WORKING PAPER NO. 96-15

THE SUBURBAN HOUSING MARKET: EFFECTS OF CITY AND SUBURBAN EMPLOYMENT GROWTH

JULY 1996

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Julie Northcott-Wilson provided excellent research assistance. Ted Crone and Joseph Gyourko provided useful comments on an earlier draft. The views expressed here are solely those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or of the Federal Reserve System

ABSTRACT

Communities in close proximity to areas of growing employment will experience greater upward housing demand shifts from job growth than more distant communities, but the housing market response will depend on the elasticity of supply, which is likely to differ across communities. Using a data set of over 88,000 housing sales in suburban Philadelphia, we find that city employment growth has a significant positive effect on suburban house values; this effect is largest for housing closest to the central business district and declines with distance from the CBD. City employment growth has a negative effect on the rate of suburban house construction; the magnitude of the negative effect increases with distance. Suburban employment growth has little aggregate effect on house prices, and there is less variation in impact by distance. Suburban growth has a significant impact on construction rates, especially at locations near the urban fringe. With regard to the value of real estate assets, city employment growth has a larger average positive effect on total value, including both price and construction impacts. Suburban homeowners and developers may, however, have divergent interests in the spatial pattern of employment growth, since suburban employment growth adds little to the value of homes in older, fully developed communities.

I. Introduction

How does the location of new jobs in a metropolitan area affect the suburban housing market? We expect job growth to increase the demand for housing, and we expect the increase in demand to be greater in communities near the new jobs than in more distant ones. Moreover, growth in jobs with higher wages should increase the demand for housing more than growth in jobs with lower wages. The market response to an increase in housing demand will depend on the elasticity of housing supply. Because of differences in proximity, wages, and housing supply, city employment growth may have dramatically different effects from suburban growth on house prices and construction rates across suburban communities. These housing market effects provide a window through which we can evaluate the overall economic contributions of city and suburban job growth as well as insights into who benefits from city and suburban job growth.

In this paper, we empirically analyze the effects of city and suburban employment growth on the housing market of Montgomery County in suburban Philadelphia over a 24-year period. This analysis is unique in three ways. First, we analyze the effects of city and suburban growth on both the price and quantity side of the housing market over a relatively long period of time. Second, we estimate how the effects of city and suburban employment growth differ spatially across the suburban housing market. Third, we estimate the total impact of city and suburban employment growth on suburban residential land value.

We find that city employment growth has a significant, positive effect on suburban house values; this effect is largest for housing closest to the central business district (CBD) and declines

with distance from the CBD. City employment growth has a negative effect on suburban house construction, and the magnitude of the negative effect increases with distance. Suburban employment growth, on the other hand, has little aggregate effect on house prices, and there is less variation in impact by distance. Suburban growth has a larger impact on construction rates, especially at locations near the urban fringe.

These findings suggest that city employment growth enhances the property values of developed communities while suburban growth enhances the return from converting agricultural land to residential uses. Because the price impacts are generally larger than the quantity impacts, city employment growth increases aggregate suburban residential value more than suburban growth. This suggests that city employment remains more productive than suburban employment.[1]

The plan of the paper is as follows. Section 2 discusses the relevant literature and theoretical considerations. Section 3 describes the data. Section 4 presents the empirical models and findings and Section 5 concludes.

II. Literature and Theoretical Considerations

The earliest models of urban economies with centralized production such as those of Mills (1967) and Muth (1969) highlight the role of proximity to employment for the housing

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[1]The decline in the number of city jobs suggests, however, that the higher compensation of city jobs may no longer reflect the true productivity differential, and, hence, city employment is declining. Moreover, these findings do not necessarily imply that aggregate production could be increased by shifting employment from the suburbs to the city.

market. Workers seeking to avoid high commuting costs bid up prices for inelastically supplied land near the employment center. With distance, the price of land falls, and the lowest prices are found on the urban fringe, where there is a perfectly elastic supply of agricultural land. As is evident in monocentric models with dispersed employment such as those of Brueckner (1979) and White (1988), rent gradients arise around employment centers, but not around dispersed employment sites. Polycentric models by Ogawa and Fujita (1980), Helsley and Sullivan (1991), and Yinger (1992) also give rise to center-specific gradients, with the size of employment centers differentially affecting suburban housing markets.

From an equilibrium perspective, rent gradients around employment centers can be sustained only if there are productivity advantages associated with centralized production that can support the higher house prices. There is a long tradition of estimating land and housing price gradients around employment centers in both monocentric and polycentric settings.[2] Changes in gradients over time are of interest because they provide insight on the evolution of the productivity benefits of agglomeration over time.[3]

The perspective of this paper is somewhat different. Rather than attempting to make

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[2]See Waddell, Berry, and Hoch (1993), Heikkila et al. (1989), and McDonald and McMillen [1990] for analyses of land value gradients in a polycentric context. In a monocentric setting, there is mixed evidence on CBD rent gradients, with some analyses finding positive or insignificant gradients (Cropper and Gordon (1991), Heikkila et al. (1989), and Voith (1991), for example). Other studies have found the expected negative gradient (Voith (1993) and Sivitanidou (1996), for example.) See Jackson (1979) for a review of earlier studies.

[3]While land price gradients should reflect the value of agglomeration, researchers have generally focused on density gradients to evaluate the relative importance of basic economic factors such as technology and income compared with urban problems such as crime in the process of decentralization. See Mills and Mieszkowski (1993) for a review of this literature.

inferences about the strength of agglomeration economies and factors affecting the value of agglomeration from price gradients, we are interested in examining the land market consequences of shifts in the degree to which production occurs in centralized versus decentralized locations. Operationally, we use central city employment growth as a measure of centralized employment growth and suburban employment growth as the measure of decentralized growth, so that the focus is basically monocentric.[4] While city and suburban job growth do not exactly correspond to centralized and decentralized job growth, we expect that the impact of city growth should be more like that of centralized growth.[5] To the extent that suburban job growth is widely dispersed and occurs substantially on the urban fringe, we expect the effects of suburban growth to be like those of decentralized growth.

A priori, we expect that shifts in demand from city employment growth will result in higher house prices in communities close to the city with little effect on construction rates while suburban growth should have little effect on house prices, but should increase the rates of housing construction in new communities on the urban fringe.[6] If suburban employment growth

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[4]Of course, not all suburban growth is decentralized growth; suburban employment centers are common throughout the U.S. To the extent that suburban growth is concentrated in discrete employment centers, we would expect greater price impacts associated with suburban growth.

[5]Because of the high density of both employment and population throughout the city of Philadelphia, all city job growth is thought of as centralized growth, which increases the intensity of land use in the existing communities. This is not necessarily true for all central cities in the United States since some central cities have significant amounts of agricultural land within their boundaries.

[6]Housing price and construction are likely to be jointly determined with employment. In the empirical analysis, we examine the effect of lagged employment on current house price and construction. Voith (1993) provides evidence suggesting that lagged city employment growth

occurs at the expense of city jobs, it may have negative effects on prices in older, developed communities. Similarly, city growth that replaces suburban jobs could reduce construction rates on the fringe. In addition, if employment growth is correlated with other factors that enhance the relative attractiveness of the community, growth in employment in one community could negatively affect the other, even though city and suburban growth are not substitutes.

With regard to the value of real estate assets, suburban homeowners and developers may have divergent interests in the pattern of employment growth. Employment growth in existing centers, such as the CBD, is likely to enhance the value of existing houses while decentralized growth is likely to result in shifts of agricultural land to residential use, with little or no price impact on existing houses. Developers and owners of agricultural land are thus the primary beneficiaries of the demand shift associated with suburban growth.

In addition to the distributional consequences of the location of employment growth, there are potentially different impacts on aggregate land value. To the extent that city employment is more productive than suburban employment, city employment growth will have a larger impact on total land value. Of course, the distribution of job locations is an outcome of individual maximization decisions, which, in the absence of externalities, should result in the distribution of employment that maximizes the value of residential land. However, because the returns to agglomeration are not purely private, it is possible that private decisions result in a level of suburban growth greater than what is consistent with aggregate land value maximization.

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positively affects house values in communities with good accessibility to the CBD.

III. Data

The data used in this analysis are unique in that they allow examination of both house prices and housing construction by location. The primary data source is the Montgomery County tax-assessment file. Montgomery County is adjacent to the city of Philadelphia, Pennsylvania, and is one of four suburban counties on the Pennsylvania side of the Philadelphia metropolitan area. (See Figure 1.) From the 1988, 1994, and 1995 tax-assessment files, we have data on more than 88,000 sales of single-family detached houses over the period 1972-1995. These data contain information about housing traits, age, and location as well as the real sale price and date of sale.[7]

Because the file includes virtually all properties in the county, it is possible to calculate the number of new houses constructed each year in a given geographical area. We compute annual rates of construction for virtually all census tracts in the county.[8] On average, 42 percent of tracts have no construction in any given year, and 4.2 percent of tracts have no new construction over the entire sample period. Figures 2a and 2b show the average real appreciation rates and construction rates over the sample period. Clearly, there is considerable variation over time in both construction and appreciation rates. This paper will show that there is also considerable variation across communities that is systematically related to the geography of employment growth.

To examine the role of city and suburban employment growth in the suburban housing

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[7]All dollar figures are in 1990 dollars.

[8]We excluded 9 of the 200 census tracts from the analysis because of coding problems in these census tracts. Tracts are based on 1980 census definitions.

market, we have linked the data on individual houses to data on neighborhoods, central city accessibility, and employment. The data on accessibility include highway travel time to the CBD and whether the house is in a census tract with commuter rail service to the CBD.[9] The neighborhood variables include average household size, racial mix, and population density by census tract.

Employment growth rates are calculated for the city of Philadelphia and the Pennsylvania suburbs of Montgomery County and the other suburban counties, all of which are adjacent to Montgomery County.[10] The employment data are based on the Bureau of Labor Statistics' establishment survey and are smoothed using three-month moving averages. Because other cyclical factors may affect the capitalization of accessibility, we also include data on mortgage rates and the CPI for gasoline. Table 1 gives the means and standard deviations of the housing, neighborhood, accessibility, and employment variables used in the house price estimations. The means and standard deviation of the variables (which are all census tract level variables) used in the construction equations are shown in Table 2.

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[9]Voith (1991) and Voith (1993) document the effects of commuter rail accessibility on house values in suburban Philadelphia. Voith (1991) describes the procedure for deciding whether a particular community is served by commuter rail service.

[10]The analysis was also done using all suburban counties in the PMSA, and the results were substantially unchanged. In addition, we also used employment data for Montgomery County only with qualitatively similar results. The Montgomery County employment data are available only annually and hence introduce noise because the date of sale may be poorly matched with calculated annual growth rate.

IV. Empirical Models: Specification and Findings

In both the house price and the housing construction equations, we estimate three classes of models. First, we estimate the effects of lagged city and suburban employment growth on the housing market. Second, we estimate similar models except we allow the effects of city and suburban employment growth to vary according to distance from house to the central business district of Philadelphia. Third, we reestimate the interacted model with additional controls for other cyclical factors that may affect the value of CBD accessibility. In the most extreme form, we estimate a model with fixed effects for the year of sale, which essentially removes the influences of the effects of city and suburban employment growth that are common across tracts. For house prices, we also estimate a model that includes a time series on mortgage rates and the CPI for gasoline, fully interacted with the accessibility variables. The price and quantity estimations are discussed in detail in the following subsections.

House Price Equations: Specification

The house price estimations are hedonic equations of the general form:

$$(1) \qquad P_{it} = \beta_0 + \beta_{1t}X_{it} + \beta_{2t}N_{it} + \beta_3 A_i + \beta_4 EC_{t-1} + \beta_5 ES_{t-1} + \beta_6 Z_t + \beta_7 A_{it}*EC_{t-1} + \beta_8 A_i*ES_{t-1} + \beta_9 A_i*Z_t + e_{it}$$

where: P_{it} is the price of house i that is sold at time t;[11]

[11]Note that there are not generally multiple sales of the same house and the t subscript indicates what year the house was sold so that it can be matched with time-varying variables.

X_{it} is a set of attributes of house i that correspond to the variables shown in Table 1;

N_i is a set of neighborhood attributes associated with house i and are shown in Table 1;

A_i is a set of accessibility variables associated with i also shown in Table 1;

EC_{t-1} is the employment growth rate in the city in the previous year;

ES_{t-1} is the employment growth rate in the suburbs in the previous year;

Z_t is a set of time-varying variables that do not vary across locations.

Several aspects of this equation are of interest. First, the coefficients β_{1t} and β_{2t} are time-varying parameters, so the price of housing traits and neighborhood attributes can change over time. Thus there are 24 parameters for each housing and neighborhood trait.[12] Second, one of the two accessibility variables, highway travel time to the CBD, is entered with its square as well to allow a non-linear relationship between price and distance. Third, the accessibility variables are not indexed by time because we wish to explain how prices in communities are differentially affected by changes in employment growth. Fourth, we use lagged employment growth to avoid simultaneity arising from the likelihood that current housing prices might affect the labor market outcomes.

One might suspect that because there is considerable correlation in city and suburban employment growth rates (correlation 0.67) it would be difficult to estimate the differential impacts of city and suburban growth in equation (1). As is evident in Figure 3, however, there are substantial differences in the movements of city and suburban growth rates. While suburban growth rates are almost always larger than city growth rates (city growth rates are predominantly

[12]F-tests strongly reject the hypothesis that hedonic prices of housing and neighborhood traits do not change over the sample period.

negative), the difference in city and suburban growth rates varies substantially over extended periods.

In an attempt to eliminate all potential biases from unobserved time-varying factors that might be correlated with employment growth, we also estimate a model with fixed effects for time. In this model, only the differential effects of employment growth across housing location are measured; all effects of employment (and other unobserved time-varying factors) that are common across location are captured in the fixed effects. In the case of fixed effects, equation (1) becomes:

$$(2) \qquad P_{it} = \beta_0 + \beta_{1t}X_{it} + \beta_{2t}N_{it} + \beta_3 A_i + \beta_7 A_i * EC_{t-1} + \beta_8 A_i * ES_{t-1} + \delta T + e_{it}$$

where T is a vector of dummy variables for each year in the sample period.
Note that there are no variables included that do not vary across space except for the time dummies.

House Price Equation: Findings

Estimates of the coefficients of interest of equation (1) are shown inTable 3.[13] The simplest models, shown in columns 1-3, include no interaction terms and provide a measure of the aggregate effects of city and suburban employment growth on suburban house values as well as measures of the value of accessibility to the CBD by train and by car. First, consider the accessibility coefficients. The coefficient on Station indicates that living in a community with

[13]We do not present the coefficients (which number 336) on the housing and neighborhood traits. Generally, the estimated coefficients are of the expected signs and magnitudes and are highly significant. Full model results are available on request.

train service adds, on average, over $12,300 to the price of the house.[14] This estimate is highly significant and remarkably stable across specifications. The coefficients on Highway Time and its square are, like Station, highly significant and stable across specification. They imply that houses decline in value as they become more distant from the CBD throughout the sample range.[15]

With regard to the effects of employment growth on house prices, there is a marked difference in the impacts of city and suburban growth. The coefficient on lagged city employment growth in column 1 is significant at the .01 level and indicates that a 1 percent increase in Philadelphia city employment generates slightly more than a $1000 increase in average suburban house prices.[16] One might suggest that the positive coefficient in column 1 reflects simply the correlation of city employment growth, but note that suburban employment growth in column 2 has an insignificant coefficient that is one-seventh the size of the estimated city effect in column 1. Finally, note that in column 3, inclusion of both city and suburban growth results in virtually no change in the city coefficient and a negative effect of suburban employment. Thus in these very simple regressions, city employment growth appears to have a

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[14]Voith (1993) shows that the value of CBD accessibility by both train and car can vary substantially over time.

[15]This finding is not consistent across all suburban Philadelphia counties. See Voith (1991) and Voith (forthcoming 1996).

[16]We also investigated longer lag structures and found significant effects of similar magnitudes as for the second and third lags. Adding additional lags caused little change on the first lag coefficient. We report only the estimation with a single lag, primarily for presentational convenience and comparability with the fully interacted specification where multiple lags greatly expand the parameter space. The magnitude and significance of the additional lags suggest that successive declines in employment have cumulative effects.

significant positive effect on average suburban house value while suburban employment growth does not.

The estimates shown in column 4 of Table 3 include accessibility/employment growth interactions.[17] Note that all of the coefficients are highly significant with the exception of the Station/Suburban Employment Growth interaction. Evaluated at the average distance from the CBD and the sample average of houses receiving train service, the estimates in column 4 imply roughly the same level of impact as do the simple estimations above. However, the magnitudes of the employment impacts become much more economically significant when one compares the impacts across suburban communities.

First, consider the effects of employment on the value of CBD accessibility by train. The coefficient on Station*City Employment Growth implies that each 1 percent of city employment growth increases the value of train accessibility by $1554. As one would expect, there is no marginal effect of suburban employment growth on neighborhoods with train stations, since train service adds little to suburban employment accessibility.

The coefficients on the effects of employment and their highway interactions are more difficult to interpret by simply examining the coefficients, but Figure 4 displays the total impacts of city and suburban employment growth on suburban house values by travel time to the CBD,

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[17]We should note that accessibility measures the accessibility to the CBD but the employment figures are for the city as a whole. It is likely that CBD employment growth is correlated with the overall growth rate of city employment, but there is evidence that the CBD has not suffered the same kinds of employment decline than has the city as a whole. Over the sample period, the CBD's share of the city's employment has increased from over a quarter to over a third.

based on the estimates in column 4.[18] For houses that are a 20-minute commute to the CBD, a 1 percent employment growth in city employment increases house prices by almost $7200, but this figure declines to zero at a commute time of 60 minutes, which is slightly greater than the average highway time to the city. After 60 minutes, the effect becomes negative, approaching -$2200 for the most distant communities.

The differences in the impact of suburban employment growth across communities are much smaller than are differences in the impact of city employment growth. Suburban growth increases the value of houses more than 52 minutes away from the CBD, but the peak positive effect is $1800 for a 1 percent increase in suburban growth.[19] Suburban employment growth of 1 percent has a negative effect on close-in suburban housing, nearly $3700 for houses 20 minutes from the CBD.

If there are omitted variables correlated with employment growth over time that affect the value of accessibility, the estimated impacts of employment could be biased. To address this issue, we reestimated the model with mortgage rates and energy prices as reflected in the CPI for gasoline. These variables were also interacted with the accessibility variables. In addition, we estimated the fixed effects model shown in equation (2). These estimations are shown in Table 4, with the fully interacted model shown in column 1 and the fixed effects model shown in column 2.

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[18]These figures include the effects of the station/employment interaction weighted for the proportion of houses in neighborhoods with train service.

[19]Because the level of suburban employment is now more than twice the level of city employment, a 1 percent increase in suburban employment is twice as large as a 1 percent increase in city employment in absolute terms.

The fully interacted model yields employment growth effects qualitatively similar to the effects found in the simpler model.[20] The marginal effect of city growth interacted with station, for example, is virtually unchanged. The magnitude of the differences in employment's effect across commuting distances, however, is somewhat smaller, as is evident in Figure 5. While the difference between the impact of city employment growth between the closest and furthest station was almost $9400 in the simple model, it is slightly over $7200 in the interacted model. With regard to the effects of suburban employment growth, the difference between the closest and furthest station is about $1600.

The fixed effects estimates shown in column 2 purge employment effects that are common across all tracts and provide an estimate of the differences across tracts that should be free from biases from omitted variables. In this estimation, the effects of the station/city employment interaction are about 25 percent larger than in the earlier models. A city employment increase of 1 percent raises the value of houses with train service almost $2000. As before there is no differential impact by station for suburban growth.

The employment/highway time interactions are consistent with those in the other models, but there are some differences. As is evident in Figure 6, the positive effects of city employment growth are much smaller than in the other models, which is not surprising because the effects of

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[20]The coefficients on the mortgage rate and CPI for gasoline and their interactions are usually significant and of the expected sign. Higher gas prices increase the value of train station accessibility and higher mortgage rates lower the capitalized value of accessibility by train. One would expect that higher mortgage rates would lower the price impact of station accessibility because accessibility is essentially a capital good that is more expensive with higher mortgage rates. With regard to highway accessibility, the gasoline interactions suggest that higher gasoline prices steepen the highway time gradient, while higher mortgage rates flatten the highway time gradient.

employment growth that are common across tracts have been eliminated. The pattern of effects is slightly different as well; the effects do not begin to decline until a commuting distance of 29 minutes and do not become negative until a commuting distance of 65 minutes. Unlike the earlier estimates, the effects decline at an increasingly rapid rate with distance. The difference in city employment effects from the closest to the furthest community is about $6000, which is considerably smaller than the simple model but quite close to the fully interacted model. The suburban employment effects, like the city effects, yield a curvature of the impact/distance relationship that is reversed from the earlier models; the magnitudes of impacts are, however, similar to those in the other models.

In summary, the estimates imply that city employment growth has a significant, positive impact on suburban house prices while suburban employment growth, on average, does not. City employment growth has a strong differential effect on suburban house prices in communities with train service while suburban employment growth does not. However, both city and suburban employment growth differentially affect communities according to their distance from the CBD. The differences in the impact of employment growth and house prices across communities are much larger for city employment growth than for suburban employment growth.

Finally, the fact that city employment growth has a negative effect on more distant communities holding suburban growth constant, and the fact that the reverse is true for suburban growth, imply that employment growth must be correlated with other factors that affect the relative attractiveness of city versus suburbs. Note that for city employment growth to have a negative effect on distant suburbs, holding suburban employment growth constant, people must

be choosing to live closer to the CBD for reasons aside from commuting. Perhaps city employment growth is correlated with improved, regionally valued city amenities, which induce more people to choose closer locations, for a given suburban employment growth rate.

Housing Quantity Estimations

The individual observations on housing by age have been used to construct housing construction rates for individual census tracts for each year of the sample. Because there are many fewer degrees of freedom, we specify considerably simpler models for the construction rate equations. The basic specification is:

(3) $$H_{it} = \alpha_0 + \alpha_1 D_i + \alpha_2 M_t + \alpha_3 A_i + \alpha_4 EC_{t-1} + \alpha_5 ES_{t-1} + \alpha_6 EC_{t-1} * A_i + \alpha_7 ES_{t-1} A_i + u_{it}$$

where H_{it} is the growth rate in housing in tract i at time t;

D_i is the 1980 population divided by land area.

M_t is the mortgage rate at time t.

In this specification, we include density to control for the availability of open land and mortgage rates for their cyclical effect on construction. Unlike the previous specification, no quadratic term is included for the highway accessibility variable, as the hypothesis of a linear effect could not be rejected. A fixed effects version of equation (4) was also specified and is shown below:

(4) $$H_{it} = \alpha_0 + \alpha_1 D_i + \alpha_2 A_i + \alpha_3 EC_t * A_i + \alpha_4 ES_i * A_t + \gamma T + u_{it}$$

Because there frequently is no construction in a census tract during a particular year, and because we do not observe negative construction, the observed distribution of errors is essentially truncated. In this situation the Tobit is the appropriate procedure to estimate equations (3) and (4). Table 5 presents three Tobit estimations that are analogous to the housing price regressions.

Column 1 includes city and suburban growth but no interactions; column 2 shows interaction terms; and column 3 shows the fixed effects model. Table 6 shows the marginal effects implied by the Tobits.

All of the coefficients except the intercept are significant in the simplest model with no interactions shown in column 1. The most important factor in the construction equation is density, which has a large negative effect on construction. The mortgage rate also has a negative coefficient, as expected. The station variable is also negative, reflecting the fact that the railroad serves suburban towns that are among the oldest suburbs developed. Highway time is positive, which is consistent with the hypothesis that there is more open space to develop housing the closer one is to the urban fringe.

The employment growth variables are both significant but have opposite signs. City employment growth has a negative effect on suburban construction, on average, holding suburban growth constant. Using the estimated marginal effect from Table 6, an increase of 1 percent in city employment growth reduces the construction rate 0.1 percent, which is economically significant considering the average construction rate is slightly less than 1 percent. The fact that city employment growth reduces suburban housing construction, given suburban employment growth, again suggests that city employment positively affects the attractiveness of a city residence compared to a suburban residence. Suburban employment growth has the expected positive coefficient, which is of similar magnitude to the negative effect of city employment growth. This, coupled with the house price results, is consistent with the idea that suburban employment growth induces a larger quantity response in the housing market than does city employment growth.

The equation containing the interaction terms--with and without fixed effects--yields very similar coefficients for density and station variables. While the fixed effects regression does not include the mortgage rate, the coefficient on the mortgage rate in the interacted model is nearly identical to that of the simple model. The non-interacted employment terms in the equation without fixed effects are very insignificant. The coefficients on the employment terms that are interacted with highway time are significant and nearly identical across the interacted and fixed effects specifications. Interestingly, there are no significant effects of either city or suburban employment growth that vary across communities with and without train stations. There is, however, significant variation in the impacts of both city and suburban growth with differing highway accessibility to the CBD.

Figure 7 shows the implied impacts of city and suburban employment growth by highway time to the city based on the estimated marginal effects from the regression with the interaction terms shown in column 2 of Table 6. As is evident in this figure, the impact of city employment growth on suburban construction rate is 0.03 percent in communities within a 20-minute commute but is highly negative, -0.27 percent, in the most distant communities.[21] Thus, a healthy city economy reduces the relative attractiveness of the most distant communities. The marginal effects for suburban employment growth are as expected. Increases in suburban employment growth have positive effects on housing supplied in distant communities but little effect on close-in communities, even controlling for density. This suggests that much of the new

[21]The figures are non-linear because the transformation of the Tobit coefficient to obtain estimated marginal effects is not linear. Note that the estimated marginal effects shown in Table 6 are computed at the average values for all variables, while the marginal effects computed for Figure 7 are evaluated at the average for all variables except for the highway time variable.

suburban employment is truly decentralized; that is, it occurs at the fringe of the metropolitan area, expanding the metropolitan area's boundaries but not increasing employment density. Employment growth of this type adds little to the job accessibility characteristics of existing suburbs.

Aggregate Land Value Impacts

Using the coefficients from the house price and house quantity estimations, we can compute the impacts of city and suburban employment growth on aggregate residential land value.[22] In addition, we can compute the impacts for particular communities in Montgomery County; for example, we can estimate the change in residential value resulting for Narberth, a community that is a 24-minute commute from the CBD and has train service, and compare those impacts with those for Salford, a community with a 77-minute commute and no train service.

There are two elements in the calculation of impacts on residential land value: the change in values for existing houses and the change in property value associated with the construction of new houses. We can construct estimates using either the simple models with no interactions or the models with interactions, but in the latter case, we need to aggregate the effects on individual communities (census tracts).[23] The change in residential value is simply the sum of impacts (basically the effects shown in Figures 5 and 6) weighted by the number of households in each

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[22]The impacts are not total metropolitan impacts but rather for Montgomery County only.

[23]The fixed effects coefficients probably should not be used to calculate aggregate residential value impacts because they would understate the impacts to the extent that employment growth has impacts that are common across tracts.

community.[24] Using the coefficients from the simplest model implies that a 1 percent increase in city employment increases aggregate house value 0.54 percent of aggregate residential value, while a similar growth of suburban employment has virtually no effect.[25] Using the estimates from the fully interacted model shown in column 1 of Table 4 yields slightly larger impacts of 0.58 percent for city employment growth and again little impact for suburban employment growth.

Calculating the change in residential land values resulting from new construction is complicated by the fact that, ideally, one would like to know the difference between the value of land before and after new construction. We do not have a good measure of the value of vacant land or of the value of land after construction. We assume that agricultural land has no value and that the value of newly developed land is equal to the average tract price including housing. Thus our aggregate construction impacts represent an upper bound. Since the dependent variable in the Tobit estimations is the fraction of total housing stock construction each year, the marginal effects shown in Table 6 straightforwardly yield the percentage increase in house construction. The simple, non-interacted model implies that an increase of 1 percent in city

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[24]The aggregate price impact of a change in city employment is

$$E_p = N\beta_1 \Delta EC_{t-1} + \sum_i^I n_i [\beta_2 HT_i * \Delta EC_{t-1} + \beta_3 HT_i^2 * \Delta EC_{t-1} + \beta_4 S_i * \Delta EC_{t-1}]$$

where N is the number of houses, I is the number of communities, n_i is the number of houses in community i, HT is the highway commute time and S is whether the community has a train station or not and the βs are the corresponding coefficients. The equation for a change in suburban employment has the same form. Note these calculations compute only the aggregate change in value of single-family, detached dwellings.

[25]The calculation assumes an average house price of $166,906, based on transactions in the period 1990-1995.

employment growth reduces the aggregate value of new housing -0.11 percent while similar suburban employment growth increases the aggregate value 0.089 percent. The fully interacted model implies similar effects, -0.11 percent for city and 0.091 percent for suburban employment growth.

The net effect of city and suburban employment growth is the sum of the aggregate price and quantity effects. Focusing on the fully interacted model, the housing price and quantity estimations imply that city employment growth of 1 percent increases the net value of housing in Montgomery County 0.48 percent while suburban employment growth of 1 percent increases the value 0.11 percent. The city effect is predominantly a result of price, while the suburban effect is predominantly a result of quantity.

Net consequences can be calculated for particular census tracts as well. For example, Narberth, a small, old, relatively dense town that has train service and is a 24-minute commute to the CBD, would enjoy an increase in value of 3.15 percent from an increase in city employment of 1 percent, but would suffer a decrease of -0.47 percent as a result of an increase of 1 percent in suburban employment. On the other hand, Salford, a town near the urban fringe (77 minutes from the CBD) with low population density and no train service, would suffer a decline of -1.38 percent in residential value with city employment growth of 1 percent but would gain 0.39 percent with a similar growth in suburban employment.

V. Conclusion

In this paper we have presented evidence that city and suburban employment growth have different effects on the suburban housing market in Montgomery County. Moreover, these effects differ across communities within the county. The findings are consistent with the notion that centralized growth tends to have large price effects on suburban housing in communities that have commuting advantages to the area of centralized growth. On the other hand, decentralized growth tends to have little price effect but modest quantity effects. The finding that city growth has negative price and quantity effects on distant suburban areas, holding suburban employment constant, implies that there are other factors correlated with city employment growth that make the city relatively more attractive when employment grows. The results also imply that central city growth slows the pace of converting agricultural land into new housing. Finally, the calculated effects of city employment growth on aggregate residential value exceed the effects of suburban growth. This fact suggests that local agglomeration externalities associated with centralized growth generate higher productivity and incomes that support the higher suburban land values.

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Table 1
Variables Used in House Price Estimations
Means and Standard Deviations

Housing Characteristics	Mean	Standard Deviation
Price	146398.44	83039.17
Dummy for central air conditioning	0.35	0.48
Number of bathrooms	1.94	0.75
Dummy for fireplace	0.61	0.49
Age at time of sale	30.49	27.54
Dummy for garage	0.80	0.40
Dummy for pool	0.07	0.26
Living area in square feet	2011.74	784.89
Lot size in square feet	19614.30	15126.70
Neighborhood Characteristics		
Percent of population black	3.11	5.77
Average commute time	22.55	3.22
Accessibility Variables		
Dummy for train station	0.42	0.49
Highway time to CBD	55.53	15.95
Time Varying Variables		
City employment growth	-0.01	0.02
Suburbs employment growth	0.02	0.02
Mortgage rate	9.83	2.00
CPI for motor fuel	83.67	22.15
Interactions		
City emp. growth*station/100	-0.42	1.27
City emp. growth*highway time	-0.57	1.06
Suburbs emp. growth*station/100	0.95	1.84
Suburbs emp. growth*highway time	1.21	1.35
CPI*station	35.01	43.53
CPI*highway time	4653.42	1858.54
Mortgage rate*station	4.17	5.06
Mortgage rate*highway time	544.46	190.29

Table 2
Variables Used in Housing Growth Estimations
Means and Standard Deviations

Variable	Mean	Standard Deviation
New Construction/Housing Stock	0.010	0.025
Mortgage Rate	10.152	2.208
City Employment Growth	-0.012	0.017
Suburbs Employment Growth	0.022	0.021
Station	0.440	0.496
Highway Time	56.838	16.406
Density	3610.855	3420.030

Table 3
Regression: Employment and House Prices

	Column 1		Column 2		Column 3		Column 4	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
Station	12318.00*	32.86	12317.00*	32.86	12318.00*	32.86	13658.00*	16.36
Highway Time	-2299.12*	-39.86	-2299.00*	-39.85	-2299.13*	-39.86	-3003.33*	23.41
Highway Time Sq.	9.48*	18.60	9.48*	18.60	9.48*	18.60	13.09*	11.51
City Employment Gr.	101559.00*	4.06			103196.00*	3.98	1182318.00*	9.42
Suburb Employment Gr.			14948.00	0.83	-4485.26	-0.24	-701694.00*	-7.03
Station*City Emp. Gr.							155388.00*	5.39
Station*Suburb Emp. Gr.							5767.65	0.25
Highway Time*City Emp. Gr.							-29391.00*	-6.61
Highway Time Sq.*City Emp. Gr.							145.45*	3.69
Highway Time*Suburb Emp. Gr.							18419.00*	5.19
Highway Time Sq.*Suburb Emp. Gr.							-96.10*	-3.05
R^2	0.698		0.698		0.698		0.699	
Number of observations	88889		88889		88889		88889	

*Denotes significance at the 5% level

Table 4
Regression: Employment and House Prices

	Column 1		Column 2	
	Coef	t-stat	Coef	t-stat
Station	16693.00*	7.11	14599.00*	17.68
Highway Time	-3557.75*	-9.76	-2104.15*	-30.75
Highway Time Sq.	18.23*	5.65	6.01*	8.33
City Employment Gr.	953487.00*	7.31		
Suburb Employment Gr.	-267193.00*	-2.46		
CPI Motor Fuel	763.88*	8.45		
Mortgage Rate	-10993.00*	-10.90		
Station*City Emp.	159311.00*	5.31	198750.00*	6.97
Station*Suburb Emp.	17931.00	0.72	-18489.00	-0.81
Highway Time*City Emp.	-23837.00*	-5.15	9309.32*	6.06
Highway Time Sq.*City Emp.	122.52*	2.98	-163.41*	-7.98
Highway Time*Suburb Emp.	7586.35**	1.95	-4876.18*	-4.10
Highway Time Sq.*Suburb Emp.	-48.07	-1.39	86.25*	5.34
Station*CPI Motor Fuel	36.52**	1.91		
Highway Time*CPI Motor Fuel	-21.25*	-7.19		
Highway Time Sq.*CPI Motor Fuel	0.09*	3.64		
Station*Mortgage Rate	-651.05*	-3.20		
Highway Time*Mortgage Rate	263.63*	8.38		
Highway Time Sq.*Mortgage Rate	-1.43*	-5.14		
R2	0.701		0.927	
Number of Observations	88889		88889	

*Denotes significance at the 5% level
**Denotes significance at the 10% level

Table 5
Tobit Estimations: Rates of New Construction

	No Employment/ Accessibility Interactions		Employment/ Accessibility Interactions		Fixed Effects by Year with Interactions	
	Coef	t-stat	Coef	t-stat	Coef	t-stat
Intercept	0.00185	0.43	0.01523**	1.94	0.01096*	1.97
Mortgage Rate	-0.00070*	-2.59	-0.00070*	-2.61		
Density	-0.000005*	-20.94	-0.000005*	-20.98	-0.000005*	-21.15
Station	-0.00396*	-2.93	-0.00420	-1.15	-0.00441	-1.22
Highway Time	0.00024*	6.29	0.00001	0.12	0.00002	0.15
City Employment Growth	-0.23319*	-4.30	0.23077	0.97		
Sub Employment Growth	0.19767*	4.78	-0.13686	-0.73		
Station*City Emp Growth			0.05871	0.49	0.05900	0.50
Station*Suburb Emp Growth			0.04409	0.47	0.04967	0.53
Highway Time*City Emp Growth			-0.00844*	-2.34	-0.00835*	-2.38
Highway Time*Sub Emp Growth			0.00550*	1.97	0.00546*	1.97
Log Likelihood	4063		4068		4109	
Number of Observations	4393		4393		4393	

*Denotes Significance at the 5% Level
**Denotes Significance at the 10% Level Mortgage Rate

Table 6
Estimated Marginal Effects of Tobits

	No Employment/ Accessibility Interactions	Employment/ Accessibility Interactions	Fixed Effects by Year with Interactions
Intercept	0.00083	0.00688	0.00494
Mortgage Rate	-0.00031	-0.00032	
Density	-0.0000023	-0.0000023	-0.0000023
Station	-0.00179	-0.00189	-0.00199
Highway Time	0.0001093	0.0000058	0.0000072
City Employment Growth	-0.10534	0.10433	
Sub Employment Growth	0.08930	-0.06181	
Station*City Emp Growth		0.02652	0.02658
Station*Suburb Emp Growth		0.01992	0.02238
Highway Time*City Emp Growth		-0.00381	-0.00376
Highway Time*Sub Emp Growth		0.00248	0.00246

Figure 1

Figure 2A

Price Appreciation

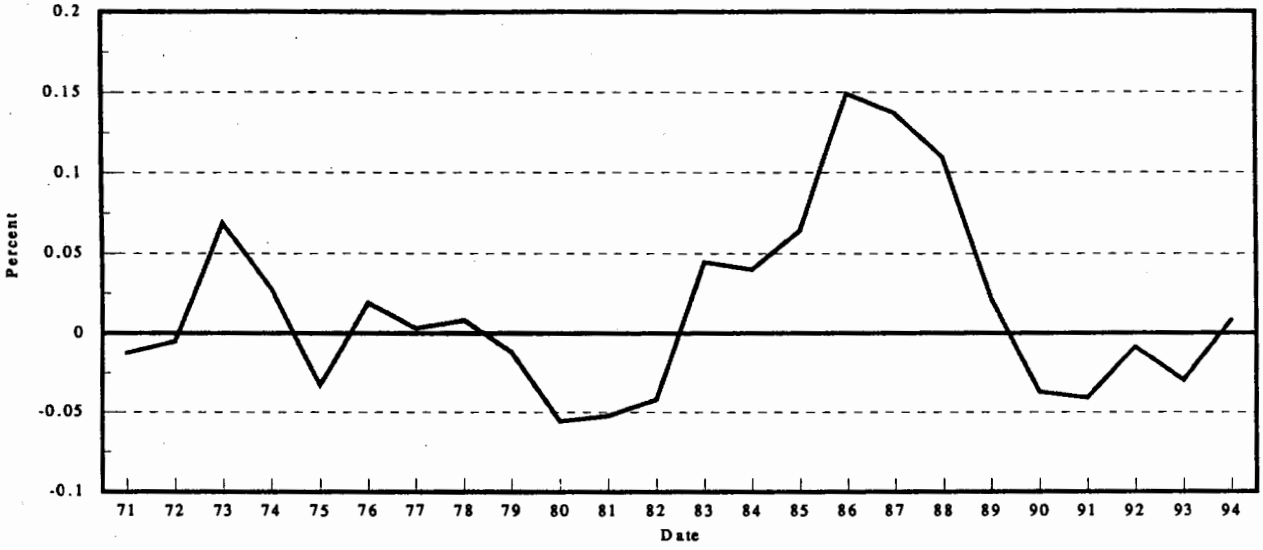

Figure 2B

Growth in Housing Stock

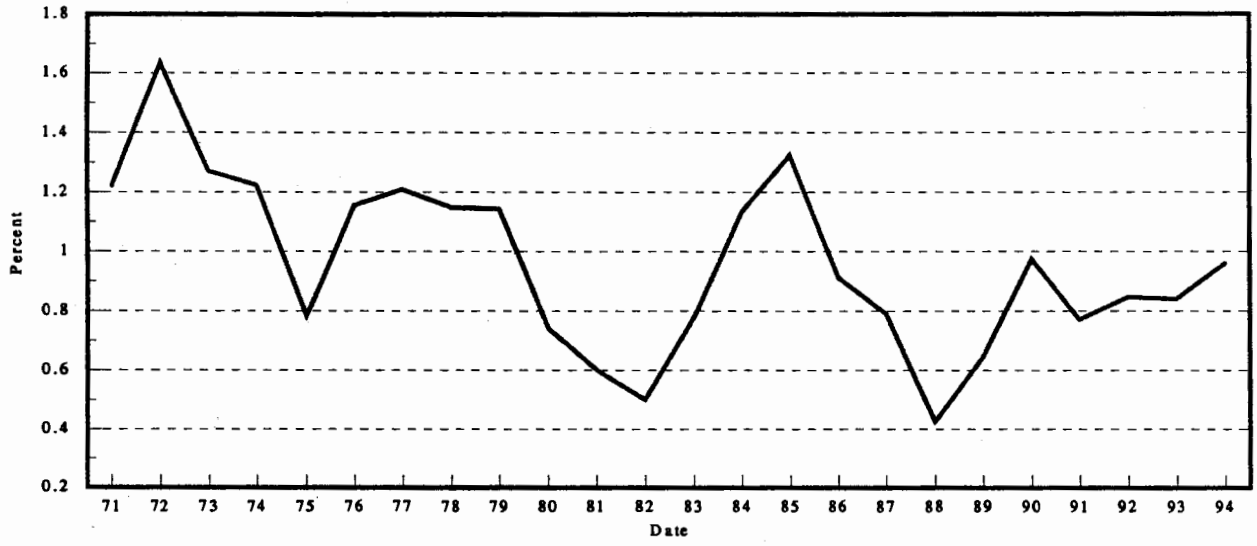

Figure 3

Excess of Suburban Employment Growth Rate over City Employment Growth Rate

(3-Month Moving Average)

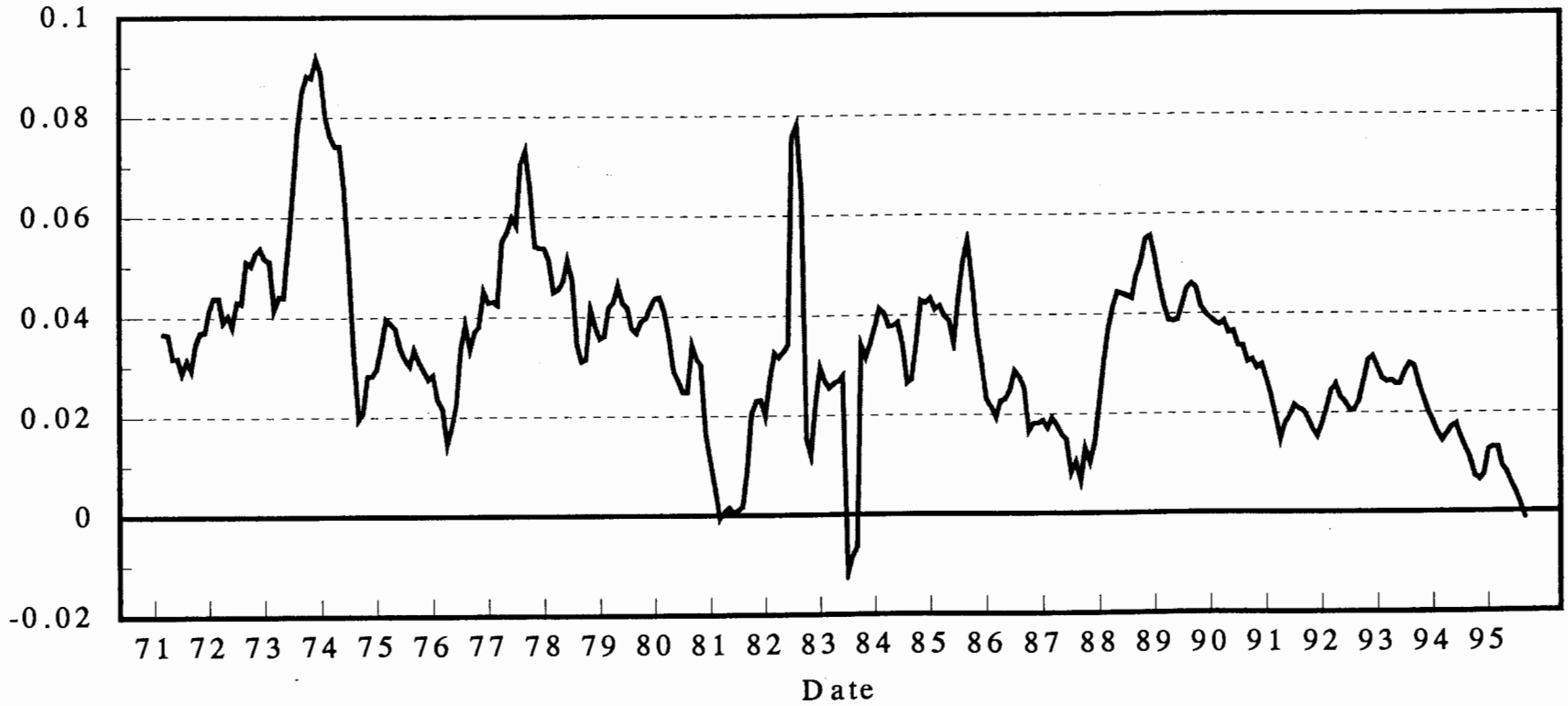

Figure 4

Basic Interacted Model: House Prices

Based on Table 3, Column 4

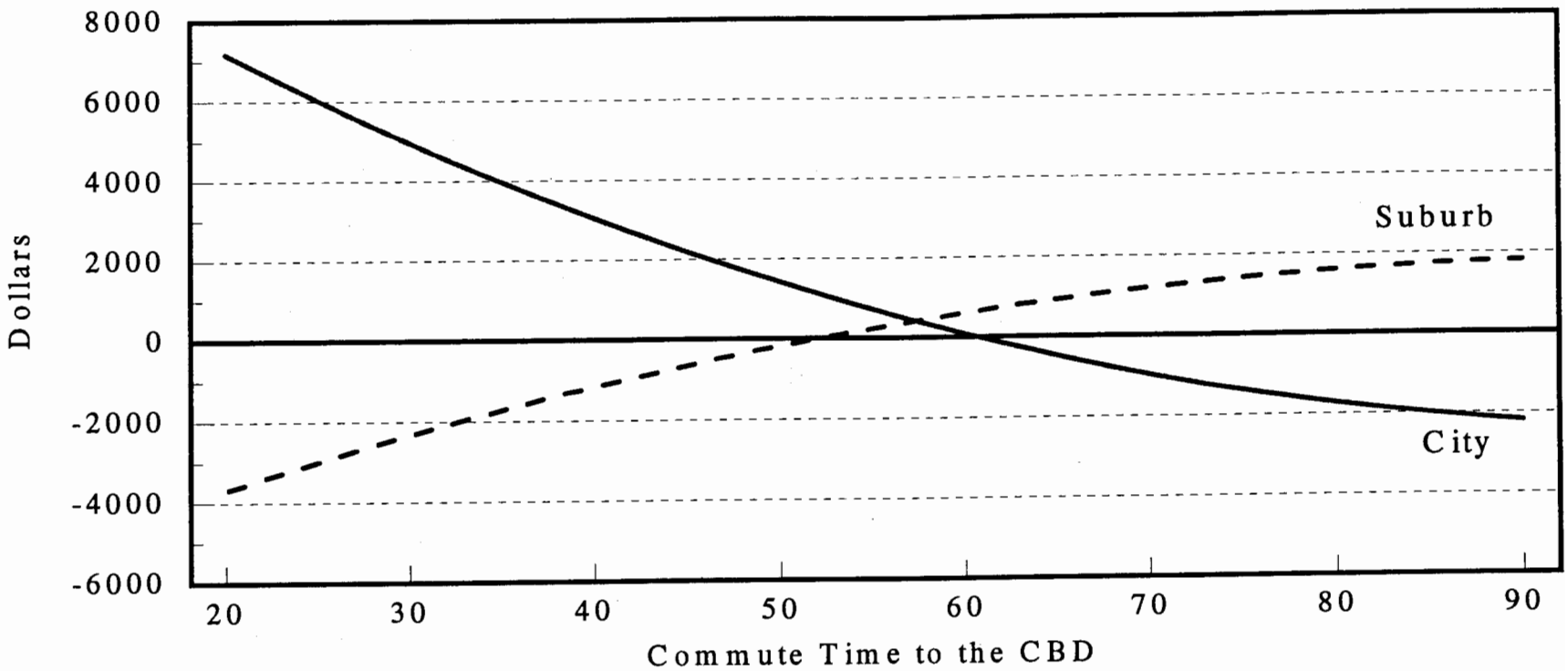

Figure 5

Fully Interacted Model: House Prices

Based on Table 4, Column 1

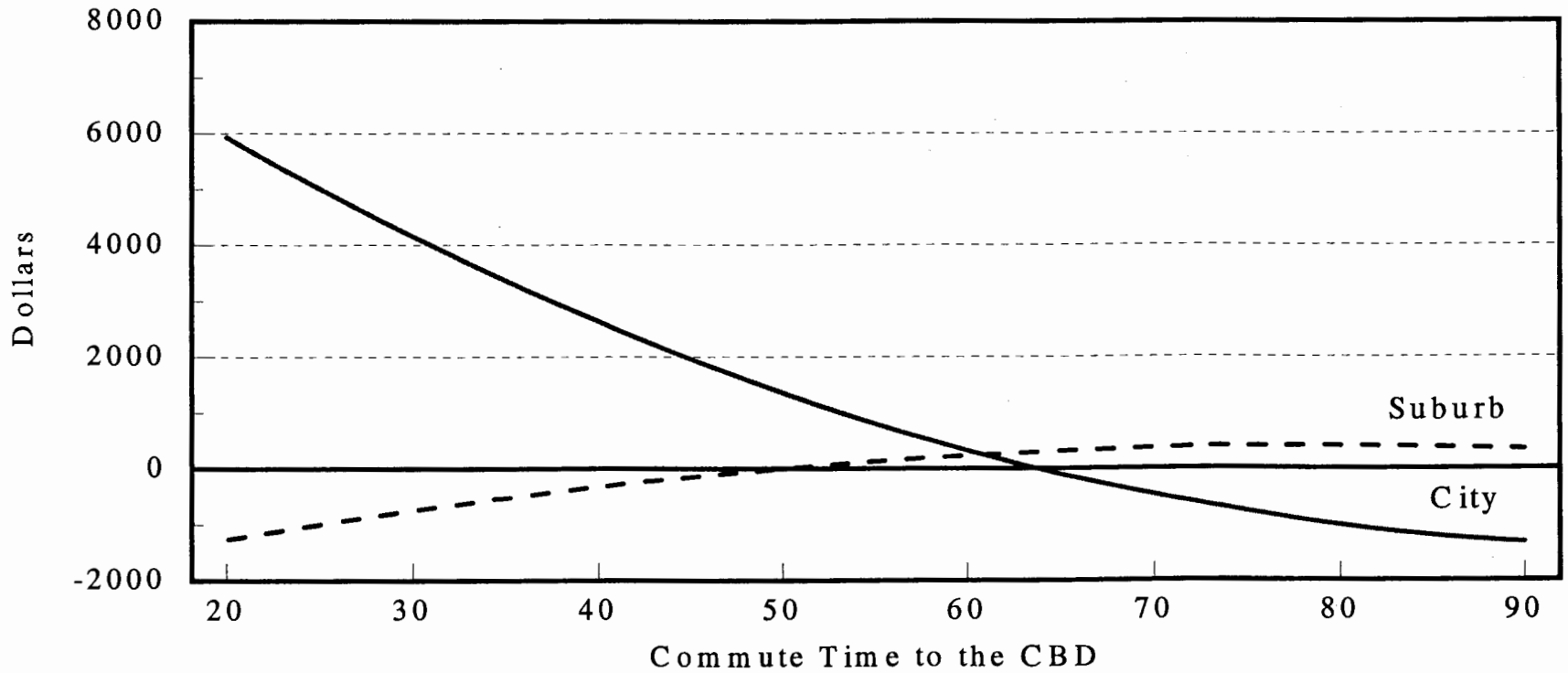

Figure 6

Fixed Effects Model: House Prices

Based on Table 4, Column 2

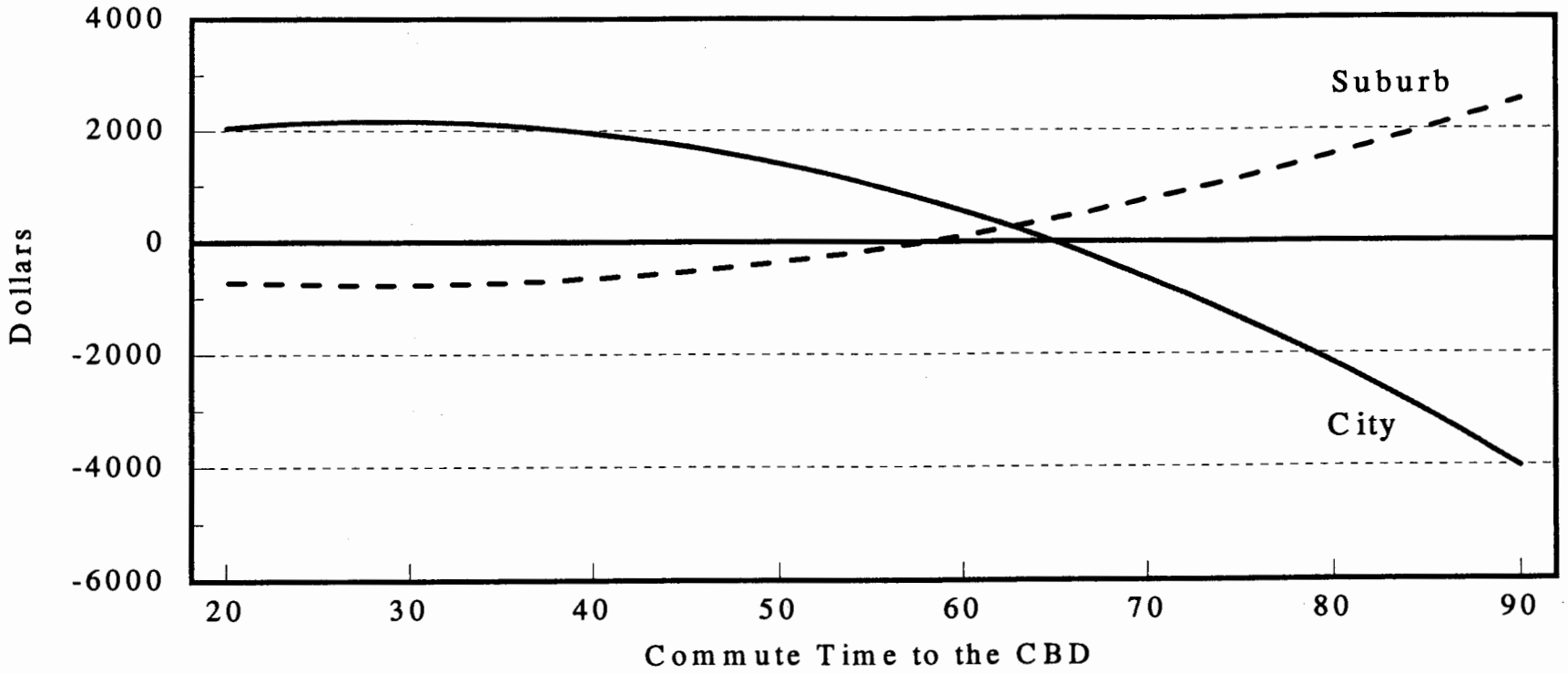

Figure 7

Fully Interacted Model: Construction Rates

Based on Table 6, Column 2