow of lot filings occurs.

BACKGROUND

The 1980s saw tremendous growth in the central Puget Sound region.[1] Population grew twenty-three percent during that decade, then increased an additional twelve percent by 1996 to an estimated 3.1 million people. This high growth rate was not unusual in the West; metropolitan areas such as San Jose, Sacramento and Phoenix grew between 15 and 34 percent during the eighties. Driving this high level of population growth in the Puget Sound region was an even higher growth rate in employment. Before slowing down in the early nineties, non-agricultural employment grew 40% between 1980 and 1990 (PSRC).

Such high levels of employment and population growth had a major impact on land and housing prices. Between 1985 and 1990, the typical price of a single-family lot increased 170 percent, from $28,000 to $77,000. During the same period, the mean selling price for single family homes in King County[2] increased by almost 80 percent, from $95,000 to $169,000. In contrast, median household income grew by thirty-two percent during the same period.

Much of the 1980s growth was due to the aerospace industry, which then hit a slow-down in the early 1990s. During the aerospace recession, however, Seattle's new information technology industry (led by Microsoft) was able to offset those losses to some extent. The aerospace industry has since come out of its slump, and 1996 saw the first increase in manufacturing employment in the region since 1990 (ULI Market Profiles 1997).

Currently, with the strength of both aerospace and the growing information technology industry, job growth in the area has returned to relatively high levels. Unlike many other areas in the US, even military jobs are growing in the Puget Sound Region, with local bases on the receiving end of transfers from closed bases.

The State of Washington and the central Puget Sound region began to address the issue of rapid growth with the adoption of the 1990 Growth Management Act (GMA) and Vision 2020, the regional growth management, economic and transportation strategy.

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[1] The central Puget Sound Region consists of King, Kitsap, Pierce, and Snohomish Counties.
[2] Throughout this report, "King County" refers to the unincorporated areas and all incorporated areas within the county, unless otherwise specified.

THE SETTING: DETERMINANTS OF SUPPLY AND DEMAND

The accompanying graphs illustrate the movement of King County's key housing demand and supply determinants over time, as well as some related indicators for the region. Employment within King County grew at a rapid and steady pace between 1983 and 1990, increasing by an average of 39,000 jobs per year (Figure 1). In contrast, between 1990 and 1995 the King County job base grew by a total of 28,000, averaging only an additional 5,600 jobs per year. Another employment boom is in progress in the mid- to late-1990's.

The relationship between the trends in employment and the escalation in single family home prices (Figures 1, 2, and 3) during the same period is striking. When new employment is created in the county, more workers must be accommodated by a slowly adjusting housing stock, and therefore prices rise. The slow change in housing supply can be seen in Figures 4 and 5. Even in times of greatly increasing demand, such as that between 1983 and 1990, the housing stock adjusts slowly. This slow adjustment leads to a housing market imbalance, which in turn causes short-term increases in housing prices as buyers and renters compete for limited supply. In addition, slow adjustment means that new housing continues to be completed after the boom period is over.

Figure 1

Figure 2

Figure 3

For single-family housing, the number of lots filed and recorded in King County is shown in Figure 6. The number of approval applications for new lots filed is an indication of demand for new land for development, while the number of lots approved and recorded is indicative of the change in supply of buildable lots. The most striking feature here is that the number of lots filed is much more closely correlated with the change in other demand indicators, such as employment (Figure 1), than is the number of lots recorded. When employment surges, and as a result, prices rise rapidly, the number of approval applications for new lots increases as well. The years 1986-1990 show lot filing levels of over 6,000 lots per year, almost reaching 10,000 in 1988. This was near the beginning of the period when prices were rising rapidly, thus indicating that demand was surging. The immediate decline from 6,500 lots to 1,000 lots filed in 1990-1991 mirrors exactly the point at which employment and prices ceased rising while significant construction-in-progress was still being completed.

The lag time between lot filings and lot recordings can also be seen in these two data series. Looking at the two points at which price increases slowed, 1984 and 1990, we see that declines in the number of approved recorded lots occur approximately one to two years later. What we can also see by looking at these data series is the extent to which the supply of lots (recordings) is much less cyclical than the demand for lots (filings). The number of approved and recorded lots during this period is 2,000-4,400, while the number of approval applications entering the process is four times as great,

Figure 4

Figure 5

Figure 6

1,000-10,000. These lag times are undoubtedly due in part to lack of flexibility in terms of available staff hours at the permitting agencies. In contrast, Snohomish County (and Portland) hires temporary staff to deal with surges in applications and consequently has shorter lags.

Real per capita income levels in King County have remained fairly steady throughout the study period (Figure 7), with the exception of two intervals. Income increased from 1982 to 1984, an important determinant of the employment growth that followed**.** Since 1994, real incomes have been increasing again.

The mortgage rate influences how affordable housing at any price will be. Its inclusion in the model helps control for changes in the annual cost of purchasing a home other than the overall price of the home. This variable moves cyclically with the national macroeconomy. Decreasing mortgage rates after 1981 helped to mitigate the impact of increases in home prices by keeping payments more affordable (Figure 8). In fact, until 1988, typical mortgage payments were actually declining, even in nominal terms, from their peak in 1981. Between 1988 and 1990, this measure increased sharply as both mortgage rates and prices rose.

From 1990 to 1995, the earlier pattern of declining mortgage payments recurred. This time, however, inflation-adjusted housing prices remained fairly flat while mortgage rates plummeted, allowing more affordable mortgage payments (although they were still higher than in the early eighties). In recent years, inflation-adjusted housing prices have been rising, leading to higher mortgage payments even despite declining mortgage interest rates. Rents have been rising along with house prices.

This visual analysis of the data for King County suggests that land developers are responsive to changes in housing prices. The number of applications for new lots adjusts to changes in price, rising to meet demand when prices are increasing, and slowing when prices are stagnant.

Figure 7

Figure 8

The primary stifling factor causing the slow overall stock adjustment is the time lag between initiation of land development plans by land developers and the completion of housing units by builders. Supply is also restricted by permitting agencies, represented by the difference between the number of lots initially requested and the final number approved (Figure 6).

In unincorporated King County, the development delay for single-family housing is caused primarily by the long plat approval process: permitting for a formal plat can take from two to four or more years to complete. Box 1 presents two sample timelines of the development process. Of course, some cases take longer and some are completed more quickly. Because multi-family development does not have the same lot creation requirements as single-family, it can occur more quickly. We can see in the trends that in the time of greatest increase in demand, multifamily permits were high. This reaction may have helped ease some substantial price and rent increases by providing additional housing quickly. Single-family permitting is somewhat higher during periods of demand growth, but the trend is not as striking.

THE ECONOMICS OF HOUSING CYCLES

As wages rise due to increased demand for workers, and as the number of jobs in the region increases, more people enter the workforce, and in-migration from other areas occurs. Population growth and rising household incomes leads to increased demand for housing. Because the housing stock can only adjust slowly to increased demand, housing prices rise in the short term. Once the housing stock expands to meet increased demand, the upward pressure on prices is relieved as the size of the housing stock increases. Prices rarely fall, however, except in times of prolonged economic recession. Therefore, to the extent that periods of

Box 1

housing shortage can be shortened, price spikes during times of expansion will be less severe.

In the short run, prices depend on how quickly new construction can meet increased demand for housing. Over the longer run, the extent of the eventual increase in housing prices depends on the long-run elasticity of supply, which is determined by cost factors, including land cost increases due to natural land scarcity and scarcity due to restrictions. The length of the lag between increased demand and the construction response is also influenced by land availability. When supply is elastic in the long run (development costs are low and land is available), large shifts in demand for housing do not necessarily result in much higher long-run prices. Conversely, when supply is inelastic (development costs are high and/or land is scarce), the cost of new construction is higher, resulting in higher prices, other things being equal.

Housing prices and construction fluctuate cyclically about their "equilibrium" levels. Development delays make cyclical patterns more severe by slowing the rate of new housing supply. The key signal to land developers and builders to begin land development and construction activities is higher housing prices. Similarly, a decline in prices (or a smaller rate of increase) is a signal to developers that supply is approaching an optimal amount, leading to a decrease in planned future construction. A long delay between the time at which prices begin to rise due to increased demand and the time at which new units are on the market causes prices to rise even more. The longer the delay, the less effective the price signal is in regulating the amount of construction that takes place. Longer delays make it more likely that the market will overreact, both in terms of price and new construction. Hence, when supply is relatively inelastic in the long run and the land development and construction lag is long, the boom and bust cycle is more pronounced. Risk is higher, too, for land developers and builders, as delays may cause them to miss the market. Higher risk also makes costs higher, which in turn also makes supply more inelastic in the long run.

ISSUE: THE ROLE OF LAND COSTS

Case studies produced by Robert Charles Lesser for the Housing Partnership in 1990 indicated that the primary "reason" for housing price escalation between 1980 and 1990 in

the Seattle area was higher land costs[3]. Land price escalation accounted for approximately one-half of the increase in development costs for single family homes, and over four-fifths of the increase in rental apartment development costs during the decade. The report further predicted that development costs would be the primary cost driver in the 1990's.

While this is true in an accounting sense, it is also important to understand the process by which potential housing prices affect the cost of undeveloped land. The amount that any given developer is willing to pay for developable land depends on the potential market value of the housing to be built on the site. Thus it is not only the scarcity of land but also the scarcity of housing that results in higher land prices. If construction of housing cannot keep up with demand, then housing prices will rise. This will increase the demand for land, driving up land prices.

There are two primary points at which supply can affect housing prices: the supply of land for development and the supply of completed housing units for purchase or rental. Households searching for housing evaluate the available options before determining what they will pay as a mortgage payment or as rent. If there are few options from which to choose (relative to the number of customers), households may bid up the price in order to obtain the housing they desire. Seattle is currently experiencing "bidding wars" which are driving up housing prices and rents.

The determinants of the market value of land are somewhat more complicated. In King County the land development business is separate from the home construction business. But even if this were not the case, there would still be separate markets for land and housing. Given the known market values of different housing types (at different locations), land developers will bid on land based on the projected revenue remaining after the sale of the approved lots and payment of development costs. In other words, they will purchase the land at a price that ensures them a competitive rate of return:

(Land selling price) - (Dev. costs) - (Competitive return[4]) = Maximum bid for purchase of land

[3] Housing Partnership, Blueprint for Affordable Housing: Case Studies

[4] The competitive rate of return is a risk-adjusted number. That is, the riskier the entitlements process, the higher the required potential return. Therefore, the more uncertain the approval, either in absolute terms (yes/no) or time uncertainty (how long will approvals take), the greater is the additional amount that is added to the price of lots.

If land is plentiful then prices will be lower. This leads to lower sales prices for lots and hence lower new housing prices and rents. Conversely, if land is scarce, then land developers will bid up the price of raw land to the point justified by expected lot sales price. In turn, builders will pay no more for lots than what they project will remain after subtracting other costs and a competitive rate of return. Competing builders may have different cost structures, may or may not be serving a higher-end market, or may be using different density configurations to determine the maximum amount they are willing to pay for land. Thus one builder may outbid another with different specifications, but no builder will pay more than a competitive rate of return dictates.

Housing market conditions thus interact with land market conditions. If housing is plentiful relative to demand and prices are thus correspondingly lower, then land prices will also be lower because builders' willingness to pay for lots is based on households' willingness to pay for housing. Even in a case where land is scarcer, if housing is plentiful (or alternatively if demand is low), then the cost of land will not be as high. Conversely, if housing prices are high due to a tight housing market, then the value of land will also be high. Thus the supply of land *per se* is only part of the land cost puzzle; both supply and demand in both the housing and land markets must be considered.

Using this conceptual framework, one could say that anything that decreases the supply of housing (permit delays, zoning, etc.) when demand is high will increase the price of housing and therefore the price that developers are willing to pay for land. It might be possible to infer then that the land price escalation that occurred in the Puget Sound region between 1985 and 1990 could have had as much to do with restrictions on housing supply as it had to do with restrictions on land supply.

One implication of this analysis is that even under the constrained supply of land within the growth boundary, if municipalities permit and builders build enough higher-density housing they can partially offset price increases that would otherwise occur. The degree to which this works, of course, will depend on the nature of household acceptance of different density levels; that is, the market absorption of these prototypes. If the demand for single-family detached housing is overwhelmingly dominant, upward pressure on housing prices will be intense. Here innovative design is crucial, and is key in both market acceptance of new forms and neighborhood acceptance of new housing.

As this series of explanations indicates, the role of supply is central to maintaining relative price stability in housing. Constrained land supply is not the sole cause of rapidly increasing housing prices, and an adequate supply of housing, once again, can moderate the rise in underlying land prices. Municipal governments, of course, can play a crucial role in providing ample housing choices for a variety of household types. The land use restrictions imposed by municipal governments often make it impossible to successfully play this role. Well-intentioned regulations designed to protect public interests have unintended impacts on housing prices that can be far greater than their directly measured cost.

The discussion above uses examples from the conventional market. These same impacts, however, have even more serious consequences for low-income housing development and availability, and hence for lower-income households. Because this housing must be provided at relatively low rents to be of use, increased development process costs and land costs contribute to an affordability problem that pushes households out of private low-cost housing. This necessitates higher capital subsidies to overcome these higher costs of providing such housing. A general tightness in the housing market also means that households with somewhat higher incomes will create an availability problem by outbidding lower-income households in the modest housing submarket. While many groups are committed to developing strategies to provide adequate housing for lower-income households, these efforts must be combined with actions in response to the above-discussed impediments to supply in the larger housing market.

In summary, King County has a time-consuming process for developing land. Strict state environmental regulations and SEPA (an additional system which requires analysis of impacts and, when called for by that analysis, mitigation of the impacts) add additional requirements and therefore costs to the site development process. These requirements can add months or years to the total processing time and, more seriously for cost and feasibility, also reduce the amount of development a parcel can support. The State of Washington has recently taken action to attempt to reduce the total amount of time needed for lot approvals. It is continuing to work on this, and it is too early to judge the effectiveness of these actions.

THE SEATTLE MODEL

The Seattle Model is a model of housing demand, prices, and new construction for King County. This section describes the construction of and uses for the Model. This is the first model to estimate semiannual change in housing prices in King County as a function of job creation, increased wage levels (changes in buying power in the marketplace), and new units reaching the market. This empirical estimation yields projections of future housing prices, rents, and construction. This allows us to model the effects of major events, such as the employment growth that is currently occurring, on housing prices, rents, and new construction. Emphasis is placed on measuring the effects on housing prices and rents of land development and construction delivery lags. Another central use of the Model is to predict how much shortening these lags would increase housing production early in a boom and thus head off the cyclical price spirals that are driven by job creation. The Model applies to King County and is based on semi-annual historical County data.

To measure the effects on housing prices of employment and wage growth in the region, we relate the demand for housing (based on housing prices, employment, income, and the cost of homeownership) to supply (which changes through new construction) to create a price determination equation. This permits evaluation of the effects of demand changes (such as increased employment) and new construction on housing prices.

New construction (defined here as net new construction, i.e., the change in total supply) depends on housing price movements, land costs and availability of approved and recorded lots, construction costs, and interest rates. Key components of the model are the land development lag and the construction delivery lag. When increased demand is reflected in increased price, suppliers will seek to build more housing, and land developers will seek to get more lots approved. These lags thus include both satisfying government requirements and actually completing the construction.

This approach uses a system of equations rather than one single equation for price because values of certain variables are dependent upon some other variables in the model while simultaneously affecting the outcome of other variables. We cannot make projections of this year's price without knowing what the current level of stock is. But the level of stock

depends on the amount of construction started a certain number of years ago, which depends on previous housing prices, and so on.

MODELING RATIONALE[5]

The model incorporates data for King County to estimate demand and supply equations for owner occupied housing. Future research will deal with a parallel model for rental housing.

The aggregate demand to own is assumed to be a function of (1) housing prices; (2) the number of households (or potential households) in the area; (3) the income level of those households, and (4) the cost of homeownership. Using the fact that, by definition, actual demand must equal actual supply, we arrive at a price determination equation. In this equation, the price of housing is dependent on the above four factors and the size of the current stock of housing.

The changes in the number of households and the size of the housing stock are combined to create a *household (or employment) / housing stock imbalance* variable. Since this imbalance can accumulate over time, a *pent-up imbalance* variable is also created. The *cost of homeownership* (also called the *cost of capital*) variable is created as follows: the mortgage interest rate is adjusted by the Federal marginal tax rate to obtain an after-tax nominal cost of capital. From this is subtracted the rate of anticipated housing price appreciation, since this affects the real cost of homeownership.

To determine the amount of new housing construction, we incorporate the components of change in the housing stock and the determinants of gross new construction. Current stock depends on previous stock, new construction, and demolitions. In regions that include an older urban area with a more a mature housing stock, such as Seattle in King County, the level of demolitions of existing housing may not be negligible. For this reason, numbers for gross new construction should be adjusted for the number of demolitions to arrive at a net new construction figure. We address this issue by defining net new construction as change in the housing stock.

[5] One challenge in this type of analysis is to obtain the longest time series possible, at the smallest time intervals, in order to maximize the effectiveness of the estimations. Much of these data (prices, mortgage rates, permits, rents) are available at monthly or quarterly intervals over the period 1980-1997. The remainder are reported on an annual basis. Our data series must have one observation at each of a specified (constant) interval, so we must compromise some of the detail of the frequent data series in order to match the yearly observations of the other variables. We therefore use biannual observations formed by averages (or sums) of quarterly or monthly data combined with interpolated values of the annual variables.

We assume that new construction in the current period is a function of (1) price changes that occurred in previous periods (when the decision to pursue the project was made); (2) construction costs; (3) interest rates; (4) availability of building lots.

Housing prices are thus determined by the demand determinants listed above and by the stock of housing. But the current stock, S, is related to values from previous periods. Current construction is determined by price changes in earlier periods and the size of the stock in the previous period. Only a portion of the difference between the actual stock and the desired stock can be built in a given period. That is, current construction is a "temporary" flow that exists as long as the actual stock is less than the "desired," or "equilibrium" stock. When current construction comes on line, it is combined with the previous stock to equal the current stock. The level of stock then effects the price, which effects construction... and so on.

MODEL RESULTS

Two equations are estimated for single-family housing: one that explains semiannual changes in housing prices, and one that explains semiannual net new construction.

Semiannual housing price change (in 1995 dollars) (Figure 9) is modeled as a function of (1) an *Index of Imbalance* between 2-year employment change and 2-year housing stock change; (2) the *Pent-Up Market Imbalance* (the cumulative Index of Imbalance); (3) *Household Income Growth*; and (4) *Cost of Capital*. The regression yields the following equation:

$$\Delta P = -2180 + 3840*\text{Imbalance} + 635*\text{Pent-Up Imbalance}$$
$$\quad\quad (-2.5) \quad (7.4) \quad\quad\quad\quad (4.6)$$

It is useful to consider the effects of each of these determinants in the order of their explanatory contribution:

Index of Imbalance between two-year employment change and two-year housing stock change (Figure 11): If employment growth is high relative to growth in the housing stock, prices will rise. Pressure on the housing stock began in the mid-1980s and continued until sharply falling at the beginning of the 1990s. Pressure on the housing stock recurred in the mid-1990s.

- *Pent-Up Market Imbalance* captures the cumulative imbalance between employment growth and housing growth that grows early in a boom period. This variable is also a strong predictor of housing price change.

Household Income Growth should also affect housing prices. This variable does not contribute much explanatory power to the equation because it is so closely related to employment growth. While these two variables are correlated, some household income changes lead to subsequent employment changes. This is quite plausible; as demand for aircraft and computer software heats up, the demand for labor increases. This bids up wage rates, which in turn leads to in-migration and higher employment levels.

- *Cost of Homeownership* (also called *Cost of Capital*) should also have an effect on housing prices. Higher costs of homeownership should depress housing prices, and vice-versa. As shown in Figure 12, at the end of the 1980s price run-up, the real cost of homeownership was actually negative because price appreciation was so great. Homeowners were actually gaining more in price appreciation than they were paying in mortgage costs. This occurrence is fairly unusual. In our model, the cost of homeownership variable plays only a minor role in the housing price equation. This is because the price changes that it includes are highly correlated with employment change.

Figure 10 presents a comparison of actual price changes (from Figure 9) and the price changes predicted by the equation.

Semiannual net new single-family construction is estimated as a function of lagged semiannual house price changes (6, 12, and 18 months); and lagged lot approvals and recordings (6 months). The resulting equation is:

$$C = 1620 + \underset{(2.2)}{.0232}*\Delta P\ (-6\ \text{mo.}) + \underset{(3.4)}{.0374}*\Delta P\ (-12\ \text{mo.}) + \underset{(3.3)}{.0354}*\Delta P\ (-18\ \text{mo.}) + \underset{(1.8)}{.362}*\text{Recordings}\ (-6\ \text{mo.})$$

Figure 13 presents a comparison of actual new construction with the new construction predicted by the equation. The effects of the explanatory variables that are used follow:

- *Lagged Semiannual Housing Price Changes* are powerful determinants of new construction. Lags of 6, 12, and 18 months are the ones that matter, with the two longer lags accounting for 80% of the predictive power provided by lagged price changes. It is important to note that these lags pertain only to the time it takes to obtain a building

permit and build a house. As discussed above, land development lags are considerably longer.

Lot Approvals and Recordings lagged 6 months also contribute to explaining new construction. Since available lots are needed for building to take place, the availability of lots should have an influence on new construction.

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Housing Price and Construction Cycles: Simulations through 2002

Using our model of housing price and construction cycles, it is possible to project future values for these cycles. As discussed above, such projections can be used to examine how more rapid development response to increased housing demand can dampen these "boom and bust" cycles. Simulations can, of course, also project future outcomes in the absence of changes in development lags. Such "base case" simulations are presented first. Then alternative development lag scenarios are compared with this base case.

Simulations use consensus macroeconomic projections derived from sources such as Dick Conway and Doug Pedersen's Puget Sound Economic Forecaster. In addition to using such external forecasts of employment and mortgage interest rates, we also generate our own projections of lot approvals and recordings. Likely lot recordings are based on numerous factors, including the historical relationship between lot recordings and previous lot filings, and the relationship between lot filings and macroeconomic conditions. Of special importance is how filings and recordings are behaving so far in this boom compared to the 1980s boom.

The simulation model operates as follows: in the first forecast period, the size of the housing stock is known. This information is combined with forecasts of employment growth and mortgage interest rates, this information is used to forecast house price change. Along with recent housing price changes and lot recordings, this permits the forecasting of the next period's new construction, and so forth.

In addition to baseline forecasts, different macroeconomic scenarios can be played out. Different future income and employment scenarios over time can be entered into the model to learn their respective effects on house prices and new construction. In turn, the results of these scenarios can be used as baselines against which to measure the effects of changes in the timing and amount of housing supply response to increased demand. In other words, in estimating the model we find the lag lengths that best explain housing market behavior. In the simulations, the effects on the cycle of reducing lag lengths are explored.

Figures 14 and 15 provide the base case simulations under consensus macroeconomic forecasts. Figure 14 presents housing price changes and construction

semiannually through 2002. Figure 15 shows price levels (in 1995 dollars) and total single-family housing stock for the same period. In this base case, housing prices continue to grow rapidly until 2001. The projected severity of the price cycle rivals that of the 1980s boom. Housing stock increases slowly at first, then more rapidly. The degree to which new construction lags behind price change is similar to the previous boom, but the amount of new construction is less than in the 1980s boom.

There are a number of ways to simulate the effects of moving construction along more quickly during the current boom on housing prices. Given the structure of the model and the respective quality of different types of data available, it is most

Figure 14

Figure 15

Table 1

useful to adjust the Housing Market Imbalance Index. (It is also possible to shorten the price lags in the construction equation. However, doing so does not substantially alter the simulations. This is because the land development lags are considerably longer than the building permit and construction lags that are measured in the construction equation.)

Thus the first set of alternative simulations presented in Figures 16 and 17 is based on the model's most important explanatory variable, the Imbalance Index. In this example, we let construction per period increase early in the current boom by decreasing the Imbalance Index by 25 percent. That is, we ask how much additional construction per period would be needed to reduce the imbalance between employment growth and housing stock growth by one-fourth. As can be seen from Figure 11 above, the imbalance becomes a problem in 1996, just as it did in 1984. Allowing for a one-year lag in implementing this construction increase, we present simulations beginning in 1997. As seen in Figures 18 and 19, the more rapid construction delivery moderates both the amplitude of the price cycle and the 5-year effect on housing prices. With higher construction early on in the boom, housing prices (in 1995 dollars) increase $9000 less by the year 2002. In addition, the 2002 single-family stock is about 1400 units greater.

Figures 20 and 21 present alternative scenarios with a slightly more rapid pace of new construction. Here new construction increases enough to decrease the Imbalance Index by 40 percent, again with a lag of one year. Figures 22 and 23 compare this case to the base case. We see that the amplitude of the housing cycle is reduced further, and that 2002 housing prices (in 1995 dollars) are now $27,000 lower than in the base case. This represents a 10 percent real housing price decrease. If a modest five-year increase in the general level of prices of 10 percent is assumed, then nominal (observed) housing prices would be 20 percent lower than in the base case. The 2002 single-family stock is now 2500 units greater.

Figure 16

Figure 17

Figure 18

Figure 19

Figure 20

Figure 21

Figure 22

Figure 23

These simulations demonstrate clearly that more rapid construction during a boom period results in less upward pressure on housing prices. Additionally, with less housing price increase, more housing will ultimately be built. The model, of course, can be used to simulate the effects of numerous other housing market goals.

Cutting back moderately on the imbalance between employment growth and housing stock growth can yield substantial dividends in terms of moderating the housing price cycle. While acceleration of the building permit and construction process can be of modest help, most of the gain must come from shortening the land development process and ensuring that an adequate flow of lot filings occurs.

DATA APPENDIX

Variable	Description and Source
Employment	Total covered employment in King County. Monthly, 1975-1996, 1997 estimated. Source: Washington State Employment Security Division.
Household Income	Household income for King County. Annual, 1970-1996. Source: U.S. Department of Commerce, Bureau of Economic Analysis.
Mortgage rates	Contract mortgage rates on loans closed in Seattle-Tacoma area. Quarterly and monthly, 1979-97. Source: Seattle-Everett Real Estate Report.
Housing Price	Average price of single family homes sold in King County. Semi-annual and quarterly, 1979-1997. Source: Seattle-Everett Real Estate Report (TRW data) and Northwest Multiple Listing Service.
Stock, Single Family Stock, Multifamily	Single family and multifamily housing stock in King County, not including mobile homes, trailers, and special units. Annual, 1980-1996, 1997 estimated. Source: Washington State Office of Financial Management.
Building Permits, Single-Family Building Permits, Multi-family	Number of single family and multifamily units authorized by building permits in King County. Quarterly, 1979-1996. Source: Seattle-Everett Real Estate Report.
Rent	Average rent of rental units in King County. Semi-annual, 1980-1996. Data for 1980-1984 are derived from combined King and Snohomish County numbers. Source: Seattle-Everett Real Estate Report.
Vacancy Rate	Vacancy rate for rental units in King County. Semi-annual, 1980-1996. Data for 1980-1984 are derived from combined King and Snohomish County numbers. Source: Seattle-Everett Real Estate Report.
Lot Filings and Recordings	Filings and recording in King County. Annual, 1980-1996, 1997 estimated from first 3 quarters. Source: Seattle-Everett Real Estate Report.