

ABSTRACT

Title of dissertation: THE IMPACT OF TARGETED HOMEOWNERSHIP
TAX CREDIT PROGRAM: EVIDENCE FROM
WASHINGTON, D.C.

Zhong Yi Tong, Doctor of Philosophy, 2003

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This study provides the first comprehensive empirical evidence on the economic impacts and distributional effects of the District of Columbia First-Time Homebuyer Credit program. This program is the only federal program that provides an income tax credit for targeted lower-income households to purchase homes in a central city. Based on IRS data, the findings indicate that the program is very successful and popular, with the participants accounting for 77 percent of all home purchasers in the District each year. Among them, the first-time homeowners represented 67 percent of all purchasers each year, a rate 27 percentage points higher than the national average. The largest cluster of program beneficiaries was those with incomes between \$30,000 and \$50,000, which corresponds to only about 42 to 69 percent of the area median income.

Using a three-stage intervention analysis, this study further finds that the program has significant impact on wealth creation through house price appreciation. The credit could explain most of the amenity-adjusted house price appreciation differentials between the District and its surrounding suburban markets, estimated at 4.9 percent each year.

Larger distributional effects are observed in the District's low/moderate-income and minority neighborhoods as compared to high-income and white neighborhoods and in the townhouse/condo sub-markets as compared to single-family detached units.

The intervention was also effective in stabilizing city neighborhoods, increasing local tax revenues, driving up owner housing supply through conversion of rental units, and reducing vacancy. However, it failed to stimulate a supply response in new construction from private sector. It also had some adverse effects on housing affordability since it appeared to have spurred an increase of voluntary displacements of District renters.

These results suggest that this targeted homeownership tax credit can serve as a strong incentive for encouraging first-time homeownership and a viable supplement/remedy to the existing tax treatments to homeownership. It represents an innovative approach to reviving central cities and their neighborhoods. The study contributes to the literature through a methodological advance, development of several key benchmarks, and improvements of our understanding of public subsidies.

THE IMPACT OF TARGETED HOMEOWNERSHIP TAX CREDIT PROGRAM:
EVIDENCE FROM WASHINGTON, D.C.

by

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The Impact of Targeted Homeownership Tax Credit Program: Evidence from Washington, D.C.

Zhong Yi Tong

Executive Summary

The goal of this study is to provide the first comprehensive assessment of the targeted homeownership tax credit program as implemented in Washington, D.C. The District of Columbia First-Time Homebuyer Credit program is the only federal program that provides an income tax credit (up to \$5,000) for targeted low/moderate-income families and individuals to purchase their first homes in a central city. The key findings indicate the following:

1. The D.C. homebuyer tax credit is very successful and popular. Based on IRS data released only to this author, 21,821 claims (in the amount of \$76.7 million) were filed for the tax credit between 1997 and 2001. On average, the program participants accounted for about 77 percent of all home purchasers in the District each year. Among the participants, those who were the first-time homeowners (as understood by the common definition) represented 67 percent of all home purchasers in the District each year, which was 27 percentage points higher than the national average (40 percent) and 16 percentage points higher than the central city average (51 percent) in terms of first-time homeownership rate.

2. The largest cluster of program beneficiaries was low-income homebuyers or those with incomes between \$30,000 and \$50,000, which corresponds to only about 42 to 69 percent of the area median income. While the vast majority of the credit claimants were D.C. residents, the homeownership credit also attracted a sizable number of homebuyers whose previous addresses were in the District's suburbs. These buyers accounted for about 14 percent of all home purchasers in the District each year studied.
3. The program's impact and distributional effect on wealth creation through house price growth are also significant. The D.C. homebuyer tax credit could explain most of the house price appreciation differentials between the District and its surrounding suburban markets, estimated at 4.9 percent per year after adjusting for housing and neighborhood characteristics. Larger effects on house prices are observed in low/moderate-income and minority neighborhoods, compared to high-income and white neighborhoods. The homeowners of lower-priced townhouses/condos also experienced better appreciation than the owners of the traditionally more expensive single-family detached units.
4. The impact on house prices was estimated through a three-stage intervention analysis, including hedonic regression and interrupted time series analysis, in the framework of the difference-in-differences approach. These outcomes are further verified by median house price comparisons using three different geographic samples: census tracts adjacent to the D.C./Maryland border, D.C. vs. surrounding suburban markets, and D.C. vs. Baltimore City. Moreover, robustness checks were also performed to determine the conclusiveness of these results. They suggest that, in tandem with the

“Williams gradual effect” large-scale investments undertaken by private-public partnerships and the D.C. Financial Control Board, the District of Columbia First-Time Homebuyer Credit could have accounted for most of the 4.9-percent price increase above its surrounding markets during the 1998-2002 period.

5. The impact of the D.C. homeownership credit was so substantial that it seems to be inconsistent with the standard theory of public subsidies. However, at least two unique features of the homebuyer credit program that emerged from the practice or were built into the design may explain the inconsistency. One is that the tax credit subsidizes not only housing consumption but also housing investment or wealth creation, a critical point that is assumed away from the standard subsidy model. The other is that the credit is able to remove or reduce some important homeownership market “imperfections,” such as the entry barriers of wealth and income to homeownership for a typical low-income and first-time homebuyer. In comparison, the standard subsidy theory is built upon the assumption that there are no market “imperfections.”
6. The D.C. homebuyer tax credit helped stabilize distressed District neighborhoods. House price movements during the impact period were only about 43 percent as volatile as those observed prior to the intervention. House price volatility in the low/moderate-income neighborhoods was also reduced by over 50 percent after the homebuyer credit took effect.

7. The tax credit also helped increase the overall homeownership rate, drive up homeowner housing supply through conversion of rental into owner units, and reduce vacant housing units for rent in the District of Columbia.
8. Although new construction (measured by residential building permits) increased significantly during the impact period, the increase was almost exclusively attributable to the HOPE VI revitalization program. The credit did not seem to be effective in stimulating a supply response in new construction from private investments.
9. The empirical evidence also suggests an adverse effect of the homeownership credit on housing affordability for future homebuyers and especially for renters. With a substantial increase in house prices and reduction of rental housing stock, the credit appears to have spurred a large increase in voluntary displacements of District renters because of rent burdens and other financial reasons.

These findings have important implications for public policies and also contribute to the literature in a number of ways:

- The income-targeted homebuyer tax credit as implemented in D.C. can indeed serve as an effective tax incentive to increase first-time, low-income homeownership rates and reverse the exodus of population in a central city.
- The program also serves as a viable supplement or remedy to the existing tax treatments to homeownership (mortgage interest and property tax deductions). It has been well documented that the existing national homeownership tax policy provides substantially fewer economic benefits and weaker incentives for low-income families.

- The substantial impact and distributional effect on house prices indicate that the homeownership tax credit is an effective policy instrument that can create home equity wealth for low-income individuals/families and also contribute to tax revenues for state and local governments.
- The D.C. homeownership tax credit also represents an innovative approach that could help solve urban problems by stabilizing the distressed neighborhoods, increasing owner housing supply, and reducing vacancy.
- The targeted homeownership tax credit program facilitated two types of income and wealth redistribution that advance social goals of resource allocation. One is income/wealth redistribution from high-income to low/moderate-income households and neighborhoods. The other is the income/wealth transfer that takes place from suburbs to central cities or from federal government to state/local governments.
- This paper has developed an innovative research methodology (a three-stage intervention analysis), three verification methods, and a number of important benchmarks that can be used to assess the impact and effectiveness for other urban/housing policy interventions. It also substantially improves our understanding of public subsidies and their actual values in a reality where the assumptions of the standard subsidy theory are no longer held. Such an improvement makes an important contribution to the literature of public policies, public/welfare/urban economics, and housing markets.

Based on these empirical evidences from the District of Columbia, I would like to make the following policy recommendations to help either design a future homebuyer tax credit or improve the existing one as implemented in Washington, D.C.:

- To maximize its effectiveness, equity, and economic efficiency, any future design or improvement of a homeownership tax credit shall target low/moderate-income first-time homebuyers. It should explicitly build a mechanism allowing homebuyers to transfer the credit into cash for the down payment and closing costs at the time of home purchase. It should include a larger incentive to attract homebuyers into minority neighborhoods. It also should be refundable to encourage very low-income households to participate in wealth creation through purchasing a piece of their own property.
- To minimize the unintended adverse effect, any future homeownership tax credit program should seek to incorporate a form of compensation for the losers of the intervention, particularly the existing low-income renters who would be at the risk of involuntary or voluntary displacement. It should also be accompanied by a supply-side policy action to stimulate at least the short-term supply of private investments on new construction to improve housing affordability for future homebuyers.

Introduction

Historically, homeownership has been a major public policy goal in the United States. The primary policy vehicle used to promote homeownership is taxation, including nontaxation of net implicit income from owner-occupied housing, mortgage interest tax deductions, property tax deductions, and tax-exempt capital gains on owner-occupied home sales. Increasingly, however, empirical and theoretical evidence indicates that while homeowner tax subsidies are the single largest federal tax expenditure, these preferential tax treatments for homeowners may be biased toward benefiting upper-income families. The key reasons are twofold: First, upper-income households are able to purchase and sustain more expensive homes and as a result reap substantially more tax benefits in all categories associated with homeownership. Second, the deductibility of mortgage interest and property taxes can be realized only through itemized deductions, which are in practice not an option for many low-income homeowners who have little tax liability or who use standard deductions for their tax returns because they own small properties. In other words, the existing tax codes provide low- and moderate-income families with significantly fewer economic benefits and weaker incentives for homeownership than to high-income families (Follain et al. 1993; Bourassa and Grigby 2000).

Therefore, in the past several decades, a new policy instrument has been proposed by various groups—academics, advocacy groups, politicians, and trade associations—as a remedy or supplement to the existing tax treatment for homeownership. The instrument being proposed is the so-called “tax credit,” “targeted homeownership tax credit” or “progressive homeowner tax credit.” But is this proposed tax credit a good idea?

While the concept of the targeted (or progressive) homeownership tax credit

seems theoretically justified on the grounds of equity or social justice (Green and Vandell 1999; Dreier 1997), there exists no empirical evidence on such grounds. More importantly, there is no empirical evidence on the possible impact of the targeted homeownership tax credit on economic efficiency (that is, there are only results obtained from econometric simulation exercises conducted by such researchers as Follain et al. (1993) and Collins et al. (1999)). The goal of this research is to fill up these gaps. Based on an innovative federal program in targeted homebuyer tax credits that has been recently implemented in Washington, D.C., this research provides the first real-world evidence on both distributional effects and economic impacts of the targeted homeownership tax credit.

Understanding the effects of the targeted homebuyer tax credit program is very important to convince policy makers to consider using the homebuyer tax credit as a potentially innovative and cost-effective policy instrument to assist with urban turnaround and to revive distressed neighborhoods. In the last four decades, the most profound changes in urban landscapes and housing markets in the United States are urban decay and central city neighborhood distress. Common problems in these distressed cities include low homeownership rates, depopulation (due to outmigration to the suburbs), depressed housing values, lack of fiscal resources, high crime rates, concentration of poverty, segregation of race and housing, and disinvestment in inner-city neighborhoods.

While problems, causes, dynamics, and possible solutions about urban declines and deteriorated housing markets in central cities are well studied by academics such as Wilson (1987 and 1996), Massey and Denton (1993), Downs (1999), and George Galster (1998), little is known about real-world success stories and their catalysts. While not

many central cities and their residential property markets have experienced a comeback, a few of them seem to be on their way back up, according to the 2000 Census. Such cities include Chicago, Denver, and New York City. To a certain extent, Washington, D.C., is another example. The new census put the population of the District of Columbia at 572,059 in April 2000, a 5.7-percent decline during the 1990s. However, data showed a surprising rebound of more than 53,000 residents since a 1999 Census estimate, the first population increase in five decades for the nation's capital city. Additionally, the city gained racial and ethnic diversity and has balanced its budget, and its housing market is also booming. All these suggest that Washington, D.C., has just begun a great comeback and renewal for the future.

Unfortunately, researchers and policy analysts have largely failed to catch up with the fast-changing reality to explain why these changes are taking place in some cities and not others and what other distressed central cities can learn from the successful experiences. The exceptions are a few demographers and sociologists who attribute the renewed viability of a few metropolises to demographic forces—in particular, the recent tide of immigration from Hispanics and Asians in gateway cities. There are not many studies to identify the key factors other than such demographics, which may include federal interventions, local innovations, or some other market forces. In Washington, D.C., the key factor is widely perceived to be the new and unique first-time homebuyer credit program. Therefore, an important goal of this research is to conduct the first comprehensive study of the experiences of the D.C. homebuyer tax credit program that may have contributed significantly to the recent renewal of the city.

This study is structured as follows: Section I provides an overview of the District homebuyer credit program and its policy and theoretic research framework. Section II of this paper contains a critical literature review of urban renewal and neighborhood revitalization. Section III offers a literature review of low-income homeownership and its tax incentive policies. Section IV provides a descriptive analysis of new empirical evidence on the distributional effects of the existing homeownership tax policies in the United States. The purpose is to demonstrate whether the tax treatments for homeownership have served as an effective policy vehicle of encouraging low-income homeownership, thereby justifying the targeted homeownership tax credit approach. Section V conducts a brief comparative policy analysis of various proposals and existing government programs featured the targeted homeownership tax credit. Government innovations as well as proposals in homeownership tax credit will be analyzed through their targets: those targeted directly at homebuyers (demand-side); those targeted at lenders; and those targeted at developers (supply-side).

The rest of the research is devoted to empirical analyses of the impacts and effectiveness of the homebuyer tax credit programs in Washington, D.C. Section VI discusses research design, especially empirical design, data, and methodology for using the amenity-adjusted house price appreciation rates as the most important indicator in this study. Section VII reports empirical results for the effectiveness of the homebuyer credit program based on the data obtained from this author's special requests to the Internal Revenue Services. Section VIII reports empirical results for the impact and distributional effect of the District homebuyer tax credit program on house price appreciation. It also includes verifications of the empirical findings, robustness checks, and analyses of the

D.C. tax credit's unique features that may explain why its observed substantial impact is not explainable by the standard theory of public subsidies. Section IX reports the empirical results concerning the impact on home equity wealth creation, tax revenues, and neighborhood stability, based on house price appreciation rates and volatility (two key benchmarks). Section X provides findings about the impact on homeownership, housing supply, vacancy through supplemental indicators, as well as the detrimental impact on housing affordability. Section XI concludes with summaries of the empirical evidences and discussions about policy implications of the findings.

I. The District of Columbia First-Time Homebuyer Credit Program: A Policy and Theoretic Framework

The first-time homebuyer tax credit program as implemented in the District of Columbia was enacted in the Taxpayer Relief Act of 1997. Since President Clinton signed the law August 5, 1997, the program was extended several times. This legislation provided that taxpayers who had not owned a main home in Washington, D.C., “during the 1-year period ending on the date of purchase” could receive a one-time federal income tax credit of up to \$5,000 for purchase of a main home in D.C. The eligible homebuyers have to claim the credit at the end of the tax year by filing IRS Form 8859 “District of Columbia First-Time Homebuyer Credit” and also by entering the amount of the credit claimed in the tax credit section of Form 1040. Unused credit is allowed to carry forward until all of it has been used. This legislation is currently set to expire January 1, 2004. There are no eligibility requirements regarding purchase price or homeownership outside the District. However, the program features *income targeting*. It requires that the tax credit be phased out as incomes increase. Specifically, the program’s eligibility requirements read as follows:

Who may claim the credit? In general, you may claim the credit if (1) you purchase a main home during the tax year in the District of Columbia and (2) you are a first-time homebuyer in D.C., that is, you (and your spouse if married) did not own any other main home in the District of Columbia during the 1-year period ending on the date of purchase. The main home purchased or constructed is the one you live in most of the time. It can be a house, houseboat, house trailer, cooperative apartment, condominium, etc. However, you may not claim the credit if any of the following apply: (1) You

acquired your home from certain related persons or by gift or inheritance. (2) Your modified adjusted gross income is \$90,000 or more if single, married filing separately, head of household, or qualifying widow(er); or \$130,000 or more if married filing jointly. (3) You previously claimed this credit for a different time.

Amount of the credit. In general, the credit is the smaller of (1) \$5,000 if single, married filing jointly, head of household, or qualifying widow(er) (\$2,500 if married filing separately) or (2) the purchase price of the home. The credit is phased out over a range that begins when your modified adjusted gross income exceeds \$70,000 if single, married filing separately, head of household, or qualifying widow(er) (\$110,000 if married filing jointly) and ends at \$90,000 if single, married filing separately, head of household, or qualifying widow(er) (\$130,000 if married filing jointly).

This income-targeted homeownership tax credit program appears to have a substantial impact on the District. Although there is no in-depth research on this program, according to a survey by the Greater Washington Research Center (currently part of Brookings Institute), the tax credit is “widely used” and the program is “very successful” and popular. In late 1998 and early 1999, the center conducted a mail survey of a random sample of 1,600 home purchasers in the District. Based on valid responses from 529 purchasers, the center estimates that about “70.1 percent of purchasers of residences in the District in 1998 claimed (or expected to claim) the new homebuyer credit. ...The total value of the credits earned in 1998 was approximately \$14.9 million” (Dearborn and Richardson 1999).

While this survey provides an important snapshot of the effectiveness of the District first-time homebuyer credit program, it clearly raises more questions than have

been answered. First, since the survey was conducted at the end of the program's first full year (1998), the program's full impact in the four years since then remains unknown. Second, given the survey's relatively small sample size and low response rate (33.1 percent), one might question the representativeness of the sample and generalizability of the results. Even if the reliability of the estimates from the survey may not be a major concern to some, it is about the time to obtain the administrative data from the Internal Revenue Services to reveal the program's actual participation. Third and most importantly, many critical and even basic questions are left unanswered. In particular, what are the policy goals and objectives the program is intended to accomplish? Has the program been effective in accomplishing these objectives? More broadly, is the policy intervention economically efficient or otherwise equitable? These are questions critical to understanding the viability of a public policy intervention and are precisely what this paper seeks to address.

The District's income-targeted homebuyer credit program is supposed to have two important policy goals: 1) To provide a tax incentive for lower-income families or individuals to participate in homeownership, and 2) To help cure urban decay and stabilize (revitalize) the central city neighborhoods in the nation's capital. These goals are made explicit by the legislation that initiated this program. The D.C. First-Time Homebuyer Credit program was in fact part of a policy package that combines initiatives on taxpayer relief with those aiming at urban renewal and neighborhood revitalization—the Taxpayer Relief Act of 1997. The District of Columbia First-time Homebuyer Credit was included in this legislation, along with other tax incentives designed for urban and neighborhood revitalization (including the D.C. enterprise zone designation, tax-exempt

economic development bonds, and a zero percent capital gains rate), in TITLE VII, Section 701 “Tax Incentives for Revitalization of the District of Columbia.”

While not made explicit in a concentrated place, the specific policy objectives of the homebuyer credit intervention are embedded in various places including the legislation, speeches of the bill’s major sponsors (such as D.C. Congresswoman Eleanor Holmes Norton), and news reports. The objectives appear to be:

- Helping remove the entry barrier to affordable homeownership through targeted tax relief and incentives, which are not currently offered by the existing tax system, in order to retain or attract population into the city.
- Helping solve the core problems facing Washington, D.C. Specifically, it is intended to boost the urban home values, increase homeownership, increase tax bases for local governments, stimulate investment activities, and reduce vacancy in the city.
- Stabilizing distressed neighborhoods.

In general, justification of a public policy change must come from meeting the criterion of either efficiency or equity. The efficiency arguments are rooted in the welfare economics tradition that program X improves the welfare of society if it makes at least one person better off and no one worse off (Pareto’s rule). Since the Pareto efficiency rule can hardly ever be adhered to in reality, the Kaldor-Hicks rule becomes the most popular and acceptable efficiency criteria in judging a public policy intervention. This rule states that program X has positive net benefits if the gainers could compensate the losers and still be better off.

On the other hand, even if a policy intervention is not economically efficient, it

may still be justified on the ground of equity arguments. The equity criterion states that a policy change or a distribution of resources/income is justified if it is judged to be equitable in the sense that the policy intervention promotes social justice. Social justice is served if the disadvantaged groups in the society are helped even at the expense of the advantaged population. Since the advantaged groups have sufficient resources to help themselves, a society or government should take the responsibility to improve the welfare of disadvantaged groups such as minorities, the poor, and the handicapped.

In the case of the District's targeted homeownership tax credit program, this study seeks to use both the equity and (to a certain extent) efficiency criteria to judge its impact or success. To assess its impact on equity and efficiency, two questions must be answered. The first question is this: "Assuming the homeownership tax credit program as implemented in the District is effective, *can it meet the efficiency and equity criteria?*" And second, "*Is the District homebuyer credit intervention effective to accomplish these policy objectives*, thereby meeting the efficiency and equity criteria? And if so, how effective is it?" I found that the policy objectives of the District homeownership credit program do help improve the welfare of society while the program as a whole is essentially designed to serve social justice.

Concerning the first question involving equity criterion, since the homebuyer credit program targets lower-income taxpayers, there is no doubt that the major beneficiaries are expected to (or should) be the disadvantaged, including low/moderate-income families and individuals, minorities, and the distressed city neighborhoods. In other words, as measured by the program's participation (claim rates, amount, etc.), changes in property value, neighborhood stability, homeownership, and other policy

objectives, the program's distributional effect should be substantial and significant. By largely serving the disadvantaged groups and distressed neighborhoods, this innovative policy intervention can indeed be a justified remedy or supplement to the existing tax treatments to homeownership that seem to mostly benefit the wealthy.

With respect to efficiency, if the program succeeded in accomplishing its intended policy objectives, the overall economic impact on public welfare or net benefits to society should, or is expected to, be positive and substantial. Population growth (or deceleration of population loss) helps change the course of urban decay and enhances urban viability and welfare through a number of important ways, such as an increased demand for and supply of housing, increased activities in commercial consumption and investment, and increased tax base. More investment (residential or commercial) activities in the city, which may have been a victim of the so-called “disinvestment” in the past decades, represent a net increase of housing producers’ surplus. They also generate chain reactions, creating strong consumer confidence and positive neighborhood atmosphere. An increase in the municipal government’s revenues, which rely on property and sales taxes, can be translated into the delivery of more and better public goods and services including education, public transportation, infrastructure, and police.

Social benefits of stable city neighborhoods stem from avoided social costs typically incurred in distressed communities. As discussed in the following section on urban decay and renewal and elsewhere in this paper, social costs of neighborhood distress include a decline in urban property value, abandonment, an increase in crimes, disinvestment, population loss, and a smaller tax base.

An increase in homeownership and property value also contributes substantially to

the gain in the welfare of society. Social benefits of homeownership have been widely recognized in two aspects. One is that it provides an accommodation for a family to live and raise their children. The other is the homeownership externality. There is a growing literature documenting the externalities. Examples include a better educational outcome of homeowners' children, a higher rate of participation in local and neighborhood activities, better maintained properties, and higher value of owner-occupied housing and its neighborhood. I would like to add a third type of social benefits: homeownership (and an appreciating housing unit in general) is the most important and effective investment vehicle of wealth creation for average people in this country.

According to Carr and Tong (2003), in the United States, owner-occupied housing is the best investment for many of reasons. First, it offers the best long-term returns of any other typical investment. A family that put \$10,000 down on a \$100,000 home in 1990 would clear about \$67,000 in equity wealth today if the home merely appreciated at the national rate. Meanwhile, that same \$10,000 invested in an S & P 500 index fund would have produced only \$16,000 in capital gains, and even less after capital gains taxes. Further, a home can also be used as collateral to leverage capital by taking a loan to finance a small business, higher education, purchase of a rental property, and other forms of physical or human investment activities to create additional wealth. Or, alternatively, a home can be refinanced to take advantage of an improved interest rate, and in the process equity can be taken out with little increase in the monthly debt payments on the mortgage. In fact, in 2001 and early 2002, more than \$131.6 billion of equity has been leveraged from home equity cash-out refinances. Data from the 1995 Survey of Income and Program Participation shows that home equity wealth accounts for more than 70 percent

of the net worth (or \$28,427 out of \$40,200 per household) for all households in the United States. And minority households have substantially less home equity wealth and therefore net worth than the national median.

This leads to the second theoretic question for this paper: “*Is the District homebuyer credit intervention effective to accomplish these policy objectives*, thereby meeting the efficiency and equity criteria? And if so, how effective is it?” The rest of the paper (especially the empirical sections) addresses this important question. The hypotheses of this policy research are therefore developed around assessing whether, and the extent to which, the District homebuyer credit program has been effective in accomplishing the intended policy objectives.

Null hypothesis 1 is that overall the D.C. homebuyer credit program is a success, as measured by participation (or claims) and amount, such that it is effective in using homeownership to reverse the exodus of population by retaining the city residents for first-time homeownership participation and also attracting homebuyers from suburbs. On the ground of equity or the program’s distributional effect, I hypothesize that the primary beneficiaries of the credits are indeed low- and moderate-income homebuyers, rather than wealthy households. The purpose of testing this hypothesis is to provide a crucial big picture of the program’s overall effectiveness and participants’ income profile. It can also create a solid foundation of empirically testing research hypotheses pertaining to the program’s economic impact and distributional effect on the housing and neighborhood outcomes discussed as follows.

Null hypothesis 2 concerning efficiency is that the targeted homeownership tax credit program has positive housing outcomes as measured by house prices. In other

words, the D.C. homebuyer credit intervention is hypothesized to have significantly raised house prices (residential property values) in Washington, D.C., thereby created home equity wealth for individual homebuyers and existing homeowners and also generated property tax revenues for the District government. Relating to the equity concerns, I further hypothesize that the targeted homebuyer credit intervention has a more sizable distributional effect on house prices and wealth creation for homeowners/buyers or neighborhoods that are more likely to be disadvantaged. The alternative hypothesis is that the intervention does not have these effects.

Null hypothesis 3 is that the homebuyer intervention stabilizes the overall housing market in Washington, D.C. More importantly, concerning equity or distributional effect on neighborhood outcomes, the hypothesis is tested in the sense that neighborhood stability is more evident in the distressed (low-income and minority) neighborhoods than in the wealthy, white neighborhoods, as a result of the implementation of the targeted homebuyer intervention. The alternative hypothesis is that the program fails to accomplish this important goal.

Null hypothesis 4 is that the first-time homebuyer credit program is also able to have an impact on a higher rate of homeownership, more owner housing supply including more private investments (residential and/or commercial), and a reduction of vacancy in Washington, D.C. On the ground of equity, the expectation is that these effects are more substantial in low-income and minority neighborhoods. Also, related to distributional effect, if an increase in owner housing supply is verified, it is expected that the D.C. homebuyer credit program may generate some unintended consequences or detrimental impact on housing affordability. The alternative hypothesis is that these impacts are not

materialized at all.

Before testing these hypotheses, it is important to conduct literature and policy reviews that are most relevant to this research. In this regard, I undertook two brief but comprehensive literature and policy reviews in the following sections: One concerns low-income homeownership, existing tax incentive policies for homeownership, and proposed targeted homeownership tax programs. The other is a review of urban/neighborhood distress and renewal, as well as government programs that have attempted to solve these urban and neighborhood problems in the past. The purpose of these reviews is to put this study in a broad context since the targeted homebuyer credit intervention in the District intersects at these two bodies of the literature. Further, if the reviews reveal that the urban and tax incentive problems addressed by the District homebuyer intervention are not unique to nor hypothetical for Washington, D.C., but true and widespread at the national level, it represents a great potential for replicating the targeted homeownership tax credit program into other central cities to help solve these common problems.

II. A Critical Review of Urban Renewal and Neighborhood Revitalization

Urban Distress

There is no shortage of literature describing the problems affecting U.S. cities. Some contend that the economic distress of the inner city is one of the most pressing problems in America today (Porter 1997). Others call attention to the problems caused by social inequality, such as racial segregation and discrimination, and call for sweeping reforms to bring opportunities to the residents of distressed neighborhoods. (Wilson 1996; Krumholz and Keating 1999; Quigley 1994) Most scholars and experts agree on the conditions that characterize urban distress: Loss of population—especially middle class households—high unemployment, low homeownership rate, disinvestment, racial segregation, poor quality public schools, high crime rates, concentration of poverty, female-headed households, low levels of educational achievement, abandonment, high vacancy rate, and concentrations of households receiving public assistance.

Rigorously defining neighborhood quality, however, has proven difficult. The most common definitions use census tract poverty rates as a proxy for other aspects of neighborhood quality. Others, such as Kasarda (1993) and Newman and Schnare (1997) combine various census-based social indicators such as number of female-headed households and welfare recipients, as well as joblessness. Paul Jargowsky argues strongly for using the poverty measure alone, rather than combining it with other measures. Most analysts follow the Jargowsky prescription, using various poverty level thresholds to determine a ghetto or underclass neighborhood (Kasarda 1993).

Most scholars agree that the pattern of suburbanization was more than just consumer preferences and changing technologies. Rather, the pace and shape of this

growth was the direct result of public policies and private institutions. The primary causes of urban decline and decentralization are most often cited as federal government policies on mortgage interest and real estate tax deductions, deindustrialization, technological advancement that led to rapid growth in Sunbelt states where sprawl-like growth was the norm, higher tax rates in center cities, exclusionary zoning by suburban governments, outmigration of jobs to suburbs, spatial concentration of racial minorities and low income families, and red-lining by banks and insurance companies.

Data from 2000 Census: Changes in Urban Landscape in Recent Decades

Since the 1930s, a pattern of decentralization and outward expansion has become the norm, leaving many center cities in distress. This is true especially in the older industrial cities of the Northeast and Midwest. Recent Census data show that many of the largest cities in those regions have steadily lost population.¹ Baltimore, Maryland's largest city, has lost residents for the past five decades. Baltimore's population dropped 11.5 percent to 651,154 in 2000 from 736,014 in 1990. Meanwhile, its suburbs have experienced continued growth in people², jobs, and wealth. Washington D.C., also experienced a population decline in the 1990s. The city lost 5.7 percent or 35,000 residents over the decade, while its suburbs posted a 13.1 percent population increase. The suburbs showed uneven growth during the 1990s. While suburban areas in the entire U.S. grew roughly 14 percent in the 90s, several suffered decline, specifically, those

¹ A study by the Brookings Institute of the largest 34 metro areas showed the following Central Cities experiencing population decline from 1990 to 2000: Baltimore, Buffalo, Cincinnati, Cleveland, Detroit, Milwaukee, Norfolk, Philadelphia, Pittsburgh, St. Louis, and Washington D.C.

² Baltimore's suburbs experienced 17.1 percent growth in population.

located in the slow growing areas of the Midwest and Northeast.³ However, many suburban areas continue to grow capturing a majority of the nation's new employment and population growth. The most recent Census shows that the suburbs are now attracting single-person households, childless couples, and immigrants—groups that tend to gravitate toward cities.

Not all of the news from the 2000 Census was bad. Data from 2000 revealed evidence of a possible turnaround. Cities that had lost population for decades like New York, Boston, and Chicago registered population gains. By far the fastest growing cities were in the West, Sunbelt, and Southern areas of the U.S. These center city gains however, were still far outpaced by their suburbs. Glaeser and Shapiro (2001) found that the main factors present in cities that experienced growth over the decade⁴ were a rise in immigrants, low unemployment rates, growth in the prior decade, warmer climates, higher levels of educational achievement, a service sector industrial base, and an automobile orientation over mass transit. They caution that the increases registered by cities with populations over one million⁵ are not statistically significant given the variety of growth experiences across all cities. Therefore, it is important to reserve judgment of a true comeback until evidence from future decades supports the upward trend.

³ Metro Areas where majority of suburbs experienced decline from 1990 to 2000 were Buffalo, Cincinnati, Cleveland, Detroit, Philadelphia, and Pittsburgh.

⁴ Analysis is taken from all cities in U.S. with 1990 populations exceeding 100,000.

⁵ Cities with populations over one million grew an overall 7 percent in the 1990s compared to -0.8 in the 1980s.

Neighborhood Revitalization and Stabilization

The Neighborhood Revitalization model seeks to rebuild low-income neighborhoods and improve the lives of their residents. It is rooted in decades of federal policy, the civil rights movement, antipoverty activism, and years of community organizing efforts (Nowak 1997). Research shows that neighborhoods do matter. Local neighborhoods are important because of the social capital they provide—such as dense social networks and local identification. These public goods help support patterns of social organization and human well-being (Sampson 1999; Wilson 1997). Ingrid Ellen and Margery Turner (1997) have synthesized the wide range of empirical research on this subject to establish the impact a neighborhood environment has on its residents.

According to Ellen and Turner, the following neighborhood characteristics are important influences on individual outcomes:

- Access to local services, especially schools
- Presence of adults who can serve as role models for acceptable behavior
- Influence from peers, especially for teenagers
- Informal networks through which to gain access to services and employment
- Exposure to crime and violence
- Physical access to jobs.

Further, Jencks and Mayer (1990) find that growing up in a predominately black neighborhood or a neighborhood with high numbers of welfare recipients leads to decreased success in the job market.⁶ Research suggests that neighborhoods with concentrated poverty and unemployment lead to negative behaviors and the inability to

⁶ A neighborhood's median income did not appear to be a factor.

escape poverty (Wilson 1987; Engberg 1996). Some caution that to be successful, neighborhood stabilization must address the underlying causes of population shift and decline. As such, the controversial issues of race and social class must be dealt with explicitly; otherwise long-term improvements will be undermined and negligible (Varady 1986).

Practitioners have long sought to improve conditions in distressed and isolated neighborhoods. Beyond addressing the adverse social impacts upon residents, the Committee for Economic Development (1995), a group of 250 business leaders and educators, use a broader context in arguing the importance of neighborhood revitalization:

- Blight undermines the fiscal and operational health of major cities.
- Distress threatens important economic assets.
- Distress weakens the nation's resources.
- The costs of the problems fall on all taxpayers, regardless of where they live.
- Isolation of distressed urban neighborhoods conflicts with our national ideals.

Revitalization Method

Several schools of thought have emerged as to the best method of bringing about the revitalization and stabilization of distressed neighborhoods. According to Rosenthal (2003) neighborhoods are in a constant state of economic change.⁷ Recognizing and encouraging the factors that produce positive change over time has been the topic of much debate. Central to this debate are two predominant themes: People vs. Place Based

⁷ Rosenthal found that rates of change are strongly influenced by local investments in human and physical capital.

Policy. People-based initiatives seek to aid the residents of distressed neighborhoods through empowerment strategies. Examples of people-based approaches include helping households move to other areas, direct cash transfers (TANF), and human investment strategies such as vocational training, improving education, and linking residents to jobs in other areas. By contrast, place-based measures focus on revitalization and improvements in distressed areas such as infrastructure investments, housing rehabilitation, and attracting economic activity. Downs (1999) and Ladd (1994) argue that both are necessary to improve quality of life in distressed center cities. Downs notes, however, that current government policies do not adequately fund person-based strategies, thus most community development practitioners turn to place-based approaches.

Place Based Initiatives

The most common approaches to neighborhood improvement supported by the literature are the promotion of homeownership; improvement in physical infrastructure such as housing stock and public amenities; social capital (improving social cohesion, networks, trust, and other factors that make relationships feasible and productive); local community development corporations (CDCs), emphasizing grassroots and neighborhood participation and empowerment; and comprehensive proposals that comprise several or all of the aforementioned. While these approaches can overlap, government and private institutions have focused their strategies and efforts in these primary areas.

Homeownership

The U.S. has long demonstrated its preference for homeownership. A growing body of literature on homeownership argues that homeowners invest in their

neighborhoods and remain in their homes longer than renters (Glaeser and DiPasquale 1999). Homeowners have a financial stake in preserving and improving the quality of their neighborhood and increasing property values. Thus, homeowners are apt to behave in way that stem decline in higher-income areas and accelerate the improvement of lower-income neighborhoods.

Based on his research of neighborhoods in Philadelphia and Washington from 1950-2000, Rosenthal (2003) argues that "...policies designed to foster homeownership are likely to elevate the future economic status of neighborhoods." Additional recent research on two affordable homeownership programs in New York City shows that property values in the immediate surrounding area rose relative to their Zip codes.⁸ While this had a positive impact on property owners and property tax revenues increased, the authors note that the higher property values do not benefit the low- and moderate-income renters in the neighborhood.

Physical Improvements

In a sample of New Jersey residents, Michael Greenberg (1999) found that the residents' perception of neighborhood quality was strongly correlated to crime/vandalism and physical decay. Sanoff (1975) states that physically decaying neighborhoods send a "psychological message of death" to their residents. As such, Greenberg argues that comprehensive initiatives to revitalize neighborhoods are meaningless unless physical blight and crime are first addressed.

⁸ Ellen et al. (2001) examined the spillover effects of the Nehemiah Program and the Partnership New Homes program in New York City from 1980 to 1999.

One of the most famous examples of large-scale physical capital improvements was New York City's Ten-Year Plan, which rehabilitated 140,000 housing units for a total city investment of \$4.2 billion. The city's goal was to "re-create neighborhoods" and bring physical revitalization. Van Ryzin and Genn (1999) found that the Ten-Year plan substantially improved the rate of boarded-up buildings and increased property values, thereby indicating that some level of neighborhood revitalization had occurred. On the other hand, they also found the program to be associated with increased concentrations of poor and disadvantaged households in the most distressed areas.

Community Development Corporations (CDCs)

A common method used to bring revitalization to distressed neighborhoods is through CDCs. Vidal (1995) and Krumholz (1999) Proscio and Grogan (2001) all make the case that CDCs are in the unique position to work directly with the residents of distressed communities. Though no rigorous studies directly link the work of CDCs to increased property values, a number of published case studies point to the success of CDCs in bringing economic development, low-income housing, job training, and physical transformation. The book "Comeback Cities" by Paul Grogan and Tony Proscio (2000) highlights stories of CDC-based renewal in places such as the South Bronx, Houston, Cleveland, Chicago, and San Francisco. In the book, CDCs are given credit for their ability to work with the community at the grassroots level, leverage public and private investments into tangible improvements, help in policing efforts, and respond quickly, as a result of being small and flexible.

This idea contrasts with the ideas of Michael Porter (1997), who believes that CDCs have strengths but have too often rested on limited and garbled communication

between entrepreneurs, companies, and advocates for inner cities. He claims that advocates often believe that companies are not doing enough for their communities, while businesses feel “victimized” by what they observe to be arduous demands and expectations. According to Porter, center cities need to move beyond the stage of traditional CDCs to a focus on private, for-profit initiatives. He cites the failure of the social model, which was built around meeting the needs of individuals rather than generating jobs and economic opportunity that would mitigate the need for social programs in the long run. Revitalization must harness the power of the market, especially the labor market. Inner cities will succeed only where they welcome new investment and provide autonomy for entrepreneurs.

Social Capital

In contrast to physical and human capital, social capital refers to social cohesion, informal networks, and relationships among people where they feel trust and obligation for one another. The social capital theory suggests that neighborhoods with high social capital are more likely to respond effectively to change, work toward neighborhood improvement, and stem decline (Rohe and Temkin 1998). The Committee for Economic Development (1995) calls on CDCs and public officials to include social capital development as one of their main components in rebuilding distressed neighborhoods.

Many studies have linked high levels of social capital to less crime and violence and increased neighborhood stability.⁹ Saegert and Winkel (1998) examined several reprivatized apartment buildings in some of New York City’s most distressed

⁹ Rohe and Steward (1996) found that homeownership helped stabilize communities through the accumulation of social capital.

neighborhoods. They found social capital to be a key determinant in the success of locally sponsored low-income housing. They also found buildings in tax delinquency that were revitalized as co-ops produce far more social capital than those taken over by CDCs. The study suggests that social capital can add value to public investment in housing. An empirical study by Rohe and Temkin (1998) examined neighborhoods in Pittsburgh and found that social capital is more important to strong neighborhoods than other more traditional indicators such as physical capital and vacancy rates. They conclude that social capital “should be included in any neighborhood revitalization or stabilization effort” (p.86).

Comprehensive Approaches

The very nature of urban problems is often multi- dimensional in scope and therefore requires a combination of revitalization techniques. This approach recognizes that social and economic conditions are inter-related. Thus, a combination of strategies based on several theories can have a greater impact on neighborhood revitalization than any one theory by itself.

According to Brown (1998), comprehensive strategies seek to bridge the gap that often exists between human services, community revitalization, and economic development. Many CDCs often engage in comprehensive initiatives that can encompass homeownership, physical and social capital, and job training. However, according to Granger (1998) and Brown (1998), determining the effectiveness of comprehensive approaches is difficult due to all of the stakeholders that have different notions of success and the sheer complexity of the interaction between physical, social, and economic factors.

Government Policy Interventions

In her discussion of urban policy, historian Alice O’Conner (1999) points to recurring patterns that have stymied urban renewal and neighborhood revitalization. First she notes that government urban policy has long worked against itself. Relatively small-scale interventions are intended to revitalize distressed areas while large-scale public policies undermine their very ability to survive. Downs (1999) agrees, asserting that federal policy often works at cross-purposes, causing the very decline that urban policy tries to reverse.¹⁰ Other patterns mentioned are the marginal treatment of place-based strategies by the federal government, the weak political coalitions between stakeholders, and devolution to the states and local government.

Urban Renewal

The Federal Government authored the first major program aimed to bring about renewal specifically in urban areas. The Federal Urban Renewal program was created through Title I in the 1949 Housing Act. The strategy behind the program emerged out of negotiations between city planners, public housing advocates, big-city mayors, and real estate developers. A vital aspect to the program’s future success was eminent domain, which allowed local redevelopment authorities to clear land and use it for nonresidential purposes. From its inception, however, the program's goals were ambiguous and ill defined (Teaford 2000), eventually leading to the displacement of many low-income neighborhoods and further encouraging middle-class migration to the suburbs (O’Conner 1999).

¹⁰ For example, public policy was instrumental in racial segregation by encouraging redlining practices by mortgage lenders and maintaining segregated practices in public housing- at the same time, the Federal government had modest programs deal with job loss, poverty, racial and economic polarization.

Intended to clean cities of blight and bring new investment to distressed areas, by the end, the program had instead become synonymous with bulldozers and displacement of the poor, “evoking images of destruction and delay rather than renaissance and reconstruction” (Teaford 2000). Urban Renewal removed hundreds of thousands of low-rent housing units, yet most were not replaced by comparable units (Krumholz and Keating 1999). The program was funded through the 1950s and 60s until funding was cut off by Congress in 1974.

Since Urban Renewal, urban policy has shifted from new construction and slum clearance to housing rehab and neighborhood revitalization. The federal government has taken a proactive role in urban development and revitalization typically through grant programs focusing on physical improvement, social transfer payments, and economic development initiatives.

Antipoverty Programs

During the 1960s, with social activism, racial tensions, and citizen protests reaching the national level, the Johnson administration declared a war on poverty. During this time, in addition to Urban Renewal efforts, several federal programs were initiated: Community Action Programs, Model Cities, and the Special Impact Program. These programs proved largely ineffective partially because they were too limited in scope and funding to alter the structural inequities that continued to segregate poor racial minorities (O’Conner 1999). Furthermore, policy makers had not decided whether their aim was to help rebuild communities or to help people leave distressed areas.

Block Grants

In the 1970s, under the leadership of Nixon and increased devolution to states, the Community Development Block Grant (CDBG) program replaced all previous urban programs. Initiated in 1974 under the Housing and Community Development Act, the CDBG program allocated federal money to states, cities, and urban counties based on certain indicators of distress.¹¹ Cities were given wide latitude in how they used the funds, but the primary beneficiaries were to be low and moderate-income residents. The program still exists, with annual budgets (since 2000) ranging from \$4.8 billion to just over \$5 billion. Grants can be over a one-, two-, or three-year period. According to guidelines set by HUD, all CDBG activities must meet one of the following objectives: benefit low- and moderate-income people, prevent or eliminate slums or blight, or meet urgent community development needs because existing conditions pose a serious and immediate threat to the health or welfare of the community.

Little rigorous analysis has been conducted to measure the impact of the program on distressed neighborhoods. The Urban Institute recently conducted research on 17 cities to determine the progress made by these areas from 1995 to 2000.¹² Overall, it found that larger CDBG investments are connected to improvements in neighborhood quality¹³. However, the authors caution the sample was not representative of the larger population nor were other public investments taken into account. Thus, results do not conclusively

¹¹ Indicators such as population, poverty level, age of housing stock, and other need factors.

¹² The two primary indicators used were home mortgage lending activity from Home Mortgage Disclosure Act data, and the number of businesses and employees from Dun and Bradstreet- both were found to be good indicators of neighborhood quality.

¹³ Measures of quality were based on numerous socio-economic neighborhood indicators as identified by the Urban Institute's *National Neighborhood Indicator Partnership (NNIP)* effort.

show CDBG investments to be positively correlated with particular calculable outcomes (Urban Institute 2002).

In response to the continued losses experienced by older industrial cities, the Urban Development Action Grant Program (UDAG) was authorized under the 1977 amendments to the 1974 Housing and Community Development Act. The UDAG program was seen as a complement to the CDBG Program. This program offered federal matching grants that could be used for commercial, industrial, or nonresidential development in central cities in hopes of creating jobs for residents and reviving downtown economies. Funds could be used for virtually any private development that produced new jobs and increased local tax revenues. The UDAG program came under criticism when most of the funding went for commercial initiatives rather than serving the poor.¹⁴ From its inception to its cancellation in 1988, the legitimacy and effectiveness of the program were in question. In the end, the UDAG program was known for its goals of facilitating public-private partnerships in the targeted redevelopment and economic recovery of urban areas, its requirements for leveraging, intergovernmental coordination, and the placement of responsibility for proposals with local governments (O’Conner 1999).

Community Reinvestment Act

The Community Reinvestment Act (CRA) was enacted in 1977 “to prevent redlining and to encourage banks and thrifts to help meet the credit needs of all segments of their communities, including low- and moderate-income neighborhoods” (Statement

¹⁴ For instance, Boston used UDAG funds to finance luxury hotels and retail shops. From 1978 to 1985 half of all newly constructed downtown malls received UDAG funding (Teaford 2000).

by the Office of the Comptroller of the Currency or OCC). The hope was that by encouraging banks to lend in their local communities, the CRA would be a tool for revitalizing communities and would stem the outward flow of capital (Haag 2000). In practice, the CRA places “enormous” pressure on banks to extend more credit to low-income areas than they otherwise would have (Grogan and Proscio 2000).

The legislation does not call for explicit penalties; however, when financial institutions seek permission to expand, merge, or otherwise change the scope of their charter, their CRA record is held up to public and regulatory scrutiny. Furthermore, legislation enacted in 1999 provides that financial holding companies and depositories are prohibited from entering new lines of business if the depository or any of its affiliates fail to maintain a satisfactory CRA record.

The National Community Reinvestment Coalition (NCRC), a group of neighborhood-based community reinvestment leaders, has kept the only systematic information on CRA commitments by depository institutions. According to NCRC, from its inception in 1977 there have been a total of \$1 trillion in total CRA commitments for loans, investments, and services to low-income and minority households.¹⁵ Between 1993 and 1998, “CRA-covered” lenders and their affiliates increased mortgage lending to low- and moderate-income borrowers and areas by 39 percent, while lending to other borrowers increased by only 17 percent (NCRC 2000). In her comprehensive literature review, Haag (2000) cites studies that found banks with CRA commitments were more likely to approve conventional mortgages for low-income minority residents than those

¹⁵ According to NCRC, 99 percent of all commitments have been committed since 1992.

without agreements. Further, CRA commitments are associated with larger increases in lending to low-income and minority households.

Regarding the profitability of CRA lending, a 1997 study conducted by Federal Reserve economists Glenn Canner and Wayne Passmore finds “no compelling evidence of lower profitability at commercial banks that specialize in home purchase lending in lower-income neighborhoods or to lower-income borrowers...regressions for the three years (1993, 1994, and 1995, which were years of high levels of CRA-related lending) suggest that the profitability of banks seems unrelated to, or perhaps slightly positively related to, the proportion of lending they extended in lower-income tracts” (NCRC 2000).

Empowerment Zones/ Enterprise Community

The 1980s were an era of increased devolution and “federal retrenchment” (O’Conner 1999). The prevailing belief was that the absence of government was key to neighborhood revitalization. A major initiative to emerge during this time was the Enterprise Zone. Modeled after a British program, Enterprise Zones promised to introduce free market principles and restore entrepreneurial activity to distressed areas through tax breaks and regulatory relief for businesses. The program was initially adopted by the states and did not become a federal program until 1993, when it became known as the Empowerment Zone/Enterprise Community (EZ/EC) initiative. The EZ/EC program is the most recent attempt by the U.S. to pursue a “place-based people strategy”¹⁶ (Ladd 1994). Intended to not only boost economic development but also to help cities compete in the global economy, the program provides explicit incentives to businesses, such as

¹⁶ It is place based in that it is tied to geographically designated areas and people based because of the block grant that provides direct funding for social services targeted to disadvantaged populations.

low-interest loans, job training assistance and subsidies, improvement of infrastructure and public services, and various business development services and assistance.

Engberg and Greenbaum (2001) examined the impact of Enterprise Zones on the growth of property values in 22 states, using a sample of small cities with and without zones. They note that typical evaluations focus on other desirable outcomes such as how many businesses and jobs the program creates. They make the case that all of these outcomes should be capitalized in local housing markets, thus property values make a valid evaluation measurement. Their findings indicate that on average, Enterprise Zones have had little impact on housing markets. In addition, zone programs in places that began the decade with high vacancy rates actually reduced the housing value growth rate.¹⁷ Their research suggests that zones should not be designated in the most distressed areas, but are more likely to have a positive impact on areas that are moderately distressed.

Other studies point to the ineffectiveness of the program. In England where the program first began, a government-funded evaluation revealed that employment grew more slowly in zones than outside zones, a majority of the jobs created in zones were not attributable to the zone designation, and most economic activity was not new but was relocated from nearby counties. Ladd (1994) presents additional research from Maryland indicating that Enterprise Zones are not a cost-effective means of generating jobs.

Low Income Housing Tax Credit

¹⁷ Engberg and Greenbaum offer three possible explanations: (1) Places given zone designation may experience a reduction in other forms of assistance that are more advantageous (2) Zone subsidies may attract businesses that are not viable after the subsidy expires or businesses that have negative externalities (3) A Zone label can carry a negative stigma, making it hard for distressed areas to overcome a reputation of being unsuitable for economic activity.

The primary vehicle of low-income housing production and rehabilitation, the Low Income Tax Credit (LIHTC) program contains incentives for development in low-income areas. To encourage affordable housing development in traditionally underserved areas, legislators increased the credit amount given to low-income housing developments in what are deemed “difficult development areas” (DDA)¹⁸ or “qualified census tracts” (QCT)¹⁹. A project in either a DDA or QCT qualifies for a 30 percent increase in the amount of the tax credit awarded to the project.

Overall, just over one-third of all projects placed in service between 1995 and 1998 are located in one of these two designated areas. McClure (2000) notes that since DDAs and QCTs can only make up 20 percent of a jurisdiction, the added incentives appear to have an impact on location decisions, as development projects are disproportionately located there. Not surprisingly, Cummings and DiPasquale (1999) and the GAO (1999) found that total development costs for projects in QCTs or DDAs were higher than projects outside of those areas.

While comparatively little research has been conducted that examines the impact of LIHTC projects upon their neighborhood, there does appear to be agreement that LIHTC projects are contributing to the reinvestment of low-income neighborhoods (Cummings and DiPasquale, 1999; Roberts and Harvey, 1999; Abt 2000b). Cummings and DiPasquale found that in many neighborhoods, LIHTC projects stand as the only new

¹⁸ A difficult development area (DDA) is defined by HUD as an area with high construction, land, and utility costs relative to the median income of the area.

¹⁹ A qualified census tract (QCT) is defined as a tract where at least 50 percent of the households have an income less than 60 percent of the area’s median family income.

residential construction in recent years. In center cities, 27 percent of the LIHTC projects were the only rental housing construction in the previous 5 years. They go further to claim that LIHTC units are highly important additions to the rental housing stock as some center cities “simply lack rental housing”. LIHTC properties represent over 20 percent of the 1990 housing stock in 13 percent of the census tracts in their sample²⁰. Likewise, the Abt 2000b report indicates that many of the developments were the “first new investments in the area.” Cummings and DiPasquale (1999) conclude that in center cities, the “LIHTC program is used much more often to provide better housing in poor neighborhoods than to provide affordable housing in higher-income neighborhoods.”

Roberts and Harvey (1999) assert that the tax credit has been successful in bringing private capital into poor neighborhoods. Cummings and DiPasquale (1999) found that about one in five LIHTC units were built in census tracts where the median household income was 40 percent below the area median²¹. In the database created and maintained by Abt Associates, (2000a) from 1995 to 1998, one out of every four units were developed in census tracts where more than half of the households had incomes under the 60 percent of area median qualifying income. Additionally, during that same time period, 19 percent of LIHTC units were developed in census tracts where 30 percent of households were below the poverty line. The 19 percent is a reduction from nearly 40 percent of the units placed in service from 1992 to 1994. The authors attribute this to the increased development of LIHTC units in suburban areas over center city locations.

State/Local Intervention: Washington-Baltimore Programs

²⁰ Cummings and DiPasquale’s sample includes 1,820 census tracts.

²¹ Based on 1990 Census.

State and local leaders have long recognized the unique nature of neighborhoods within city limits and the need to focus micro-level attention on problems affecting these neighborhoods. In Baltimore, the mayor has initiated an Office of Neighborhoods, a department whose principal task is to ensure that city government is an effective partner with communities in improving the quality of life in neighborhoods. Furthermore, in both Baltimore and Washington, D.C., the Department of Planning works at the neighborhood level with residents to create Strategic Neighborhood Action Plans or SNAPs. These plans have the stated goal of bringing revitalization to distressed neighborhoods.

Working to revitalize distressed neighborhoods, Maryland's Department of Housing and Community Development has 20 programs in its arsenal designed to bring and leverage private investment, spur homeownership, and provide assistance to local governments. One example is the Neighborhood Stabilization Act of 1996, which provided an 80-percent property tax credit incentive to middle-income homebuyers in several distressed neighborhoods. While programs continue to be developed and employed, knowledge regarding their effectiveness is limited to mostly anecdotal evidence, not research and evaluation.

A commitment to neighborhood revitalization is not unique to Baltimore or Washington D.C., nor is the idea that homeownership is one of the best ways to accomplish these goals. Many state and local governments use countless programs in their attempt to restore center city neighborhoods.²² However, what's unique and important to Washington, D.C. and Baltimore is that their policy interventions are solely

²² In 1991, The National Center for the Revitalization of Central Cities, examined six cities under a controlled framework. The most commonly used strategies in these cities were: Public investment as a tool to spur private investment, use of private, non-profit development corporations, human capital building

centered around promotion of homeownership for targeted income groups in a center city or for a targeted distressed neighborhood. Moreover, in the case of Washington, D.C., the first-time homebuyer credit program is the ONLY homeownership tax credit program financed by the federal government and implemented in a state/local setting..

In summary, the programs and methods mentioned in this section are by no means exhaustive. There are numerous renewal initiatives throughout the country with the expressed goal of revitalizing urban communities. To date, the academic literature is very limited in its evaluation of these programs. There does appear to be a common theme: Compelling, consistent, and generally accepted measures of neighborhood improvement are not easily derived. Continued research as to what constitutes revitalization and whether federal, city, or private initiatives can stem decline and promote renewal are central to the future of urban policy.

such as job training and career counseling, transit improvement, public- private partnerships, creation of redevelopment agencies with strong financial backing, and a strong commitment to planning and managed growth.

III. A Literature Review of Low-Income Homeownership and Its Tax Incentive Policy

Low-Income Homeownership

Both Presidents Clinton and Bush have promoted policy initiatives to improve the rate of homeownership among low-income and minority households to narrow the significant gaps in homeownership between these groups and the national total.

Homeownership for low-income households can have profound economic and social benefits to owners, their families, and their neighborhoods.

Homeownership provides economic benefits to individual households.

Homeowners generally live in larger, better-quality homes than renters, face costs that fall over time, and are shielded against rent risk (McCarthy, Van Zandt, and Rohe 2001, Sinai and Souleles 2001). Housing is a relatively low-risk investment, generally providing homeowners with substantially increased wealth in the form of home equity. Moreover, housing can be a good investment, even if one loses money on the investment, since it also provides dividends equal to home's rental value. Homeowners also gain access to home equity or other lines of credit, which can serve as a buffer against income shocks or facilitate additional investments (McCarthy, Van Zandt, and Rohe 2001). Finally, residential construction and investment helps the economy as a whole. Housing-related spending makes up 20 percent of the country's gross domestic product (Carr 1999).

Moreover, homeownership may yield broader social benefits to individuals and communities. First, homeownership grants owners a financial stake in the quality of the surrounding environment, providing incentives for positive neighborhood effects and strong local schools (Trefzger 1998). Second, homeownership may have a psychological

effect upon households, granting homeowners with a motivation to work hard and to become involved in their community. Social work professors Michael Sherradan and Alice K. Johnson write that: “While income supports consumption, assets change psychological outlook, behavioral effort, and social interaction” (Johnson and Sherradan 1992). Third, homeownership can provide financial and residential stability to households, both of which are crucial to family and childhood outcomes. A study by Joseph Harkness and Sandra Newman finds that the acquisition of home equity and the reduction in residential mobility, both associated with homeownership, improve key childhood outcomes (Harkness and Newman 2000).

Several caveats apply to the argument for low-income homeownership. Investments in housing by low-income households make up a larger portion of their investment portfolio than optimal, leaving them vulnerable to downturns in the housing market. This is particularly risky for homebuyers in low- and moderate-income tracts, since these areas generally have lower than average or unstable levels of price appreciation (McCarthy, Van Zandt, and Rohe 2001). Moreover, low-income households often face an unstable income stream and a lack of non-housing assets to cover emergency housing repairs and monthly payments. As a result, foreclosure rates are high among low-income homeowners, bringing to question the long-term sustainability of low-income homeownership without further government assistance (Meyer, Yeager, and Burayidi 1994, Elugardo and Klein 1998). Finally, the social benefits associated with homeownership may not manifest themselves for “pioneer” homeowners in distressed neighborhoods (Harkness and Newman 2000).

Low-Income Homeownership: Changes in Recent Years

In recent years, homeownership rates among low-income and minority households have increased but still remain far below the average. After rising for decades, the national homeownership rate stagnated during the 1980s at 64 percent, largely due to demographic changes and changes in household type (Green 1996). During the 1990s, the homeownership rate increased by two percentage points, the largest gain since the 1950s. By 2000, 66.2 percent of Americans owned their homes, the highest homeownership rate ever recorded in a decennial census. There are, however, significant gaps among racial groups. According to Simmons (2001), the homeownership rate for non-Hispanic whites increased by 3.4 percentage points, compared with an increase of 2.8 percentage points for all minorities. In 2000, the homeownership rate for non-Hispanic whites was 72.4 percent; African Americans, 46.3 percent; Hispanics, 45.7 percent; Asians, 53.2 percent; and all minorities, 47.4 percent (Simmons 2001). Raphael W. Bostic and Brian J. Surrette, in an analysis of CPS data from 1989 and 1998, found that the homeownership rate rose for all groups during this time, but that it rose at a faster rate for blacks, Hispanics, and lower-income families (Bostic and Surrette 2001).

Possible determinants of the growth in low-income homeownership include economic and demographic factors, as well as regulatory changes and financial innovation. During the 1990s, mortgage lenders developed sophisticated methods of credit scoring and utilized innovation in statistical modeling to expand risk-based lending. At the same time, an expansion of HMDA and CRA requirements as well as targets for affordable mortgage purchases for Fannie Mae and Freddie Mac provided new incentives for low-income homeownership. Bostic and Surrette find that regulatory

changes and technological innovation are largely responsible for the 1990s low-income homeownership boom, rather than “family-related characteristics.” Family-related characteristics, which include demographic and economic indicators, would have actually predicted a decrease in low-income homeownership (Bostic and Surrence 2001).

Low-Income Homeownership: Government Programs

In the past decades, the federal government has acted to support low-income homeownership through several relatively small HUD programs. Turnkey III rewarded public housing residents who maintained their apartments with a savings account for homeownership. Section 235 was a mortgage support program for newly built units that faced significant criticism for corruption among profit-maximizing real estate agents and ineffective government agencies. Section 236 subsidized the construction and operation of cooperative housing run by nonprofit organizations. Tenants “owned” their units but were prohibited from selling them for a profit. Finally, HOPE (Homeownership Opportunities for People Everywhere) allows for tenant ownership of public housing (Johnson and Sherradan 1992). The Clinton Administration’s National Homeownership Strategy aimed to reach a 67.5-percent homeownership rate by 2001, largely by expanding opportunities to traditionally underserved households. The Bush Administration proposed several homeownership programs under its HUD budget, including a down payment assistance program and American Dream Funds.

Housing advocates have recommended new variations on these programs or increased funding for the existing homeownership programs. The National Housing Institute, for example, calls for housing vouchers that could be used for both rental units and homeownership. They also propose a program similar to Section 236, where well

functioning public housing units would be converted into cooperatives run by nonprofit organizations.

David W. Berson and Eileen Neely have projected a national homeownership rate as high as 75 percent in 2005, conditional upon several policy changes: (1) fiscal and monetary policy decreasing interest rates, (2) expansion of low/no down payment programs and credit-risk mechanisms, (3) cost-saving home building technology, (4) programs to build low-cost manufactured or modular homes, (5) minority outreach programs and enforcement of fair housing laws, and (6) demographic changes projected to occur by 2005. According to Berson and Neely, efforts to increase minority homeownership would be have the most substantial effect (4.5 percentage points) on the national homeownership rate (Berson and Neely 1998).

Tax Incentives for Homeownership

By far, the largest government expenditure on housing comes not from HUD, but in the form of tax deductions for homeowners. According to Cushing Dolbeare, the total of all assisted housing payments made under all HUD programs from 1937 to 1980 is greater than the cost of all housing-related tax expenditures in the year 1980 alone. In 1998, Steven C. Bourassa and William G. Grigsby calculate that all tax breaks for homeownership cost the federal government about \$700 billion in lost revenues (Bourassa and Grigsby 2000).

American homeowners are able to deduct both mortgage interest and local real estate taxes from their federal income taxes. These deductions were developed in 1913, when taxes were fairly low, but have become immensely popular since the rise in taxes during and following World War II. Other tax concessions include the non-taxation of net

imputed income from owner-occupied homes and the non-taxation of the first \$250,000 (\$500,000 for married couples) of capital gains on the sale of a home. Similar tax concessions exist in other developed countries, but are not uniformly as generous as the United States (Bourassa and Grigsby 2000).

The mortgage and property tax deductions, while generally popular in the United States, have raised considerable controversy among advocates of low-income homeownership primarily because they go largely to wealthy households. The biased distribution of tax deduction benefits by income seems to result from two reasons. First, many low-income households don't benefit from the deduction as they don't find it worthwhile to itemize their deductions. Citing data from the Joint Tax Committee of Congress (FY 1995), Peter Dreier notes that over 80 percent of homeowners with income over \$200,000 claimed the deduction, compared to under 30 percent of homeowners with incomes between \$40,000 and \$50,000 and under 7 percent of those in the \$20,000-\$30,000 income bracket. Second, even without the gap between those who itemize and those who don't, the tax benefit is still regressive, since those with larger incomes are more likely own larger homes, thus receiving greater tax benefits. For example, the average benefit to homeowners with incomes over \$200,000 is more than 10 times that saved by those in the \$40,000-\$50,000 bracket (Dreier 1996).

Comparisons with Canada, which lacks a mortgage tax deduction, lead Bourassa and Grigsby to believe that the deduction does little to increase the nation's homeownership rate. The tax concession may, in fact, lead to overconsumption of housing, but Bourassa and Grigsby believe that this is a value judgment (Bourassa and

Grigsby 2000). At the very least, the current tax concession is not a homeownership incentive for those who do not itemize their deductions.

Defenders of the tax deduction believe that it is a valuable tax incentive for middle-class families and is justified by the positive externalities associated with homeownership (Weicher 2000). Eliminating the deduction or lowering the cap on qualifying home values (currently at \$1 million) would be politically unpopular and would lower existing real estate values as people move “down market” to less expensive homes. Bourassa and Grigsby recommend phasing out the tax deduction over 15-20 years to avoid capital losses for current homeowners and to allow for gradual adaptation on the supply and demand sides of the housing market (Bourassa and Grigsby 2000).

IV. New Empirical Evidence on Distributions of Mortgage and Property Tax Deductions in the United States

This section offers new empirical evidence on the distributions of mortgage and real estate tax deductions by income class for 1991 through 2001. While it is only a descriptive analysis based on calculations of the data from the U.S. Joint Committee on Taxation, it is central to this study. This empirical evidence verifies whether, and why, the existing tax policies for homeownership do not provide an effective incentive for lower-income families to participate in homeownership. This, in turn, provides a critical context for the targeted homeownership tax credit as the appropriate remedy or supplement to the current system.

As shown in Table 1, only 72.7 million lower-income families (with family income below the national median income in a given year) filed individual tax returns for the real estate tax deductions for years 1991 through 2001. They accounted for merely 7.3 percent of all returns by lower-income families per year. In contrast, about 58.1 percent of all higher-income tax filers (whose family income is above the national median income in a given year) claimed the real estate tax deduction benefits every year. As a result, the lower-income class received substantially fewer benefits from the deduction than the higher-income class did. Between 1991 and 2001, the aggregate deduction claimed by higher-income families was estimated at \$175 billion in 2001 dollars, compared to only \$16.6 billion for lower-income families. Most strikingly, Figure 1a indicates that the real estate tax deduction received by the higher-income class accounted for about 91 percent of the aggregate real estate tax deductions for the period, while lower-income class accounted for only 9 percent.

Table 1. Distribution by Income Class of Real Estate Tax and Mortgage Interest Deductions Under Individual Income Tax

[money amounts in millions of 2001 dollars, return in thousands]

YEAR	Lower-Income Class (below Median Income)			Higher-Income Class (above Median Income)		
	Returns*	Returns as % of All Returns	Amount	Returns*	Returns as % of All Returns	Amount
<u>Real Estate Tax Deduction</u>						
1991	5,972	7.5	1,285	19,233	58.5	12,081
1992	6,083	7.6	1,373	20,784	60.5	14,061
1993	4,837	6.4	1,021	23,327	58.1	14,365
1994	4,579	5.3	954	23,486	53.1	14,653
1995	7,828	8.0	1,914	20,467	62.2	14,621
1996	8,024	8.3	1,964	22,304	62.7	15,109
1997	7,486	7.9	1,818	22,410	59.3	15,846
1998	7,243	7.7	1,726	23,350	58.4	17,132
1999	7,947	8.1	1,868	23,628	57.8	17,640
2000	6,465	7.0	1,479	26,479	55.4	19,334
2001	6,246	6.9	1,181	27,312	53.1	20,164
Sum (1991-2001)	72,710		16,583	252,780		175,007
Mean	6,610	7.3	1,508	22,980	58.1	15,910
Standard Deviation	1,206	0.9	370	2,406	3.2	2,422
<u>Mortgage Interest Deduction</u>						
1991	6,009	7.6	5,074	18,049	54.9	42,758
1992	6,125	7.7	4,625	19,869	57.8	46,835
1993	5,087	6.7	3,498	22,382	55.8	47,551
1994	4,690	5.4	3,481	22,453	50.8	57,655
1995	7,910	8.1	7,082	19,939	60.6	60,708
1996	7,876	8.2	4,775	21,570	60.7	40,762
1997	7,107	7.5	4,578	21,379	56.6	41,565
1998	6,948	7.4	4,460	22,599	56.5	46,582
1999	7,753	7.9	5,478	22,572	55.2	51,308
2000	6,347	6.9	4,399	25,462	53.2	57,941
2001	6,080	6.7	3,777	26,001	50.5	60,753
Sum (1991-2001)	71,932		51,226	242,275		554,418
Mean	6,539	7.3	4,657	22,025	55.7	50,402
Standard Deviation	1,089	0.8	1,018	2,324	3.4	7,672

Source: Calculated from Joint Committee on Taxation, *Estimates of Federal Tax Expenditures, fiscal years 1991-2002*

Note: According to a telephone conversation on July 24, 2002 with Mr. Thomas F. Koerner, Associate Deputy Chief of Staff at the Joint Committee on Taxation, the statistics in these JCT reports are the estimates for the specified calendar year. The yearly estimate is derived from the JCT econometric models on the basis of the past real data on income tax returns. Cautions must be exercised in comparing these estimates among various years due to methodological changes from time to time, which may have resulted in a somewhat inconsistent time series for estimations.

* Number of individual tax returns that filed real estate tax deduction or mortgage interest deduction under the itemization section.

Similarly, the lower-income class also received disproportionately fewer tax benefits from the mortgage interest deduction. Over the 1991-2001 period the aggregated mortgage interest deduction received by the higher-income class (or 55.7 percent of all returns from the higher-income group) was \$554.4 billion in 2001 dollars, compared to \$51.2 billion for the lower-income tax filers (whose claim rate was 7.3 percent per year). This key information is illustrated in Figure 1b, which also shows that the aggregate mortgage interest deduction claimed by the high-income class accounted for, once again, about 92 percent of the national total, compared to 8 percent for the lower-income class.

These data clearly indicate that lower-income families have not received significant economic benefits from existing tax treatments to for homeownership. The question remains as to why, or how, this has happened. There are two possible explanations:

First, the majority of low- and moderate-income families in the U.S. are not able to itemize their tax returns so as to receive the mortgage interest and property tax deductions. This is because they either have little or no tax liability, they rent their housing, or they own a home so small and inexpensive that itemizing the mortgage interest and real estate taxes would have no impact on their returns. As a result, although there were as many as 89.7 million lower-income families who filed tax returns each year between 1991 and 2002, only 10.8 percent of them were able to itemize their tax returns. In contrast, for an average of 39.9 million higher-income tax filers per year, their rate of itemization was 65.4 percent during the same period (Table 2 and Figure 2).

Second, even for those who did itemize their tax returns for mortgage interest and real estate tax deductions, the disparity in deductions per return between the lower- and

Figure 1a. Distributions of Real Estate Tax Deduction (1991-2001)

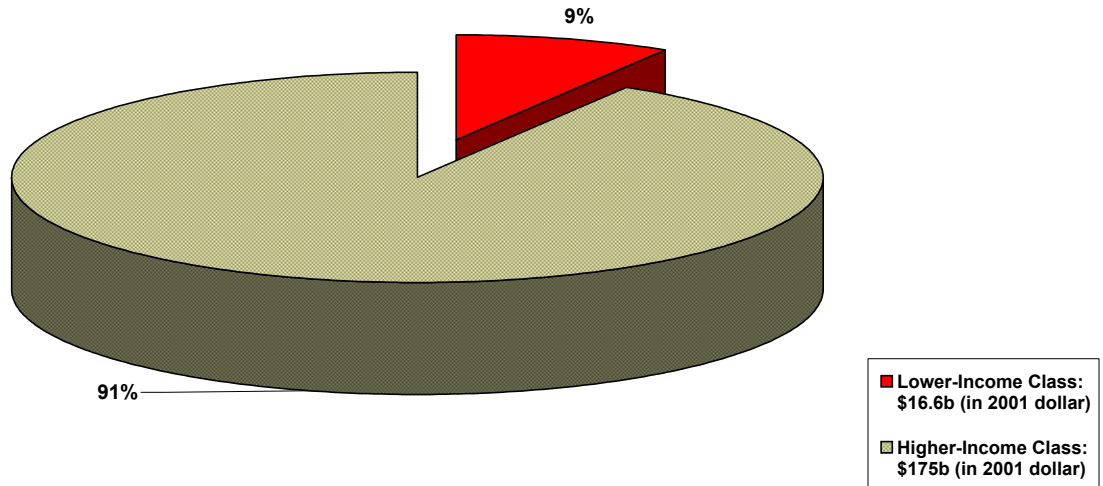


Figure 1b. Distributions of Mortgage Interest Tax Deduction (1991-2001)

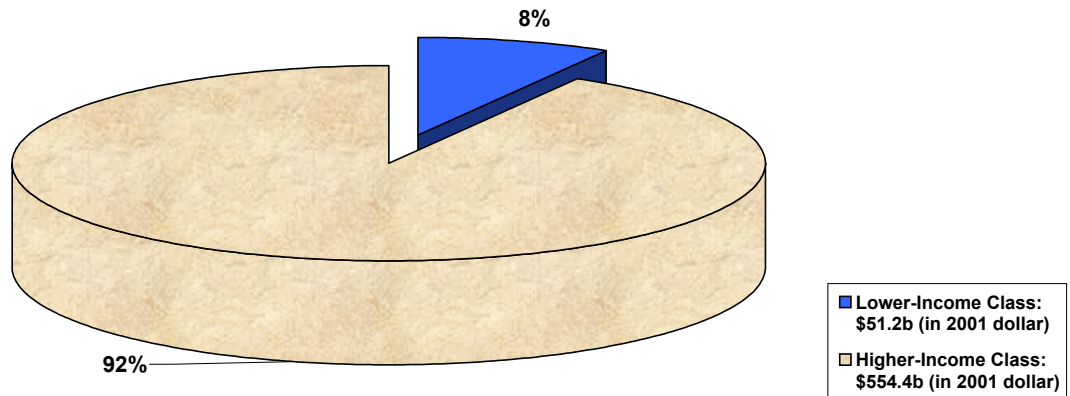


Table 2. Tax Liability and Itemized Tax Returns Under Individual Income Tax

[money amounts or tax liability in millions of 2001 dollars, return in thousands]

YEAR	Lower-Income Class (below Median Income)				Higher-Income Class (above Median Income)			
	All Returns	Itemized Returns	Itemized Returns as % of All Returns	Tax Liability	All Returns	Itemized Returns	Itemized Returns as % of All Returns	Tax Liability
1991	79,492	9,281	11.7	102,225	32,875	21,901	66.6	534,274
1992	79,778	8,961	11.2	97,054	34,364	23,411	68.1	503,264
1993	75,674	7,340	9.7	74,759	40,140	26,020	64.8	523,363
1994	86,639	6,968	8.0	64,653	44,227	26,331	59.5	582,352
1995	98,094	10,782	11.0	104,724	32,921	22,737	69.1	554,267
1996	96,636	10,693	11.1	94,872	35,549	24,490	68.9	580,308
1997	95,026	10,553	11.1	90,152	37,804	24,984	66.1	612,380
1998	93,941	10,159	10.8	75,578	39,996	26,209	65.5	685,552
1999	97,970	12,104	12.4	88,354	40,859	27,018	66.1	757,312
2000	92,378	9,823	10.6	67,645	47,835	29,982	62.7	841,339
2001	90,547	10,493	11.6	40,126	51,478	31,952	62.1	907,465
Sum (1991-2001)	986,175	107,157			438,048	285,035		
Mean	89,652	9,742	10.8	81,831	39,823	25,912	65.4	643,807
Standard Deviation	8,062	1,525	1.1	19,438	6,072	2,998	3.0	136,466

Source: Calculated from Joint Committee on Taxation, *Estimates of Federal Tax Expenditures, fiscal years 1991-2002*

higher-income filers is substantial. Table 3 shows that a typical higher-income filer received a total deduction of nearly \$2,985 (in 2001 dollars) per return per year, including \$2,295 from mortgage interest deduction and \$690 from real estate tax deduction, over the 1991-2001 period. At the same time, the total deduction per return was merely \$939 per year, including \$713 from mortgage interest deduction and \$226 from property tax deduction, for a typical lower-income filer. Put differently, the tax benefits received by the lower-income class from these two types of homeownership-related tax deductions were slightly less than one-third of the benefits received by the higher-income families. This may reflect the fact that the higher the family income, the more expensive the home and the larger the mortgage loan (and property tax liability) would be. This key information is illustrated in Figure 3a.

What would the pattern look like if the deductions are calculated as a percentage of household income²³? The results are also documented in Table 3 and depicted in Figure 3b. They show that: (1) On average, the mortgage interest and real estate tax deductions per household accounted for about 2.3% of median household income for the lower-income class and 3.2% for the higher-income tax filers. (2) The small standard deviations indicate that the gap of about 0.9 percentage point between the two groups was largely consistent over time (1991-2001). Together, these results suggest that, as compared to higher-income homeowners, the lower-income homeowners received fewer homeownership-related tax benefits even relative to their incomes. Obviously, this outcome is consistent with other findings reported in this section.

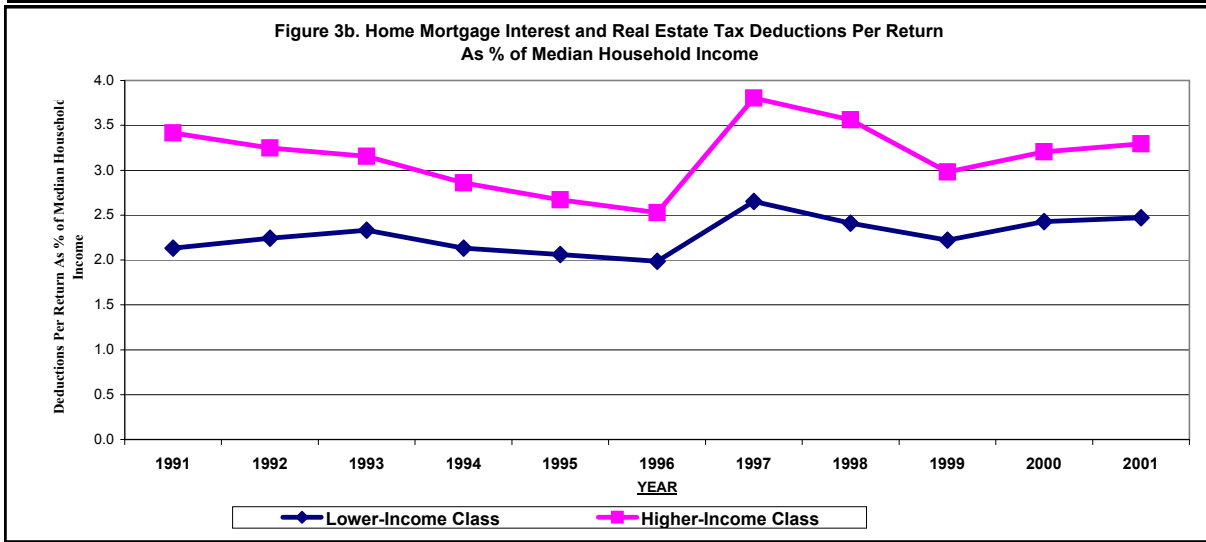
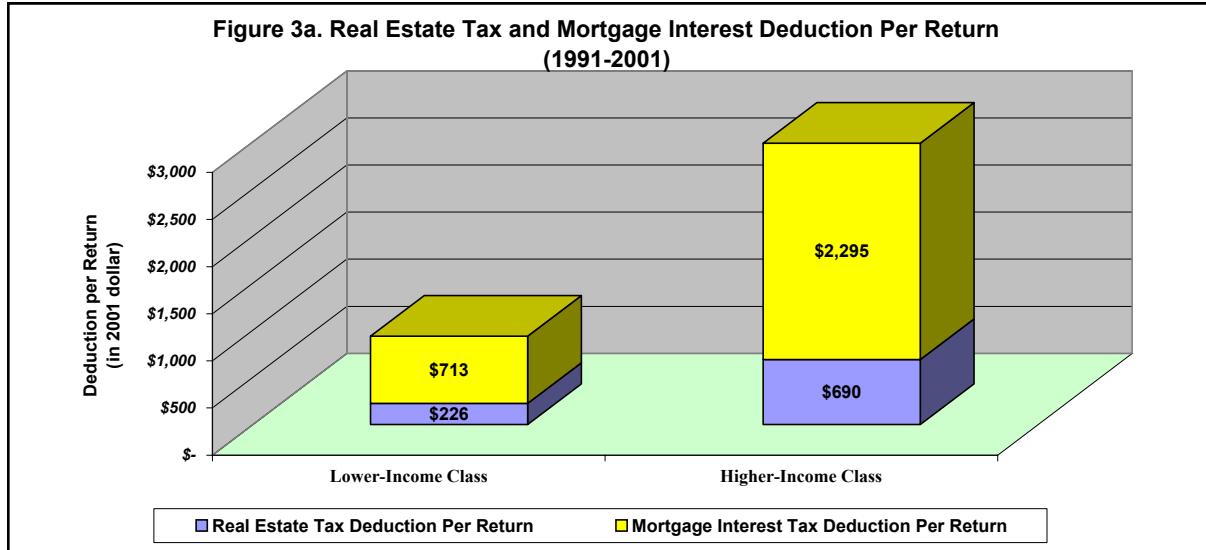
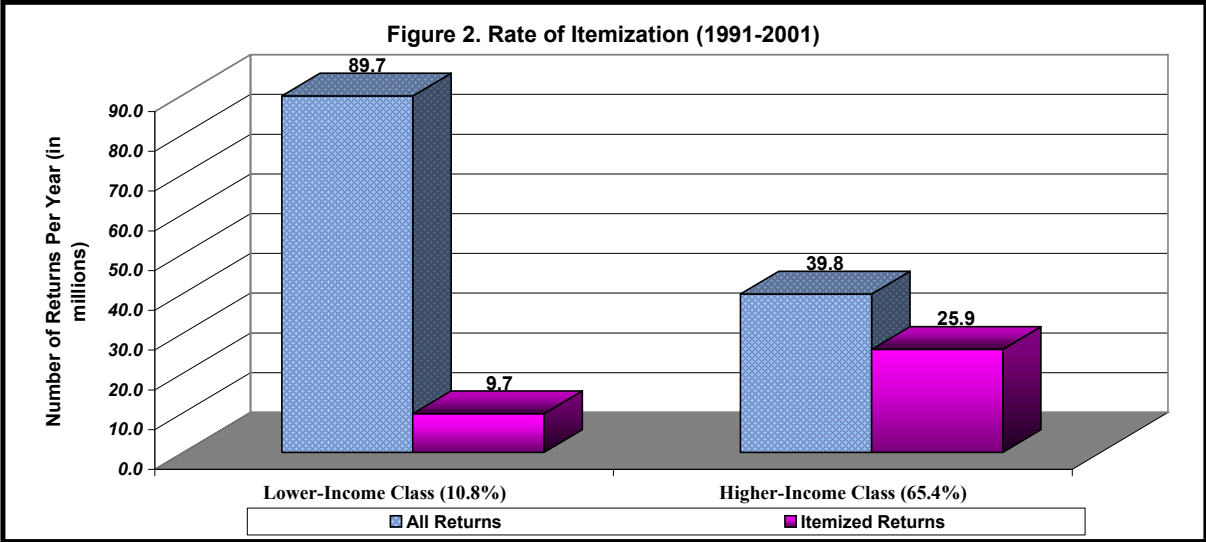
²³ Examining this question was suggested by Dr. Robert Goodman, the former research director of Maryland Department of Housing and Community Development.

Table 3. Real Estate Tax and Mortgage Interest Deductions Per Return by Income Class

[money amounts in 2001 dollars]

YEAR	Lower-Income Class (below Median Income)				Higher-Income Class (above Median Income)				
	Real Estate Tax Deduction Per Return	Home Mortgage Interest Deduction Per Return	Deductions Per Return As % of Median Household Income*	Real Estate Tax Deduction Per Return	Home Mortgage Interest Deduction Per Return	Deductions Per Return As % of Median Household Income*	Real Estate Tax Deduction Per Return	Home Mortgage Interest Deduction Per Return	Deductions Per Return As % of Median Household Income*
1991	215	844	2.1	628	2,369	3.4	628	2,369	3.4
1992	226	755	2.2	677	2,357	3.2	677	2,357	3.2
1993	211	688	2.3	616	2,125	3.2	616	2,125	3.2
1994	208	742	2.1	624	2,568	2.9	624	2,568	2.9
1995	244	895	2.1	714	3,045	2.7	714	3,045	2.7
1996	245	606	2.0	677	1,890	2.5	677	1,890	2.5
1997	243	644	2.7	707	1,944	3.8	707	1,944	3.8
1998	238	642	2.4	734	2,061	3.6	734	2,061	3.6
1999	235	707	2.2	747	2,273	3.0	747	2,273	3.0
2000	229	693	2.4	730	2,276	3.2	730	2,276	3.2
2001	189	621	2.5	738	2,337	3.3	738	2,337	3.3
Mean	226	713	2.3	690	2,295	3.2	690	2,295	3.2
Standard Deviation	18	92	0.2	49	319	0.4	49	319	0.4

* Including both real estate and mortgage interest deductions. Median household income is the income of those who were roughly at the middle point of the lower- or higher-income classes claimed for these deductions.



In summary, these findings suggest that the mortgage interest and real estate tax deductions may not have served as strong incentive instruments for lower-income families to participate in homeownership, through which they can build home equity wealth. The ineffectiveness is rooted in the structure of the current tax treatments to housing in which the low/moderate-income families receive substantially fewer economic benefits because of their substantially lower rate of itemization, higher rate of renting, or smaller homes they own.

These findings are consistent with a 2002 study by Edward Glaeser and Jesse Shapiro of Harvard University. Their study finds that while externalities from homeownership are significant, the home mortgage interest deduction is a particularly poor instrument of encouraging homeownership since it targets the wealthy, who are almost always homeowners. Using a time series, their empirical results show that the homeownership subsidy moves with inflation and has changed significantly between 1960 and today, but the homeownership rates have been essentially constant.

The implications of these findings should be viewed with caution. First, although the mortgage interest and property tax deductions as reported here are substantial, they are still not the major tax benefits of homeownership in this country. The main portion of homeownership subsidies comes from the non-taxation of imputed rent of owning a home. That is, if owner-occupied and renter-occupied housing are treated the same way, homeowners would be able to claim for mortgage interest and property tax deductions but they would also have to be taxed for the implicit rent they pay themselves. Under the existing tax system, however, the imputed (implicit) rent of homeownership is not taxed but the deductions are still allowed. Second, even for the deductions themselves, the

existing tax system contains some important built-in mechanisms such as deduction cap and standard deduction. These mechanisms appear to have served as an effective break that stops/prevents the wealthy from taking too many (or unlimited) tax benefits of homeownership while they also provide the lower-income households with some tax benefits even if they are without homeownership attainment.

V. Targeted Homeownership Tax Credit: An Overview and Analysis of Existing Programs and Proposals in the U.S.

Despite the substantial biases associated with the distributions of mortgage and property tax deduction system, it appears to be not feasible both politically and practically to end this system entirely in this country. Therefore, low-income homeownership advocates, politicians, trade associations, as well as academics have instead focused on tax credits, targeted at those homeowners who do not receive full tax benefits according to the current tax code. Tax credits have been justified on equity grounds (Vandell 2000) and for their potential in promoting local economic development (Norton 2002). Yet, a tax credit in and of itself may not be a panacea for low-income homeownership, as it does not address substantial wealth constraints of minorities and low-income households (Green and Reschnovsky 2001, Rohe 1996).

Examples of tax credit plans have been implemented in the District of Columbia and Baltimore and suggested by the Millennial Housing Commission, the Bush Administration and various academics, politicians and advocacy organizations. The remainder of this section (and Table 4) details these various tax credit plans. The first programs (both existing and proposed) directly target homebuyers. Other proposed homeownership tax credits target lenders and low-income housing developers.

Target: Homebuyer

As shown in Table 4 and also discussed in Section I, the D.C. First-Time Homebuyer Tax Credit utilizes income targeting, allowing homebuyers in a specified income range to claim a \$5,000 credit against their federal income taxes. If those taxes are less than \$5,000, the remainder of the credit can be carried on to the following year.

Table 4. A Comparison of the Existing Programs or Proposals on Targeted Homeownership Tax Credit in the United States

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Washington D.C. First-Time Buyer Tax Credit	Existing program in D.C. ⁱ	Individual homebuyer takes tax credit up to \$5000 to compensate for a portion of the sales price.	Demand-Home-buyer	Credit phased out for individuals at \$70,000-\$90,000; for married couples at \$140,000-\$180,000. Cannot have purchased a home in D.C. during the last year.	No	<ul style="list-style-type: none"> - Low transaction costs and minimal inefficiencies - Addresses the wealth barrier to homeownership. (Fannie Mae 'tax credit equity loans' allow individuals to use credit toward downpayment.) - Credited for major urban revitalization in D.C. - Addresses equity concerns in current tax policy. 	<ul style="list-style-type: none"> - Subsidy goes to some homeowners who would have bought homes anyway. - Doesn't help low-income individuals with no tax liability unless it is refundable.
National First Time Buyer Tax Credit	Proposed by Congressman English ⁱⁱ	Individual homebuyer takes tax credit to compensate for a portion of the sales price. Credit would be 10% of sales price, up to \$6500.	Demand – Home-buyer	No income limit. First time buyers only.	No	<ul style="list-style-type: none"> - Low transaction costs and inefficiencies 	<ul style="list-style-type: none"> - Subsidy goes to some homeowners who would have bought homes anyway. - Could cost \$16 billion a year. - Does not address wealth

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Revenue Neutral Flat Tax Credit as Alternative to Deductions	(Green and Vandell, 1999, - Green and Reshovsky, 2001)	Fixed credit of \$500 per year replaces the mortgage interest deduction	Demand- (homeowner)	No	No	<ul style="list-style-type: none"> - No additional costs or bureaucracy - Raise projected homeownership rate by 2.3 percentage points; higher among low-income, African Americans. - Addresses equity concerns in current tax policy. 	<p>constraint unless it can be used for downpayment.</p> <ul style="list-style-type: none"> - No income limit- subsidy goes to those who already receive tax benefits for homeownership - Could have long-term effects on the value on housing prices. - Does not address wealth constraints to homeownership (without monetizing the credit) - If one were to monetize the credit, however, it would have been more efficient to give credit directly to the investor.

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Graduated Homeowner Ship Tax Credit	National Housing Institute ⁱⁱⁱ	Eliminate the current homeownership deduction and use its funding (\$50 billion) to fund a refundable progressive homeownership tax credit, available to all families.	Demand-homeowner	Progressive (by income) and capped at \$250,000 mortgages	Could be adjusted for regional housing costs	<ul style="list-style-type: none"> - No additional costs or bureaucracy - Provides greater incentives for homeownership to those that might not purchase a home otherwise; minimizes subsidies to those who need no incentive to buy a home. - Increases demand for homes; gain housing industry support. 	<ul style="list-style-type: none"> - Challenges politically popular tax deductions for homeownership - Potential negative effects on existing housing values
Neighborhood Preservation and Stabilization Credits	Existing Program in Baltimore	Tax credit for property taxes on owner occupied housing in designated neighborhoods. Tax credit is 80% of property taxes paid for the first five years of ownership, declining to 10% for the following years and expiring in the 11 th year. The cost of the credit is divided evenly between state income taxes and local property taxes. The credit on state income taxes is refundable.	Demand-homeowner	none	Designated neighborhoods only	<ul style="list-style-type: none"> - Only addresses neighborhoods with very low rates of homeownership 	-

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Mortgage Subsidy Tax Credit (Three Variations below)	Abt Associates ^{iv}	Lender or mortgage insurer uses tax credit or sells to investors along with below-market financial instruments. Lenders apply credits to first or second mortgages or to mortgage insurance.	Demand - Lender	First time buyers with income below 80% of area median, adjusted for household size.	No	<ul style="list-style-type: none"> - Lower transaction costs than supply-side model. - Has minimal inefficiencies relative to supply-based credit (does not need to cover above-market costs of new housing production) - Lower transaction costs associated with syndication (than supply-side model) - Addresses barriers to homeownership (income, wealth, credit) 	<ul style="list-style-type: none"> - Could be more successful if community-based non-profits helped target the subsidy. - Subsidy would go to some homeowners who would have bought homes anyway.
Mortgage Subsidy #1: First Mortgage Subsidy Tax Credit	Mortgage Guaranty Insurance Company Source: Abt Associates ^v	Interest rate buy down through prepaid interest point (10-20%) of the house price. Maximum subsidy of \$25,000 (\$10,000 for higher income households).	Demand-lender	First time buyers with income below 80% of area median, adjusted for household size	Incomes could be higher in "HUD targeted zones"	<ul style="list-style-type: none"> - Larger size of loans (relative to second mortgages) would make it easier to pool them efficiently. 	<ul style="list-style-type: none"> - May cause gentrification
Mortgage Subsidy #2: Low Income Second Mortgage	J. Michael Collins, Eric S. Belsky and Nicolas Retinas,	State agencies sell tax credits to financial institutions and community development corporations. Bidders	Demand - Lender	Households with incomes below 80%	HUD defined underserved areas		No well-developed secondary market for below-market second mortgages exists. It would be

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Tax Credit	Joint Center for Housing Studies, Harvard University ^{vi} Also-Legislation by Congressman Roybal-Allard. ^{vii}	would agree to originate and fund below-market interest rate second mortgages. The subsidy would cover the difference between the below market interest rate (required by the program) and the expected risk-adjusted market rate of return on second mortgages. Loans (known as “piggy back loans” would be used to finance downpayment and closing costs. They would reduce loan-to-value ratio to below 80%, eliminating the need for mortgage insurance.		of the local area median income, adjusted for family size.			necessary to collect information on loan performance, taking time and running high transaction costs.
Mortgage Subsidy #3: Deep Mortgage Insurance	Abt Associates ^{viii}	Tax credit allocated to private mortgage insurers, who use credit in association with “deep mortgage insurance” contract with below-market premium. (Deep MI covers at least 50% of mortgage balance, while regular MI covers 15-30%.)	Demand-lender	Not specified	Not specified	-	-

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Renewing the Dream Tax Credit	Bush Administration (draft legislative proposal) Source: Abt Associates ^{ix}	Deep MI typically used for small high-risk loans. Most individuals who qualify for deep MI would otherwise utilize the subprime market Subsidy for the development cost of new/ rehabilitated housing sold at affordable prices to targeted households (up to half the cost of development of the housing unit.) Like LIHTC model: states receive allocation. State agencies distribute credits to developers who can use them or sell them through a syndicator. The value of the tax credit would be recaptured from the homebuyer when the household no longer within the income group sold the house to someone not within the income limit	Supply-Developer	Households with incomes below 80% of area median income/ 70% for 1-2 person households.	Census tracts with average income below 80% of the area median income. No income cap in designated Census tracts	- Overcomes the ‘appraisal gap’ in some neighborhoods (sales price/value of house is too low to cover new construction/improvements)	- High transaction costs associated with Syndication - Subsidy would go housing that would have been developed without assistance - Does not lower the cost of housing to the buyer. - Could be more successful if community-based non-profits helped target the subsidy. - Highly

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
Single Family Tax Credit	Millennial Housing Commission ^x	<p>The tax credit cannot exceed the difference between the development cost and a lower appraised value of the unit. This means it would not provide a below-market sales price.</p> <p>Tax Credit allocated to state housing finance agencies, which could use credit to build supply, to stimulate demand or both.</p> <p>Supply: Developers compete for tax credits and sell them to investors. Proceeds cover the difference between the cost of production and fair market value (up to 50% of total costs.)</p> <p>Demand: State could auction off credits to lenders in return for commitment to reduce borrowing costs, downpayment requirements or both.</p>	Both - developer or lender	<p>Supply side- no</p> <p>Demand-side- yes (first time homebuyers with incomes below 80% of area median income)</p>	<p>Supply-side: yes (eligible census tracts)</p> <p>Demand-side: no</p>	<ul style="list-style-type: none"> - Devolves authority to states - Relies on private sector partnerships for delivery of services - Flexibility 	<p>inefficient- encourages developers to have high costs.</p> <ul style="list-style-type: none"> - Could lead to gentrification <ul style="list-style-type: none"> - Must be carefully crafted to avoid negative impact on existing low income housing tax credit - Disadvantages of lender and developer based programs listed by Abt associates still apply

Policy Proposal	Advocate(s)	Mechanics	Supply or Demand Side	Income Targeted	Neighborhood Targeted	Advantages	Disadvantages
		Credits would be applied against the borrower's mortgage in the form of prepaid points, below-market interest rates, etc					

ⁱ Khadduri, Jill, Austin Kelly and Laura Talle. 2002. Low-Income Homeownership through Tax Credits: A Review of Design Choices. ABT Associates., Norton, Eleanor Holmes. \$5000 D.C. Homebuyer Credit-Q&A. www.norton.house.gov

ⁱⁱ Khadduri et al

ⁱⁱⁱ National Housing Institute. A Progressive Housing Plan for America

^{iv} Khadduri et al

^v Ibid

^{vi} Collins, J. Michael and Belsky, Eric S. Toward a Targeted Homeownership Tax Credit. Working Paper. Joint Center for Housing Studies at Harvard University/Brookings Institution.

^{vii} Khadduri et al

^{viii} Ibid

^{ix} Ibid

^x Ibid, Meeting our Nation's Challenges. 2002. Report of the Millennial Housing Commission

The credit is phased out for single filers with incomes of \$70,000-\$90,000 and married filers with incomes of \$110,000-\$130,000. Individuals qualify as “first-time homeowners” if they have not owned a home in the District during the past year.

District Congresswoman Eleanor Holmes Norton credits this tax concession for the District’s economic turnaround in the late 1990s. The District had experienced massive flight to the suburbs in the 1980s and a financial crisis in the 1990s. Beginning in 1998, however, D.C. led the nation in home sales increases several times in the quarterly house price index published by the Office of Federal Housing Enterprise Oversight. According to the Greater Washington Research Center, 70 percent of the District homebuyers used the credit in 1998 (Dearborn and Richardson 1999). Analysis by Abt Associates further credits this tax system for its minimal transaction costs and inefficiencies (Khadduri et al 2002).

While the District tax incentive appears to be successful, some caveats apply. First, the credit goes to many homebuyers who would have purchased a home without the tax incentive. Second, without being refundable, the tax credit has no effect on very low-income people who have no tax burden (Khadduri et al 2002). Initially, there was also a criticism that the tax credit alone addressed only the income constraints of low-income homebuyers, not the wealth constraints. However, it is no longer the case since a new enhancement to the credit was developed by the private sector several years ago. In partnership with a number of local mortgage lenders, Fannie Mae has made a “tax credit equity loan” available to the first-time homebuyers in the District allowing them to apply the credit toward a down payment or closing costs.

Politicians and academics have proposed expanding a first time homebuyer tax credit nationally. Congressman English (R-PA) proposed the National First Time Buyer Tax Credit, a credit of 10 percent of the sales price (up to \$6,500) for all new homebuyers, regardless of income or location. This proposal, which could cost \$16 billion a year, would not target only low-income households and would reach the households who already receive substantial tax benefits for homeownership (Khadduri et al 2002).

Finally, several proposals call for more radical changes in the tax system in order to promote equity in homeownership tax incentives. Researchers at the University of Wisconsin (Vandell and Green 1999, Green and Reshovsky 2001) call for a fixed credit of \$500 a year for all homeowners, as a replacement to the mortgage tax deduction. This proposal would be revenue neutral and is projected to dramatically increase low-income homeownership, raising the national homeownership rate by 2.3 percentage points. The National Housing Institute has proposed a similar plan, where the credit would be distributed progressively and capped at \$250,000 mortgages.

The second existing program is the Neighborhood Preservation and Stabilization Tax Credit, established in Baltimore city and Baltimore County in 1996. This program targets neighborhoods, rather than income groups, allowing homebuyers in specified neighborhoods to claim a credit against 80 percent of the property taxes paid in the first five years of ownership. The benefit declines to 10 percent a year until the 11th year. The cost of the credit is split evenly between state income taxes and local property taxes. The state projects that the tax credit will decrease revenues initially, but that revenue loss will gradually taper off. Through neighborhood targeting, the program is largely aimed at

revitalizing distressed areas with very low homeownership rates. After running a pilot program from 1996 to 1999, the state has expanded through June 30, 2002 and added new qualifying neighborhoods. (Department of Legislative Services, Maryland General Assembly, 1999)

Target: Lender

A report by Abt Associates details proposals for lender-based tax credits for low-income homeownership. Through a mortgage subsidy tax credit, a lender or mortgage insurer would use tax credits or sell them to investors along with below-market financial instruments. This paper details three different possible variations on a mortgage subsidy tax credit.

First, the Mortgage Subsidy Tax Credit, suggested by the Mortgage Guaranty Insurance Company (MGIC), would provide a tax credit to lenders who make low-interest first mortgages to low-income first time homebuyers. Lenders would lower interest rates through prepaid interest points and could buy and sell the credits (Khadduri et al 2002).

Second, academics at the Joint Center for Housing Studies at Harvard University (Collins and Belsky) and Congresswoman Roybal-Allard (D-CA) have proposed the Low Income Second Mortgage Tax Credit. This credit would allow state agencies to sell tax credits to financial institutions or CDCs that originate and fund below-market interest rate second mortgages. The subsidy would cover the difference between the below-market interest rate and the expected rate of return on the mortgage. “Piggy back loans” could be used to finance down payment and closing costs, thus reducing the loan-to-value ratio to below 80 percent and eliminating the need for mortgage insurance. This proposal would

cover low-income households and HUD defined underserved areas. Analysts from Abt Associates note that since no well-developed secondary market exists for below market second mortgages, it would be necessary to spend time and money collecting necessary information on loan performance (Khadduri et al 2002).

Third, the Abt Associates report recommends a tax credit allocated to private mortgage insurers, who use the credit in association with “deep mortgage insurance” contract with below market premium. Deep mortgage insurance covers at least 50 percent of mortgage balance, compared to 15-30 percent under regular mortgage insurance. Those who would qualify for deep mortgage insurance require high-risk loans and would otherwise likely use the subprime market (Khadduri et al 2002).

Target: Developers

The Bush Administration has recently promoted a supply side tax credit to encourage low-income homeownership. The subsidies, as proposed, would be distributed to state agencies and bought and sold by developers who could use them or sell them through a syndicator (like the LIHTC model). Subsidies could be used to cover up to half the cost of development or rehabilitation of a housing unit. The tax credit could not exceed the difference between the development cost of the home and a lower appraised value of the unit, meaning that it would not provide a below-market sales price. (Bush Administration 2001 and Khadduri et al 2002) This proposal is intended to overcome the “appraisal gap” in some neighborhoods, where the market value of a house is too low to cover construction or improvements.

The Abt Associates report critiques this proposal, claiming that the subsidy will go to housing that would have been built without it and that it does not lower the cost of

housing to the buyer. Furthermore, according to Abt Associates, there are high transaction costs associated with syndication and the system would be inefficient, encouraging developers to have high costs. Finally, the report states that this tax subsidy would be more successful in community-based nonprofits helped to target it effectively (Khadduri et al 2002).

Flexible Tax Credit

Finally, the Millennial Housing Commission recently recommended a flexible tax credit. In this case, tax credits would be allocated to state housing finance agencies, which could choose to offer the credits to developers or lenders. The supply-side choice would be similar to that proposed by the Bush administration. For the demand-side approach, states could auction off credits to lenders in return for their commitment to reduce borrowing costs, down payment requirements or both. Credits would be applied against the borrower's mortgage in the form of prepaid points or below-market interest rates (Millennial Housing Commission 2002). The Abt Associates report explains that the proposal relies on regional flexibility and public-private partnerships. It stresses, however, that this proposal must be carefully constructed to avoid negatively impacting the existing low-income housing tax credit.

VI. The Impact of First-Time Homebuyer Credit Program in Washington, D.C.: Empirical Research Design, Data and Methodology

To empirically test the first hypothesis concerning the effectiveness of the District of Columbia First-time Homebuyer Credit program, such key program information as the number of tax returns/claims and their amounts has to be obtained and analyzed. Between March 2001 and June 2003, I made a number of requests to the U.S. Internal Revenue Service (IRS) for permission to access its database related to IRS Forms 8859. Although I have been unable to directly use the database because of confidentiality concerns and regulations, in June 2003 Charles E. Hicks of the IRS Statistics of Income Division provided me with special tabulations of some key information on Forms 8859 using the IRS Individual Master File.

To evaluate the program's overall success and effects on retaining or attracting population into the city through homeownership, I not only reported the IRS processing data on the number of tax credit claims and amount of those claims but also develop a number of conservative estimates. The estimates include new (initial) claim rate, claimants' first-time homeownership rate (as percent of all home purchasers in the District), D.C. resident participation rate, and rate of participation by previous suburban residents. These estimates are developed by integrating the IRS data, the survey data from the Greater Washington Research Center, and a transaction-assessment database purchased for this study. Furthermore, to assess the program's distributional effect, I seek to address the research question: "Who benefits the most?" In other words, are low- and moderate-income individuals and families the primary beneficiaries of the D.C. homebuyer credit program? To examine this question, I collected and analyzed the IRS

data on the number of tax returns containing a claim for the credit, as well as total and average amount of the credit claims, classified by the claimants' household income. These IRS data and my empirical estimates of the program's effectiveness and distributional effects by income are reported in section VII.

To empirically test the research hypotheses relating to the economic impact and distributional effect on the housing and neighborhood outcomes (as discussed at the beginning of the study), several indicators have to be developed. The most important indicator or benchmark is the amenity-adjusted house price appreciation rate. The rate of house price appreciation is indicative not only to the District homebuyer credit program's overall economic impact on efficiency in testing hypothesis 2 but also to the program's distributional effect on various housing sub-markets. Moreover, the house price appreciation rate also provides the foundation for developing the other key indicator—house price volatility. This second benchmark, or volatility of house price movement, is designed to test hypothesis 3 for evaluating the impact of the homebuyer credit intervention on neighborhood stability in Washington, D.C.

These two key indicators are then supplemented by five additional indicators, which are used to test hypothesis 4 concerning housing supply and homeownership. The supplemental indicators are:

- 1) Housing units authorized by building permits for years 1991 through 2002,
- 2) Change in housing units by tenure in the 1990s,
- 3) Change in homeownership rate in the 1990s,
- 4) Change in vacant units from 1990 to 2000,
- 5) Change in renter's displacement rates from 1993 to 1998.

It is important to note that, similar to the two house-price-related key indicators, the annualized data on building permits can also largely serve as conclusive evidence. However, the other three supplemental indicators (housing units by tenure, homeownership, and vacancy) may provide only suggestive evidence because these data are available at only two points of time, namely 1990 and 2000.

Since the house price appreciation rate is pivotal to test both research hypotheses 2 and 3, its empirical research design, data and methods are discussed in this section, while the results are reported in section VIII. Following that are the sections that document the remaining outcomes of the hypotheses to be tested in this paper, namely, the impact on wealth creation, local tax revenues, neighborhood stability, as well as supplemental indicators.

Empirical Research Design: House Price Appreciation as the Key Benchmark

1. Impact on House Price Appreciation (Residential Property Values)

To assess the impact of the tax credit programs on economic efficiency, the empirical study will seek to address the research question “Does the targeted tax credit intervention have significant positive economic impacts on residential property values in the affected city?” As discussed in the literature review section and elsewhere, depressed housing value and residential disinvestment in the central cities (and underserved neighborhoods) are both outcomes and added causes of urban decline in this country. They discourage commercial investment and homeownership and reduce the city’s tax base. Thus, a justified policy intervention should help stimulate stronger demand on owner-occupied properties and consequently generate better appreciation of residential property values in the affected city.

The key impact measure used in this study is house price appreciation rates or market value changes in residential properties, which may be independently caused by the targeted tax credit interventions. House price movement essentially reflects the changing balances between housing supply and demand. The theory of housing market adjustments emphasizes the equilibrium values for the stock of housing and the price per unit. Depending upon the elasticity of supply and demand in a local market, changes in equilibrium values generally reflect shocks on either demand or supply from exogenous variables. In the case of Washington, D.C., the targeted homeownership tax credit constitutes an exogenous policy shock on the demand side. If the owner-occupied housing stock is increased insignificantly or disproportionately or lags behind in response to the strong demand stimulated by the policy shock (i.e., the homebuyer tax credit interventions), the impacts of these interventions on the housing market dynamics should be capitalized in a significant price appreciation of residential properties as well as a decrease in vacancy rates.

On the other hand, house price appreciation can also be used to measure the impact of the tax credit interventions on local tax revenues and wealth creation for individual homeowners. An increase in the market values of residential properties would no doubt lead to an increase in the tax base for local governments because their major source of revenues comes from residential and commercial property taxes. Moreover, a significant growth of house prices would also build home equity wealth for homeowners substantially. It is a conventional wisdom that the most important path to build individual wealth for the vast majority of average Americans is through homeownership. However, only a steady increase in the housing value, rather than a decline, would legitimize the

homeownership and policy intervention enough to promote it as a real wealth-building tool for individuals.

Therefore, house price appreciation captures the economic impacts on housing market dynamics and local fiscal conditions, as well as individual homeowners' wealth creation. Accordingly, the analytic focus of this research is to determine whether, and to what extent, the tax credit interventions ("policy shocks") have independently caused the upward movements in housing prices after the interventions went into effect. The methodological challenges rest clearly on (1) obtaining accurate rates of amenity-adjusted house price appreciation and (2) separating out the impact of the targeted tax credit programs on price appreciation from the possible impacts of other price determinants, market forces, and alternative historical events, and neighborhood developments.

2. Distributional Effects on Lower-Priced Residential Properties, Low/Moderate-Income and High-Minority Neighborhoods

To assess the impact on equity, this research will seek to address the research question "What are the distributional effects of the targeted tax credit interventions on the housing outcomes of the disadvantaged groups?" In other words, the research objective is to determine the distributional effects on the housing outcomes of various income and racial groups, especially whether, and to what extent, the low- and moderate-income and minority families are primary beneficiaries of the tax credit interventions in the city's housing markets. However, because the household tax and income records with detailed property addresses that can directly answer these questions are not permitted by law to be disclosed to the general public due to confidentiality concerns, the following proxy measure was developed to examine the program's distributional effects on the housing

markets: the differential impacts on house price appreciation in various sub-markets, especially where residential properties are more likely purchased and owned by low- and moderate-income and minority families.

The literature has thoroughly documented that the housing market is generally segmented by several sub-markets. A major indicator of housing market segmentation is location or neighborhood. The key findings from this line of the research (Can 1990, Goodman and Thibodeau 1998, Quercia et al. 2000, and Macpherson and Sirmans 2001) are that neighborhood dynamics or spatial structure account for house price variations and that racial and income compositions have significant effects on price movement at the neighborhood level. Another critical indicator of the market segmentation is structure type (condominium, townhouse, and single-family detached unit), according to recent studies by Tong and Glascock (2000) and Skaburskis (1999). They found that, on average, condos and townhouses are less spacious and more affordable and exhibit different patterns of price appreciation than single-family detached houses.

In relation to this research, the following two kinds of sub-markets are included:

(1). By location, the sub-markets used to gauge the impact on equity are low/moderate-income and minority neighborhoods. The following cut-off points are used to categorize census tracts by income and racial composition: A census tract is defined as a low-income neighborhood if it has a tract median income below 80 percent of the area median income. A tract with median income between 80-120 percent of the area median income is defined as a moderate/middle-income neighborhood. A tract with median income greater than 120 percent of area median income is treated as a high-income neighborhood. The cut-off points for grouping census tracts by race are 30 percent and 50

percent. A low-minority tract is a tract with a nonwhite population less than 30 percent of the total. A moderate-minority tract has a nonwhite population between 30 and 50 percent of the total. And a high-minority tract has a nonwhite population greater than 50 percent of the total.

(2). By structure type, the sub-markets of most concern are condominiums and townhouses since they are more affordable and more likely to be purchased by low-income families. Therefore, the research question to be addressed is whether, and to what extent, the market values of owner-occupied residential properties in the low/moderate-income and predominantly minority neighborhoods as well as the lower-priced townhouse/condo sub-markets are increased as a result of the homebuyer credit interventions.

It is expected that while a tax credit of up to \$5,000 may not be a big incentive for purchasing an expensive house in Washington, D.C., this homebuyer credit may serve as a strong incentive for purchasing moderately priced and inexpensive houses in the city. Also, given the fact that this program is targeted at lower-income households, the eligible homebuyers are expected to be those more likely facing financial and credit constraints to purchase expensive houses. Therefore, the tax credit program in the District is expected to generate more significant impact on condo and townhouse sub-markets than on the higher-priced detached house sub-market, and also more impact on housing values in low- and moderate-income and minority neighborhoods where houses are generally cheaper and vacancy rates are higher.

Data and Sample

Data used to carry out this research design for the key indicators (house price

appreciation rates and volatility) is from a unique database that merges information from a transaction-assessment database, 1990 Census data, historical events, and neighborhood developments. The transaction-assessment database called Win2Data was purchased from First American Real Estate Solutions (FARES) of Anaheim, California. The Win2Data can be subscribed to online and/or on a CD-ROM. This data set was successfully used in various house price studies, including a recent study on house price differentials among structure types by Tong and Glascock (2000). It was also frequently used by some major newspapers such as the Real Estate section of the Washington Post for tracing trends on median prices in local real estate markets.

The Win2Data has information on real estate transactions for all properties in a county or city, including their sale prices and dates, assessed value, and tax information. It also provides detailed physical characteristics of housing units, thus allowing me to generate explanatory variables in controlling for variations in quality and amenity among different housing units. Moreover, the database contains the 1990 census tract designations for every property, which allows me to link each transaction of a residential property with the 1990 Census information. Some other information is also included in this database, such as location of the property (municipality, school district, and street address), name of the owner, telephone number, and mortgages.

FARES claims to be the largest broker of real estate data in the country, and its archives currently contain some 70 percent of real estate properties in the United States. With respect to the reliability and completeness of the Win2Data, FARES obtains data daily from county/city assessors' offices and recorders of deeds and then packages them into the standardized database—Win2Data. It is therefore claimed as a reliable reflection

of the property and transaction information collected by county/city agencies. In fact, in the process of using the Win2Data (formerly Metroscan) for another house price study (Tong and Glascock 2000) a few years ago, we visited selected properties listed in the database and confirmed that the property characteristics were indeed identical to those contained in the database. Moreover, the Win2Data is also the most complete data set available on the market. FARES claims it to be the world's most extensive (and the nation's most comprehensive) database of property information covering property owner names, sales transactions, property characteristics, and tax assessor maps. In relation to this study, my investigation of its completeness leads to the following three conclusions:

First, its full coverage of all residential properties in the counties and cities studied seems unquestionable. Its full coverage of properties makes it distinctive from other databases used to create publicly accessible house price indices. For example, the repeated-sales House Price Index published by the Office of Federal Housing Enterprise Oversight covers properties only with conforming loans backed by Fannie Mae and Freddie Mac. The median house price index published by the National Association of Realtors covers only existing housing units. The house price index produced by the U.S. Department of Commerce applies only to newly constructed houses.

Second, information on transactions contained in the Win2Data is more complete in recent years than earlier years. This is caused primarily by the way the Win2Data is standardized: It keeps only the most recent two records of transactions for a property. If a property were sold more than twice in the period of 1987-2002, the most recent two records on sales transactions would be available in the database while the earlier ones

would be deleted²⁴.

The third observation of the data completeness is that, using a different data source, I have verified the completeness of the transactions as recorded in the Win2Data for recent years. The District of Columbia's Office of Tax and Revenue maintains official records on home sales indicating that, for instance, 5,280 single-family and condominium units were sold in the District in 1999. My calculation of the records from the Win2Data indicates that there were 5,786 single family detached houses, townhouses/rowhouses, and condos sold in the same year²⁵. The differential between the District government's official record and the Win2Data is almost exclusively caused by the agency's exclusion of sales deemed as not "arm's length." Arm's length sales are those sales made between a willing buyer and a willing seller with no known extraneous factors affecting the sale.

Another important data set is the 1990 Census data at tract level. The 1990 Census data are extracted through the Urban Institute's Neighborhood Change Database, formerly Underclass Database, and are formatted for use in SAS. The census tract information is included in the analysis to capture the influence of location accessibility and neighborhood (census tract) traits on house price appreciation. The reasons to use the 1990 Census information, rather than 2000 Census data, are twofold: the transaction-assessment database does not contain the 2000 Census tract designations for each property, and more importantly, the 1990 Census information is more suitable than the

²⁴ However, despite the incompleteness of sales for some properties in earlier years, it is not a concern for this study because the program's impact on house prices is assessed or estimated using a very large sample after all (as discussed later in this section).

²⁵ Note that because of data cleaning, the size of the analytic sample used for estimating the impact on the District's house prices in this paper is 4,978 sales in 1999.

2000 Census in controlling for neighborhood characteristics in the proposed hedonic regressions. Since the hedonic pricing is based on transactions that took place from 1987 through 2002, using the 2000 census tract information would suffer from the “after-the-fact” problems, making the causality analysis as proposed in this study unfeasible to implement.

Historical information on neighborhood-based developments, which may also influence the urban housing markets (and sub-markets), is collected from administrative sources including the U.S. Department of Housing and Urban Development and District of Columbia. These sources include project information on Empowerment Zone/Enterprise Community, Low Income Housing Tax Credit, and HOPE VI. Information on such historical events as the election of Anthony Williams as new mayor of Washington, D.C., is obtained from newspapers and websites.

The analytic sample used to examine the house price key indicators is based on the transactions (“base sample”) that took place in a 16-year period from January 1, 1987, through December 1, 2002. The database (or base sample) contains 66,369 transactions for Washington, D.C.; 198,725 for Montgomery County, Maryland; 137,824 for Prince George’s County, Maryland; 30,214 for Alexandria City, Virginia; 35,705 for Arlington County, Virginia; and 286,871 for Fairfax County, Virginia. These base samples are used for describing the dependent variable—house prices—to provide a context in which the research questions are addressed.

To describe explanatory variables and run regression analyses, these base samples are transformed into analytic samples through a series of data-cleaning procedures and steps: A transaction is excluded if it has a missing value for any explanatory variable,

involved a substantial home improvement after the sale, has a sales price deemed not as a reasonable market price but likely a “gift” price, or has more than one unit in the structure. All outliers are also excluded to avoid possible heteroscedasticity. These procedures yield the following:

The analytic sample for Washington, D.C., has 56,936 observations or transactions, among which 23,509 sales come from single-family detached houses, 18,180 from townhouse/ rowhouses, and 15,247 from condominiums. In terms of housing sub-markets by neighborhoods, the analytic sample for Washington, D.C., contains 17,064 transactions of properties in high-income census tracts, 10,884 in moderate/middle-income tracts, and 28,988 in low-income tracts. In another categorization, the D.C. sample has 20,073 transactions that took place in low-minority census tracts, 4,652 in moderate-minority tracts, and 32,211 in high-minority tracts. In comparison, the analytic samples for Washington, D.C.’s surrounding markets contain 198,725 transactions in Montgomery, 137,824 in Prince George’s, 30,214 in Alexandria, 35,705 in Arlington, and 263,615 in Fairfax.

Additionally, there are also a number of supplemental indicators examined in the paper. I used the 1990 Census information from the Under Class Database and 2000 Census information from the Bureau of Census to examine these supplemental indicators, including changes in housing units by tenure, homeownership rates, and vacant units in the 1990s. The information on housing units authorized by building permits is obtained from the Census Bureau’s Residential Building Branch, which sells a CD-ROM containing pre-2000 building permit information at place, county, state, and MSA level. It also maintains a website on permit information for the most recent years. Moreover, the

potential adverse effect on housing affordability is examined using data from the 1993 and 1998 *American Housing Survey* for the Washington Metropolitan area.

Methodology: A Three-Stage Intervention Analysis

The primary methodology of assessing the impact and effects on house price appreciation is a three-stage intervention analysis in the framework of the difference-in-differences approach and hedonic pricing models²⁶. The basic form of intervention analysis (also called “impact analysis” or “interrupted time series analysis”) is the before-after approach or pretest-posttest experimental design (Bonate 2000). However, this approach is often criticized as unreliable and inaccurate in that it fails to partial out the impact of the intervention (input series) from effects of other significant important historical events and forces that may also affect the response series at about the same time. This basic approach is thus vulnerable to the common threat to internal validity that precludes confirmation of a causal relationship between input (intervention) and response (impact) in a time series quasi-experiment (Cook and Campbell 1979). Therefore, establishing sufficient protection against possible alternative historical impacts on the process to ensure internal validity is often the most important and most challenging task for almost any intervention or impact analysis (Yeffee 2000).

²⁶ I have considered using an alternative to the three-stage intervention analysis. The alternative is to pool the data from all counties/cities in question into one giant data set. A regression analysis can then be conducted in only one step to detect the impact of the tax credit intervention dummy variable and its interaction terms (interacting with time and location) on the District’s house prices. However, this alternative methodology is not feasible to implement because the variables describing physical characteristics of housing units (used for hedonic pricing) have different specifications and structures across the District of Columbia and its comparison suburban counties/cities. The reason is simple: The assessor’s offices in different jurisdictions and different states (DC, MD and VA) collect their assessment data for residential units with dramatically disparate formats. Moreover, pooling data across heterogeneous housing markets would likely suffer from an aggregation bias in hedonic regression analysis. Therefore, this alternative methodology has to be precluded from this study.

This research uses a three-stage estimation strategy to carry out the methodology of intervention analysis with ensured internal validity. The first stage uses hedonic pricing models to create rates of amenity-adjusted house price appreciation (or “constant-quality house price indices”) for Washington, D.C., and its housing sub-markets (by structure type, neighborhood income, and neighborhood racial composition), for the years 1987 through 2002. The hedonic regressions are also performed for the five comparison housing markets that immediately surround the District: Montgomery County, Prince George’s County, Alexandria City, Arlington County, and Fairfax County. The estimation at this stage will also contain controls for, or concurrent isolation of, possible alternative historical impacts on real estate price movement. These observed concurrent important historical events include major neighborhood-level events, such as demolition and revitalization of public housing projects (HOPE VI), establishment of Empowerment Zone/Enterprise communities, and Low-Income Housing Tax Credit projects. The important historical events such as the election of Mayor Anthony Williams are also included in the sensitivity analysis.

The second stage will use information estimated from the first stage to create a time series with a one-year interval that measures the geographic difference in house price appreciation rates between Washington, D.C. (treatment group) and its surrounding markets (comparison group). Consequently, this procedure establishes a “difference” series that will effectively partial out other (unobserved) concurrent historical impacts. It also rules out the alternative explanations to the net impact and distributional effects caused by the targeted homebuyer tax credit program.

Finally, based on the “difference” of price appreciation rate series, the study will use an interrupted time series model (ARIMA) with an intervention indicator to detect inter-temporal differences in annual house price appreciation between pre-intervention and post-intervention series for the District’ housing market and sub-markets. Only until this stage can it be conclusively demonstrated whether, and to what extent, the “difference” trend in price appreciation during the interruption (intervention) period in Washington, D.C. is caused independently by the first-time homebuyer tax credit intervention.

Based on a recent study of housing price dynamics by Tong and Glascock (2000), Yaffee (2000) and McDowell et al. (1980), mathematically, the three-stage modeling strategy is expressed as follows:

$$\textit{The 1st stage: } \ln(P) = \alpha + \beta_1(\text{HS}) + \beta_2(\text{NL}) + \beta_3(\text{OH}) + \beta_4(\text{T}) + \varepsilon \quad (1).$$

$\ln(P)$ is the log of house sales price, HS represents a vector of housing unit and structural traits, NL is a vector of neighborhood characteristics and locational accessibility, OH denotes dummy variables measuring impact of observed historical events and neighborhood developments (other than the homebuyer credit intervention), and T or dummy variable “time” (year) shows the value of time or cumulative rate of house price appreciation.

Explanatory variables are specified as follows:

Housing unit and structural characteristics (HS) is measured by the following variables: lot size (square footage), unit size or living space (sf), number of bedrooms, number of bathrooms (full and half bathrooms), total rooms, number of stories in unit of structure, housing unit age (years) and age squared, owner- or renter-occupied, presence

of fireplace, presence (or type) of basement, presence of porch, presence of patio and deck, structure type (single-family detached, townhouse, or condominium), type of parking, type of exterior wall material, type of heating system, type of air conditioning system, and type of roof materials.

Neighborhood characteristics and locational accessibility (NL) are measured by the following variables at the census tract level: median family income, percent of population who are nonwhites, poverty rate, affordability (percentage of households paying more than 35 percent of their income for housing), percent of the population who are foreign-born, percent of the population aged 65 or older, homeownership rate, average household size (number of people per housing unit), turnover rate (percent of owner-occupied households who moved since 1985), and accessibility (percent of the working population whose travel time to work is less than 25 minutes, as well as percent of the working population whose travel time to work is in 25-45 minutes). These data were obtained from the 1990 Census using the Urban Institute's Underclass Database (UDB).²⁷

Observed neighborhood development and historical events (OH) include HOPE VI projects through which public housing projects are demolished either as vacant lots or for redevelopment, designation of empowerment zone/enterprise community (Engberg and Greenbaum 1999), and Low-Income Housing Tax Credit projects. The major events deemed as possible alternative forces are the election of Anthony Williams as mayor and the terrorist attack on September 11, 2001.

²⁷ Unlike the standard census files, tract-level variables for the entire nation can be extracted readily from the UDB (Tobin 1993).

Time (t) is a dummy for the year of sales with 1987 as the base line. Coefficients on time dummy variables are interpreted as cumulative price appreciation rates since the base line.

$$\text{The 2}^{nd} \text{ stage: } Y_{Dt} = Y_{Wt} - Y_{Ct} \quad (2).$$

Equation (2) means that Y_{Dt} or difference of house price appreciation rate between Washington, D.C., and its comparison markets at time t equals to the appreciation rate in each comparison group at time t (Y_{Ct}) subtracted from Y_{Wt} or the price appreciation rate in Washington, D.C., at time t . In this equation, the treatment group is Washington, D.C., while the comparison groups are Washington's five surrounding suburban markets.

$$\text{The 3}^{rd} \text{ stage: } Y_{Dt} = \mu + \sum_i \Psi_i(B)I_{i,t} + n_t \quad (3).$$

Where Y_{Dt} denotes the response series or a difference in appreciation rate at time t , μ is the mean term, $\Psi_i(B)$ is the transfer function weights for the i th input series, $I_{i,t}$ is the i th input time series at time t , a deterministic (dummy) intervention indicator for the homebuyer tax credit program that measures difference between pre- and post-intervention in this research, n_t is the noise series. This equation is actually a special case of an ARIMA model with input series. With the intervention indicator as the input variable, the ARIMA model becomes the so-called "interrupted time series analysis" model, "dynamic regression," or simply "intervention model." This model expresses the response series (difference in price appreciation rate between Washington, D.C., and its comparison markets) as a combination of past values of the random shocks and past values of input series (homebuyer credit intervention series in this case).

Obviously, it is this intervention variable ($I_{i,t}$) we care about the most because it represents the net impact of the tax credit intervention. Note that the intervention indicator ($I_{i,t}$), a step function (or continuing variable), has a value of 1 if the appreciation rate is recorded in the intervention period and 0 if otherwise. The intervention or impact period is determined in this study as 1998 through 2002 in that 1998 was the first full year after the District of Columbia First-time Homebuyer Credit program took effect in late 1997.

VII. Empirical Evidence from the Internal Revenue Services

Program's Overall Effectiveness: Claims and Participation Rates by Homebuyer Status and Previous Residence

Table 5 documents important information on Forms 8859 obtained from the Individual Master File through the IRS Statistics of Income Division. These statistics indicate that the D.C. homebuyer credit program is indeed very successful and popular as measured by both number and amount of claims. There were 21,821 tax returns in total or 4,643 returns per year claiming for the D.C. First-Time Homebuyer Credit during the 1997-2001 tax years. These tax returns were generally processed in the year immediately after each of these tax years. As also illustrated in Figure 4, there were 995 claims for the credit based on residential properties purchased between August 5 and December 31, 1997. Tax year 1998 witnessed a dramatic jump in number of claims for the credit (4,071). It further increased to 5,541 in 1999, peaked at 5,797 in 2000, and reached 5,417 claims in 2001—the last tax year for which data were obtainable from the IRS.

The amount of D.C. homebuyer credit claimed during the 1997-2001 period was \$76.7 million in total or about \$16.3 million per year. (The total amount of the credit during the 1998-2002 period was estimated at \$89.5 million²⁸). On average, about \$3,507 of the credit was claimed for each return per year. As also shown in Figure 5, the total amount of claims in 1997 was about \$3.5 million, representing claimants who bought housing units between August 5 and December 31. The claims grew explosively to about \$14 million in 1998, increased to \$18.9 million in 1999, reached as high as \$24 million in

²⁸ It was estimated as follows: the total amount during the 1997-2001 period (\$76,696,000) – the amount in 1997 (\$3,530,000) + annualized mean for 1998 (\$16,328,000) = \$89,494,000.

Table 5. The District of Columbia First-Time Homebuyer Credit in 1997-2001: IRS Processing Data and Estimates of New Claimants

Year*	Claims of DC First-Time Homebuyer Credits ¹				Estimate of New Claimants							
	Number of Returns Claiming for Homebuyer Credits	Total Amount of Homebuyer Credit Claims (in thousands of dollars)	Average Amount of Claims	Number of Home Sales**	Number of Returns from New Claimants of Homebuyer Credits ²	Number of Returns with Credit Carryforward to Next Year or Phasing-Out ³	Rate of Growth of New Claimants from Prior Year	Rate of New Claim Participation (%) ⁴	First-Time Homeownership Rate (%) ⁵	DC Resident Participation Rate (%) ⁶	Suburban Resident Participation Rate (%) ⁶	
1997 (Aug. 5 - Dec. 31)	995	3,530	3,548	1,586	995	289	0	62.7	54.5	38.6	11.5	
1998	4,071	13,929	3,422	4,921	3,782	912	58.4	76.9	66.7	47.3	14.1	
1999	5,541	18,857	3,403	5,786	4,629	569	22.4	80.0	69.4	49.2	14.6	
2000	5,797	23,970	4,135	6,311	5,228	252	12.9	82.8	71.9	50.9	15.2	
2001	5,417	16,410	3,029	6,163	5,165	1,840	-1.2	83.8	72.7	51.5	15.3	
Total	21,821	76,696		24,767	19,799	3,862						
Mean ⁷	4,643	16,328	3,507		4,238	854	23.1	77.2	67.1	47.5	14.1	

1. These data include the returns with credit carryforward from prior year. The data for number of returns and amount are obtained through a number of special requests to IRS. Calculated from IRS Individual Master File relating to Forms 8859, these data were provided by Mr. Charles E. Hicks of IRS Statistics of Income Division to this author on June 6, 2003.

2. Lowest possible number of new claimants each year is estimated from the following formula: Number of returns in a given year - the prior year's highest possible number of returns with credit carryforward (to next year). Note that 3. Highest possible number of returns with carryforward to next year is estimated from the formulas: 1. For 1997, (No. of returns * \$5000 - amount of credits)/\$5000. 2. For years 1998 through 2002, [No. of returns * \$5000 - amount of credits - the prior year's number of returns with credit carryforward * (\$5000 - the prior year's average amount)] / \$5000.

4. New claim rate is calculated by the number of new claimants (lowest possible number of returns from new claimants) divided by the number of total home purchasers (home sales).

5. First-time homeownership rate is defined as percent of all home purchasers who have never owned homes before. It is estimated from the formula: (Lowest possible number of new claimants * 86.8%) / number of home sales. My calculation of the Greater Washington Research Center's survey indicates that about 86.8 percent of purchasers claiming the credit in 1998 had not owned any homes before.

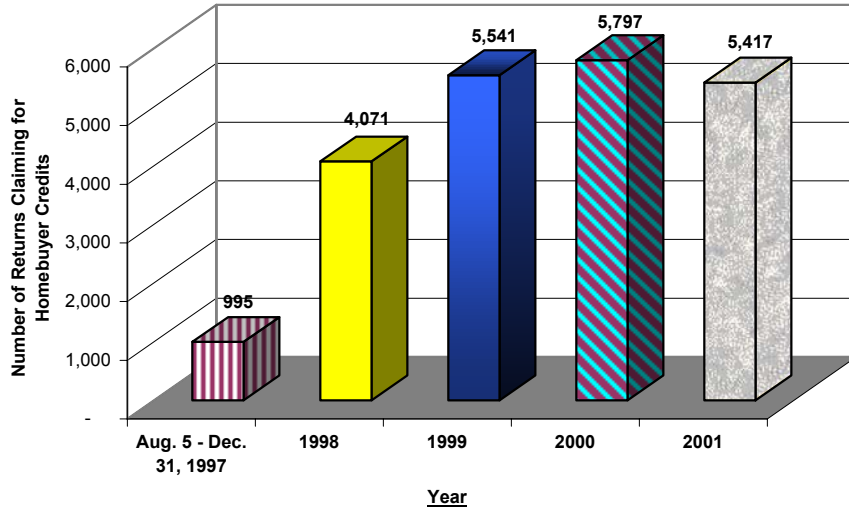
6. DC and suburban resident participation rates are expressed as shares of all home purchasers in the District each year. They are estimated using the following formulas: DC resident participation rate = (lowest possible no. of new claimants) * 61.5% / no. of home sales; Suburban resident participation rate = (lowest possible no. of new claimants) * 18.3% / no. of home sales. The Greater Washington Research Center's DC Homebuyer Credit survey indicates that about 61.5 percent of the credit claimants in 1998 were those with previous address in DC, compared to 18.3 percent with previous address in the District's suburbs.

7. Since the 1997 data only cover about 5 months (8/5-12/31), they have been annualized in calculating the means for number of returns per year, total amount per year, lowest possible number of new claimants, and highest possible number of credit carryforwards. For instance, the annualized number of returns is calculated as 2,388 (or 12/5/995). The annualized total amount, new claimants, and returns with credit carryforward in 1997 are 8,472, 2,388 and 694, respectively.

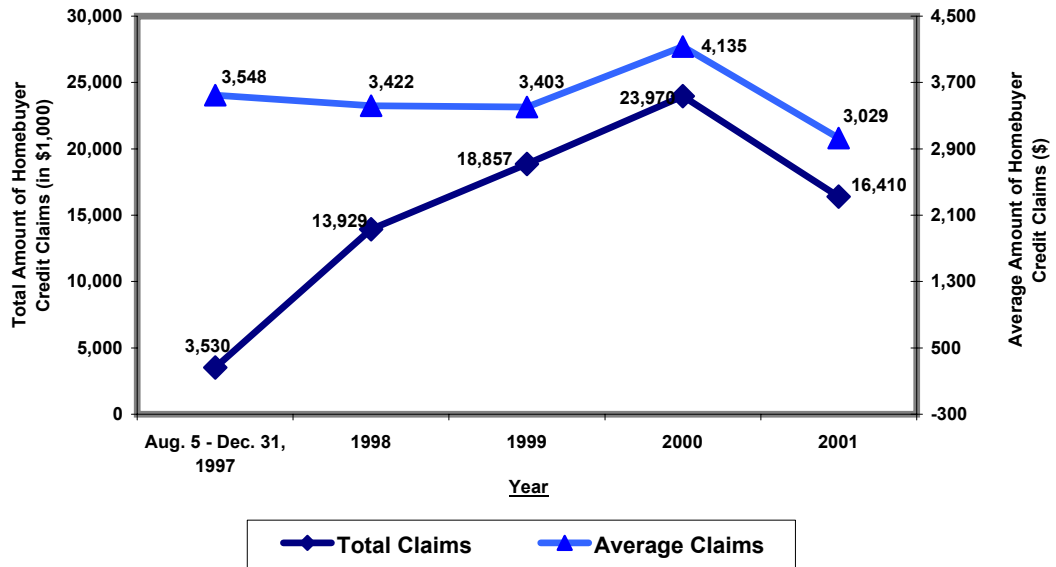
* Year refers to the tax or calendar year. The homebuyer credit claims for year t are processed in the subsequent year t+1.

** Number of home sales is calculated from the transaction-assessment database (Win2Data) purchased from the First American Real Estate Solutions.

**Figure 4. The District of Columbia First-Time Homebuyer Credit:
Number of Returns**



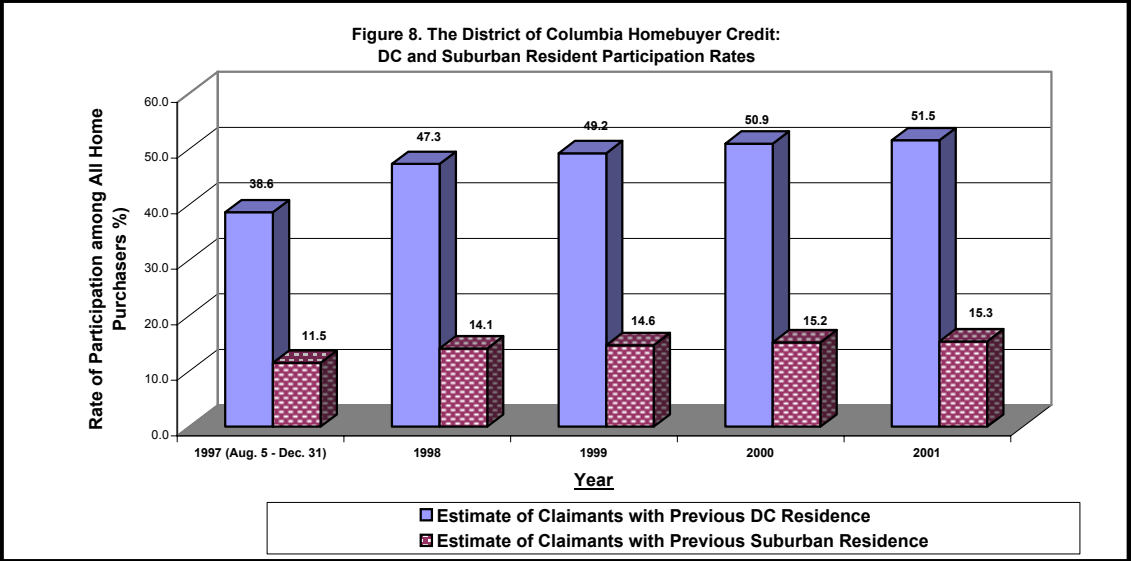
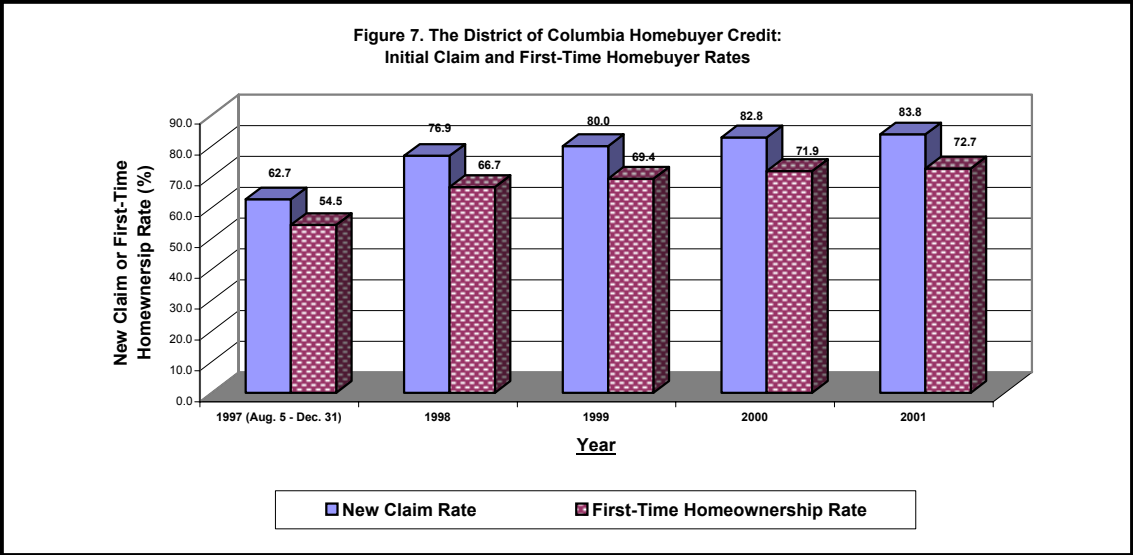
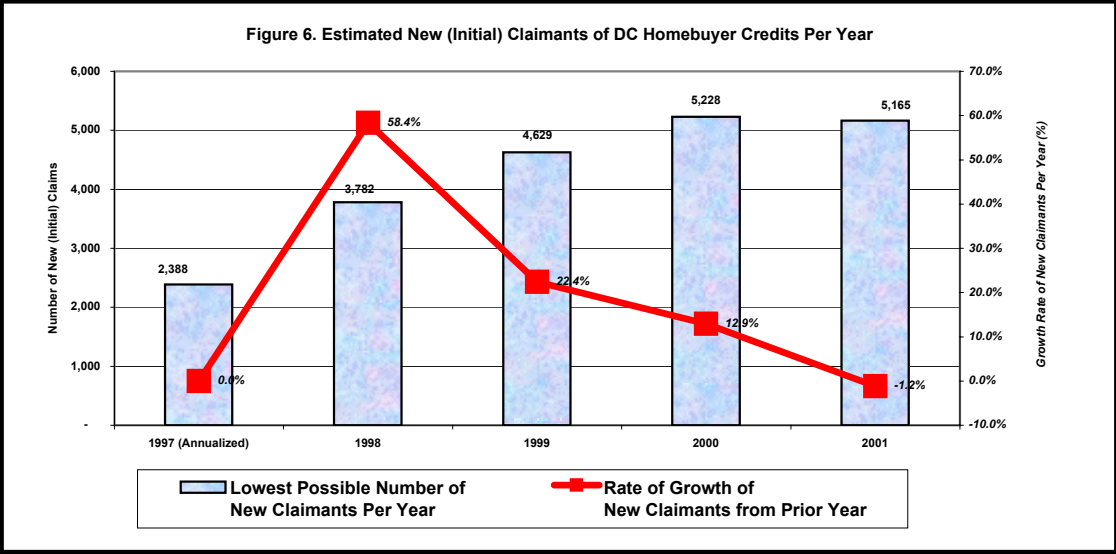
**Figure 5. The District of Columbia First-Time Homebuyer Credit:
Total and Average Amount**



2000, and were \$16.4 million in 2001. The average amount per claim is in the neighborhood of \$3,029 (in 2001) and \$4,135 (in 2000).

However, the number or amount of claims itself may not be indicative of whether the program is truly effective in meeting its intended policy objectives without putting them in a context. Moreover, the claims filed for tax years 1998 through 2001 include not only those from new claimants for that year but also those with the credit carrying forward from prior years. Therefore, to test research hypothesis 1 as proposed earlier in the paper, I have developed a number of estimates, including the highest possible number of claims with credit carrying forward each year, lowest possible number of new claimants (initial claims), rate of initial claims, and percentage of D.C. homebuyers who were new claimants of the credit and had never owned a home before (“first-time homeownership rate”). I have also estimated the program participation rates for new claimants with previous addresses in the District and for those with previous addresses in the suburbs, both of which are expressed as percent of all home purchasers in D.C. each year. The estimates are made through integrating the IRS data with the home sales information calculated from the transaction-assessment database (Win2Data) and the D.C. homebuyer credit survey data (appendix Table 1) compiled by the Greater Washington Research Center. The results are also displayed in Table 5 and depicted in figures 6, 7 and 8.

The findings suggest that there were an estimated total of 19,799 homebuyers, or 4,238 new claimants per year, who claimed the D.C. homebuyer credits during 1997-2001. As also shown in Figure 6, there were 995 homebuyers (or 2,388 annualized) who claimed the credit for the first time in 1997, 3,782 in 1998, 4,629 in 1999, 5,228 in 2000,



and 5,165 in 2001. Clearly, the number of new claimants experienced an explosive growth in the first full year and reached the climax in 2000. The 58.4-percent growth in the number of new claimants from 1997 to 1998 indicates that the immediate impact of the targeted homebuyer credit intervention on attracting homebuyers was unmistakably substantial. Moreover, the overall trend in new homebuyers claiming the credit featured a generally continuous growth, although with a diminishing rate of increase over time: The growth rate was 58.4 percent in 1998, 22.4 percent in 1999, 12.9 percent in 2000, and – 1.2 percent in 2001.

The estimated rate of initial claims (or new claims) was about 77.2 percent per year during the 1997-2001 period. This means that, after excluding those who may have carried over the credits from the prior year, homebuyers who made their initial claims for the tax credit still accounted for about 77.2 percent of all home purchasers in D.C. each year. Moreover, the rate of initial claims exhibits a rising trend over time (Figure 7). During the initial months of the program in 1997, only about 62.7 percent of all D.C. home purchasers were new claimants of the credit. That number jumped to 76.9 percent in its first full year—1998—and continued its steady growth in subsequent years: 80 percent in 1999, 82.8 percent in 2000, and 83.8 percent in 2001.

Similar patterns are also found in the estimates of new claimants' first-time homeownership rate, as well as participation rates of D.C. residents and those previously residing in the District's suburbs. Although the rate of initial claims is equivalent to the rate of first-time homebuyers as defined by the program's requirements, it is different from the first-time homeownership rate as commonly understood. As noted earlier, a first-time homebuyer eligible for the D.C. homebuyer credit is defined as one who did not

own any other main home in the District of Columbia during the one-year period ending on the date of purchase. This definition does not preclude those who owned or still own homes outside the District from qualifying for the D.C. homebuyer credit. In contrast, the common definition of a first-time homebuyer refers to the purchaser of the first home ever owned by that person. Therefore, I have developed estimates of the first-time homeownership rate based on the commonly understandable definition. As shown in Table 5 and Figure 7, the results suggest that first-time homebuyers claiming the credit accounted for about 67.1 percent of all D.C. home purchasers each year. Over time, rate of first-time homebuyers participating in the program (as a share of all home purchasers in D.C.) has been steadily rising in the District: about 54.5 percent in 1997, 66.7 percent in 1998, 69.4 percent in 1999, 71.9 percent in 2000, and 72.7 percent in 2001.

It is also evident that the tax credit has been effective in stabilizing the District's population base by encouraging both existing city residents and those with previous addresses in the suburbs to buy homes in the District. The results, as also reported in Table 5, suggest that new claimants of the credit who previously resided in the District accounted for about 47.5 percent of D.C.'s home purchasers each year in the 1997-2001 period. In the same period, some 14 percent of D.C.'s home purchasers each year were first-time credit claimants whose previous addresses were in the District's suburbs.

The active program participation by existing D.C. residents and homebuyers previously residing in the suburbs also exhibits a trend of steady growth over time. As illustrated in Figure 8, the program's new claimants who were existing D.C. residents accounted for merely 38.6 percent of all District home purchases settled between August 5 and December 31, 1997. However, this participation rate (as a share of all home

purchasers) increased substantially to 47.3 percent in 1998, 49.2 percent in 1999, 50.9 percent in 2000, and 51.5 percent in 2001. The previous suburban residents were also increasingly attracted by the D.C. homebuyer tax credits as well: An estimated 11.5 percent of D.C. home purchasers in the last five months of 1997 were previous suburban residents who claimed the credit, increasing to 14.1 percent in 1998, 14.6 percent in 1999, 15.2 percent in 2000, and 15.3 percent in 2001.

However, caution should be exercised in interpreting these estimates. They are developed in part by using recalculations of the D.C. homebuyer credit survey data released by the Greater Washington Research Center (Dearborn and Richardson 1999). Although the center's key survey result—rate of credit use was estimated at 70.1 percent in 1998—is very close to the rate of new claims (76.9 percent in 1998) as reported in this paper using IRS data, a gap still exists between the two. Thus, it is also likely that my estimates on first-time homeownership rates and D.C. existing resident and previous suburban resident participation rates, which stem partially from the center's survey information for these categories, might have understated (or overstated) what they are in reality. Moreover, the center's survey results are only applicable to tax year 1998. Because there is no information available from any sources relating to other years, I had to combine the IRS data and home sales information with the center's 1998 estimates to derive the first-time homeownership and D.C./suburban resident participation rates throughout all the impact period, assuming that the 1998 estimates have not changed substantially over time.

Distributional Effect: Income Profile of D.C. Homebuyer Credit Claimants

To further test hypothesis 1 on the ground of equity concerns, I also obtained data from the IRS for claims classified by each tax filer's adjusted gross income. The results are reported in tables 6 and 7. They clearly indicate that the vast majority of D.C. First-Time Homebuyer Credit claimants were those earning adjusted gross incomes under \$75,000. The top three income clusters, as measured by both number and amount of claims, are within the income range of \$20,000 to \$75,000. The single largest income cluster claimed for the credits is found to be the one with annual incomes between \$30,000 and \$50,000.

What do these numbers mean in the context of distributional effect? According to the 2000 Census, median family income in the Washington metro area in 1999 was \$72,247. The adjusted gross incomes (AGI) of \$20,000 and \$75,000 are equivalent to about 28 and 104 percent of the area median family income, respectively²⁹. And the income range of \$30,000 to \$50,000 is only about 42 to 69 percent of the area median income. Therefore, it is safe to say that the primary beneficiaries of the D.C. homebuyer credits in the 1997-2001 tax years were very low-, low- and moderate-income families³⁰. The single largest homebuyer cluster that benefited most from the credits was found to be

²⁹ Note that adjusted gross income (AGI) is not exactly the same as family income. For instance, some incomes such as municipal bond interest are included in family income but excluded from AGI. However, for the purpose of providing a context or reference, I treat them roughly comparable here given that the income data I received from IRS concerning Forms 8859 is available only in the form of AGI.

³⁰ I use the following commonly acceptable criteria to categorize the income groups in this section: A family income below 30 percent of the area median income is deemed as very low income. A family income between 30 and 80 percent of the area median income is deemed as low income. An income between 80 and 120 percent is categorized as moderate and middle income. Above 120 percent of the area median income is classified as high income. Note that, however, as discussed in the earlier section, the income categorization for estimating the program's impact on house prices and neighborhood stability by census

**Table 6. The District of Columbia First-Time Homebuyer Credit in 1997-2001:
IRS Processing Data - Number of Returns**

	Number of Returns by Tax Year					Total
	1997	1998	1999	2000	2001	
Returns by Adjusted Gross Income*						
**Under \$10,000	9	23	51	33	29	136
\$10,000 - \$20,000	42	138	251	256	220	865
\$20,000 - \$30,000	140	455	660	746	671	2,532
\$30,000 - \$50,000	336	1,418	2,095	2,386	2,205	8,104
\$50,000 - \$75,000	289	1,232	1,537	1,506	1,476	5,751
\$75,000 - \$100,000	106	521	595	540	559	2,215
\$100,000 - \$150,000	50	242	277	240	197	956
\$150,000 - \$200,000	7	10	28	25	23	86
\$200,000 - \$500,000	11	16	33	46	25	120
\$500,000 and Over	5	16	14	19	12	61
Total Returns*	995	4,071	5,541	5,797	5,417	20,826

* These data include returns with credit carryforward from prior year and a few returns from the subsequent tax year.

** Includes returns with AGI less than or equal to zero.

Source: These data are obtained through a number of special requests to IRS. Calculated from IRS Individual Master File relating to Forms 8859, these data were provided in the form of "processing year" by Mr. Charles E. Hicks of IRS Statistics of Income Division to this author in June 2003. The "processing year" data is directly converted into the tax year data based on the fact that each processing year is generally a year later than the tax year. For instance, returns processed in 2002 would largely include returns for Tax Year 2001 although they would also include some returns with credit carryforward from prior year and a few Fiscal Year 2002 returns.

Table 7. The District of Columbia First-Time Homebuyer Credit in 1997-2001: IRS Processing Data - Amount

Amounts in Thousands	Total Amount by Tax Year (\$1,000)					Total	Average Amount Per Return by Tax Year(\$)					Average	
	1997	1998	1999	2000	2001		1997	1998	1999	2000	2001		
Claimed Amount by Adjusted Gross Income*													
**Under \$10,000	17	20	79	49	54	219	1,889	870	1,549	1,485	1,862	1,531	
\$10,000 - \$20,000	73	191	354	363	226	1,207	1,738	1,384	1,410	1,418	1,027	1,396	
\$20,000 - \$30,000	319	987	1,323	7,000	1,188	10,817	2,279	2,169	2,005	9,383	1,770	3,521	
\$30,000 - \$50,000	1,265	4,825	6,496	7,335	6,366	26,287	3,765	3,403	3,101	3,074	2,887	3,246	
\$50,000 - \$75,000	1,188	5,179	6,662	6,095	5,968	25,092	4,111	4,204	4,334	4,047	4,043	4,148	
\$75,000 - \$100,000	355	1,763	2,129	1,767	1,771	7,785	3,349	3,384	3,578	3,272	3,168	3,350	
\$100,000 - \$150,000	156	823	1,293	884	663	3,819	3,120	3,401	4,668	3,683	3,365	3,648	
\$150,000 - \$200,000	66	14	228	40	59	407	9,429	1,400	8,143	1,600	2,565	4,627	
\$200,000 - \$500,000	82	76	262	122	53	595	7,455	4,750	7,939	2,652	2,120	4,983	
\$500,000 and Over	12	50	30	315	63	470	2,400	3,125	2,143	16,579	5,250	5,899	
Total Claims*	3,530	13,929	18,857	23,970	16,410	76,696	3,548	3,422	3,403	4,135	3,029	3,507	

* These data include returns with credit carryforward from prior year and a few returns from the subsequent tax year.

** Includes returns with AGI less than or equal to zero.

Source: The total amount data are obtained through a number of special requests to IRS. Calculated from IRS Individual Master File relating to Forms 8859, these data were provided in the form of "processing year" by Mr. Charles E. Hicks of IRS Statistics of Income Division to this author in June 2003. The "processing year" data is directly converted into the tax year data based on the fact that each processing year is generally a year later than the tax year. For instance, returns processed in 2002 would largely include returns for Tax Year 2001

low-income families, or those with adjusted gross incomes ranging from 42 to 69 percent of the area median income.

This key information is also depicted in figures 9, 10, and 11. These charts show that, between 1997 and 2001, about 83 percent of the program's participants or credit claimants were those with adjusted gross incomes under \$75,000 (or below 104 percent of the area median income), compared to only about 17 percent for those earning more than \$75,000. Homebuyers with incomes between \$20,000 and \$50,000 accounted for roughly half of the program participants. The identical distributional effect is also found in comparing their total amounts of the credit claims.

These charts also show that both number of claims and amount of claims are pyramid-shaped (Figure 11). They were centered on the homebuyers who reported their adjusted gross incomes in the neighborhood of \$30,000-\$50,000. This income group filed a total of 8,104 tax returns claiming the D.C. homebuyer credits in the amount of \$26.3 million during the 1997-2001 period. This largest group was followed by 5,751 homebuyers with incomes between \$50,000 and \$75,000, who claimed for \$25.1 million of the credits in the same period. The third largest income group claiming the credit was found in an income range of \$20,000 to \$30,000, representing 2,532 claims for \$10.8 million. Moreover, it is striking that at the bottom of the pyramid are those earning under \$10,000 on the one hand and those earning above \$150,000 on the other. During the 1997-2001 period, only 136 claims of the credit were made from homebuyers with

tracts has clustered very low-income and low-income homebuyers together for simplicity purposes, with all other cut-off points remaining the same.

Figure 9. Share in Number of Claims of the District of Columbia First-Time Homebuyer Credits by Claimant's Adjusted Gross Income: 1997-2001

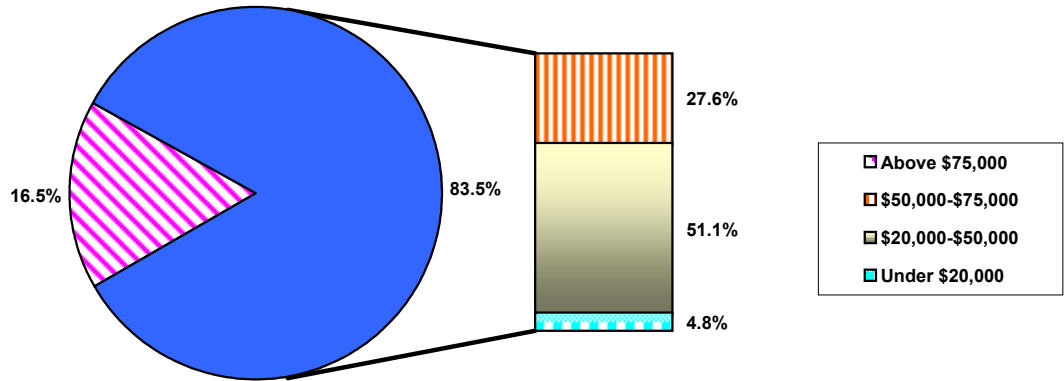


Figure 10. Share in Total Amount of Claims of the District of Columbia First-Time Homebuyer Credits by Claimant's Adjusted Gross Income: 1997-2001

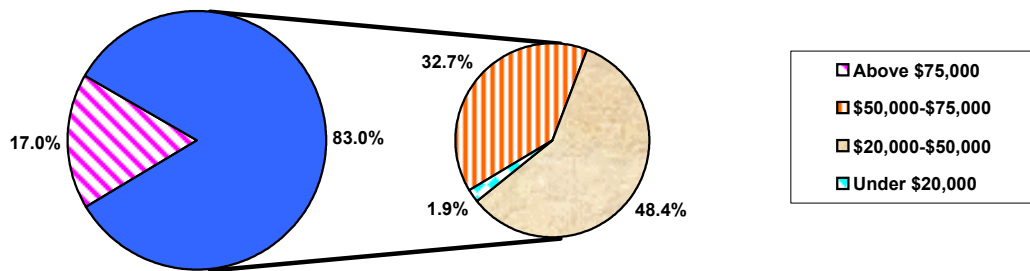
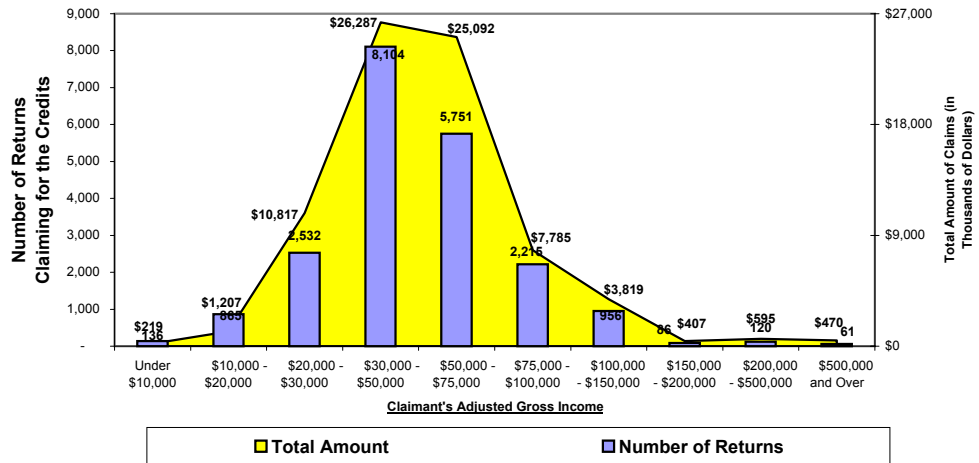


Figure 11. Number and Total Amount of Claims for the District of Columbia First-Time Homebuyer Credit by Claimant's Income: 1997-2001



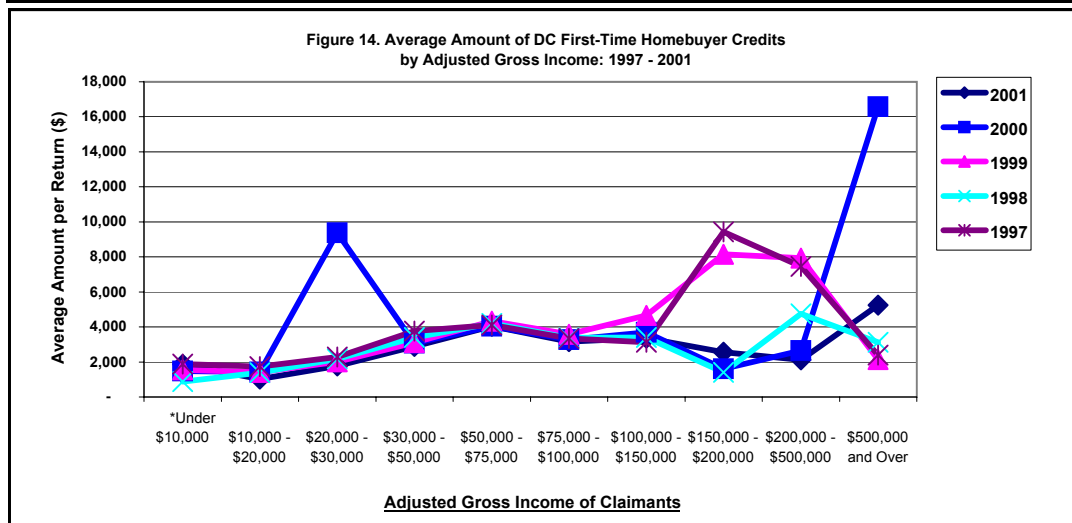
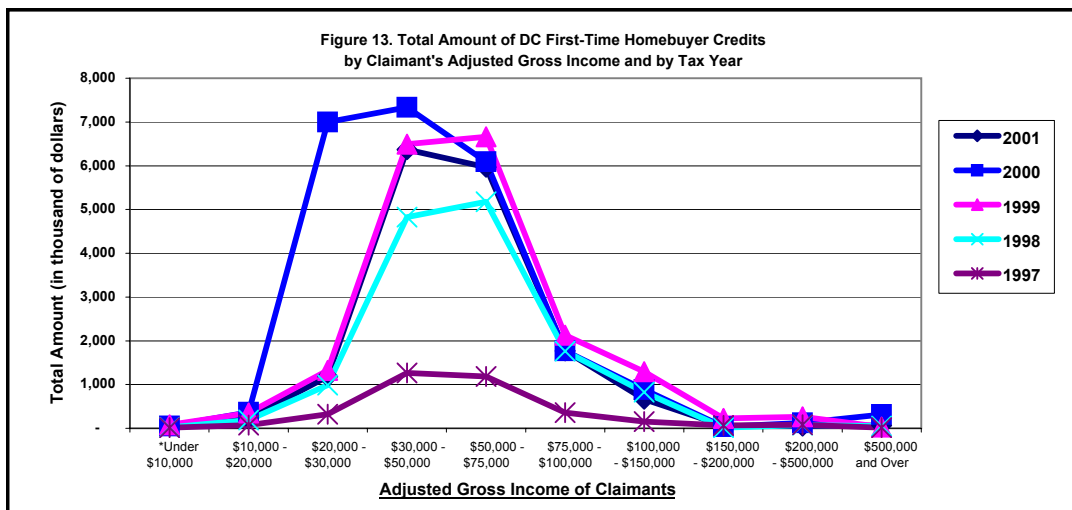
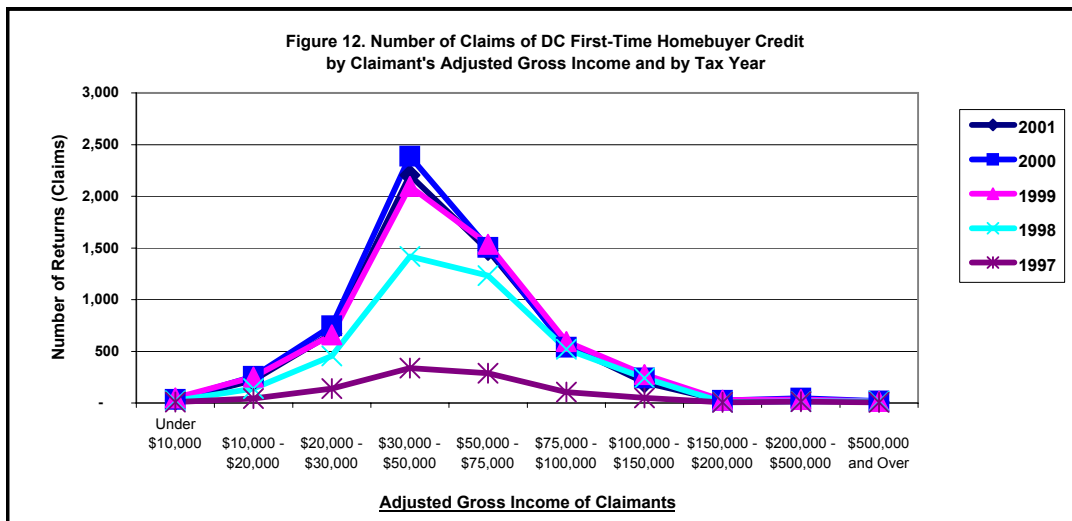
adjusted gross income under \$10,000, compared to merely 266 claims from homebuyers earning more than \$150,000³¹.

The pyramid-shaped distribution by claimant's income over 1997-2001 is generally consistent with the year-to-year trend as graphed in figures 12 and 13. Two exceptions or special features should be noted, however. The pyramid-shaped distribution in number of claims was more evident in recent years (1999-2001) than early years (1997-1998) of the program. This indicates that more and more low-income homebuyers (with incomes between \$30,000 and \$50,000 or 42 to 69 percent of area median income) were attracted by the D.C. homebuyer credit over time. Furthermore, while the homebuyer cluster earning between \$30,000 and \$50,000 was the largest one claiming the credit in terms of amount in three out of five tax years since 1997, the \$50,000 to \$75,000 income cluster surpassed it in two other years (1998 and 1999). This suggests that despite the fact that moderate-income homebuyers (with incomes of \$50,000 to \$75,000) filed fewer tax returns for the credit than low-income homebuyers (earning \$30,000 to \$50,000), most of the moderate-income claimants appeared to be able to claim for relatively more, or even

³¹ There are some unusual data observed in Figures 11 through 14 concerning claimants earning more than \$150,000. Since the income threshold of the program eligibility is no more than \$130,000 in adjusted gross income, why could these claimants have incomes higher than \$150,000? Moreover, looking at Figure 14, one may ask, "Why were some of the average amounts even higher than the maximum allowable amount of \$5,000 for these high-income claimants?" According to my conversations with the data provider, Charles Hicks of the IRS, the following three factors may have contributed to the unusual aspects of these data. First, the law does NOT require that a claimant have to meet the program's income eligibility when claiming for the unused credits carried over from prior years. Through marriage, job change, promotion, and so forth, some homeowners claiming for unused credits may have increased their family incomes significantly beyond \$130,000 (if married) or \$90,000 (if single). Second, some high-income homebuyers might have mistakenly made claims for the credit they were actually not qualified for. Third, some homebuyers might have carelessly or unknowingly claimed for an incorrect amount of the credit so that the amount claimed may be higher than the maximum allowable amount of \$5,000. Also, other errors such as typos are not uncommon in tax filings, including Forms 8859.

full, homebuyer credits against their income tax liability for the tax year when their properties were purchased.

The dynamic interplay between number of claims and amount of claims can be seen more clearly by analyzing the average amount of claims by income. Figure 14 shows that, in general, the higher the income, the higher amount per claim each year. This pattern is especially evident for homebuyers earning under \$75,000 and is also generally held for claimants with incomes between \$75,000 and \$150,000. It implies that, since higher-income homebuyers usually have more tax liabilities than lower-income homebuyers, the former were more likely to claim for the qualified full amount of the credit for the year when their properties were purchased. In contrast, the lower-income homebuyers were less likely to be able to claim for the qualified full amount for the tax year when their properties were purchased and therefore were more likely to carry forward the unused credits to the next year.



VIII. Empirical Evidence from the Housing Markets in Washington, D.C.

As reported in the above section, the analyses of the IRS data combined with other information show that the District of Columbia First-Time Homebuyer Credit program has been extremely successful since being enacted in late 1997 (and especially since 1998) by all of the following measures: number and amount of tax returns claiming for the credit, estimated number and growth rate of new claimants, initial claim and first-time homeownership rates (as share of all home purchasers in the District), as well as rates of participation by both District and suburban residents. In sum, these outcomes indicate that the tax credit program did indeed create an extraordinary, continuously rising, and exogenous shock on the demand for owner-occupied housing units in the District. In turn, the impact of such a demand shock should be, one way or another, capitalized in the District's house price appreciation, as well as other indicators (neighborhood stability, housing supply, homeownership rate, and so forth) during the impact period. This section reports the empirical results on the program's impact and distributional effect on house prices (hypothesis 2), with the subsequent sections discussing the findings for the impact on other indicators.

Descriptive Analysis: A Housing Profile of Washington, D.C. and Surrounding Markets

Trends in Median Sale Prices (Dependent Variable)

As shown in Table 8 (and appendix tables 2a through 2e), a number of important patterns emerged about the median house prices in Washington, D.C., and surrounding markets between 1987 and 2002.

First, along with Prince George's County, the District of Columbia had the lowest house price level in the metro area before 1998. The median prices of houses sold in 1987

Table 8. Descriptive Statistics: Median Sales Prices in Washington, DC

(Sales prices in \$1,000)

Year	Washington, DC				Neighborhoods by Income				Neighborhoods by Race			
	Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	High-Minority	Moderate-Minority	Low-Minority	High-Minority	Moderate-Minority	Low-Minority
1987	93	125	82	225	95	74	185	88	76	88	185	76
1988	105	140	89	265	109	82	235	105	85	105	235	85
1989	115	157	99	290	120	86	250	110	90	110	250	90
1990	120	145	109	285	120	93	241	110	100	110	241	100
1991	125	179	107	290	123	93	258	115	99	115	258	99
1992	128	199	110	282	126	95	250	117	105	117	250	105
1993	131	198	110	289	129	91	266	136	97	136	266	97
1994	130	173	110	288	127	95	260	133	103	133	260	103
1995	125	176	104	275	123	93	254	115	100	115	254	100
1996	124	173	108	285	125	90	263	123	95	123	263	95
1997	130	187	112	295	127	95	275	123	100	123	275	100
1998	143	225	122	312	133	105	290	134	112	134	290	112
1999	141	195	131	350	140	112	309	135	119	135	309	119
2000	152	191	140	399	159	120	350	165	125	165	350	125
2001	182	215	165	448	190	139	398	207	143	207	398	143
2002	226	250	209	499	219	175	449	253	177	253	449	177

(the base year of this study) were only \$93,000 in Washington, D.C., and \$90,000 in Prince George's County, as compared to \$155,000 in Alexandria, \$145,000 in Fairfax, \$139,000 in Montgomery, and \$129,000 in Arlington. Ten years later when the D.C. first-time homebuyer credit program was launched, this pattern largely remained: The median sales prices in Washington, D.C., and Prince George's in 1997 both were \$130,000, the lowest in the region. Surprisingly, however, by the end of 2002—the fifth year of the tax credit program—Washington, D.C., experienced an explosive growth in house prices. The median price in D.C. reached an astonishing \$226,000, \$69,000 (44 percent) higher than its long-standing price partner Prince George's County and merely \$28,000 (11 percent) short of what is sold in Fairfax County.

Second, consistent with previous findings and expectations discussed earlier, condominium and townhouse/rowhouses are indeed priced substantially less than single-family detached houses and therefore more likely owned by low-income and minority households. Overall, in the Washington metro area, condominiums have the lowest median sales price, detached house the highest, and townhouses fall somewhere in between. There is one exception in the District where condos and townhouses were priced very close to each other (with condo slightly higher), and their prices also moved nearly in tandem until 1997. In the last five years when the homebuyer credit was in place, however, the condo market in D.C. had unprecedented growth compared to any other structure type or to rates anywhere in this region.

Third, the sales of residential properties in the Washington, D.C., region have a much lower price level in low- and moderate-income census tracts than those in high-income tracts. In particular, the median housing prices of low-income neighborhoods in

D.C. were consistently only about one-third of the house prices of high-income neighborhoods during the pre-intervention period before 1998 (for example, \$74,000 vs. \$225,000 in 1987, \$95,000 vs. \$295,000 in 1997). This pattern, or the existence of substantial price differentials between low/moderate- and high-income tracts, has resonated in Washington's surrounding counties throughout the last 16 years, worsening recently. However, the low- and moderate-income neighborhood housing markets in Washington, D.C., broke away from this pattern starting in 1998. Consequently, the median price in low-income tracts reached \$175,000 in the District in 2002, which accounted for more than 35 percent of the median price (\$499,000) of the properties sold in high-income tracts in the same year. It apparently presents a strong signal that the D.C. homebuyer credit program seems to be having a greater impact on low/moderate-income neighborhoods than high-income neighborhoods.

The fourth pattern emerging in the median housing prices involves minority neighborhoods. Although it is not a surprise that homes in moderate- and high-minority census tracts were sold for lower prices than homes in low-minority or white neighborhoods throughout the region, the price differentials have been dramatically decreasing for the moderate-minority neighborhoods in Washington, D.C., and Alexandria City. The median sale prices in Washington's moderate-minority neighborhoods accounted for merely 48 and 45 percent of the prices of homes sold in its white neighborhoods in 1987 (\$88,000 vs. \$185,000) and in 1997, respectively, but jumped to 56 percent by the end of 2002 (\$253,000 vs. \$449,000). This increase is not seen elsewhere in Washington's surrounding markets, except for Alexandria City; the price differentials remained essentially constant in Montgomery and Fairfax counties and

became even larger in Prince George's and Arlington in the last 16 years.

In contrast, home sales in high-minority neighborhoods have a different, mixed picture. From 1987 to 2002, the median transaction prices in high-minority neighborhoods (as percent of prices in white neighborhoods) rose in Montgomery, dropped in Alexandria and Prince George's substantially, and experienced little change in Washington, Arlington, and Fairfax. However, an important V-shape was observed in Washington: The median price in high-minority tracts was \$76,000 or about 41 percent of home price (\$185,000) in low-minority tracts in 1987, went down to only 36 percent in 1997, and back up to 39 percent in 2002. These results suggest that the D.C. homebuyer credit program initiated in late 1997 may have had an important effect on changing the trend of house price movements in Washington's high- and especially moderate-minority neighborhoods.

Supplemental tables 1 and 2 report the median sale prices by Zip codes and neighborhoods of Washington, D.C. Although much more specific, these results indicate house price trends consistent with those discussed above. For instance, all the top 5 fast-growth Zip codes have an average income accounting for only 53 to 83 percent of area median income (AMI), and their population is predominately non-whites. Of the top 10 fast-growth neighborhoods, six are located in low-income and high-minority tracts. In terms of price level, the 10 most affordable (inexpensive) neighborhoods in Washington, D.C. are either low- or moderate-income, and their rates of minority concentration ranged from 89 to as high as 100 percent.

Housing Characteristics, locational accessibility and neighborhood traits (explanatory variables)

Table 9 (and appendix Table 3) shows the descriptive statistics for regression explanatory variables. As expected, Washington, D.C., has the smallest lots and units per house in the metropolitan area, the fewest rooms, the oldest housing stock (i.e., the average age of unit when sold is 63.4 years old), the lowest owner-occupation rate (79 percent), and the fewest amenities (fireplace, porch, deck.) However, the District has the best balance of housing structures in its stock (detached 41 percent, townhouse 32 percent, and condo 27 percent), in contrary to its surrounding suburban counties where detached houses and townhouses (to a lesser extent) generally dominate the markets. Housing is mostly made by concrete for its exterior wall in D.C. while suburban housing is dominated with aluminum siding, frame, and brick. Housing units are usually heated through radiant and warm air in Washington, D.C., compared to hot air and forced air that are the most prevailing heat systems in surrounding areas.

The homes sold in D.C. are located in the census tracts more easily accessible to work. This locational accessibility is similar to D.C.'s two closest surrounding areas—Arlington and Alexandria—but differs from Montgomery, Prince George's, and Fairfax, which require a much longer commute to work. In terms of neighborhood demographic characteristics, the homes sold in Washington, D.C., during the 1987-2002 period are located in the census tracts that on average have the highest concentration of non-white population in the metro area, the highest poverty rates, the oldest population, the lowest homeownership rates, the lowest rate of housing turnover, and the highest vacancy rates.

Table 9 also summarizes physical and neighborhood traits of housing units sold by structure type and by neighborhood income and racial composition. As compared to

single-family detached houses, high-density houses (condos and townhouses) have substantially smaller lots and units, fewer rooms (bedroom, bath, and total rooms) and fireplaces, lower owner-occupation rates, and a smaller garage and basement (if any). Condos and townhouses are also more likely to be located in neighborhoods with a younger population and a lower homeownership rate. There are other unique features about condos and townhouses. Compared to two other structure types, the condominium units sold in the last 16 years are substantially newer and located in neighborhoods with a much shorter commute to work, a lower proportion of nonwhites, a higher share of foreign-borns, a smaller household size, and a substantially higher rate of housing turnover. In contrast, townhouses have a substantially older housing stock and are more likely to be located in neighborhoods with lower household incomes, a higher proportion of nonwhites, a higher poverty rate, a higher percentage of households unable to afford housing, a larger household size, and a higher vacancy rate.

On average, the homes sold in the low/moderate-income and minority neighborhoods are older and have smaller lots and units, fewer rooms, smaller basements (if any), fewer garages and fireplaces (if any), and a lower owner-occupation rate. These neighborhoods are also more likely to have a higher proportion of condominium units and townhouses, as compared to high-income and low-minority neighborhoods that are dominated with single-family detached houses and, to a lesser extent, some condominiums.

Neighborhood-based developments and historical events (explanatory variables)

In December 1994, the Clinton administration designated 72 urban and 33 rural communities as the first Empowerment Zones or Enterprise Communities (EZ/EC) that

use a number of tax incentive entitlements to spur economic development and promote financial independence in some of these communities' most depressed neighborhoods. Although Washington, D.C. lost its bid to become an Empowerment Zone, for which a winner such as Baltimore received as much as \$100 million in federal grants over 10 years, the District did win the designation of an Enterprise Community for a lower tier, one-time grant of \$3 million. By 1997, the D.C. Enterprise Zones consisted primarily of all census tracts with 20 percent and higher poverty rates, as defined by the 1990 Census. These tracts represent more than one-third (65) of the District's 193 census tracts and cover about half of the District's developable land area, including Anacostia, Congress Heights, Marshall Heights, Shaw, Mt. Vernon Square, North Capital, Buzzard's Point, Chinatown-Gallery Place, and Columbia Heights. The EZ/EC businesses were entitled to claim more than \$1.2 billion of federal tax credits, deductions, exemptions and exclusions in Washington, D.C. between January 1, 1998, and December 31, 2002.

Perhaps more directly affecting the housing market dynamics in a central city setting—such as Washington, D.C. and Baltimore—are two other neighborhood-based government housing programs: the Low Income Housing Tax Credit (LIHTC) and the HOPE VI program. Initiated in 1986, the LIHTC projects (for new construction or rehabilitation) are widely credited as the “only new housing developments” ever happened in many of the most distressed center-city neighborhoods³². In addition, there were 11 HOPE VI projects aimed at demolition and/or revitalization in Washington, D.C. between 1996 and 2001.

³² For a comprehensive review and analysis of the LIHTC program and its effects, please see a working paper by Tong, Bogdon and Mengel (2003) on this topic.

As a result, as shown in Table 9, the transactions of residential units that took place in the District EZ/EC tracts and were completed after these EC initiatives became effective account for 8.1 percent of all home sales in the District in the 1987-2002 period. Sales of homes located in a census tract with at least one Low Income Housing Tax Credit project in place account for 3.1 percent of the District's total sales at the same period, as compared to 0.1-0.2 percent in suburban Maryland and Virginia. The home sales that might be affected by the Hope VI demolition or revitalization projects are about 0.7 percent of the total sales in the District. More specifically, the EZ/EC, LIHTC, and HOPE VI projects in the District are mostly located in the low-income and high-minority neighborhoods and in the places where townhouse/rowhouse is disproportionately over-represented.

Three-Stage Intervention Analysis of the District Homebuyer Credit Program

This section reports the empirical results from the three-stage intervention analysis of the impact of the District first-time homebuyer credit program on amenity-adjusted house prices (hypothesis 2). At the first stage, the hedonic regression generates the cumulative price appreciation rates for Washington, D.C. and its comparison surrounding markets. Then, their cumulative appreciation rates are converted into annual rates so that the differences in the annual rates of price appreciation between the District and its comparison markets can be calculated. Lastly, based on this geographic difference series in annual appreciation rates, an interrupted time series analysis (ARIMA with an input series) is performed to identify the inter-temporal difference between the pre-intervention period and the tax credit intervention period.

The results show that the income-targeted homeownership tax credit program, as

implemented in Washington, D.C. does have a statistically significant, positive, and very large net economic impact both on the District as a whole and across structure types and neighborhoods. The tax credit intervention also has a large distributional effect. Holding all else equal and also compared to surrounding housing markets, the District homebuyer credit program has independently and consistently caused an explosive growth of amenity-adjusted house prices in both townhouse and especially condominium sub-markets. It is also responsible for a substantial house price appreciation observed in the moderate-minority neighborhoods, as well as low- and moderate-income neighborhoods. However, a relatively smaller effect on house price movements is observed in the high-minority neighborhood sub-market, which is somewhat unexpected. These results are verified with a number of robustness checks.

Stage 1: Hedonic regressions and cumulative price appreciation rates

Table 10 (and appendix tables 4 and 5) report the empirical results from hedonic regression analyses (the 1st stage estimation or equation 1). These results show that the regression models fit very well for Washington, D.C., its housing sub-markets, and the District's comparison markets in suburban Maryland and Virginia. As indicated by the adjusted R^2 , the pooled model for the District can explain about 71.9 percent of variations in the log of amenity-adjusted sales price. For Washington, D.C.'s housing sub-markets, the regression models can explain about 80.6 percent of the price variations for single-family detached, 69.1 percent for townhouse/rowhouse, and 63.4 percent for condominium markets. The model's explanatory powers for the District's neighborhood sub-markets, by income and race, are ranged from 42.6 to 74.4 percent. Similarly, overall, the regression pricing models for the suburban housing markets also perform very well.

Table 10a. Hedonic Regressions for Washington, DC and Housing Sub-Markets by Structure Type
(Dependent Variable: Log of Nominal Transaction Price)

Variable	Washington, DC		Single Family Detached		Townhouse/Rowhouse		Condominium	
	Coefficient	T	Coefficient	T	Coefficient	T	Coefficient	T
Intercept	9.651 ***	157.9	10.434 ***	109.9	10.409 ***	91.9	7.403 ***	34.8
Housing Unit Characteristics								
Lot Size (1,000 S. F.)	0.014 ***	13.4	0.015 ***	13.9	0.070 ***	11.6		
Living Space (1,000 S. F.)	0.177 ***	40.6	0.124 ***	22.1	0.120 ***	14.2	0.458 ***	38.9
Number of Bedroom	0.053 ***	19.6	0.023 ***	6.5	0.002	0.5	0.049 ***	5.9
Number of Bathroom	0.076 ***	29.3	0.055 ***	16.7	0.047 ***	10.3	0.056 ***	7.9
Total Rooms	0.001 **	3.0	0.000	0.5	0.011 ***	3.4	0.099 ***	21.9
Number of Story	0.029 ***	12.5	0.083 ***	11.9	0.048 ***	4.5	0.033 ***	13.2
Age of Unit When Sold (years)	-0.004 ***	-17.0	-0.003 ***	-7.6	-0.001 **	-2.6	-0.008 ***	-18.0
Unit Age Squared	0.00004 ***	23.5	0.00003 ***	10.0	0.00002 ***	4.6	0.00009 ***	24.7
Owner-occupied ¹	0.129 ***	29.3	0.107 ***	16.4	0.153 ***	20.5	0.065 ***	8.4
Presence of Fireplace ²	0.144 ***	30.4	0.124 ***	17.6	0.073 ***	8.9	0.092 ***	9.8
Basement Area (S. F.)	0.000 ***	13.2	0.000 ***	18.3	0.000 ***	17.9	0.000	-0.8
Presence of Porch ²	-0.034 ***	-6.5	-0.020 **	-3.0	-0.013	-1.5		
Presence of Deck ²	-0.009	-0.9	0.002	0.2	-0.010	-0.7		
Parking Type²								
Garage (detached or attached)	0.043 ***	9.8	0.039 ***	6.6	0.033 ***	4.6	-0.019	-1.5
Basement	0.037 ***	5.4	0.027 **	3.1	-0.005	-0.4	0.099 ***	4.4
Build-in	-0.072 ***	-4.5	-0.027	-1.4	0.027	1.0		
Carport	0.069 ***	3.8	0.084 ***	4.3	0.015	0.4	0.129	0.8
Structure Type³								
Townhouse	0.010 +	1.9						
Condo	0.123 ***	5.3						
Quality/Condition⁴								
Excellent	0.221 ***	13.5	0.025	1.0	0.034	0.8	0.279 ***	10.6
Good	0.031 ***	6.1	0.036 ***	5.2	0.036 ***	3.4	0.040 ***	4.5
Fair	-0.068 ***	-8.3	-0.098 ***	-8.9	-0.079 ***	-5.9	0.008	0.4
Poor	-0.242 ***	-8.7	-0.235 ***	-6.1	-0.228 ***	-5.8	-0.532 ***	-6.1
Other	-0.046	-1.2			0.042	0.2	0.121 **	2.9
Exterior Wall Material⁵								
Shingle	-0.047 *	-2.0	-0.013	-0.6	-0.179 **	-2.8		
Brick/stone or brick/stone veneer	0.099 ***	5.2	0.128 ***	5.5	0.003	0.1	0.355 *	2.3
Concrete	0.132 ***	7.7	0.123 ***	6.4	0.003	0.1	0.354 *	2.3
Stucco	0.098 ***	4.9	0.102 ***	4.7	-0.030	-0.8	0.509 **	3.1
Wood or wood siding	0.072 ***	3.9	0.088 ***	4.3	-0.085 *	-2.1		
Other	0.193 ***	3.8	0.133 *	2.1	0.032	0.4		
Heat System⁶								
Hot Air	-0.040	-0.9	0.190	1.1	0.150	0.6	0.489 ***	6.0
Hot water	0.306 ***	7.2	0.033	0.5	-0.075	-0.8	1.260 ***	16.6
Radiant	0.335 ***	8.6	0.136 *	2.2	0.109	1.5		
Forced Air	0.343 ***	8.8	0.142 *	2.3	0.077	1.0	0.791 ***	11.7
Gravity	0.229 ***	4.1	0.195 *	2.2	0.001	0.0		
Wall/wall furnace	0.316 ***	6.4	0.172 *	2.2	0.088	1.1		
Warm Air	0.411 ***	10.5	0.206 **	3.3	0.203 **	2.7		
Other	-0.127 **	-3.2	0.079	1.0	0.106	1.1	0.757 ***	10.1
Roof Materials⁷								
Composition shingle/roll composition	0.026 ***	3.7	0.018 *	2.2	-0.017	-1.0	-0.581 ***	-10.1
Metal	0.131 ***	12.2	0.175 ***	5.2	0.397 +	1.7	-0.618 ***	-11.1
Tile	0.076 ***	3.6	0.091 ***	4.2	0.000	0.0	-0.358 ***	-4.0
Slate	0.065 ***	8.5	0.078 ***	8.2	0.022	1.1	-0.619 ***	-11.0
Wood shake	-0.040 **	-3.0	0.030 +	1.9	0.038	1.1	-0.759 ***	-12.6
Other	-0.014 *	-2.4	0.026 **	2.9	0.006	0.8	-0.814 ***	-14.0
Locational Accessibility								
Workers whose travel time to work <25 minutes (%)	0.009 ***	21.1	0.004 ***	6.7	0.008 ***	10.0	0.025 ***	17.4
Workers whose travel time to work 25-45 minutes (%)	0.011 ***	21.4	0.004 ***	5.5	0.008 ***	8.3	0.032 ***	18.9
Neighborhood Characteristics								

Median family income (\$1,000)	0.003 ***	19.4	0.005 ***	19.8	0.002 ***	5.1	0.001 ***	4.4
Share of nonwhite population (%)	-0.004 ***	-27.4	-0.005 ***	-23.7	-0.007 ***	-18.4	-0.003 ***	-6.7
Poverty rate (%)	-0.003 ***	-9.2	-0.005 ***	-9.4	-0.002 **	-2.7	-0.001	-1.6
Affordability	-0.001	-1.5	-0.005 ***	-7.5	-0.003 ***	-4.1	0.004 ***	4.3
Foreign-borns (%)	0.012 ***	46.1	0.010 ***	18.3	0.011 ***	23.1	0.011 ***	22.9
Population aged 65 or older (%)	-0.005 ***	-12.5	-0.001 +	-1.8	-0.005 ***	-6.3	-0.007 ***	-13.3
Homeownership rate (%)	-0.001 ***	-4.4	-0.001 ***	-4.5	0.001 ***	4.4	-0.004 ***	-9.4
Household size	-0.048 ***	-9.1	-0.076 ***	-10.0	-0.080 ***	-8.6	0.006	0.4
Turnover (% owner households moved since 1985)	0.002 ***	7.6	0.003 ***	7.7	0.002 ***	5.3	0.001 **	3.0
Vacancy rate (%)	-0.005 ***	-10.5	-0.006 ***	-10.0	-0.002 *	-2.4	-0.001	-0.8
Events & Neighborhood Developments								
Enterprise Community/Empowerment Zone ²	0.003	0.3	-0.004	-0.3	0.007	0.5	-0.079 ***	-4.2
Low-Income Housing Tax Credit Projects ²	0.000	0.0	0.076 ***	4.5	0.008	0.7	-0.103 ***	-3.7
HOPE VI Projects ²	-0.002	-0.1	0.028	1.4	-0.008	-0.2	-0.218 ***	-4.6
September 11 Terrorist Attack ³	0.057 ***	3.7	0.061 **	2.7	0.029	1.1	0.055 +	1.9
Transaction Date⁹								
1988	0.174 ***	17.8	0.193 ***	13.9	0.153 ***	8.6	0.142 ***	8.5
1989	0.288 ***	29.4	0.323 ***	22.8	0.310 ***	17.4	0.207 ***	12.6
1990	0.304 ***	29.2	0.349 ***	23.7	0.327 ***	17.4	0.215 ***	12.0
1991	0.287 ***	27.1	0.318 ***	21.7	0.306 ***	15.9	0.213 ***	11.6
1992	0.281 ***	26.9	0.290 ***	19.9	0.274 ***	14.3	0.201 ***	11.2
1993	0.251 ***	23.7	0.275 ***	18.9	0.233 ***	12.0	0.164 ***	8.8
1994	0.235 ***	22.9	0.294 ***	20.9	0.199 ***	10.7	0.128 ***	6.9
1995	0.205 ***	19.2	0.248 ***	16.7	0.189 ***	10.1	0.135 ***	7.0
1996	0.179 ***	17.0	0.238 ***	16.3	0.203 ***	10.9	0.052 **	2.6
1997	0.187 ***	18.9	0.254 ***	18.5	0.176 ***	10.0	0.067 ***	3.7
1998	0.279 ***	29.7	0.333 ***	25.6	0.290 ***	17.2	0.155 ***	9.3
1999	0.388 ***	42.5	0.448 ***	34.4	0.446 ***	27.3	0.238 ***	14.9
2000	0.550 ***	60.6	0.598 ***	45.9	0.605 ***	37.6	0.429 ***	27.0
2001	0.698 ***	73.9	0.695 ***	51.5	0.762 ***	45.7	0.642 ***	38.4
2002	0.909 ***	98.0	0.869 ***	65.5	0.997 ***	61.1	0.881 ***	53.0
Adjusted R²	0.719		0.806		0.691		0.634	
Number of Observations	56,936		23,509		18,180		15,247	

Note: 1. Omitted variable is renter-occupied. 2. Omitted variable is "none." 3. Omitted variable is single family detached. 4. Omitted variable is "average."
5. Omitted variable is "aluminum siding/vinyl." 6. Omitted variable is "heat pump". 7. Omitted variable is "built-up." 8. The 9/11 dummy variable has a value of 1 if the sales took place in Oct. and Nov. of 2001, 0 otherwise. 9. Omitted variable is "1987".
*** p<0.001, ** p<0.01, * p<0.05, +p<0.1.

Table 10b. Hedonic Regressions for Washington, DC Neighborhoods by Income
(Dependent Variable: Log of Nominal Transaction Price)

Variable	High-Income Neighborhoods		Moderate/Middle-Income Neighborhoods		Low-Income Neighborhoods	
	Coefficient	T	Coefficient	T	Coefficient	T
Intercept	13.605 ***	45.3	10.336 ***	43.2	9.865 ***	117.1
Housing Unit Characteristics						
Lot Size (1,000 S. F.)	0.016 ***	12.5	0.011 ***	5.8	0.013 ***	5.4
Living Space (1,000 S. F.)	0.172 ***	31.0	0.226 ***	22.0	0.178 ***	23.4
Number of Bedroom	0.056 ***	13.4	0.050 ***	7.6	0.031 ***	7.5
Number of Bathroom	0.060 ***	17.4	0.043 ***	7.8	0.076 ***	17.4
Total Rooms	0.014 ***	6.8	0.037 ***	9.3	0.001	1.2
Number of Story	0.028 ***	8.2	0.005	1.0	0.034 ***	7.6
Age of Unit When Sold (years)	-0.002 ***	-8.2	-0.004 ***	-7.4	-0.007 ***	-15.1
Unit Age Squared	0.00003 ***	12.9	0.00004 ***	8.9	0.00006 ***	16.5
Owner-occupied ¹	0.031 ***	4.3	0.115 ***	12.9	0.155 ***	24.4
Presence of Fireplace ²	0.117 ***	13.5	0.129 ***	14.9	0.114 ***	15.6
Basement Area (S. F.)	0.000 +	1.7	0.000	0.7	0.000 ***	15.2
Presence of Porch ²	-0.023 *	-2.3	0.013	0.8	-0.050 ***	-6.6
Presence of Deck ²	-0.007	-0.5	0.101 ***	3.6	-0.024 +	-1.7
Parking Type²						
Garage (detached or attached)	0.031 ***	4.4	0.045 ***	5.0	0.049 ***	7.2
Basement	0.049 ***	5.4	0.043 **	2.7	0.015	1.2
Build-In	-0.025	-1.4	-0.158 **	-3.2	-0.049	-1.6
Carport	0.070 *	2.4	0.071 *	2.6	0.037	1.2
Structure Type³						
Townhouse	-0.030 **	-2.9	-0.027 +	-1.8	0.029 ***	3.7
Condo	0.478 ***	6.5	-0.113	-1.6	0.256 ***	8.5
Quality/Condition⁴						
Excellent	0.029	1.4	-0.033	-0.6	0.302 ***	11.4
Good	0.043 ***	6.7	-0.010	-1.0	0.092 ***	9.5
Fair	-0.094 **	-2.7	-0.067 ***	-4.0	-0.057 ***	-5.4
Poor	-0.154 *	-2.0	-0.176 *	-2.1	-0.203 ***	-6.0
Other	-0.313 **	-3.0	0.153 *	2.6	-0.244 ***	-4.2
Exterior Wall Material⁵						
Shingle	0.034	0.6	0.052	0.8	-0.124 ***	-3.9
Brick/stone or brick/stone veneer	-0.014	-0.3	0.077	1.2	0.102 ***	4.1
Concrete	-0.006	-0.1	0.156 *	2.6	0.148 ***	7.2
Stucco	0.029	0.6	0.123 +	1.9	0.031	1.1
Wood or wood siding	0.037	0.7	0.099	1.6	-0.067 **	-2.6
Other	0.118	0.9	0.000		0.190 **	3.2
Heat System⁶						
Hot Air	0.000		-0.319 +	-1.7	0.540 **	3.0
Hot water	0.120	0.7	-0.228	-1.3	0.429 ***	8.4
Radiant	0.029	0.2	-0.073	-0.4	0.396 ***	8.7
Forced Air	0.029	0.2	-0.027	-0.2	0.396 ***	8.6
Gravity	0.000		0.103	0.3	0.293 ***	4.6
Wall/wall furnace	0.056	0.3	0.059	0.3	0.358 ***	6.1
Warm Air	0.070	0.4	0.005	0.0	0.478 ***	10.4
Other	-0.909 ***	-5.1	-0.199	-1.1	-0.001	0.0
Roof Materials⁷						
Composition shingle/roll composition	0.033 *	2.5	0.009	0.7	0.042 ***	3.7
Metal	-0.008	-0.4	0.101 ***	4.8	0.072 ***	3.9
Tile	0.031	1.2	-0.007	-0.1	0.109 **	2.7
Slate	0.087 ***	6.8	0.052 **	3.2	-0.034 *	-2.4
Wood shake	0.036 +	1.9	-0.214 ***	-7.7	-0.043 +	-1.8
Other	-0.042 **	-3.2	0.013	1.0	0.006	0.7
Locational Accessibility						
Workers whose travel time to work <25 minutes (%)	-0.013 ***	-6.0	0.012 ***	9.3	0.008 ***	12.1
Workers whose travel time to work 25-45 minutes (%)	-0.016 ***	-6.6	0.010 ***	5.4	0.014 ***	17.7
Neighborhood Characteristics						
Median family income (\$1,000)	0.004 ***	14.9	-0.002 +	-1.7	-0.002 **	-3.2
Share of nonwhite population (%)	-0.004 ***	-13.0	-0.004 ***	-7.3	-0.006 ***	-14.6
Poverty rate (%)	-0.012 ***	-9.9	0.010 ***	4.0	-0.006 ***	-11.0
Affordability	0.014 ***	13.1	-0.006 **	-3.1	-0.004 ***	-7.3
Foreign-borns (%)	0.002 +	1.9	0.014 ***	9.4	0.010 ***	26.2
Population aged 65 or older (%)	-0.009 ***	-8.3	-0.013 ***	-7.3	-0.001 +	-2.0
Homeownership rate (%)	-0.004 ***	-10.4	0.002 ***	4.2	-0.001 *	-2.2
Household size	-0.433 ***	-15.7	-0.190 ***	-7.9	-0.010	-1.5
Turnover (% owner households moved since 1985)	0.001	1.6	-0.002 +	-1.7	0.001 ***	4.7

Vacancy rate (%)	-0.010 ***	-4.7	0.004	1.5	-0.004 ***	-5.8
Events & Neighborhood Developments						
Enterprise Community/Empowerment Zone ²	0.000	5.5	0.000		-0.015	-1.4
Low-Income Housing Tax Credit Projects ²	0.000		0.000		0.024 *	2.3
HOPE VI Projects ²	0.000		0.000		-0.009	-0.4
September 11 Terrorist Attack ⁸	0.082 **	3.2	0.013	0.4	0.072 **	3.2
Transaction Date⁹						
1988	0.215 ***	15.3	0.153 ***	8.5	0.157 ***	10.1
1989	0.344 ***	24.5	0.262 ***	14.7	0.267 ***	17.0
1990	0.316 ***	20.6	0.285 ***	15.6	0.302 ***	18.2
1991	0.261 ***	17.6	0.287 ***	15.2	0.307 ***	17.9
1992	0.255 ***	17.6	0.277 ***	14.4	0.288 ***	17.1
1993	0.244 ***	16.8	0.282 ***	14.5	0.235 ***	13.5
1994	0.245 ***	16.9	0.239 ***	13.1	0.209 ***	12.5
1995	0.202 ***	13.4	0.202 ***	10.7	0.210 ***	12.2
1996	0.196 ***	13.1	0.161 ***	8.3	0.184 ***	10.9
1997	0.221 ***	16.0	0.163 ***	8.9	0.176 ***	10.9
1998	0.304 ***	23.6	0.231 ***	13.3	0.275 ***	17.9
1999	0.422 ***	32.4	0.341 ***	20.7	0.388 ***	26.3
2000	0.595 ***	44.9	0.505 ***	30.7	0.551 ***	38.0
2001	0.703 ***	50.8	0.680 ***	39.7	0.709 ***	47.1
2002	0.855 ***	62.2	0.828 ***	48.2	0.961 ***	65.6
Adjusted R²	0.694		0.573		0.426	
Number of Observations	17,064		10,884		28,988	

Note: 1. Omitted variable is renter-occupied. 2. Omitted variable is "none." 3. Omitted variable is single family detached. 4. Omitted variable is "average."
5. Omitted variable is "aluminum siding/vinyl." 6. Omitted variable is "heat pump". 7. Omitted variable is "built-up." 8. The 9/11 dummy variable has a value of 1 if the sales took place in Oct. and Nov. of 2001, 0 otherwise. 9. Omitted variable is "1987".
*** p<0.001, ** p<0.01, * p<0.05, +p<0.1.

Table 10c. Hedonic Regressions for Washington, DC Neighborhoods by Race
(Dependent Variable: Log of Nominal Transaction Price)

Variable	Low-Minority Neighborhoods		Moderate-Minority Neighborhoods		High-Minority Neighborhoods	
	Coefficient	T	Coefficient	T	Coefficient	T
Intercept	10.862 ***	36.9	365.932 ***	1.8	10.698 ***	123.7
Housing Unit Characteristics						
Lot Size (1,000 S. F.)	0.014 ***	11.1	0.037 +	1.8	0.018 ***	10.1
Living Space (1,000 S. F.)	0.193 ***	35.5	0.319 ***	16.5	0.143 ***	21.0
Number of Bedroom	0.073 ***	18.0	-0.016	-1.3	0.031 ***	8.4
Number of Bathroom	0.050 ***	14.7	0.066 ***	5.5	0.065 ***	17.5
Total Rooms	0.020 ***	10.2	0.119 ***	16.9	0.000	0.3
Number of Story	0.018 ***	6.5	0.020 **	2.9	-0.007	-1.4
Age of Unit When Sold (years)	-0.002 ***	-7.9	-0.009 ***	-10.4	-0.007 ***	-16.1
Unit Age Squared	0.00003 ***	13.4	0.00009 ***	11.6	0.00005 ***	15.9
Owner-occupied ¹	0.036 ***	5.4	0.135 ***	9.4	0.147 ***	25.0
Presence of Fireplace ²	0.135 ***	17.4	0.130 ***	8.6	0.087 ***	13.3
Basement Area (S. F.)	0.000 **	-3.0	0.000 **	-3.1	0.000 ***	21.0
Presence of Porch ²	-0.013	-1.3	-0.133 *	-2.2	-0.018 **	-2.7
Presence of Deck ²	-0.006	-0.5	-0.341 ***	-4.2	-0.001	-0.1
Parking Type²						
Garage (detached or attached)	0.050 ***	7.4	0.075 ***	4.1	0.040 ***	6.9
Basement	0.063 ***	6.9	-0.098 +	-2.0	0.023 *	2.3
Build-In	-0.031	-1.6	-0.426 *	-2.0	0.021	0.9
Carport	0.080 *	2.5	0.313 **	2.6	0.030	1.4
Structure Type³						
Townhouse	-0.027 **	-2.7	0.026	0.8	0.030 ***	4.4
Condo	0.447 ***	6.6	0.434 ***	5.8	0.199 ***	6.7
Quality/Condition⁴						
Excellent	0.028	1.4	-0.018	-0.4	0.154 ***	5.4
Good	0.030 ***	5.0	0.054 **	3.3	0.044 ***	5.3
Fair	-0.032	-1.1	-0.050 +	-1.8	-0.053 ***	-5.6
Poor	-0.007	-0.1	-0.020	-0.2	-0.200 ***	-6.4
Other	0.030	0.5	-0.086	-1.2	-0.150 +	-1.9
Exterior Wall Material⁵						
Shingle	0.055	0.9	0.733 +	1.8	-0.097 ***	-3.7
Brick/stone or brick/stone veneer	-0.016	-0.3	0.610 **	3.2	0.009	0.4
Concrete	0.038	0.7	0.607 **	3.2	0.119 ***	6.3
Stucco	0.066	1.2	0.528 **	2.7	0.032	1.4
Wood or wood siding	0.074	1.3	0.857 ***	3.8	-0.028	-1.3
Other	-0.008	-0.1	0.000		0.186 **	3.3
Heat System⁶						
Hot Air	0.000		-0.156	-1.3	-0.126 *	-2.3
Hot water	0.095	0.4	-0.191	-1.6	0.336 ***	6.8
Radiant	0.008	0.0	0.238 *	2.0	0.266 ***	6.0
Forced Air	-0.001	0.0	0.378 ***	3.3	0.261 ***	5.8
Gravity	0.000		-0.007	0.0	0.216 ***	3.5
Wall/wall furnace	0.059	0.2	0.598 *	2.5	0.254 ***	4.6
Warm Air	0.041	0.2	0.299 *	2.5	0.336 ***	7.5
Other	-0.879 ***	-3.6	-0.136	-1.3	-0.080 +	-1.7
Roof Materials⁷						
Composition shingle/roll composition	0.037 **	2.8	0.318 ***	5.9	0.017 +	1.8
Metal	0.041 *	2.5	0.281 ***	5.5	0.050 **	2.7
Tile	0.056 *	2.1	0.227 **	2.6	0.037	1.1
Slate	0.084 ***	6.5	0.139 **	2.8	0.073 ***	6.3
Wood shake	0.031	1.6	0.154 **	2.7	-0.136 ***	-7.0
Other	-0.009	-0.7	0.132 ***	4.1	0.004	0.6
Locational Accessibility						
Workers whose travel time to work <25 minutes (%)	-0.005 ***	-3.4	-9.296 +	-1.8	0.006 ***	10.8
Workers whose travel time to work 25-45 minutes (%)	-0.005 **	-2.8	-7.438 +	-1.8	0.007 ***	9.2

Neighborhood Characteristics						
Median family income (\$1,000)	0.005 ***	18.1	7.172 +	1.8	0.003 ***	7.9
Share of nonwhite population (%)	0.017 ***	14.1	5.078 +	1.8	-0.011 ***	-22.9
Poverty rate (%)	-0.008 ***	-11.0	-5.190 +	-1.8	-0.002 **	-3.1
Affordability	0.024 ***	28.6	3.973 +	1.8	-0.003 ***	-5.7
Foreign-borns (%)	0.006 ***	7.0	5.587 +	1.8	0.010 ***	26.8
Population aged 65 or older (%)	0.002 **	2.7	-1.823 +	-1.8	0.002 *	2.5
Homeownership rate (%)	-0.003 ***	-10.7	-3.816 +	-1.8	0.000	-1.4
Household size	-0.142 ***	-8.7	0.000		-0.020 **	-2.7
Turnover (% owner households moved since 1985)	0.005 ***	10.2	0.000		0.001 ***	4.3
Vacancy rate (%)	0.017 ***	11.2	0.000		-0.004 ***	-7.3
Events & Neighborhood Developments						
Enterprise Community/Empowerment Zone ²	0.000		0.000		-0.004	-0.5
Low-Income Housing Tax Credit Projects ²	0.000		0.000		0.036 ***	3.6
HOPE VI Projects ²	0.000		0.000		-0.008	-0.4
September 11 Terrorist Attack ⁸	0.046 *	2.0	0.017	0.4	0.063 **	3.1
Transaction Date⁹						
1988	0.196 ***	15.2	0.118 ***	3.9	0.165 ***	11.9
1989	0.312 ***	24.3	0.224 ***	7.4	0.279 ***	19.9
1990	0.285 ***	20.5	0.230 ***	7.2	0.330 ***	22.4
1991	0.243 ***	18.0	0.168 ***	4.9	0.340 ***	22.3
1992	0.237 ***	17.7	0.172 ***	5.1	0.302 ***	20.1
1993	0.229 ***	17.0	0.174 ***	5.0	0.255 ***	16.7
1994	0.229 ***	17.2	0.117 ***	3.5	0.247 ***	16.8
1995	0.189 ***	13.5	0.048	1.4	0.239 ***	15.9
1996	0.165 ***	11.8	0.106 **	3.1	0.207 ***	13.9
1997	0.195 ***	15.1	0.062 +	2.0	0.202 ***	14.2
1998	0.278 ***	23.2	0.161 ***	5.4	0.292 ***	21.4
1999	0.385 ***	32.4	0.250 ***	8.9	0.419 ***	31.8
2000	0.572 ***	47.2	0.487 ***	17.2	0.565 ***	43.7
2001	0.710 ***	56.4	0.717 ***	24.5	0.707 ***	52.5
2002	0.860 ***	67.8	0.965 ***	33.5	0.941 ***	71.9
Adjusted R²	0.744		0.579		0.477	
Number of Observations	20,073		4,652		32,211	

Note: 1. Omitted variable is renter-occupied. 2. Omitted variable is "none." 3. Omitted variable is single family detached. 4. Omitted variable is "average."
5. Omitted variable is "aluminum siding/vinyl." 6. Omitted variable is "heat pump". 7. Omitted variable is "built-up." 8. The 9/11 dummy variable has a value of 1 if the sales took place in Oct. and Nov. of 2001, 0 otherwise. 9. Omitted variable is "1987".
*** p<0.001, ** p<0.01, * p<0.05, +p<0.1.

The adjusted R^2 are 71.3 percent in Montgomery, 46.6 percent in Prince George's, 70.4 percent in Alexandria, 69.1 percent in Arlington, and 81.1 percent in Fairfax³³.

I also ran several procedures for regression diagnostics. During the early phase of the modeling for trial and error, multicollinearity problems are detected for several explanatory variables as indicated by the Variance Inflation Factor (VIF). One problem comes from the unit age variable, which seems strongly correlated with the unit age square variable, as well as the age of the housing stock at the census tract level. As a solution to this problem, while the unit age and age square variables have to be kept in the equations because of their well-documented importance according to the literature, the census tract housing age variable is removed from the current regressions. Other collinearity problems come from dummy variables for structure type with heating systems and roof materials. The heating and roof variables are therefore regrouped or aggregated to avoid their multicollinearity in the current regressions. Moreover, because the housing markets are notoriously heterogeneous, I implemented several procedures to preempt the heteroscedasticity problems. The most important step was to delete the outliers—the major source of heteroscedasticity—during the sampling phase³⁴.

With respect to independent variables, virtually all of them are statistically significant, except some of the dummy variables for heating systems and exterior wall materials in the neighborhood sub-market equations and for neighborhood-based

³³ The goodness-of-fit measures for sub-markets by structure type and neighborhoods in DC's surrounding areas have similar results to those reported here. These results are available from the author, upon request.

³⁴ The following transactions are deemed as outliers and therefore excluded from the analytic sample: if the property has a living space greater than 15,000 or less than 100 square feet; if the number of bathrooms is more than 10; if story in a unit is more than 6; if the sales price is greater than \$1 million or less than \$5,000; and if the property was built before 1750.

development programs. The vast majority of the explanatory variables have the expected signs. For example, on net, the lot size, living space, and room variables are strongly and positively associated with the sales price of the properties. A typical owner-occupied house has a higher transaction price than a typical renter-occupied property. The unit age variable has a negative sign indicating that, holding all else equal, the older a home the lower it is priced. In contrast, the unit age square variable has a positive sign, suggesting that the declining trend on the value of older homes is diminishing over time.

Moreover, there are two variables describing historical events and neighborhood-based development that are worth noting. One is the 9/11 terrorist attack variable that measures the immediate impact of 9/11 (in the following two months of 2001) on house prices. This variable has a statistically significant and consistently positive effect on home prices in Washington, D.C., its sub-markets, and all other suburban housing markets. This indicates that, although the September 11 attack on New York and the Pentagon did make substantial and immediate damages to the U.S. economy including the stock markets, it did not stop the high-speed gear of the housing markets, at least in the Washington metro area. The other is the dummy variable specifying the number of Low-Income Housing Tax Credit projects in a census tract. LIHTC has a statistically significant and positive effect on sales prices of the homes located in the low-income and high-minority neighborhoods, as well as single-family detached house prices. This effect is not, however, detected from the two other government programs (EZ/EC and Hope VI) also featuring neighborhood developments in the District.

The main purpose of hedonic regressions is to produce the cumulative price

appreciation rates accurately by adjusting for physical characteristics of housing units, locational accessibility and neighborhood traits, and also controlling for the observed neighborhood developments and historical events. The cumulative appreciation rates are essentially the percentage change in the average amenity-adjusted price of transactions since 1987 (the base year used in this study). They are calculated directly from the coefficients of time (year) variables in the hedonic regressions³⁵.

The cumulative appreciation rates are reported in Table 11 (and appendix tables 6 through 10) and illustrated in figures 15a through 16c. They show that prior to 1992 the upward trend on adjusted house price appreciation in Washington, D.C. was similar to those in its comparison markets in suburban Maryland (i.e., Montgomery and Prince George's counties). Between 1993 and 1997, while these suburban Maryland markets were essentially flat in their adjusted price movements, Washington, D.C. took a steadily downward path. Consequently, the cumulative appreciation rate in Washington was merely 20.6 percent in 1997, compared to 33.1 percent in Montgomery and 35.3 in Prince George's in the same year.

In 1998 (the first full year of the homebuyer credit program), however, the house price movements in Washington, D.C., as a whole and in its sub-markets (by structure type and neighborhood) had a surprising and unprecedented spike. Since 1998, although house prices have experienced a substantial growth in all markets, Washington's amenity-adjusted house prices appreciated at a consistently higher rate than its comparison

³⁵ The cumulative (adjusted) price appreciation rate is calculated as the antilog of the coefficient of the time (year) dummy minus 1 (i.e., $\text{antilog}(\text{coeff})-1$). For instance, the cumulative appreciation rate in Washington, D.C. in 2002 is antilog of 0.90933 from Table 10a (2.4826) minus 1, or 1.483 (148.3 percent). This is consistent with the work of Havorson and Palmquist (1980), explained in Gujarati (1995, 525), and also demonstrated in my previous work (Tong and Glascock 2000).

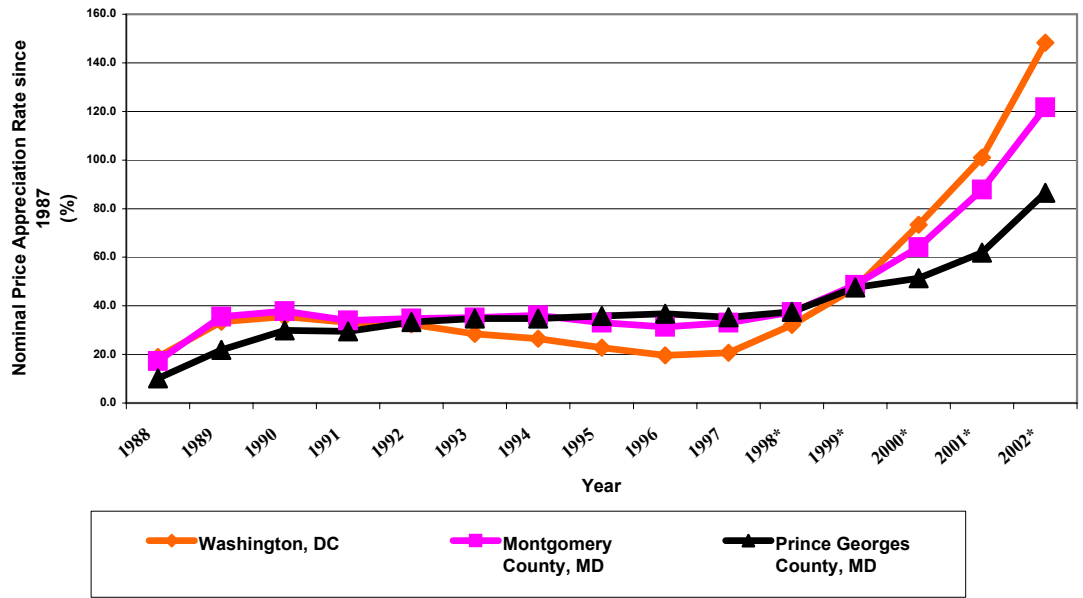
Table 11. Cumulative Price Appreciation Rate in Washington, DC

Year	Washington, DC	Structure Type			Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority
Cumulative Appreciation Rate Since 1987 (%)**										
1988	19.0	21.3	16.5	15.2	24.0	16.5	17.0	21.7	12.5	17.9
1989	33.4	38.1	36.4	23.0	41.1	30.0	30.6	36.6	25.1	32.2
1990	35.6	41.7	38.7	24.0	37.1	33.0	35.2	32.9	25.9	39.2
1991	33.2	37.5	35.8	23.8	29.8	33.3	35.9	27.6	18.3	40.5
1992	32.4	33.6	31.6	22.3	29.1	31.9	33.4	26.8	18.7	35.3
1993	28.5	31.7	26.3	17.8	27.6	32.6	26.5	25.7	19.1	29.0
1994	26.5	34.2	22.1	13.6	27.8	27.0	23.2	25.7	12.4	28.0
1995	22.7	28.1	20.8	14.4	22.4	22.4	23.3	20.8	4.9	27.0
1996	19.6	26.8	22.5	5.3	21.7	17.5	20.1	17.9	11.2	23.0
1997	20.6	28.9	19.3	7.0	24.8	17.7	19.2	21.5	6.4	22.4
1998*	32.1	39.6	33.7	16.8	35.6	26.0	31.7	32.0	17.5	33.9
1999*	47.4	56.4	56.2	26.9	52.5	40.6	47.4	47.0	28.5	52.0
2000*	73.3	81.9	83.1	53.5	81.2	65.7	73.5	77.2	62.7	76.0
2001*	101.0	100.4	114.3	90.1	102.0	97.4	103.3	103.4	104.8	102.7
2002*	148.3	138.4	170.9	141.4	135.2	128.9	161.5	136.4	162.5	156.2

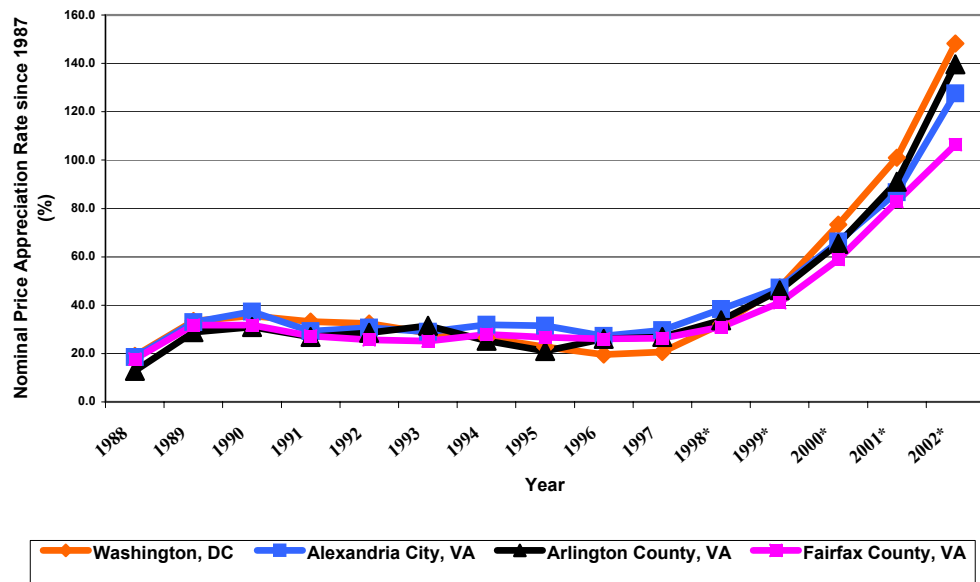
Note: ** The appreciation rate shown in this table is calculated as the antilog (to base e) of the coefficient on time dummies minus 1. For example, 148.3% for 2002 (for Washington, DC) is calculated from the antilog of 0.90933 (2.48266) minus 1. This is consistent with the work of Halvorsen and Palmquist (1980) and explained in Gujarati (1995: page 525).

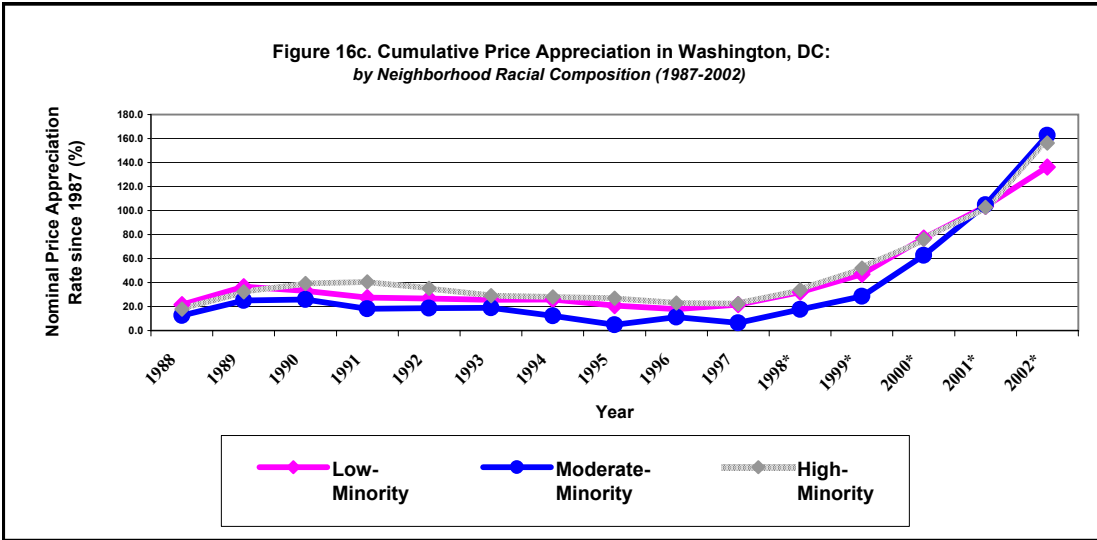
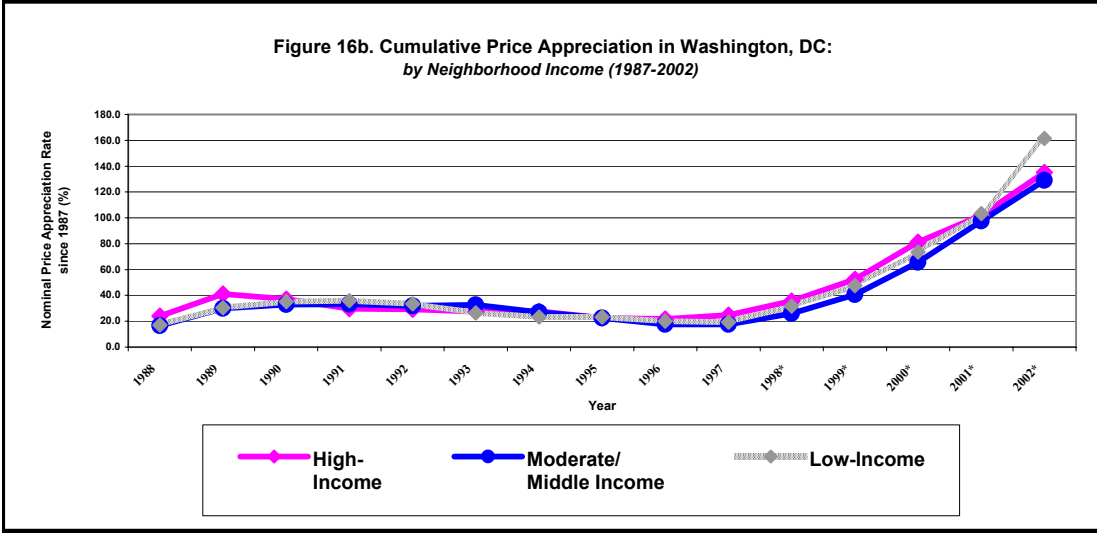
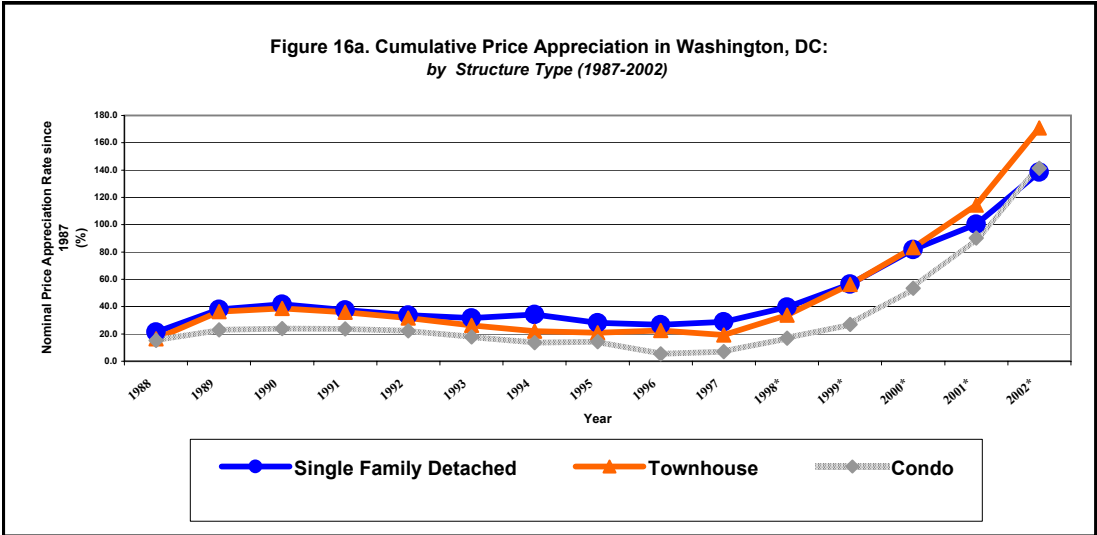
* This period of time is deemed as the "impact period" in Washington, DC.

**Figure 15a. Cumulative Price Appreciation
Washington, DC vs. Comparison Markets in Maryland (1987-2002)**



**Figure 15b. Cumulative Price Appreciation
Washington, DC vs. Comparison Markets in Virginia (1987-2002)**





markets in Maryland every year in the 1998-2002 period. As a result, the cumulative appreciation rate in Washington, D.C., reached an astonishing 148.3 percent in 2002, compared to 121.7 percent in Montgomery and only 86.5 percent in Prince George's.

A nearly identical pattern is also detected in comparing the District's cumulative price appreciation rates with those in the three suburban Virginia markets between 1987 and 2002.

With respect to the District's housing sub-markets, 1998 once again marked a turning point across structure types and neighborhoods (census tracts), which is particularly evident in lower-priced condo/townhouse markets, low/moderate-income neighborhoods, and moderate/high-minority neighborhoods. As shown in Table 11 and Figure 16, single-family detached houses had a cumulative adjusted price appreciation rate of 28.9 percent from 1987 to 1997, which significantly outpaced the price appreciation of townhouses (19.3 percent) and condominiums (merely 7 percent) in the same period. However, the opposite is true since 1998. With a consistently steeper price increase each year over the last five years (1998-2002), the cumulative appreciation rates reached 170.9 percent for townhouses and 141.4 percent for condominiums in 2002, as compared to 138.4 percent for detached houses.

Similarly, house price growth in low/moderate-income neighborhoods and moderate/high-minority neighborhoods had generally lower starting points than in high-income and low-minority neighborhoods in 1987 and 1997. By 2002, the cumulative rates in low/moderate-income and minority neighborhoods generally outpaced (or were close to) the rates in high-income and white neighborhoods. In particular, the District's moderate-minority neighborhoods and low-income tracts experienced a rapid growth of

adjusted house prices since 1998, leading to gains as high as 162.5 and 161.5 percent, respectively, over the last 16 years.

Stage 2: Geographic differences in annual price appreciation

In an effort to control for unobserved effects on the District's house price growth, I first converted the cumulative appreciation rates into the annual appreciation rates and then calculated the geographic differences, in terms of the annual rates of amenity-adjusted price appreciation, between the District and its comparison markets.

Table 12 (and appendix tables 11 through 15) summarizes the annual appreciation rates for Washington, D.C, and its five surrounding housing markets in suburban Maryland and Virginia. Although taking a different angle, the findings are consistent with those discussed in the above subsection on the cumulative appreciation rates. In brief, during the pre-intervention period (1987-1997), the annual appreciation rates in the District and its sub-markets were somewhat lower than those in every comparison housing market in the District's suburban area. For instance, the average annual appreciation rate for Washington, D.C. as a whole in this period was 2.1 percent, as compared to 3.1 percent in Montgomery, 3.2 percent in Prince George's, 2.9 percent in Alexandria, 2.6 percent in Arlington, and 2.5 percent in Fairfax. The average annual rates of house appreciation in the District's townhouse/condominium, low/moderate-income, and moderate-minority neighborhood sub-markets are particularly striking: They ranged from only 0.8 to 2 percent during this pre-intervention period.

In a sharp contrast, compared to the surrounding markets, the District's housing market dynamics experienced a dramatic change during the impact period of 1998-2002. The average annual appreciation rate in the District reached 15.6 percent, while

Table 12. Annual Price Appreciation Rate in Washington, DC**

Year	Washington, DC	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High Income	Moderate/Middle Income	Low Income	Low-Minority	Moderate-Minority	High-Minority	
Appreciation Rate¹											
1988	19.0	21.3	16.5	15.2	24.0	16.5	17.0	21.7	12.5	17.9	
1989	12.1	13.8	17.1	6.7	13.7	11.6	11.6	12.3	11.2	12.1	
1990	1.6	2.6	1.7	0.8	-2.8	2.4	3.6	-2.7	0.6	5.3	
1991	-1.7	-3.0	-2.1	-0.2	-5.3	0.2	0.5	-4.1	-6.1	1.0	
1992	-0.6	-2.8	-3.1	-1.2	-0.5	-1.0	-1.9	-0.6	0.4	-3.7	
1993	-3.0	-1.5	-4.0	-3.7	-1.2	0.5	-5.2	-0.9	0.3	-4.6	
1994	-1.5	2.0	-3.3	-3.5	0.1	-4.2	-2.6	0.0	-5.6	-0.8	
1995	-3.0	-4.6	-1.1	0.7	-4.2	-3.6	0.1	-3.9	-6.7	-0.8	
1996	-2.5	-1.0	1.4	-8.0	-0.6	-4.1	-2.6	-2.4	6.0	-3.1	
1997	0.8	1.6	-2.6	1.6	2.5	0.2	-0.8	3.1	-4.3	-0.5	
1998*	9.5	8.3	12.1	9.2	8.7	7.1	10.5	8.6	10.4	9.4	
1999*	11.6	12.1	16.8	8.6	12.5	11.6	11.9	11.4	9.3	13.5	
2000*	17.6	16.3	17.3	21.0	18.8	17.9	17.7	20.5	26.6	15.8	
2001*	16.0	10.2	17.0	23.8	11.5	19.2	17.2	14.8	25.9	15.2	
2002*	23.5	18.9	26.4	27.0	16.4	15.9	28.6	16.2	28.2	26.4	
Arithmetic Return (%)	6.6	6.3	7.3	6.5	6.2	6.0	7.0	6.3	7.3	6.9	
Standard Deviation	9.4	8.7	10.4	10.8	9.4	8.6	10.1	9.2	12.0	9.6	
Sub-periods											
Pre-Intervention: 1987 - 1997											
Arithmetic Return (%)	2.1	2.9	2.0	0.8	2.6	1.8	2.0	2.3	0.8	2.3	
Standard Deviation	7.4	8.3	8.0	6.4	9.2	6.9	7.0	8.3	7.0	7.4	
Impact Period: 1998 - 2002											
Arithmetic Return (%)	15.6	13.2	17.9	17.9	13.6	14.3	17.2	14.3	20.1	16.1	
Standard Deviation	5.5	4.4	5.2	8.5	4.0	5.0	7.1	4.6	9.4	6.3	

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $rt = (Rt - Rt-1)/(1+Rt-1)$ or $rt = (1 + Rt)/(1 + Rt-1) - 1$
 Where, r_t is annual appreciation rate for year t , R_t is cumulative price appreciation rate for year t , and R_{t-1} is cumulative price appreciation rate for year $t-1$.
 * This period of time is deemed as the "impact period" in Washington, DC.

Montgomery had an average annual rate of 10.9 percent, Prince George's 6.7 percent, Alexandria 12.1 percent, Arlington 13.8 percent, and Fairfax 10.4 percent during the same period. The gaps in some of the sub-markets were even larger, especially the townhouse/condo markets, low/moderate-income neighborhoods, and moderate-minority neighborhoods.

As shown in tables 13 through 15 and also illustrated in figures 17a through 20c, a number of important patterns have emerged from the geographic differences in the annual price appreciation rates between the District and the comparison markets. First, except for 1988 and to a less extent 1991, nearly all the geographic differences were negative under any comparison categories during the pre-intervention period of 1987-1997. Second, with just one exception (Washington, D.C., vs. Arlington in 2002), the differences between the District as a whole and the five comparison markets were dramatically turned into the positive territory and they were also substantial every year during the 1998-2002 impact period. In particular, the dramatic U-turn in the geographic differences was observed in 1998, suggesting an enormous, immediate impact of the D.C. homebuyer credit program in its first full year. And the vast majority of the differences reached their climaxes in 2000. (Note that this information is consistent with the findings reported earlier using the IRS data.) Third, the differences during the impact period for all the housing sub-markets were generally positive and large. This pattern is particularly evident for the townhouse/condominium sub-markets, low/moderate-income neighborhoods, and moderate-minority neighborhoods. There are, however, some inconsistencies (or "noises") observed for single-family detached housing and in high-income census tracts and low- and high-minority tracts over the last two years (2001-2002).

**Table 13. Differences in Annual Price Appreciation Rates:
Washington, DC vs. Surrounding Markets**

Year	DC - Montgomery	DC - Prince Georges	DC - Alexandria	DC - Arlington	DC - Fairfax
1988	1.7	8.8	0.4	6.2	1.3
1989	-3.4	1.5	0.0	-2.1	0.2
1990	-0.1	-5.1	-1.8	0.0	1.6
1991	1.0	-1.4	4.2	1.4	1.7
1992	-1.1	-3.5	-1.8	-2.0	0.8
1993	-3.2	-4.0	-1.6	-5.2	-2.5
1994	-2.3	-1.6	-3.8	3.2	-3.9
1995	-0.7	-3.7	-2.8	0.3	-2.0
1996	-1.2	-3.2	0.7	-6.6	-2.0
1997	-0.5	1.9	-1.1	0.2	0.6
1998*	6.3	7.9	2.8	4.1	5.8
1999*	3.5	4.3	5.2	2.3	3.9
2000*	7.1	14.9	4.6	4.4	4.9
2001*	1.6	9.0	3.7	0.4	0.9
2002*	5.5	8.3	1.6	-1.9	10.6
Arithmetic Return (%)	0.9	2.3	0.7	0.3	1.5
Standard Deviation	3.3	6.2	2.9	3.5	3.7
<u>Sub-periods</u>					
Pre-Intervention: 1987 - 1997					
Arithmetic Return (%)	-1.0	-1.0	-0.7	-0.5	-0.4
Standard Deviation	1.7	4.2	2.2	3.8	2.0
Impact Period: 1998 - 2002					
Arithmetic Return (%)	4.8	8.9	3.6	1.9	5.2
Standard Deviation	2.2	3.8	1.4	2.7	3.5

* This period of time is deemed as the "impact period" in Washington, DC.

Table 14. Differences in Annual Price Appreciation Rates between Washington, DC and Surrounding Markets: By Structure Type

Year	DC - Montgomery	DC - Prince Georges	DC - Alexandria	DC - Arlington	DC - Fairfax
<u>Single Family Detached</u>					
1988	2.0	10.8	5.7	2.3	1.5
1989	-1.9	3.2	1.4	-2.3	2.9
1990	2.6	-4.1	-1.5	1.4	5.0
1991	0.6	-2.3	2.3	0.7	1.2
1992	-2.3	-5.2	-4.6	-3.7	-2.5
1993	-2.8	-2.1	0.4	-2.1	-2.9
1994	0.6	0.5	-0.4	2.7	-1.7
1995	-2.1	-4.4	-2.7	-5.5	-3.3
1996	0.3	-1.9	1.2	-1.4	-0.7
1997	0.5	2.7	-0.9	-1.4	0.5
1998*	4.0	6.5	0.2	0.6	2.6
1999*	3.5	3.7	5.4	-0.3	1.9
2000*	4.9	13.8	2.9	2.0	1.3
2001*	-4.6	3.0	-1.5	-2.5	-3.6
2002*	0.2	3.3	-2.1	-3.6	8.8
<u>Townhouse/Rowhouse</u>					
1988	4.8	7.3	-9.6	1.4	0.1
1989	0.3	6.6	6.1	-0.2	4.4
1990	-3.4	-5.7	-0.1	1.1	1.0
1991	-0.4	-4.2	4.1	2.5	0.5
1992	-6.2	-6.1	-1.9	0.7	-2.0
1993	-1.6	-9.1	-3.3	-16.6	-2.3
1994	-2.9	2.3	-5.3	1.4	-5.2
1995	-1.6	-7.0	-2.2	10.5	-1.0
1996	2.0	0.8	3.7	-4.9	2.0
1997	-5.0	-2.3	-2.1	-15.3	-3.0
1998*	10.7	11.4	10.6	19.2	10.6
1999*	11.2	17.1	10.8	3.8	10.8
2000*	7.4	12.1	3.9	7.3	4.3
2001*	2.9	11.3	3.3	-2.0	0.7
2002*	7.9	12.6	3.3	6.3	11.7
<u>Condominium</u>					
1988	8.3	3.2	-8.6	7.2	2.6
1989	-9.0	-13.8	3.3	-8.5	-6.2
1990	-6.0	-0.9	-12.6	1.0	-3.5
1991	-3.1	-1.5	0.8	1.4	2.7
1992	-1.0	-1.8	-1.7	-2.3	0.6
1993	-1.4	-3.4	2.4	-3.0	0.6
1994	-11.6	-7.7	-9.3	2.3	-3.1
1995	6.3	10.0	5.3	4.1	1.6
1996	-6.7	-12.3	-2.4	-12.4	-7.2
1997	5.8	7.0	3.0	5.5	3.0
1998*	8.4	16.0	7.7	5.3	8.3
1999*	3.0	-2.0	3.8	1.0	3.7
2000*	13.5	24.0	19.2	6.6	8.3
2001*	3.2	17.7	12.9	4.0	4.5
2002*	13.4	12.5	4.0	0.4	10.0

* This period of time is deemed as the "impact period" in Washington, DC.

Table 15a. Differences in Annual Price Appreciation Rates between Washington, DC and Surrounding Markets: By Neighborhood Income

Year	DC - Montgomery	DC - Prince Georges	DC - Alexandria	DC - Arlington	DC - Fairfax
<u>High-Income Neighborhoods</u>					
1988	4.1	16.6	-0.2	0.5	5.0
1989	-2.5	2.0	-1.2	-0.5	2.8
1990	-2.1	-10.4	1.4	0.5	-1.1
1991	-0.3	4.8	-3.3	-1.4	-1.9
1992	-1.2	-4.2	-2.0	-1.1	0.4
1993	-2.6	-1.8	-0.9	-6.5	-1.1
1994	-0.6	1.3	-4.8	0.8	-3.5
1995	-2.2	-4.7	-1.1	-5.6	-3.4
1996	1.9	0.6	1.5	-2.2	-0.1
1997	-1.0	2.8	-1.4	1.3	1.5
1998*	4.7	6.3	3.9	1.0	3.9
1999*	4.2	4.7	3.4	3.8	3.9
2000*	6.1	13.7	8.8	3.3	4.7
2001*	-3.4	0.3	-1.9	-2.0	-2.6
2002*	-0.2	3.7	-0.8	-3.7	4.7
<u>Moderate/Middle-Income</u>					
1988	2.1	4.1	-3.3	6.6	0.0
1989	-3.1	0.7	1.2	-1.5	-1.4
1990	-1.6	-3.9	-4.5	0.8	1.5
1991	1.7	1.0	4.0	2.6	3.4
1992	-0.8	-3.4	2.6	-2.5	0.3
1993	1.9	-0.9	-0.2	-1.0	0.7
1994	-5.8	-4.8	-3.5	1.0	-5.0
1995	-1.2	-5.0	-7.3	-3.5	-2.7
1996	-4.0	-4.6	0.2	-4.8	-4.0
1997	1.2	1.3	2.0	-1.1	0.6
1998*	4.2	5.6	-1.6	2.1	4.2
1999*	4.0	4.1	6.1	0.4	5.0
2000*	10.3	15.2	4.5	7.7	5.9
2001*	4.2	12.4	6.6	2.9	3.2
2002*	-3.2	1.1	-8.7	-7.6	1.3
<u>Low-Income Neighborhoods</u>					
1988	1.7	11.4	10.5	5.0	1.5
1989	-6.8	2.7	3.0	-4.9	0.9
1990	3.0	-3.6	-4.1	-0.6	-3.1
1991	-1.3	-2.9	21.1	4.4	3.4
1992	-4.7	-4.8	-20.2	0.7	2.1
1993	-5.9	-5.8	2.5	-1.1	0.3
1994	-0.6	-1.7	-13.4	-1.6	-3.3
1995	-0.3	0.3	8.8	6.6	2.7
1996	-3.2	-4.5	-5.1	-6.3	0.8
1997	1.6	0.0	-9.1	0.4	1.6
1998*	9.1	9.5	14.3	6.5	13.5
1999*	3.9	5.5	-3.9	5.9	2.6
2000*	6.7	15.5	2.8	-1.0	9.7
2001*	5.2	11.5	3.6	2.2	-3.3
2002*	5.1	12.8	6.7	-6.3	16.2

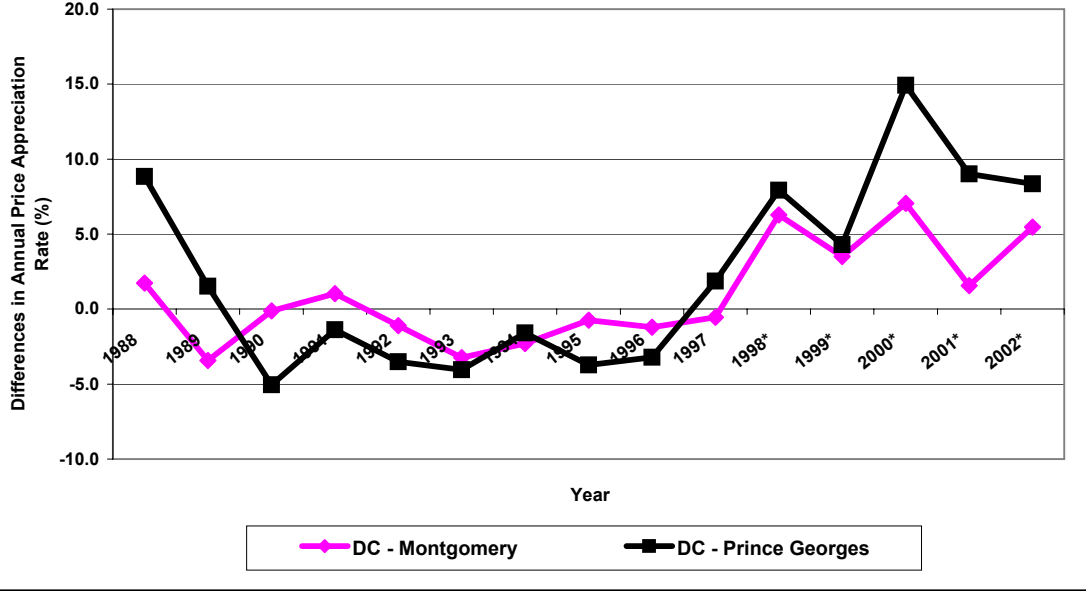
* This period of time is deemed as the "impact period" in Washington, DC.

Table 15b. Differences in Annual Price Appreciation Rates between Washington, DC and Surrounding Markets: By Neighborhood Racial Composition

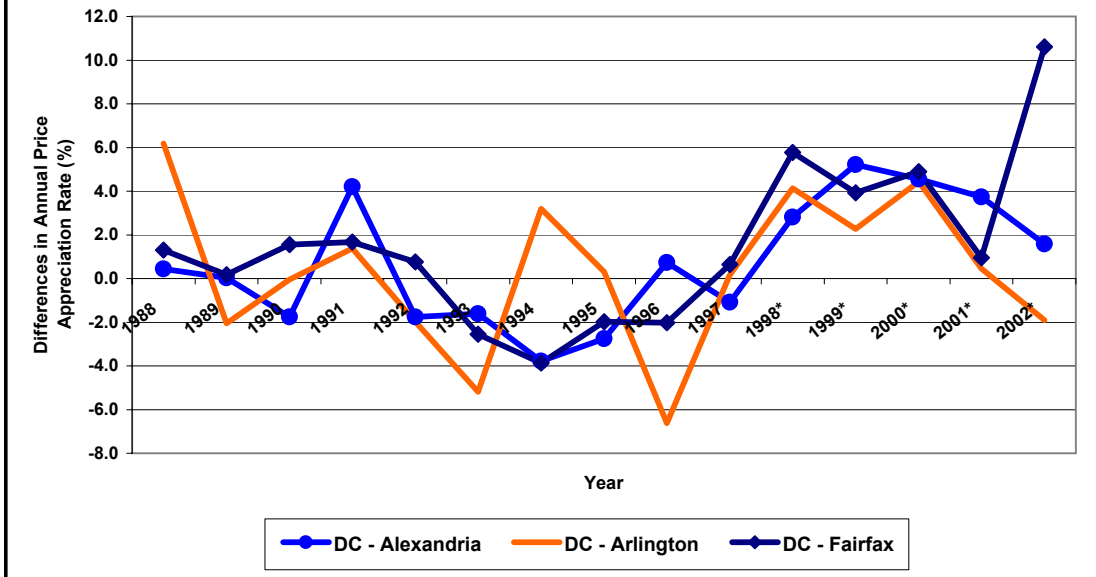
Year	DC - Montgomery	DC - Prince Georges	DC - Alexandria	DC - Arlington	DC - Fairfax
<u>Low-Minority Neighborhoods</u>					
1988	4.7	7.1	1.0	6.1	4.0
1989	-3.7	-1.2	-2.2	0.2	0.3
1990	-4.5	-8.1	-6.3	-2.6	-2.1
1991	-0.4	0.2	2.5	-1.1	-0.9
1992	-0.6	-2.5	-1.5	-2.1	0.7
1993	-0.9	0.2	-0.1	-3.8	-0.7
1994	-1.4	-2.9	-3.5	3.2	-2.4
1995	-1.5	-4.9	-2.4	-3.4	-3.1
1996	-0.9	-0.5	-0.9	-4.5	-1.9
1997	0.9	3.4	-0.2	3.9	2.6
1998*	5.4	7.9	4.6	2.1	4.8
1999*	4.0	1.7	2.4	1.7	3.7
2000*	10.0	18.2	10.2	7.8	7.4
2001*	-0.6	4.7	3.0	0.9	0.0
2002*	-1.3	1.4	-3.6	-8.5	3.0
<u>Moderate-Minority Neighborhoods</u>					
1988	-6.1	2.8	-11.4	5.7	-5.6
1989	-3.1	-0.3	2.6	-6.5	-0.9
1990	-0.4	-5.9	-2.1	-2.3	-2.8
1991	-4.8	-3.8	-6.0	-2.0	-2.0
1992	-1.6	-2.5	3.9	0.7	1.8
1993	-0.7	-0.8	0.7	3.2	2.3
1994	-5.5	-5.2	-6.4	-2.6	-6.1
1995	-5.9	-6.5	-10.6	-6.1	-4.6
1996	6.8	4.3	10.3	7.4	5.1
1997	-3.8	-3.2	-6.9	-8.5	-1.4
1998*	7.3	9.3	8.8	6.8	8.2
1999*	0.6	0.1	2.2	-3.0	3.8
2000*	16.1	22.4	12.7	18.6	16.6
2001*	14.0	20.2	12.4	9.4	8.8
2002*	8.2	13.0	5.7	-0.4	16.4
<u>High-Minority Neighborhoods</u>					
1988	0.3	9.1	9.7	4.6	6.0
1989	-4.2	3.2	0.3	-6.0	3.4
1990	0.9	-2.2	0.9	-1.0	-2.2
1991	1.2	-0.8	18.6	6.7	5.3
1992	-0.9	-6.8	-17.9	-1.0	-1.6
1993	-5.6	-6.6	-0.6	-2.5	0.8
1994	0.9	-0.1	-4.7	7.5	-1.7
1995	0.9	-1.5	9.8	0.8	0.2
1996	-3.9	-4.7	-3.9	-9.1	2.3
1997	3.6	0.7	4.6	-4.4	0.0
1998*	5.0	7.1	-15.7	5.8	12.2
1999*	1.2	8.2	12.7	12.0	3.6
2000*	6.6	13.6	-3.9	-7.3	7.1
2001*	0.2	9.0	1.1	-9.3	-5.9
2002*	4.3	11.9	1.7	3.8	12.6

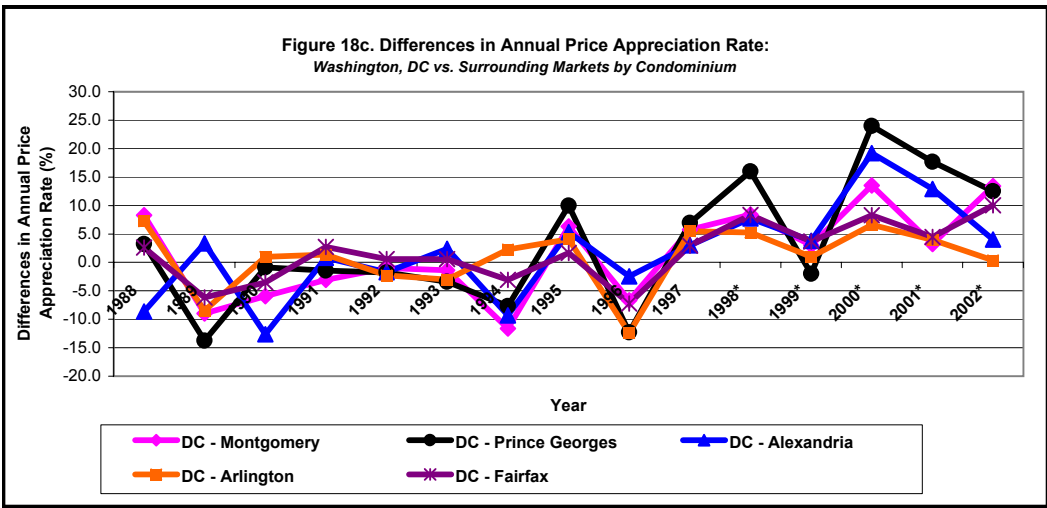
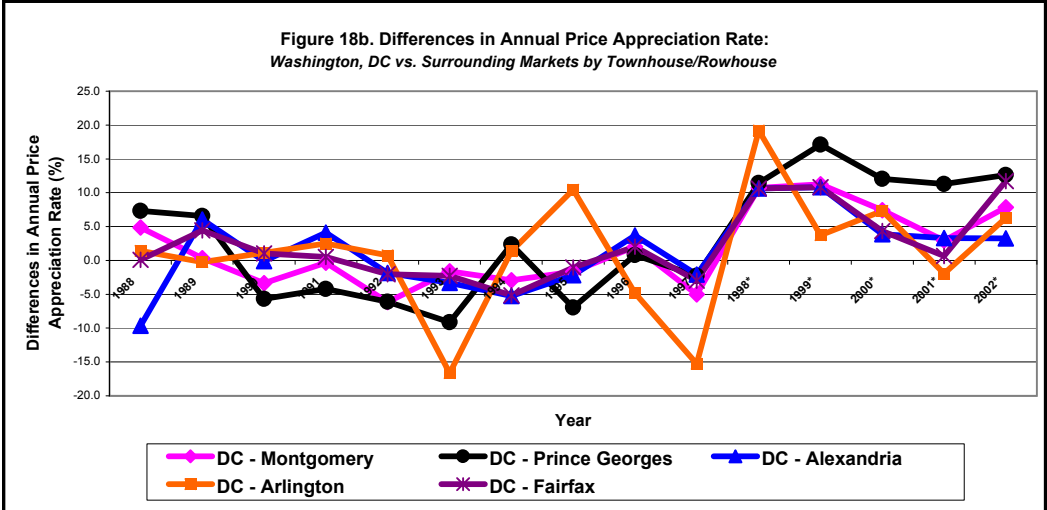
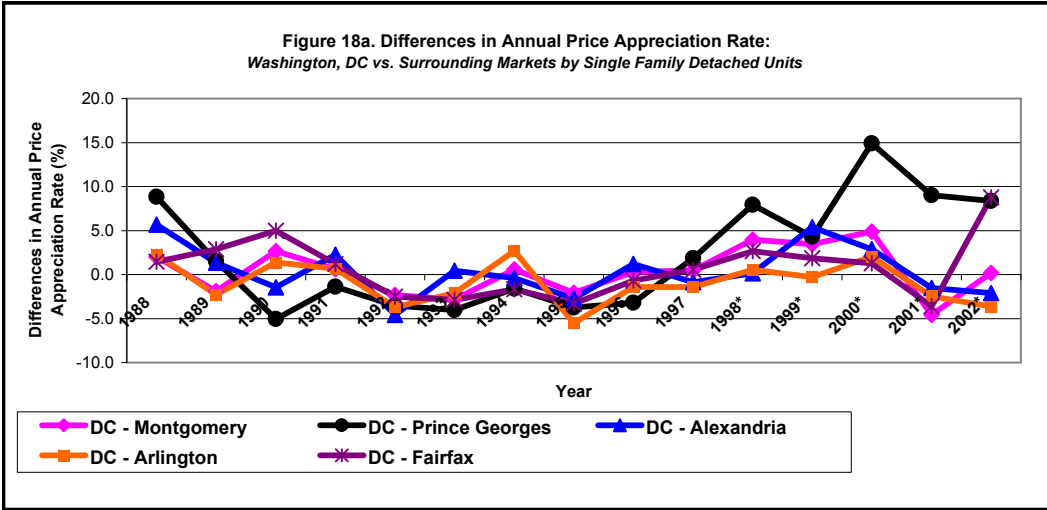
* This period of time is deemed as the "impact period" in Washington, DC.

**Figure 17a. Differences in Annual Price Appreciation Rates:
Washington, DC vs. Suburban Maryland**



**Figure 17b. Differences in Annual Price Appreciation Rates:
Washington, DC vs. Suburban Virginia**





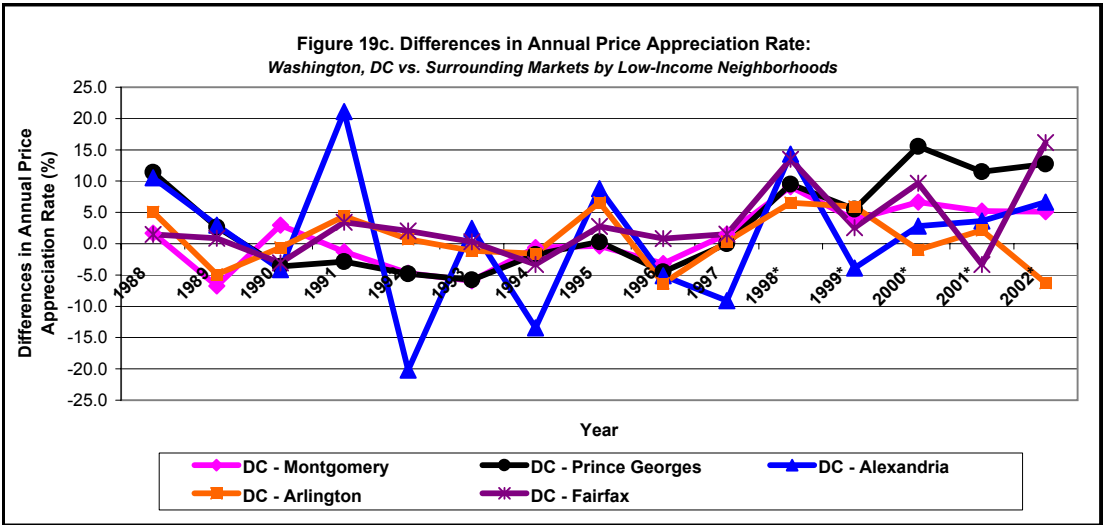
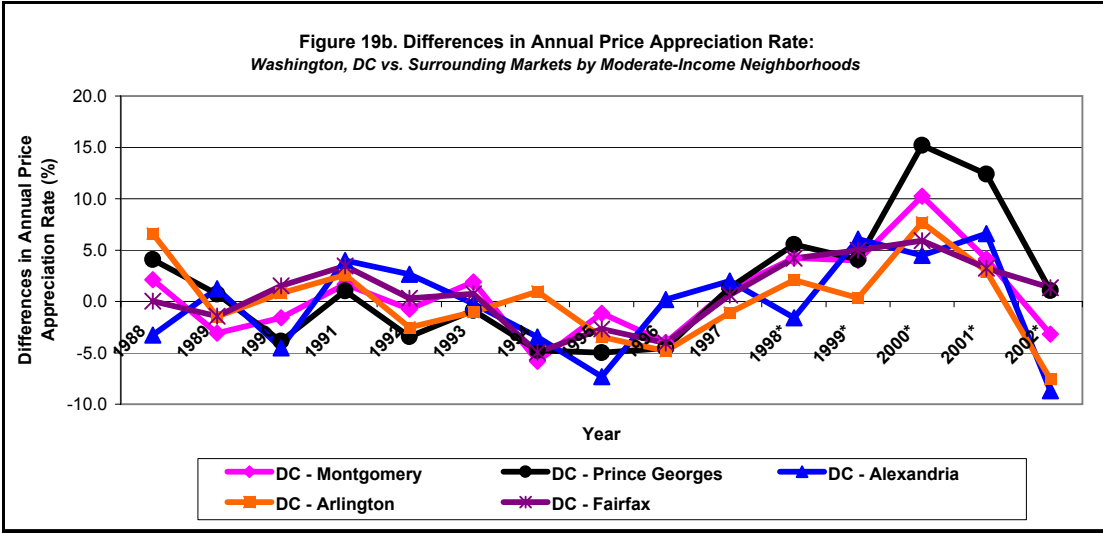
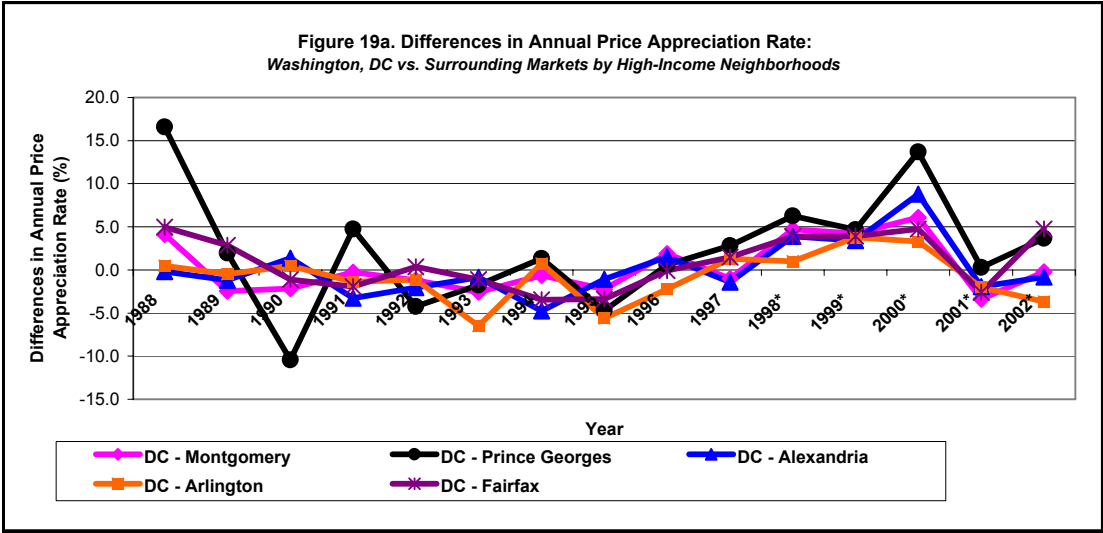


Figure 20a. Differences in Annual Price Appreciation Rate:
Washington, DC vs. Surrounding Markets by Low-Minority Neighborhoods

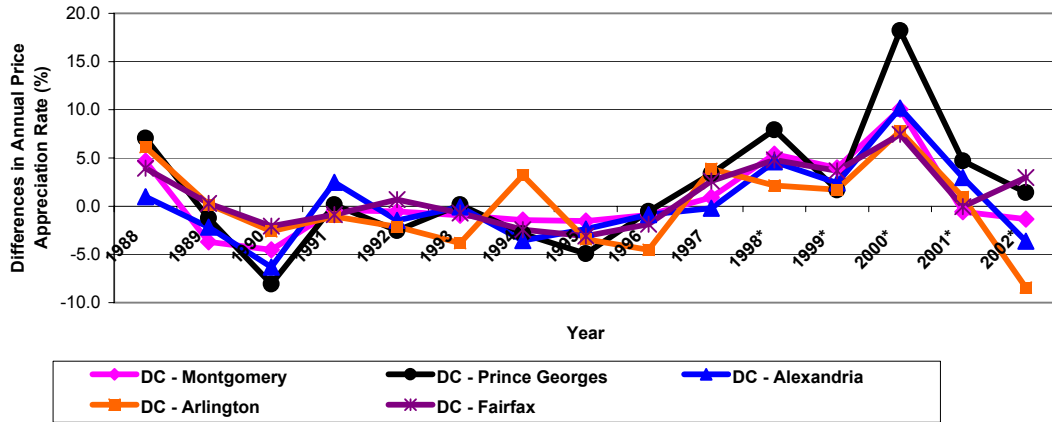


Figure 20b. Differences in Annual Price Appreciation Rate:
Washington, DC vs. Surrounding Markets
by Moderate-Minority Neighborhoods

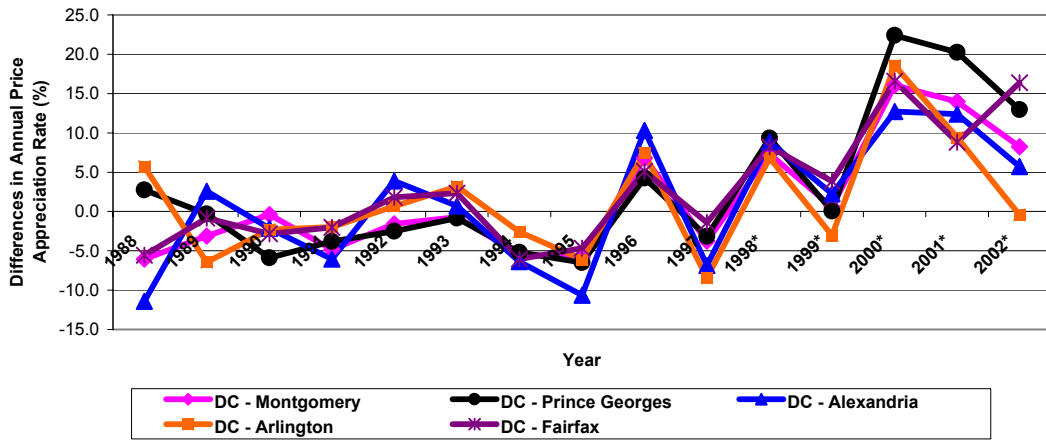
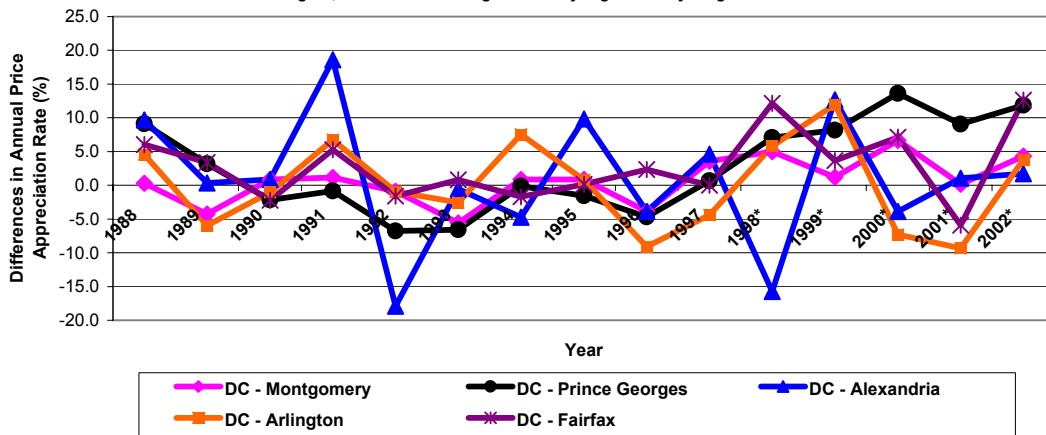


Figure 20c. Differences in Annual Price Appreciation Rate:
Washington, DC vs. Surrounding Markets by High-Minority Neighborhoods



Although these results provide important information about the magnitude and sign of the geographic differences in annual rates of appreciation, it is still unclear if the difference is statistically significant during the pre-intervention or impact period. Next, I used a simple 2-tailed t-test to test a null hypothesis that the two paired samples have the same underlying population, that is, the mean difference in amenity-adjusted annual price appreciation rates between Washington, D.C. and its comparison markets equals zero. The tests generate p value (probability value or exact significance level) that indicates the lowest significance level at which the null hypothesis can be rejected.

As shown in table 16 (column 1), the null hypothesis that the mean differences between D.C. and its comparison markets during the pre-intervention period are zero cannot be rejected for all paired samples at 10 percent significance level and for 4 out of 5 pairs at 5 percent significance level. (The exception is D.C. vs. Montgomery, which has a p value of 0.09. It means that there is a 9% chance for the mean annual rates of appreciation in D.C. to be equal to those in Montgomery during the pre-intervention period.) In contrast, except for the D.C./Arlington pair, annual appreciation rates in all other paired samples during the impact period have very low p values (ranging from 0.01 to 0.03). They indicate that there is only a 1-3% chance for the average appreciation rates being the same between the pairs. In other words, at both 10% and 5% significance levels, the mean differences between D.C. and its suburban markets (except for Arlington) are statistically significantly different from zero during the impact period.

By the same token, I also cannot reject the null hypothesis for all paired samples during the pre-intervention period when comparing their mean differences for nearly all sub-markets and neighborhoods. And except for the D.C./Arlington pair again, during the

Table 16. Probability Value of Statistical Significance t-Test for Paired Means of Annual Price Appreciation Rates in Washington, DC and Comparison Markets*

Probability Value of Equal Means between Samples	At County/City Level	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	High-Minority	Moderate-Minority	High-Minority	
<u>DC vs. Montgomery County</u>											
Pre-Intervention (1988-1997)	0.09	0.17	0.26	0.78	0.19	0.40	0.18	0.16	0.04	0.39	
Impact Period (1998-2002)	0.01	0.01	0.01	0.09	0.01	0.03	0.03	0.01	0.00	0.14	
<u>DC vs. PG County</u>											
Pre-Intervention (1988-1997)	0.45	0.45	0.39	0.65	0.90	0.30	0.69	0.28	0.55	0.49	
Impact Period (1998-2002)	0.01	0.01	0.00	0.03	0.01	0.01	0.01	0.02	0.01	0.00	
<u>DC vs. Alexandria City</u>											
Pre-Intervention (1988-1997)	0.33	0.42	0.38	0.71	0.16	0.61	0.90	0.09	0.24	0.60	
Impact Period (1998-2002)	0.01	0.01	0.04	0.04	0.01	0.10	0.33	0.00	0.03	0.78	
<u>DC vs. Arlington County</u>											
Pre-Intervention (1988-1997)	0.71	0.03	0.48	0.63	0.15	0.96	0.76	0.59	0.90	0.72	
Impact Period (1998-2002)	0.19	0.09	0.26	0.59	0.00	0.19	0.98	0.09	0.53	0.88	
<u>DC vs. Fairfax County</u>											
Pre-Intervention (1988-1997)	0.51	0.43	0.47	0.67	0.46	0.57	0.37	0.48	0.84	0.37	
Impact Period (1998-2002)	0.03	0.10	0.03	0.09	0.05	0.02	0.13	0.03	0.04	0.16	

* The probability value (commonly known as p value or exact significant level) of t-test statistic represents the lowest significant level at which a null hypothesis can be rejected. The null hypothesis here is that the two paired samples have the same underlying population, i.e., the mean difference in annual price appreciation rates between DC and its comparison markets is zero.

impact period, the null hypothesis can be rejected for the vast majority of sub-markets and neighborhoods at the 10% or 5% significance level. (That is, about 31 out of 36 pairs by sub-market comparisons have a p value of below/at 0.1, and 27 out of 36 pairs have a probability value below/at 0.05). Even for D.C. vs. Arlington, there are 3 out of 9 pairs by sub-markets whose mean differences are significantly different from zero at the 10% level.

This information provides both the context and solid foundation for a more rigorous econometric analysis of determining whether the differences are statistically significant and, more importantly, the extent to which the (positive) geographic differences in the annual appreciation rates are attributable to the inter-temporal interruption, i.e., the District first-time homebuyer credit intervention.

Stage 3: Difference in differences: interrupted time series analysis (ARIMA)

After separating out the potential effects of the observed variables (at the 1st stage) and unobserved factors (at the 2nd stage) on house prices, the stage is set for the interrupted time series model (equation 3). This model, also named “intervention model,” “impact analysis model,” “dynamic regressions,” or “ARIMA model with input series,” is designed to examine the causality of the District homebuyer credit program (“policy shock”) for the inter-temporal differences between the pre-1998 series and the post-1998 series of the geographic differences in the annual rates of adjusted price appreciation.

Table 17 summarizes the results from the interrupted time series analyses of Washington, D.C., as compared to its five comparison markets, which will serve as the measure of the overall economic impact of the targeted homebuyer credit program in the District. To assess its distributional effects on various housing sub-markets, the

**Table 17. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates:
Washington, DC vs. Surrounding Markets (1987 - 2002)**

	Washington, DC - Alexandria					Washington, DC - Montgomery				
	Parameter	Standard Error	t Value	Approx Pr > t		Parameter	Standard Error	t Value	Approx Pr > t	
Conditional Least Squares Estimation										
Estimated Mean	-0.693	1.212	-0.6	0.579		0.930	2.154	0.4	0.674	
Moving Average Factor	1.000	2.872	0.4	0.734		0.538	0.486	1.1	0.292	
Autoregressive Factor	0.962	2.789	0.3	0.737		1.000	0.254	3.9	0.002	
Intervention ("input" dummy variable)	4.293	1.326	3.2	0.008		5.767	2.829	2.0	0.066	
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq		To Lag	Chi-Square	DF	Pr > ChiSq	
	6	3.34	4	0.503		6	3.42	4	0.490	
	12	8.33	10	0.596		12	15.21	10	0.125	
	Washington, DC - Arlington					Washington, DC - Prince Georges				
	Parameter	Standard Error	t Value	Approx Pr > t		Parameter	Standard Error	t Value	Approx Pr > t	
Estimated Mean	-0.317	2.682	-0.1	0.908		-0.959	1.540	-0.6	0.546	
Moving Average Factor	1.000	1.217	0.8	0.429		-0.843	0.534	-1.6	0.143	
Autoregressive Factor	0.859	1.033	0.8	0.424		-0.589	0.671	-0.9	0.399	
Intervention ("input" dummy variable)	2.106	2.017	1.0	0.319		10.219	2.646	3.9	0.003	
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq		To Lag	Chi-Square	DF	Pr > ChiSq	
	6	9.59	4	0.048		6	2.84	4	0.585	
	12	16.37	10	0.090		12	17.20	10	0.070	
	Washington, DC - Fairfax									
	Parameter	Standard Error	t Value	Approx Pr > t						
Estimated Mean	-0.419	1.614	-0.3	0.800						
Moving Average Factor	1.000	5.246	0.2	0.852						
Autoregressive Factor	0.985	5.204	0.2	0.853						
Intervention ("input" dummy variable)	5.625	2.102	2.7	0.022						
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq						
	6	0.94	4	0.746						
	12	5.54	10	0.852						

Note: 1. A sensitivity analysis indicates that an addition of a dummy variable for the DC Mayor election of Anthony Williams to the models would generate a higher average of parameter estimates for the homebuyer credit intervention variable than those in the models without the addition. Moreover, the new DC Mayor dummy is statistically insignificant in all models.

2. There are 15 observations/residuals analyzed in each model.

interrupted time series analysis is also performed for each structure type and also by neighborhood income and racial composition. Tables 18 through 26 report the results for the distributional effects. All the interrupted time series models (1,1,1) are carried out through the conditional least squares estimation method. Chi-square statistics are generated for the purpose of diagnostics or autocorrelation check for white noise.

As shown in Table 17, interrupted time series models yield several important outcomes. First, the parameters of the intervention/input variable are statistically significant in all the models at 10 percent significance level, with just one exception (D.C. vs. Arlington). These results indicate that there is indeed a significant impact of the intervention variable, or the homebuyer credit program, on the house price appreciation in the District as a whole, even controlling for the effects of both observed price determinants (such as housing amenities, locations, and neighborhood developments/events) and unobserved factors.

Second, these parameters are positive and generally large. Note that the intervention dummy variable takes a value of 1 if the annual house price difference is observed in the 1998-2002 period and 0 if observed in the pre-intervention period (1987-1997). The parameter estimate is therefore interpreted as the net impact of the intervention on the District's house prices after comparing both the inter-temporal and geographic differences in price movements. For example, the parameter of 5.767 means that, in reference to Montgomery County, the District's house prices during the impact period (1998-2002) appreciated at an annual rate of 5.8 percentage points **higher than** the house prices during the District's pre-intervention period. The net impact was an annual rate of 10.2 percentage points higher in reference to Prince George's, 4.3 to Alexandria,

**Table 18. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates:
Single Family Detached Houses (1987 - 2002)**

	Washington, DC - Alexandria				Washington, DC - Montgomery			
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	0.011	1.011	0.010	0.99	-0.084	0.730	-0.110	0.911
Moving Average Factor	-1.000	7.686	-0.130	0.90	1.000	0.974	1.030	0.327
Autoregressive Factor	-0.985	7.696	-0.130	0.90	0.715	0.939	0.760	0.462
Intervention ("input" dummy variable)	1.168	1.760	0.660	0.52	2.112	1.529	1.380	0.194
Autocorrelation Check for White Noise								
To Lag		Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
6		3.88	4	0.42	6	3.43	4	0.489
12		9.08	10	0.52	12	12.46	10	0.255
	Washington, DC - Arlington				Washington, DC - Prince Georges			
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	-0.741	1.611	-0.460	0.65	-0.242	1.776	-0.140	0.894
Moving Average Factor	1.000	1.244	0.800	0.44	-0.796	0.860	-0.900	0.385
Autoregressive Factor	0.826	1.065	0.780	0.45	-0.590	1.016	-0.580	0.573
Intervention ("input" dummy variable)	0.038	1.693	0.020	0.98	6.657	3.091	2.150	0.054
Autocorrelation Check for White Noise								
To Lag		Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
6		7.91	4	0.10	6	2.29	4	0.682
12		12.79	10	0.24	12	12.36	10	0.262
	Washington, DC - Fairfax							
	Parameter	Standard Error	t Value	Approx Pr > t				
Conditional Least Squares Estimation								
Estimated Mean	0.018	1.241	0.010	0.99				
Moving Average Factor	-0.034	6.027	-0.010	1.00				
Autoregressive Factor	0.061	5.770	0.010	0.99				
Intervention ("input" dummy variable)	2.297	2.184	1.050	0.32				
Autocorrelation Check for White Noise								
To Lag		Chi-Square	DF	Pr > ChiSq				
6		1.1	4	0.89				
12		6.65	10	0.76				

Note: There are 15 observations/residuals analyzed in each model.

Table 20. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates: Condominium (1987-2002)

	Washington, DC - Alexandria				Washington, DC - Montgomery			
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	-2.780	3.183	-0.870	0.401	0.474	4.711	0.100	0.922
Moving Average Factor	1.000	1.268	0.790	0.447	0.820	0.881	0.930	0.372
Autoregressive Factor	0.751	1.085	0.690	0.503	1.000	0.618	1.620	0.134
Intervention ("input" dummy variable)	13.179	6.624	1.990	0.072	10.183	9.182	1.110	0.291
Autocorrelation Check for White Noise								
To Lag		Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
6		5.59	4	0.232	6	15.96	4	0.003
12		11.53	10	0.317	12	14.7	10	0.006
Washington, DC - Arlington								
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	-0.344	1.408	-0.240	0.812	-1.524	4.210	-0.360	0.724
Moving Average Factor	1.000	1.178	0.850	0.414	0.998	155.557	0.010	0.995
Autoregressive Factor	0.428	1.043	0.410	0.689	1.000	155.385	0.010	0.995
Intervention ("input" dummy variable)	3.970	3.493	1.140	0.280	15.655	10.072	1.550	0.148
Autocorrelation Check for White Noise								
To Lag		Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
6		8.61	4	0.072	6	11.66	4	0.020
12		19.36	10	0.036	12	19.16	10	0.038
Washington, DC - Fairfax								
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	-0.845	0.825	-1.020	0.328				
Moving Average Factor	1.000	4.275	0.230	0.819				
Autoregressive Factor	0.856	4.017	0.210	0.835				
Intervention ("input" dummy variable)	7.458	2.204	3.380	0.006				
Autocorrelation Check for White Noise								
To Lag		Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
6		5.33	4	0.255	6	11.66	4	0.020
12		15.65	10	0.110	12	19.16	10	0.038

Note: There are 15 observations/residuals analyzed in each model.

**Table 23. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates:
Low-Income Neighborhoods (1987-2002)**

	Washington, DC - Alexandria						Washington, DC - Montgomery					
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t				
Estimated Mean	-0.409	1.972	-0.210	0.840	-2.463	1.894	-1.300	0.220				
Moving Average Factor	0.063	0.545	0.120	0.910	1.000	0.903	1.110	0.292				
Autoregressive Factor	-0.523	0.459	-1.140	0.279	0.829	0.830	1.000	0.339				
Intervention ("input" dummy variable)	3.930	3.644	1.080	0.304	8.403	4.461	1.880	0.086				
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq				
	6	3.61	4	0.461	6	3.08	4	0.544				
	12	6.96	10	0.729	12	10.15	10	0.428				
	Washington, DC - Arlington						Washington, DC - Prince Georges					
Estimated Mean	0.429	1.234	0.350	0.735	-0.720	1.794	-0.400	0.696				
Moving Average Factor	1.000	1.613	0.620	0.548	-0.814	0.465	-1.750	0.108				
Autoregressive Factor	0.646	1.409	0.460	0.656	-0.556	0.612	-0.910	0.383				
Intervention ("input" dummy variable)	1.778	2.430	0.730	0.480	12.003	3.040	3.950	0.002				
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq				
	6	3.1	4	0.540	6	1.93	4	0.748				
	12	3.82	10	0.955	12	10.94	10	0.362				
	Washington, DC - Fairfax											
Estimated Mean	0.511	0.840	0.610	0.555								
Moving Average Factor	-0.353	0.510	-0.690	0.504								
Autoregressive Factor	-1.000	0.372	-2.690	0.021								
Intervention ("input" dummy variable)	5.681	1.508	3.770	0.003								
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq								
	6	3.92	4	0.417								
	12	10.07	10	0.434								

Note: There are 15 observations/residuals analyzed in each model.

**Table 24. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates:
Low-Minority Neighborhoods (1987-2002)**

	Washington, DC - Alexandria						Washington, DC - Montgomery					
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t				
Estimated Mean	-1.389	1.230	-1.130	0.283	-0.824	1.213	-0.680	0.511				
Moving Average Factor	-0.953	0.333	-2.860	0.016	-0.798	1.031	-0.770	0.455				
Autoregressive Factor	-0.825	0.460	-1.790	0.101	-0.654	1.194	-0.550	0.595				
Intervention ("input" dummy variable)	4.563	2.152	2.120	0.058	4.470	2.120	2.110	0.059				
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq				
	6	2.39	4	0.665	6	1.66	4	0.799				
	12	15.82	10	0.105	12	20.54	10	0.025				
	Washington, DC - Arlington						Washington, DC - Prince Georges					
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t				
Estimated Mean	-0.090	1.806	-0.050	0.961	-1.446	2.915	-0.500	0.630				
Moving Average Factor	-0.780	0.450	-1.730	0.111	1.000	1.128	0.890	0.394				
Autoregressive Factor	-0.418	0.709	-0.590	0.567	0.750	1.046	0.720	0.488				
Intervention ("input" dummy variable)	0.608	3.359	0.180	0.860	7.731	3.287	2.350	0.038				
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq				
	6	9.02	4	0.061	6	1.84	4	0.765				
	12	17.27	10	0.069	12	17.1	10	0.072				
	Washington, DC - Fairfax											
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t								
Estimated Mean	-0.338	0.894	-0.380	0.713								
Moving Average Factor	-0.833	0.872	-0.960	0.360								
Autoregressive Factor	-0.675	0.993	-0.680	0.511								
Intervention ("input" dummy variable)	4.252	1.552	2.740	0.019								
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq								
	6	1.31	4	0.860								
	12	5.83	10	0.829								

Note: There are 15 observations/residuals analyzed in each model.

**Table 25. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates:
Moderate-Minority Neighborhoods (1987-2002)**

	Washington, DC - Alexandria				Washington, DC - Montgomery			
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	-2.479	1.918	-1.290	0.223	-3.163	0.760	-4.160	0.002
Moving Average Factor	1.000	0.626	1.600	0.138	1.000	1.009	0.990	0.343
Autoregressive Factor	0.151	0.520	0.290	0.777	0.533	0.935	0.570	0.580
Intervention ("input" dummy variable)	11.728	1.447	8.110	<.0001	12.993	3.762	3.450	0.005
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
	6	5.36	4	0.253	6	6.84	4	0.145
	12	19.47	10	0.035	12	8.54	10	0.576
	Washington, DC - Arlington				Washington, DC - Prince Georges			
	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Conditional Least Squares Estimation								
Estimated Mean	-0.799	0.924	-0.860	0.406	-1.825	2.058	-0.890	0.394
Moving Average Factor	1.000	0.857	1.170	0.268	1.000	4.949	0.200	0.844
Autoregressive Factor	0.266	0.653	0.410	0.691	0.966	4.895	0.200	0.847
Intervention ("input" dummy variable)	6.548	3.050	2.150	0.055	15.109	6.535	2.310	0.041
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
	6	3.77	4	0.438	6	8.66	4	0.070
	12	11.96	10	0.283	12	14.8	10	0.140
	Washington, DC - Fairfax							
	Parameter	Standard Error	t Value	Approx Pr > t				
Conditional Least Squares Estimation								
Estimated Mean	-1.703	2.321	-0.730	0.478				
Moving Average Factor	1.000	1.500	0.670	0.519				
Autoregressive Factor	0.680	1.270	0.540	0.603				
Intervention ("input" dummy variable)	11.733	2.744	4.280	0.001				
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq				
	6	4.57	4	0.334				
	12	8.39	10	0.591				

Note: There are 15 observations/residuals analyzed in each model.

Table 26. Interrupted Time Series Analysis (ARIMA) of Differences in Annual Price Appreciation Rates: High-Minority Neighborhoods (1987-2002)

	Washington, DC - Alexandria				Washington, DC - Montgomery			
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Estimated Mean	0.920	1.355	0.7	0.511	0.019	2.416	0.0	0.994
Moving Average Factor	0.527	0.449	1.2	0.265	0.767	1.006	0.8	0.462
Autoregressive Factor	-0.155	0.493	-0.3	0.758	1.000	0.755	1.3	0.212
Intervention ("input" dummy variable)	-1.202	2.910	-0.4	0.687	4.656	4.022	1.2	0.272
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
	6	0.93	4	0.920	6	7.81	4	0.099
	12	5.28	10	0.872	12	11.57	10	0.315
	Washington, DC - Arlington				Washington, DC - Prince Georges			
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t	Parameter	Standard Error	t Value	Approx Pr > t
Estimated Mean	0.435	2.679	0.2	0.874	-0.438	1.704	-0.3	0.802
Moving Average Factor	-0.918	0.171	-5.4	0.000	-0.920	0.188	-4.9	0.001
Autoregressive Factor	-0.442	0.356	-1.2	0.240	-0.459	0.371	-1.2	0.242
Intervention ("input" dummy variable)	0.586	4.487	0.1	0.898	10.628	2.799	3.8	0.003
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq	To Lag	Chi-Square	DF	Pr > ChiSq
	6	8.70	4	0.069	6	4.22	4	0.377
	12	16.00	10	0.100	12	10.88	10	0.367
	Washington, DC - Fairfax							
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t				
Estimated Mean	1.492	1.067	1.4	0.190				
Moving Average Factor	-0.529	0.506	-1.0	0.318				
Autoregressive Factor	-1.000	0.384	-2.6	0.025				
Intervention ("input" dummy variable)	3.644	1.886	1.9	0.080				
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq				
	6	2.79	4	0.594				
	12	10.02	10	0.439				

Note: There are 15 observations/residuals analyzed in each model.

2.1 to Arlington, and 5.6 to Fairfax.

Third, the chi-square statistics and p values (for the first 6 and 12 lags) indicate that we cannot reject the no-autocorrelation hypothesis at a 10 percent significance level in four out of five models (except for the model for D.C. vs. Arlington). This means that the residuals generally have a white noise (that is, they are uncorrelated) and therefore the ARIMA models are fully adequate for the difference-in-differences series.

Tables 18 through 26 show that, in general, the interrupted time series models are also fully adequate for the difference-in-differences series observed in all nine housing sub-markets. (Note that five models are performed for each of the nine sub-markets in question, resulting in a total of 45 models reported in these tables.) Similar to the overall net impact as discussed earlier, the net effects or parameter estimates of the homebuyer credit intervention are positive in nearly all the housing sub-markets examined (i.e., 44 out of 45 models have a positive parameter of the input variable). It means that the policy shock from the first-time homebuyer credit program has lifted all boats in the District's housing markets, no matter what type of the house or where the house is located.

These positive net effects are NOT, however, uniform across the District's housing sub-markets once their magnitude and statistical significance are considered. The first tier constitutes four types of sub-markets. The District's moderate-income neighborhoods and townhouses stand out as the sub-markets that had the strongest impacts from the District homebuyer credit intervention at 10 percent significance level. Their intervention parameters are estimated mostly above or around 10 percentage points (per year), respectively, and are statistically significant in 5 or 4 out of all 5 models performed. Condominium units and low-income neighborhoods also had a large and

generally significant net effect of the intervention, with their parameters either mostly above 10 or averaged around 6 percentage points, respectively.

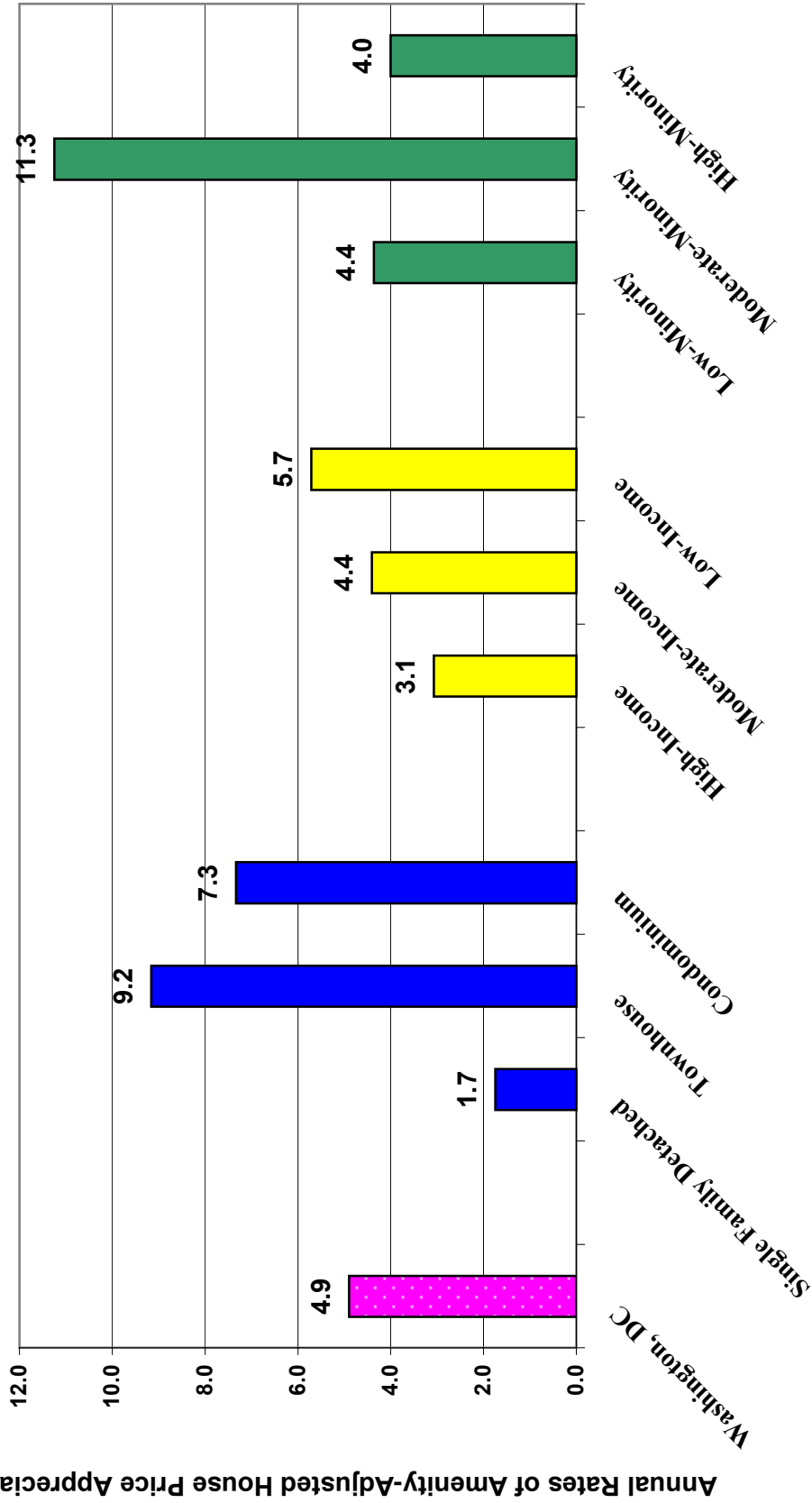
The second-tier sub-markets, in terms of the net effect of the homebuyer credit “shock,” are the District’s moderate/middle-income neighborhoods and low-minority (predominately white) neighborhoods. Although significant for most of their interrupted times series models, their net impacts (parameter estimates) are modest and averaged about 4-5 percentage points per year.

The third-tier sub-markets had largely insignificant and relatively small net effects. They include the single-family detached housing sub-market, high-income neighborhoods, and to a certain extent high-minority neighborhoods. Their net impacts averaged about 3 percentage points or so per year.

In summary, by calculating a weighted average of the intervention variable’s parameter estimates for each category³⁶, Figure 21 illustrates the net economic impact and distributional effect of the District first-time homebuyer credit program. Clearly, the income-targeted homeownership tax credit program had a significant and substantial net impact on the District’s housing market. The overall net impact was 4.9 percentage points per year in its adjusted price appreciation, relative to its comparison surrounding markets, over the 1998-2002 impact period. Recall that the annual rate of adjusted price appreciation in Washington, D.C. was 15.6 percent during the 1998-2002 period, as shown in Table 12. The overall economic impact of 4.9 percentage points per year means that, on net, nearly one-third (31.4 percent or 4.9 out of 15.6 percentage points) of the

³⁶ The weighted average is calculated using the following formula: $(W1*M1 + W2*M2 + W3*M3 \dots) / (W1 + W2 + W3 \dots)$, where W1 and M1 are the weight and estimated mean of the observation 1, respectively. The weight is calculated as the inverse of variance (or standard deviation squared).

**Figure 21. Weighted Averages of Difference in Difference:
The Net Impact and Distributional Effect of
the District of Columbia First-Time Homebuyer Credit Program**



annual house price appreciation in the District since 1998 is independently caused by the targeted first-time homebuyer credit program. In the absence of the homebuyer intervention, the District would have grown at a rate of 10.7 percentage points per year, due to the market forces and other factors, a rate consistent with the overall trend in other parts of the Washington metropolitan area over the last five years,³⁷ as well as historical differences between Washington, D.C. and its surrounding markets prior to 1998.

On the other hand, the targeted homeownership credit program as implemented in the District of Columbia had a positive, largely significant, but differing effect on various housing sub-markets and neighborhoods. The biggest winners are the moderate-minority neighborhoods, townhouse and condominium sub-markets, as well as low-income neighborhoods. Their house prices' net gains attributed solely to the intervention reached astonishing 11.3, 9.2, 7.3, and 5.7 percentage points each year, respectively, over the last five years. A modest net gain of about 4.4 percentage points per year was also seen in the moderate-income and low-minority neighborhoods. The smallest winners (not "losers") are single-family detached housing sub-market, high-income neighborhoods, and somewhat unexpectedly high-minority neighborhoods. Their net gains in the adjusted house price appreciation were 1.7, 3.1, and 4 percentage points per year, respectively, during the impact period.

In short, both the overall impact and distributional effects on house prices have met all the prior expectations as discussed in the earlier parts of the paper, with an exception of the high-minority neighborhoods. Nevertheless, it may not be too surprising

that the high-minority neighborhoods turn out not to be a big beneficiary of the intervention. After all, the District first-time homebuyer credit program directly targets incomes, rather than race or neighborhood.

Verification, Robustness Check, and Uniqueness of the D.C. Targeted Homebuyer Tax Credit

As reported above, the D.C. homebuyer credit program had a substantial impact and distributional effect on amenity-adjusted house prices: The intervention could explain as much as 4.9 percentage points per year in house price appreciation in the District, or roughly \$7,000 a year after 1997. Larger effects of the intervention on house prices are observed in low/moderate-income and moderate-income neighborhoods, as compared to high-income and predominantly white neighborhoods. The lower-priced townhouses/condos also experienced a better appreciation than single-family detached units. Nevertheless, a critical issue remains. The substantial impact on house prices appears to be unexplainable by a standard theory of public economics. Simply speaking, the theory states that the value (effect) of a public subsidy has to be bounded by the cost of the subsidy itself. In the case of the D.C. homebuyer tax credit, the impact is supposed to be no more than the tax credit of up to \$5,000 provided per unit. Addressing this issue requires three types of additional information:

(1) Because the three-stage econometric analyses as reported in the above subsections rely on the coefficient of time (year dummies) to come up with the rates of house price appreciation, a verification of such a substantial impact on house prices using

³⁷ Over the 1998-2002 period, the annual appreciation rate was 10.9 percent in Montgomery County, 6.7 percent in Prince George's, 12.1 percent in Alexandria, 13.8 percent in Arlington, 10.4 percent in Fairfax. See appendix tables 11 through 15.

a different research methodology is critical and warranted. (2) Even though I have controlled for as many as possible of both observed and unobserved factors in the house price analyses, there still might be other factors contributing to the enormous house price growth in the District around or during the impact period of 1998-2002. Thus, a robustness check and analysis is necessary to determine the conclusiveness of the reported key results. (3) If the empirical results are largely verified and proven to be at least mainly attributable to the D.C. homebuyer tax credit, how could the inconsistency between such a substantial impact and the standard economic theory be explained? This subsection provides the research outcomes from my investigations of these concerns.

Verifications: Median house price movements in the District and comparison markets

The principal methodology of verifications is to compare the annual appreciation rates of median house price, as well as median house price per square foot, observed in the District with those observed in its comparison markets. Since the median house prices are notable for their lack of controls for sample variations that may be caused by different unit size, housing age, and other housing characteristics in different samples (or different times), I used not only the median house price but also the median house price per square foot in the comparisons. Obviously, the median price per square foot is preferable in that it at least contains controls for one of the most important physical characteristics of housing units, namely, median unit size.

I used three geographic samples to carry out these comparisons for verification purposes. To be consistent with the geographic sample used in the above subsections for the three-stage estimations, the first comparison for verifications is made between the District and its five surrounding suburban counties/cities.

The second comparison for verifications is made between the District and Baltimore City, Maryland. In addition to the two price measures—appreciation rates of median house prices and median price per square foot—I also added amenity-adjusted house price appreciation rates for this comparison. The purpose of this central city comparison is to verify that the District’s extraordinary house price performance during the impact period of 1998-2002 was indeed attributable mainly, if not solely, to the D.C. homebuyer tax credit, rather than other central-city-related factors. Since there seemed to be a development of the so-called “going back to the city” movement in the United States starting in the mid-1990s, one may suspect that the relatively explosive house price growth during 1998-2002 was not unique to Washington, D.C., but to other similar central cities as well. Baltimore was selected for the central city comparison because it is the only other major central city that has similar demographic and housing market characteristics to the District and is also geographically close. Moreover, the District’s housing and labor markets are much more closely connected with Baltimore than with any other central cities in the country. In fact, the District of Columbia and Baltimore are often clustered together by the Census Bureau as “Baltimore-Washington, DC CMSA.”

The third type of comparison for verifications is carried out through comparing annual appreciation rates of both the median house price and median price per square foot for the census tracts located at both sides of the D.C.-Maryland border. In other words, median house prices (and median price per square foot) observed in the D.C. tracts neighboring Montgomery County are compared to the median prices in Montgomery’s tracts neighboring D.C. to see whether and to what extent they are different before and after the D.C. homebuyer tax credit took effect. The same comparison is also done for the

tracts located on the District side and Princes George's County side. Comparing the neighboring areas across a state, county, or city border is a popular and well-documented research method among labor economists, although it is rarely seen in the housing literature³⁸. In relation to this study, the cross-D.C./Maryland-border comparison method is used in conjunction with the difference-in-differences approach so that the substantial impact and distributional effect as reported from the three-stage estimations (using county/city level data) may be verified. There are three major rationales for my use of this method at the census tract level.

First, although the tracts are located in different jurisdictions, being adjacent to each other means that they are usually homogenous or similar in terms of neighborhood demographics, as well as economic, environmental, and housing characteristics³⁹. The homogeneity or similarity in turn exhausts, or at least substantially isolates, the potential influences of these factors on house price appreciation differentials for these neighborhoods. In fact, many neighboring tracts across the D.C.-Maryland border are in integral neighborhoods that are nearly undistinguishable even to a typical native, except perhaps for the boundary and somewhat older units on the D.C. side. For instance, the

³⁸ This method (for verifications) was suggested to this author by Dr. Robert Schwab of the University of Maryland, and later by Anthony Pennington-Cross of the Office of Federal housing Enterprise Oversight and Charles Capone of the Congressional Budget Office at the American Real Estate and Urban Economics Association Mid-Year Policy Conference on May 28, 2003. Coincidentally, at the conference was a paper presented by Andreas Lehnert of the Federal Reserve Board (co-authored with Karen Pence) that used a similar method to estimate the impact of foreclosure laws on mortgage foreclosures and house prices among different states. This paper represents an exception for a housing-related study to employ such a cross-border comparison approach.

³⁹ The traits of their housing stocks may vary to some extent, however, if some of them belong to a central city while others are located in suburbs. In particular, one would expect that houses in a central city are older than those in its suburban areas. However, the literature has well documented that, holding other factors constant, older homes generally appreciate at smaller rates than the newer ones. Therefore, this variation, if true in this case, would not have any adverse effect on the cross-border approach employed in this subsection.

areas on the D.C. side of Western Avenue between Wisconsin and Connecticut avenues is called Chevy Chase (Washington, DC) while the Maryland side is also called Chevy Chase (Maryland). In contrast, the comparisons in house prices between neighboring counties/cities as a whole are more likely to encounter the heterogeneity and thus aggregation problems, especially if these counties or cities are large and vastly diverse.

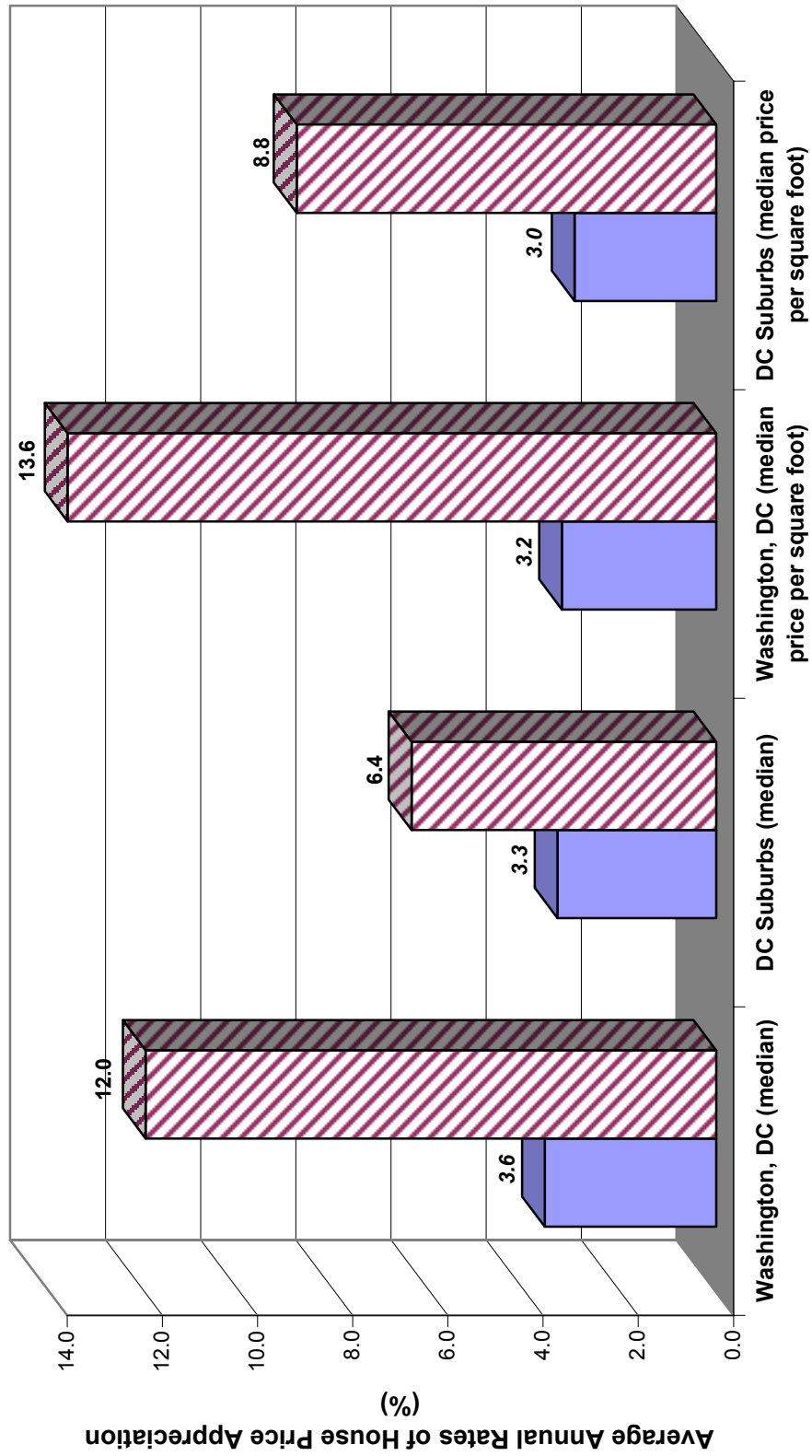
The second rationale of using the cross-border tract comparison approach is that neighboring each other eliminates all possible impact of locational factors on house price movements over time for these tracts. In general, location has three features that may influence house prices: (1) Locational accessibility to work, transportation systems, shopping and recreation centers, and other locational amenities, (2) location- and/or jurisdiction-based public services such as schools and police, and (3) jurisdiction-specific events or the exogenous shocks that affect house prices in the tracts affiliated with one jurisdiction but not those belonging to another jurisdiction. Obviously, comparing the neighboring tracts on two sides of the D.C.-Maryland border should exhaust any potential impact of locational accessibility on house prices for these tracts. And this comparison as measured by the inter-temporal difference in geographic differences would also partial out the effect of location/jurisdiction-based public services on house prices over time. Therefore, what remains would be only the impact of the exogenous shocks, if any, that are unique to just one (or some) jurisdiction and not to others. Over the period of 1998-2002, the D.C. First-Time Homebuyer Credit is deemed as a large shock; this shock could, of course, affect house prices in the census tracts only on the D.C. side and not on the Maryland side.

The third reason of comparing the tracts across the D.C./Maryland border, rather than the D.C./Virginia border, is that a river is widely recognized as an important divider of the economic and social integration for the areas neighboring it. While Maryland suburbs (Montgomery and Princes George's counties) are separated from the District only through streets (such as Western and Eastern avenues), Virginia suburbs and the District are divided by the Potomac River.

Now, I turn to the empirical research results from these verifications. Using the transaction-assessment database (Win2Data), my calculations yield a number of important outcomes. Table 27 shows that the annual appreciation rates of median house prices were not much different between the District and its five surrounding markets prior to the D.C. homebuyer credit intervention: 3.6 percent per year in the District versus 3.3 percent (by weighted average) in the District's five surrounding suburban markets. During the impact period of 1998-2002, however, median house prices rose by 12 percent per year in the District, compared to merely 6.4 percent in the surrounding markets. Thus, based on these geographic differences, the inter-temporal difference between the impact and pre-intervention periods is found to be 5.3 percentage points per year. When adjusted to the median unit size, the house prices exhibit similar patterns overall but rose slightly higher in both D.C. and surrounding markets during the impact period. These led to a downward adjustment for the program's net impact or difference in differences in median house price per square foot to about 4.5 percentage point per year. These key results are also depicted in Figure 22.

Table 28 reports the verification results from the comparisons made between Washington, D.C., and Baltimore City (the other major central city in the area). It shows

Figure 22. Average Annual Appreciation Rates of Median House Price and Median Price Per Square Foot: District of Columbia vs. DC Suburbs



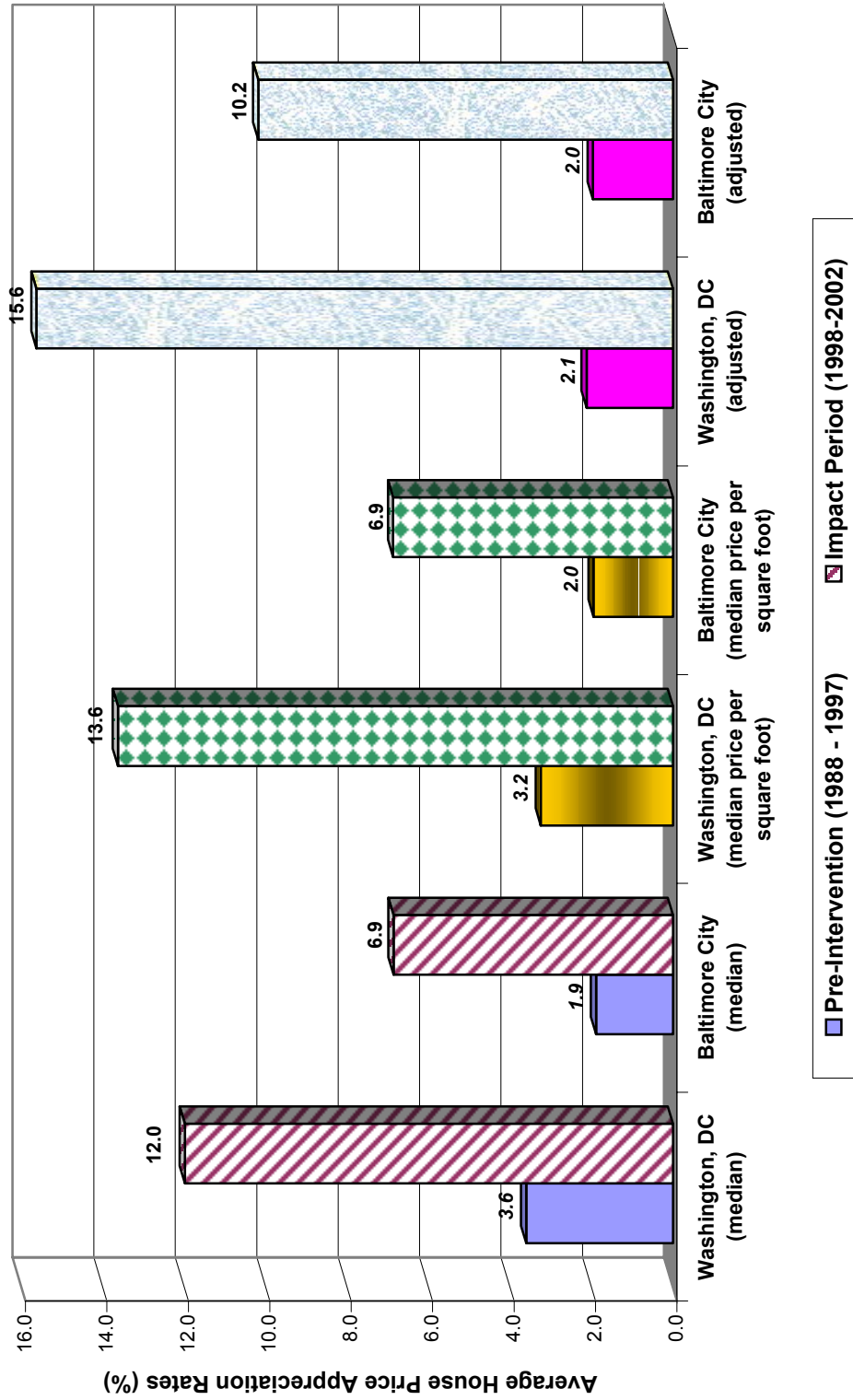
that, between 1988 and 1997, District homes appreciated at a rate of 3.6 percent in median sales price, 3.2 percent in median price per square foot, and 2.1 percent in amenity-adjusted price, all of which were considerably higher than those for Baltimore (with 1.9 percent, 2 percent, and 2 percent, respectively). In contrast, during the impact period (1998-2002), house prices in the District increased at a substantially and consistently higher rate than those in Baltimore, no matter which price measure is employed. The annual appreciation rates for the District were at 12 percent in terms of median house price, 13.6 percent in median price per square foot, and 15.6 percent in amenity-adjusted price; at the same time, they were only 6.9 percent, 6.9 percent, and 10.2 percent for Baltimore, respectively. The inter-temporal difference in these geographic differences is therefore found to be 3.4 percentage points per year as measured by median house price and 5.5 percentage points in median price per square foot. It is further estimated at 5.3 percentage points per year, using an amenity-adjusted house price approach (which is consistent with the method reported in the earlier subsections). Again, these important results are also illustrated in a chart as well (Figure 23).

Before reporting the empirical results from house price comparisons made between the census tracts adjacent to each other on the D.C./Maryland border, I first examined the 1990 Census data to determine the homogeneity or similarity of these neighborhoods. The data show that these tracts are indeed similar to each other as measured by their income and racial compositions (see appendix Table 16). On average (or by median), both census tracts neighboring the border for D.C./Prince George's County (Maryland) are occupied predominately by low-income families (below 80 percent of the area median income) and by minorities (over 80 percent). In contrast, on

Table 28. Annual Appreciation Rates of Median House Price and Amenity-Adjusted House Price: Washington, DC vs. Baltimore City, MD

Year	Median House Price (\$1,000)		Median Unit Size (1,000 square feet)		Median House Price Appreciation Rate (%)		Appreciation Rate of Median Price Per Square Foot (%)		Amenity-Adjusted House Price Appreciation Rate (%)	
	Washington, DC	Baltimore City	Washington, DC	Baltimore City	Washington, DC	Baltimore City	Washington, DC	Baltimore City	Washington, DC	Baltimore City
1987	93	48	1,288	1,223	13.5	6.9	16.0	7.4	19.0	9.1
1988	105	51	1,260	1,216	9.5	5.3	13.2	4.6	12.1	4.9
1989	115	54	1,220	1,224	4.3	6.5	2.7	6.5	1.6	7.3
1990	120	58	1,238	1,224	4.2	4.2	1.6	4.9	-1.7	-1.8
1991	125	60	1,270	1,216	2.4	0.0	2.5	0.0	-0.6	0.4
1992	128	60	1,269	1,216	2.3	1.8	-1.6	1.2	-3.0	-0.2
1993	131	61	1,320	1,224	-0.8	-4.1	-1.1	-3.5	-1.5	-3.3
1994	130	59	1,323	1,216	-0.8	-4.1	-1.1	-3.5	-1.5	-3.3
1995	125	57	1,310	1,232	-3.8	-3.4	-2.2	-4.7	-3.0	-2.7
1996	124	58	1,332	1,216	-0.6	1.8	-2.2	3.1	-2.5	3.6
1997	130	58	1,342	1,216	4.9	0.0	4.2	0.0	0.8	2.3
1998	143	60	1,320	1,216	9.8	4.2	11.6	4.2	9.5	6.6
1999	141	64	1,280	1,216	-1.5	6.7	1.5	6.7	11.6	11.4
2000	152	70	1,240	1,240	7.9	9.4	10.2	7.3	17.6	14.6
2001	182	72	1,246	1,238	19.7	3.4	20.3	3.6	16.0	4.0
2002	226	80	1,243	1,216	24.2	10.7	24.5	12.7	23.5	14.3
Mean or Arithmetic Return (%)										
1988 - 1997: 6.4 3.5 6.7 3.6 6.6 4.7										
1998 - 2002: 3.6 1.9 3.2 2.0 2.1 2.0										
Differences in Appreciation (DC - Baltimore): 12.0 6.9 13.6 6.9 15.6 10.2										
Pre-Intervention (1988 - 1997): 1.7 1.3 1.3 1.3 0.1 0.1										
Impact Period (1998-2002): 5.1 6.8 6.8 6.8 5.4 5.4										
Impact vs. Intervention: 3.4 3.4 5.5 5.5 5.3 5.3										

Figure 23. Average Annual Appreciation Rates of Median House Price, Median House Price Per Square Foot, and Amenity-Adjusted House Price: District of Columbia vs. Baltimore City



both sides of the D.C./Montgomery County border, the neighborhoods feature high incomes (over 120 percent of the area median income) and few minorities (about or below 30 percent). As for housing traits, consistent with earlier expectations, houses on the D.C. side are somewhat older than the houses on the Maryland side. The implication is clear: Under normal market conditions or without significant shocks on housing demand/supply, houses on the D.C. side of the border should exhibit a somewhat smaller pace of price appreciation than houses on the other side.

The findings from the cross-border tract comparisons are reported in tables 29 and 30, with key information depicted in figures 24a and 24b. These findings indicate that, during the pre-intervention period of 1988-1997, the median house prices of the D.C. tracts adjacent to the Prince George's border appreciated at a rate of 1.7 percent per year, or 1.5 percentage points less than the appreciation rate (3.2 percent) observed in neighboring Prince George's tracts. Since the first full year (1998) of the D.C. homebuyer credit program, the trend was reversed substantially: The D.C. tracts rose at a rate of 7.3 percent per year, or 2.5 percentage points higher than the appreciation rate (4.8 percent) observed on the other side of the border. The difference in differences (as measured by median house price appreciation) was therefore 4 percentage points per year, which should attribute to the exogenous shock from the D.C. homeownership tax credit. Adjusting to the size of housing units sold, the difference in differences of price appreciation (as measured by the median house price per square foot) was found to be 5.3 percentage points per year. This upward adjustment reflects the fact that the homes sold on the D.C. side of the border since 1998 were generally smaller in size than the homes sold on the other side.

Table 29. Median Sales Price at the Census Tracts Neighboring the District of Columbia, Prince Georges (Maryland) and Montgomery (Maryland)

YEAR	DC Tracts Neighboring Prince Georges		DC Tracts Neighboring Montgomery		Prince Georges Tracts Neighboring DC		Montgomery Tracts Neighboring DC	
	Median Price	Median Square Feet	Median Price	Median Square Feet	Median Price	Median Square Feet	Median Price	Median Square Feet
	Unit Price (\$1,000) or Size							
1987	74.5	1,154	239.5	1,841	76.0	1,134	221.3	1,841
1988	78.0	1,168	290.0	1,824	83.0	1,120	280.0	1,972
1989	76.7	1,169	328.0	1,740	86.5	1,110	327.4	1,900
1990	89.9	1,147	329.0	1,753	91.4	1,066	327.0	2,016
1991	92.0	1,122	318.0	1,808	95.2	1,086	270.5	1,748
1992	92.2	1,142	302.5	1,791	101.5	1,120	306.5	1,868
1993	93.0	1,130	311.3	1,792	109.0	1,120	317.5	1,869
1994	100.0	1,139	310.0	1,755	104.7	1,141	313.3	1,773
1995	103.0	1,136	297.6	1,762	105.5	1,150	298.0	1,742
1996	92.0	1,175	316.0	1,872	108.0	1,152	287.5	1,762
1997	86.5	1,147	310.0	1,782	103.3	1,125	315.0	1,794
1998	91.6	1,136	325.0	1,752	101.0	1,106	325.0	1,747
1999	98.4	1,116	375.0	1,711	111.4	1,149	340.0	1,650
2000	107.5	1,143	429.0	1,665	115.0	1,152	375.3	1,591
2001	110.0	1,110	480.0	1,691	116.0	1,139	458.0	1,641
2002	122.9	1,078	548.0	1,650	129.9	1,125	500.0	1,634
	Annual Appreciation Rate (%)							
1988	4.7	3.4	21.1	22.2	9.2	10.6	26.6	18.1
1989	-1.7	-1.8	13.1	18.6	4.2	5.2	16.9	21.3
1990	17.2	19.5	0.3	-0.5	5.7	10.0	-0.1	-5.9
1991	2.3	4.6	-3.3	-6.3	4.2	2.8	-17.3	-4.6
1992	0.2	-1.6	-4.9	-3.9	6.6	2.8	13.3	6.0
1993	0.9	2.0	2.9	2.8	7.4	7.4	3.6	3.5
1994	7.5	6.7	-0.4	1.7	-3.9	-5.7	-1.3	4.0
1995	3.0	3.3	-4.0	-4.4	0.8	-0.1	-4.9	-3.2
1996	-10.7	-13.6	6.2	-0.1	2.4	2.2	-3.5	-4.6
1997	-6.0	-3.7	-1.9	3.1	-4.4	-2.1	9.6	7.6
1998	6.0	7.0	4.8	6.6	-2.2	-0.5	3.2	6.0
1999	7.4	9.3	15.4	18.2	10.3	6.2	4.6	10.8
2000	9.2	6.7	14.4	17.5	3.2	3.0	10.4	14.5
2001	2.3	5.4	11.9	10.2	0.8	2.0	22.0	18.3
2002	11.7	15.0	14.2	17.0	12.0	13.4	9.2	9.6

Table 30. Difference in Differences of Median Sales Price between the District's Census Tracts and the Tracts in the Neighboring Maryland Counties

	DC Tracts Neighboring Prince Georges		DC Tracts Neighboring Montgomery		Prince Georges Tracts Neighboring DC		Montgomery Tracts Neighboring DC	
	By Median Price	By Median Price Per Square Foot	By Median Price	By Median Price Per Square Foot	By Median Price	By Median Price Per Square Foot	By Median Price	By Median Price Per Square Foot
Annual Rate of Median House Price Appreciation by Sub-Periods (%)								
Mean:								
1987-1997	1.7	1.9	2.9	3.3	3.2	3.3	4.3	4.2
1998-2002	7.3	8.7	12.1	13.9	4.8	4.8	9.9	11.8
Standard Deviation:								
1987-1997	7.5	8.4	8.4	9.6	4.6	5.2	12.6	9.5
1998-2002	3.5	3.8	4.3	5.2	6.1	5.4	7.4	4.7
Coefficient of Variation:								
1987-1997	4.3	4.5	2.9	2.9	1.4	1.6	2.9	2.2
1998-2002	0.5	0.4	0.4	0.4	1.3	1.1	0.8	0.4
	DC Tracts Neighboring Prince Georges		DC Tracts Neighboring Montgomery		DC Tracts Neighboring Montgomery		DC Tracts Neighboring Montgomery	
	vs.		vs.		vs.		vs.	
	PG Tracts Neighboring DC		PG Tracts Neighboring DC		Montgomery Tracts Neighboring DC		Montgomery Tracts Neighboring DC	
Difference in Differences	By Median Price	By Median Price Per Square Foot	By Median Price	By Median Price Per Square Foot	By Median Price	By Median Price Per Square Foot	By Median Price	By Median Price Per Square Foot
Appreciation Rate (%):								
Pre-Intervention (1987-1997)	-1.5	-1.4	-1.4	-1.4	-1.4	-1.4	-0.9	-0.9
Impact (1998-2002)	2.5	3.9	3.9	3.9	2.3	2.3	2.1	2.1
Impact vs. Preintervention	4.0	5.3	5.3	5.3	3.6	3.6	3.0	3.0
Volatility (CV Ratio):								
Pre-Intervention	3.03	2.89	2.89	2.89	0.98	0.98	1.28	1.28
Impact	0.38	0.39	0.39	0.39	0.47	0.47	0.93	0.93
Impact vs. Preintervention	0.13	0.14	0.14	0.14	0.48	0.48	0.73	0.73

Figure 24a. Annual Rates of Median House Price Appreciation in the Neighboring Census Tracts: Washington, DC vs. Neighboring Maryland Suburbs

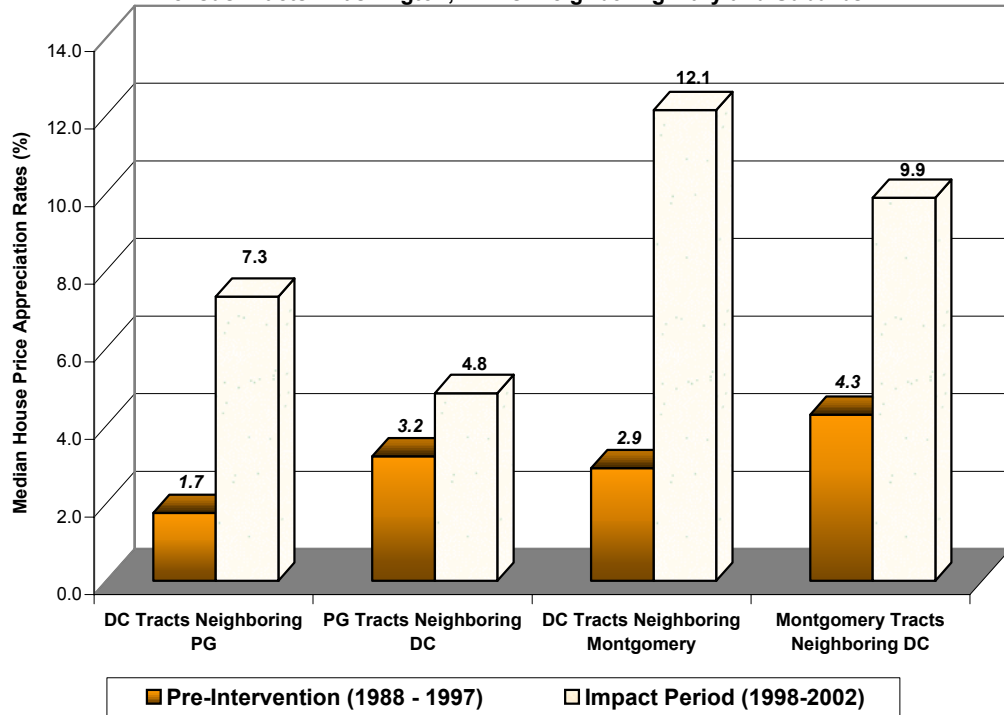
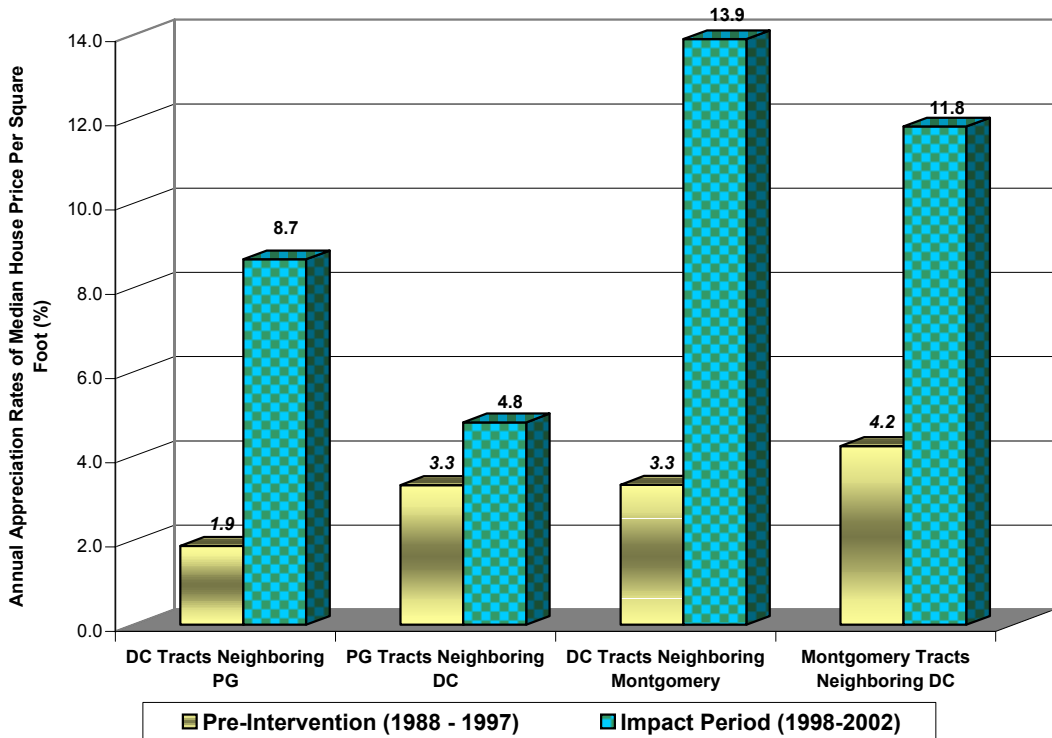


Figure 24b. Annual Appreciation Rates of Median House Price Per Square Foot in the Neighboring Census Tracts: DC vs. Neighboring Maryland Suburbs



The results also show that, although the homes neighboring the D.C./Montgomery County border experienced better appreciation than their counterparts neighboring the D.C./Prince George's border, the observed geographic differences in appreciation rates for the former were somewhat smaller than the latter. The appreciation rate of median house prices on the D.C. side of the D.C./Montgomery border was 1.4 percentage points per year less than those on the Montgomery side over the pre-intervention period (2.9 percent on the D.C. side vs. 4.3 percent on Montgomery side). It was 2.3 percentage points higher during the impact period (12.1 vs. 9.9 percent). This led to the difference in differences, in terms of median price appreciation, of 3.6 percentage points per year. When adjusted to unit size, the tax credit program's net impact on the homes sold on the D.C. side of the D.C./Montgomery border (or difference in differences as expressed by median price per square foot) was found to be 3 percentage points per year.

Are these results from the cross-border comparisons statistically significant? A 2-tailed t-test is therefore performed to identify if the mean difference in median price appreciation rates (per square foot) between the census tracts on the D.C. side and those on the Maryland side is significantly different from zero. The t-test results indicate that there is only a 2% probability (p value=0.02) that the median price appreciation rates would, on average, be the same across the D.C./P.G. border during the impact period. In contrast, this paired sample has a p value of 0.6 during the pre-intervention period. These test results suggest that the average appreciation rate of median house prices (per square foot) on the D.C. side was not significantly different from those on the PG side during the pre-intervention period but was statistically different during the impact period at both 10% and 5% significance levels. On the other hand, according to the t-test, the probability

values for the paired samples across the D.C./Montgomery border are found to be 0.55 and 0.51 for the pre-intervention and impact periods, respectively. Thus, we cannot reject the null hypothesis that the mean difference in median price appreciation rates was statistically insignificant across the D.C./Montgomery border, regardless of pre-intervention or impact period. Given the fact that the census tracts are low-income across the D.C./P.G. border and high-income across the D.C./Montgomery border, the above test results are therefore consistent with the outcomes from the 3-stage estimations in terms of statistical significance.

To recap, using the appreciation rates of median house price, median price per square foot, and amenity-adjusted price, I have compared the District of Columbia with its five surrounding suburbs and Baltimore City for the pre-intervention and impact periods. The results indicate that the difference in differences for all these price measures was concentrated in a range of 4.5 to 5.5 percentage points per year⁴⁰. Moreover, I have compared the census tracts across the D.C./Maryland border, finding that, for homes located in the low-income and high-minority census tracts along the D.C./Prince George's border, the D.C. homebuyer credit program significantly raised the median sales price per square foot by 5.3 percentage points per year for those on the D.C. side. For D.C. homes in the wealthy and predominately white neighborhoods adjacent to the D.C./Montgomery border, the tax credit's net impact on their median prices per square foot was also positive but smaller and statistically insignificant, namely, 3 percentage points per year. In summary, no matter what price measures or geographic samples were employed, these

⁴⁰ The exception was found when comparing D.C. with Baltimore in terms of the median house price differential, which is observed at a slightly lower rate or 3.4 percentage points per year.

findings point to the same conclusion: they are consistent with and nearly identical to the empirical outcomes obtained through the three-stage intervention analyses reported in previous subsections. In other words, I have indeed verified that the overall impact on amenity-adjusted house prices for Washington, D.C. was about 4.9 percentage points per year and the larger distributional effects were found in townhouse/condo sub-markets and distressed neighborhoods (particularly 5.7 percentage points per year for low-income tracts compared to 3.1 points for high-income tracts).

Robustness check: Were there still other factors in play?

Although I have controlled for many observed and unobserved factors affecting house prices, a critical question still must be investigated further: Was the substantial price increase during the impact period (1998-2002) caused exclusively by the D.C. homebuyer credit program? This subsection seeks to address this question by discussing other potential factors that might be perceived as contributing to the substantial impact on house prices.

The “Williams graduate effect.” Possible contributing factors to house price growth during the impact period include a political event that took place in the late 1990s. After a decade of government mismanagement and financial bankruptcy in the District, Anthony Williams won a mayoral election and took office in early 1999. The new mayor and his manager-type administration are perceived by many as a positive force for consumer/investor confidence and thereby the District’s real estate markets. The potential impact of this political event might be two-fold: One is an immediate impact on house prices in late 1998 and 1999, while the other is a gradual effect that is more likely to affect house prices in more recent years. Although this study concludes that the

immediate impact of Williams' election has to be ruled out empirically (as discussed later in this subsection), it is very likely that its gradual effect may have played a role in the District's housing boom in most recent years.

Indeed, on one hand, the Williams administration remained untested in its early years (1999 or so), so that any immediate impact on such long-term investment assets as housing is likely to be minimal and insignificant. On the other hand, the new mayor and his city government have gradually but visibly improved government services and financial stability over time, with the accomplishments more visible in most recent years (after 2000). While no concrete evidence can be gathered to determine what, if any, effect this political change had on the market, the fact that Williams was easily re-elected in 2002 is certainly indicative of D.C. residents' approval of and investors' confidence in his administration and thus an overall improvement of the city's image. This suggests that the gradual effect of the Williams administration on house prices cannot be completely ruled out⁴¹.

Public-private investments and DC Financial Control Board. A number of other unique factors are also likely to have somehow contributed to District house price growth since the homebuyer credit became available. They include large-scale investments undertaken by private-public partnerships and other federal government interventions, in particular, the establishment of the D.C. Financial Responsibility and Management Assistance Authority ("Financial Control Board") that was chaired by Andrew F. Brimmer and later Alice M. Rivlin. Established in the summer of 1995, the D.C. Financial Control Board

⁴¹ The "Williams (gradual) effect" was first suggested by Robert Lang of the Metropolitan Research Institute at Virginia Tech, Robert Nelson and Steve Fetter of the University of Maryland at College Park.

finally accomplished all its goals pre-set by Congress and thus suspended its operations on September 30, 2001. The work done by this board may have had a positive impact on the city's image, overall livability, and hence real estate investment activities.

The most important large-scale investment by private-public partnerships that may have affected the District housing market when the homebuyer credit was in effect is perhaps the "Howard University/LeDroit Park Homeownership Initiative." This large-scale community revitalization initiative was launched by Howard University and Fannie Mae/Fannie Mae Foundation in 1997, in partnership with the city government, a number of banks, and other private companies. With an investment of \$25 million from Fannie Mae (and concept design by the Fannie Mae Foundation), the partnership leveraged the initial investment amount to over \$100 million by December 2000. The initiative completed a series of well-designed and comprehensive residential and commercial rehabilitation, new construction, streetscape improvements, development financing, mortgage loan assistance, and other revitalization and investment activities in a distressed low-income neighborhood, LeDroit Park. Such a large-scale place-based investment made an important difference in house price performance: median house prices in the LeDroit Park neighborhood increased by 249 percent from \$68,000 in 1987 to \$239,000 in 2002. Therefore, LeDroit Park is ranked as one of the top three neighborhoods in best price appreciation in the District of Columbia (see supplemental Table 2b in this paper).

Factors deemed less significant for the uniqueness of D.C. price appreciation. These factors include a potential immediate impact of new Mayor Anthony Williams, the role of market forces, the maturity of the D.C. housing market, and the "speculators."

Although there is a strong likelihood of a “Williams gradual effect” as discussed earlier, the empirical evidence from my robustness check largely rules out the possibility that, instead of the homebuyer credit program, the new-mayor phenomenon might be a major contributor to the significantly higher rates of price appreciation in the District than in its surrounding markets since 1998.

First, if the new mayor were the real reason, one should expect a substantial immediate impact on District house price appreciation relative to comparison markets in 1999. However, the findings from this study indicate otherwise. As shown in Table 23 and figures 6a and 6b, precisely in 1999, the difference in the annual price appreciation rate between Washington, D.C., and surrounding markets reached the lowest level, though positive, among the last five years (1998-2002). In contrast, a spike occurred not in 1999 but in 1998, the first full year of the homebuyer credit intervention but the year before the new mayor took office.

Second, I ran a sensitivity analysis that includes the new mayor as another “input” variable, in addition to the homebuyer credit intervention, in the ARIMA models (or the third stage estimations) to verify the sensitivity of the impact of the homebuyer credit program after controlling for the new mayor’s potential effects, or vice versa. The results indicate that an addition of a dummy variable for the election of Anthony Williams to the ARIMA models increases the parameter estimates for the homebuyer credit intervention. Moreover, the new D.C. mayor dummy is statistically insignificant in all models that compare the District with its five surrounding markets. Therefore, I conclude that the political event is not a statistically significant factor that may explain the District’s faster growth of house price appreciation than the price growth in its comparison surrounding

markets from 1998 through 2002.

Third, one may argue that even if Anthony Williams officially took office in early 1999, the anticipation of his election might have already developed in 1998 and therefore excited the housing market in that year. A careful news search leads me to conclude that the potential impact of this anticipation could not have materialized for about three-quarters of 1998. The timetable of Williams' election is as follows: In February 1998, Williams announced that he would not run for mayor. In June he made a last-minute entry into the race soon after then-Mayor Marion Barry announced his intention not to seek re-election. On September 15, Williams won the Democratic primary. On November 3, 1998, he defeated Republican candidate Carol Schwartz in the general mayoral election. He then took office in January 1999.

It is clear that, even if an anticipation of his election developed in 1998, it would have to trace back to either November 3 or September 15 at the earliest. Between his announcement in June and his victory in the primary on September 15, his chance to win was extremely unclear to the general public and in fact was regarded by commentators as very low. His disadvantages included the fact that he had never run for political office in the city. He was also a relative newcomer to the city. Further, the three leading candidates (Kevin Chavous, Harold Brazil, and especially Jack Evans) had already set a District record for fund-raising in June when Williams was just starting his fund-raising from the ground (Woodlee 1998). More deadly, perhaps, was the fact that Williams was a completely new face to most residents. His low name recognition compared to several leading candidates was evident in a Washington Post poll conducted in late May and early June, which showed that "about 70 percent of District resident do not know much about

Anthony Williams or have no opinion about him” (Vise 1998).

In an effort to make sure whether the possible anticipation effect of Williams was true or not, I conducted another sensitivity analysis assuming that the anticipation of his election started in June/July 1998. The analysis uses a 6-month interval instead of a 12-month. I found that the semiannual rate of house price appreciation was 8.14 percent and -0.06 percent for the first half of 1998 and second half of 1998, respectively. Therefore, I conclude that, despite a possible gradual effect, a potential immediate effect and anticipation effect of Anthony Williams on the District’s house prices appear to be less significant. In other words, the overall Williams effect is very likely a long-term factor for D.C. prices but was not a major contributor to the relatively higher rate of price appreciation observed during the 1998-2002 period when the D.C. homebuyer credit program was in effect.

One may suspect that the house price increase in Washington, D.C., since 1998 is due largely to the same market forces of the housing boom as seen elsewhere, such as low unemployment rates and a strong economy in the late 1990s, as well as historically low interest rates in the early 2000s. The problem with this argument is that it fails to explain the relative rapidness or sudden explosiveness of the adjusted house price appreciation in Washington, D.C., and not elsewhere in the same metro area. If those market forces were the major reason behind the explosive growth in District house price appreciation, one should expect to see an upward but similar trend on house prices in both the District and its surrounding areas. However, this is not the case as shown by the empirical results reported in this paper. Because the post-1998 differences in house price appreciation rates between the District and its surrounding markets are consistently and substantially larger

than their pre-1998 differences, one has to conclude that there must be something in the District beyond the “usual suspects” that is responsible for these differences. Put differently, it is something unique, not the normal market forces, that has directly impacted the District’s housing demand and fundamentally changed the dynamics there more so than other markets since 1998. Therefore, the D.C. homebuyer credit has to be the main answer.

Moreover, the low mortgage rates affect the housing markets in all the parts of the region and the entire country. And such potential factors as a booming local economy, increasing income, and declining unemployment rates were even more evident in the suburban areas than in the District in the late 1990s and at present. For example, Fairfax County (along with Loudon County) has recently emerged as one of the new centers of the so-called “new economy” featuring information technology. Montgomery County is one of the indisputable biotech centers in the country. As a result, these two counties had incredibly lower unemployment rates and a faster growth of household income than Washington, D.C., throughout the 1998-2002 period. Hence, if these market forces were the real factors that may lead to a relatively higher rate of house price appreciation in one jurisdiction than another, these two suburban markets should have outpaced the District in their house price appreciation in the 1998-2002 period, an outcome certainly not supported by any empirical evidence.

One may also attribute the relatively rapid growth in the District’s house prices to the maturity of the District housing market itself, which may stem from such market traits as the land use constraints and distorted market value of the houses (especially condos) in the District prior to 1998. However, this line of thinking fails to explain the

unprecedented movements in District house prices since 1998. Since these market traits are always there and not suddenly coming to life in recent years, why do they become so powerful starting in 1998? Even if these market traits might have helped the maturity of the District housing market, they still cannot explain away the critical roles of the homebuyer credit intervention as the catalyst and continuing force of the District's housing boom. Simply put, it cannot be a coincidence that 1998 marked the turning point for Washington, D.C., just by chance, at and after which the District's house prices dramatically changed their pattern from under-performing to substantially outperforming all the surrounding markets. In addition, the land use constraints as well as the distorted condo values prior to 1998 are not unique to Washington, D.C. They can be seen almost everywhere in the metropolitan area, such as in Montgomery County and Alexandria City. Why, then, didn't they also drive the post-1998 house prices in these markets with a pace of appreciation similar to the District?

One may even suspect that the "speculators" who buy houses and then rent them out in order to take advantage of the tax credits might have played a role in the house price run-up in the District after the homebuyer credit program took effect. My assessment is that the impact of the speculators, if any, is insignificant. The reasons are simple: First, these activities are illegal and constitute tax fraud. Second, a rational investor could easily realize that the potential costs (both legal and financial) of engaging in these types of illegal transactions substantially outweigh the tax benefits of up to \$5,000 from the IRS in the form of first-time homebuyer credits and even the potential price appreciation of the property. Third, these speculators are more likely to be high-income individuals or those who are financially capable of investing assets in addition to

maintaining their own houses. However, the IRS data indicate that the vast majority of the credit claimants were low/moderate-income households rather than wealthy ones. Therefore, even if there were some wealthy investors acting as speculators, the number of such opportunists should be too small to have a significant impact.

In summary, there are a number of perceived factors that actually cannot be deemed responsible for the uniqueness of D.C. price movement between 1998 and 2002. However, there appeared to be some valid contributors other than the D.C. homebuyer credit. This information suggests that, on one hand, the D.C. First-Time Homebuyer Credit program may not be the exclusive or sole force that caused the District's substantially higher growth rate of house prices than its comparison suburban markets (e.g., 4.9 percentage points higher than the comparison suburban markets). On the other hand, the impacts of other contributors (including "Williams gradual effect," large-scale investments by private-public partnerships, and the D.C. Financial Control Board) appeared to be limited in scope, duration, magnitude, or direct connection to homeownership and housing demand. Therefore, it is perhaps safe to conclude that the relatively higher rates of price appreciation for the District as a whole and larger price effects on distressed neighborhoods and condo/townhouse sub-markets should be largely, but not exclusively, attributable to the D.C. homebuyer credit program.

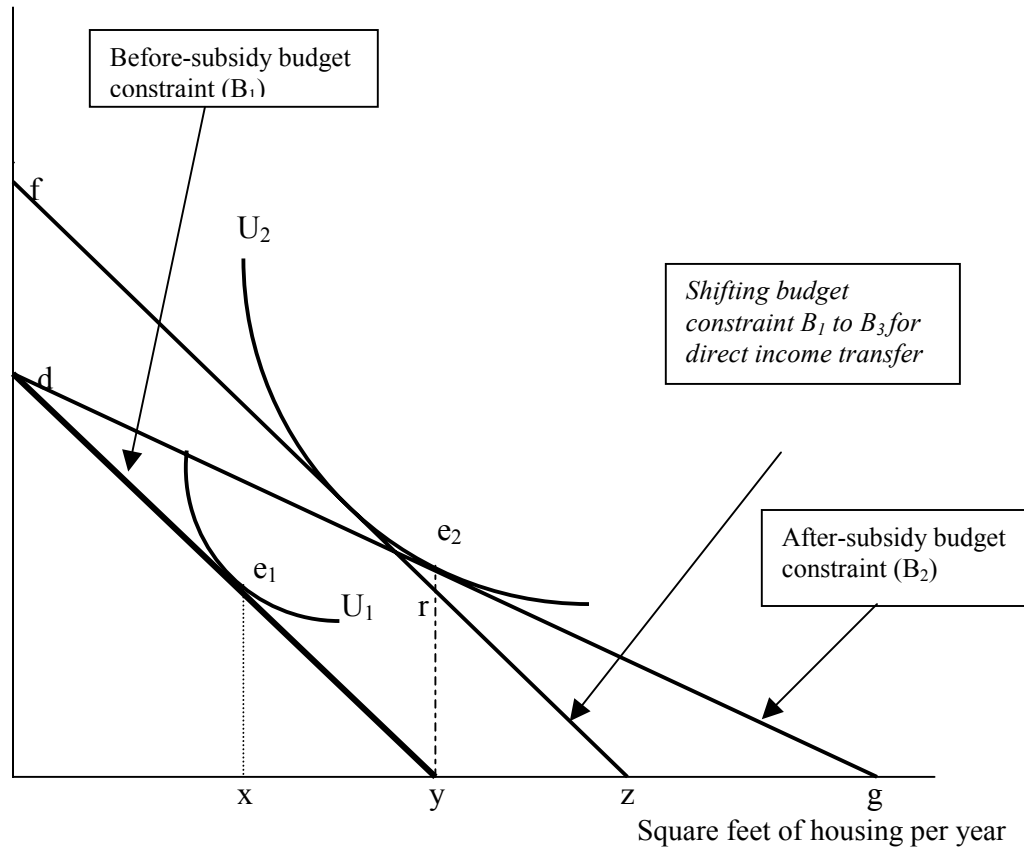
Unique features of the D.C. first-time homebuyer credit: explaining the inconsistency with the standard economic theory

A standard theory of public economics concerning subsidies states that the actual value of a government subsidy of consumption of various commodities is worth no more than the cost of the subsidy itself. This theory is widely recognized and discussed in the

literature of microeconomics, public finance, and urban economics. For instance, in the context of equivalent variation, Katz and Rosen (1994) provide an excellent illustration of this theory using housing subsidy as the example. For simplicity, consider Peter, who has a fixed income that he spends on housing and a composite of all other goods. Peter's housing consumption is measured on the horizontal axis and the consumption of all other goods on the vertical, as shown in the diagram below. His budget constraint is line B_1 (distance between the point d and y) and he maximizes his utility at the point e_1 . Suppose that the government provides a subsidy on housing at a certain percentage rate, the subsidy changes his budget constraint to line B_2 (distance between d and g) and his most preferred bundle (of consuming housing and other goods) at e_2 . Thus, the associated distance between budget constraints B_1 and B_2 is the line connecting point e_2 and y , representing the actual outlay or cost of the public subsidy. Clearly, with the housing subsidy Peter is better off at e_2 than he was at e_1 .

Nevertheless, if the subsidy takes the form of direct income transfer (rather than in-kind housing subsidy), it would shift B_1 outward in a parallel fashion to the budget constraint B_3 or the line connecting f and z , which is tangent to indifference curve U_2 such that Peter could still enjoy the same level of utilities as with the housing subsidy. In this case, however, the actual cost of the income transfer—the so-called “equivalent variation” —is only the distance between budget constraints B_1 and B_3 , or the line connecting the point r and y . Therefore, the value or effect of the housing subsidy to the recipient (measured by the dollars of equivalent variation or distance between r and y) is less than the cost of the subsidy (measured by the actual outlay of the government's housing subsidy or distance between e_2 and y).

All other goods per year



Note: Actual cost of the rental housing subsidy = distance between the point e_2 and y . Equivalent variation = distance between budget constraints B_1 and B_3 or the line connecting the point r and y . The value loss of the subsidy = distance between e_2 and r .

Indeed, a number of empirical studies have confirmed this standard theory. Their results indicate that, in the case of public housing, tenants receive a benefit of about 75-80 cents per dollar spent on public housing (Kraft and Olsen 1977, Barton and Olson 1976, Murray 1975, Smeeding 1982, and O'Sullivan 2000). Applying this theory into the case of the D.C. First-Time Homebuyer Credit program, it may be inferred that the impact of the tax credit, or the credit's value to the recipient, should not exceed the cost of the credit (\$5,000). Nevertheless, as reported, verified, and discussed earlier in this section,

the homebuyer credit program explains as much as a 4.9-percent house price increase, or roughly \$7,000, per year per unit during the impact period. An inconsistency apparently exists between the standard economic model and what was actually observed and estimated in the case of the D.C. homebuyer tax credit.

A careful analysis of the credit program's dynamics shows that the inconsistency is largely caused by a number of unique features of the D.C. homebuyer tax credit that were either built in the design or emerged from the practice. Many of these features are not captured in the standard theory of public economics. In other words, a number of assumptions, which are the underlying foundations of the standard subsidy theory, are no longer held in the case of the D.C. First-Time Homebuyer Credit program. At least two important assumptions matter a great deal for comparing the D.C. homebuyer credit with the standard theory. First, the standard subsidy theory assumes that a public subsidy is typically provided to subsidize consumption of a commodity (rental housing, food, etc.). Not surprisingly, the most cited examples in the case of housing subsidies concern the effect of public housing (for producer subsidy) or Section 8 vouchers (for tenant subsidy). Second, the standard subsidy model also explicitly assumes that there are no market "imperfections," that is, the market is operating efficiently. For instance, individuals or firms are all price-takers rather than price-makers. There are no externalities or asymmetric information. And there is a market (or sub-market) for each and every commodity (or segment of the commodity), and the entry into the market is not blocked. However, these two assumptions are not held in the case of D.C. homebuyer credit program.

Investment subsidy vs. consumption subsidy. Regardless of whether they are place-based

subsidies (such as public housing) or tenant-based subsidies (such as Section 8 vouchers), recipients of these public subsidies are subsidized only for their *renting or housing consumption*. In contrast, a homebuyer or homeowner receiving a public subsidy in the form of a homeownership tax credit or tax deduction is actually subsidized for not only housing consumption but more importantly *housing investment or wealth creation*. In other words, the critical difference between a rental housing subsidy and homeownership subsidy is that the former only subsidizes consumption with an effect explainable by the above-mentioned subsidy theory. However, subsidizing purchase of owner-occupied housing units has a dramatically different dynamic and effect: It, in fact, helps jump-start the investment of the most important vehicle of wealth creation in the United States—homeownership. Owner-occupied housing is both a commodity for consumption and a capital asset that can appreciate over time to build home equity wealth. Therefore, it is not surprising that the consumption-based standard subsidy model may not explain the substantial effect observed from the D.C. homebuyer tax credit, which involves wealth creation or investment subsidization.

There are several specific reasons why an investment in homeownership, using one's own funds or through public subsidies, may have an extraordinary return that could be larger than the cost of the subsidies or own funds themselves: (1) The return to an investment on homeownership (subsidized or otherwise) can be more than the return to the funds invested out of pocket or from subsidy. For instance, a homebuyer who puts down 5 percent or \$5,000 (from homebuyer subsidy, savings, or gifts) for a \$100,000 home typically enjoys the return that would come from appreciation of the entire \$100,000 home, rather than just a portion (5 percent) of the home. The ability of

leveraging small initial funds for a large amount of private funds (in the form of a mortgage) is one of the key distinctive features of investing and returning in housing, compared to other financial instruments such as stocks and bonds or mere housing consumption. (2) The return to investment on an owner-occupied housing unit is partly determined by the present discounted value of replacement costs for producing an identical or similar unit. In the U.S., the key components of replacement costs including labor, land, and building materials have generally seen a substantial rise over time.

(3) The owner-occupied housing demand has been fueled by income growth and population growth (especially rapid immigration) in the last few decades. The housing market is, however, widely recognized for its slow adjustment in supply in general, in the central cities in particular. New construction, rehabilitation, and even conversion of rental units to owner units are typically expensive and take a long time to bring the housing to market. Also, the existing dwellings are well known for their slow deterioration over time. As a result, housing supply is inelastic for relatively long periods of time (O'Sullivan 2000). Thus, the increasing demand met with usually lagging supply drives up house prices or the return to homeownership. (4) Inflation is another factor explaining the larger return to a relatively smaller investment on owner-occupied housing. Rising inflation rates push up interest rates, including homeowner's mortgage interest costs, and lead to large nominal capital gains on the houses (Poterba 1984). Therefore, the combination of all or some of these factors makes possible, at least theoretically, a larger return to homeownership realized through a smaller fund of public subsidy and/or own investment.

Plenty of empirical evidence supports this concept. In Section I, which discusses

homeownership as the best investment vehicle of wealth creation, I cited recent data indicating that a family that put \$10,000 down on a \$100,000 home in 1990 would clear about \$67,000 (or 6.7 times the initial funds) in equity wealth today if the home appreciated at the national rate. My personal experience is another perfect example: Using about \$4,000 from savings and \$7,000 from a subsidy provided by the Fannie Mae Foundation (through an “employer-assisted-housing” program), I purchased a one-bedroom condo priced at \$116,000 in North Bethesda, Maryland, in September 2001 for homeownership. As of July 2003, the condo has a market value of about \$190,000. Thus, in less than two years, the \$7,000 subsidy from my employer has generated a return of about \$47,000 (i.e., seven-elevenths of the \$74,000 in home equity growth).

Furthermore, I would like to highlight an important empirical work in the case of mortgage interest deductions to illustrate that tax subsidies for owner-occupied housing can have returns or effects on house prices that are larger than the cost of the subsidies, even on an annual basis. The Joint Committee on Taxation estimated that there were about 17.4 million tax returns claiming \$7 billion in home mortgage interest deductions in the United States in 1979. Thus, the cost of the homeownership subsidy, in the form of mortgage interest tax deductions, was only about \$405 per tax filer in 1979 (the earliest year one can trace back in the Committee’s database). On the other hand, in his classic essay titled “Tax Subsidies to Owner-Occupied Housing: An Asset-Market Approach” (Poterba 1984), James Poterba estimates that the tax subsidy for mortgage interest deductibility, in tandem with rising inflation rates, could explain most of the 30-percent increase in real prices of housing structures during the 1970s. My calculations indicate that the 30-percent increase in real terms is equivalent to an annual price increase of about

\$1,392 and \$1,368 (in 1979 dollars) per year for new and existing single-family homes, respectively, during the 1970s⁴². Clearly, the effect of the tax subsidy for mortgage interest tax deduction on house prices (\$1,368 to \$1,392 per unit) was more than three times the cost of the subsidy itself (\$405 per tax filer) in 1979 or any other year of the 1970s.

Therefore, from both empirical and theoretic perspectives, it wouldn't be a surprise to see that the D.C. First-Time Homebuyer Credit (up to \$5,000) was the major contributor to the 4.9-percent (roughly \$7,000) increase in house prices per year during the impact period. A main reason is that this tax subsidy helps not only housing consumption but also, more importantly, housing investment or wealth creation through homeownership. Subsidizing wealth creation or investment makes substantial differences in its return or effect and explains why the tax credit's effect seems inconsistent with the standard subsidy theory, given that the latter is built upon the assumption that a public subsidy is a subsidy of consumption of a commodity.

Homeownership market "imperfections." There is another important, unique feature of the D.C. homebuyer tax credit that may have also contributed to its extraordinary effect on house prices that the standard model of public subsidies fails to explain. The tax credit is able to correct a number of market imperfections, thus fostering an unprecedented attractiveness and accessibility to the District's homeowner housing market for two sorts of the perspective homebuyers: low/moderate-income renters and suburban residents. As

⁴² According to *U.S. Housing Market Conditions*, the median value was \$23,400 for new single-family homes and \$23,000 for the existing single-family homes in the United States in 1970. Adjusted to inflation, they were about \$46,389 and \$45,596 in 1979 dollars, respectively. A 30-percent real price increase means an arithmetic (average) return of \$1,392 and \$1,368 per year (in 1979 dollars), respectively.

a result, an unprecedented huge demand on owner-occupied housing (especially less expensive housing units) has been created in the District of Columbia, which leads to the fact that in aggregate these new or unconventional homebuyers appeared to have acted as price-makers in these untapped sub-markets. The key point here is that the standard subsidy theory assumes that there are no market “imperfections.” However, for the homeownership markets in general and urban markets in particular, some important “imperfections” or failures do exist, and the D.C. homebuyer tax credit precisely addresses these market failures. Hence, one should not expect that the standard model of public subsidy could explain the dynamics and price effect of the D.C. homebuyer tax credit program.

What are the homeownership market “imperfections” or inefficiencies addressed by the D.C. homebuyer tax credit? The most significant imperfection is that the entry into the first-time homeownership market is actually not free but blocked for many renters in this country. Renters (or any other perspective homebuyers) face three barriers or lender-imposed constraints to becoming a homeowner: insufficient wealth (savings) for down payment and closing cost; insufficient incomes for purchasing properties above certain price levels; relatively poor credit history or low credit scores for obtaining a mortgage and at a favorable rate. Although the D.C. homebuyer credit has no effect on lender-imposed credit constraint, the homeownership tax credit and its enhancements do have the efficacy of eliminating or reducing a perspective homebuyer’s wealth constraint and/or income constraints. For those with little personal wealth (such as savings and other liquid assets) to draw from, the D.C. homebuyer credit of \$5,000 may in practice be used for basic down payment and closing costs to jump-start their home purchases. For those

facing income constraints, the D.C. credit may actually help buy down the amount of the mortgages (by as much as \$5,000), thus lowering (or reaching) the level of current incomes required by the lender.

Obviously, such an elimination/reduction effect on wealth and income constraints is not an explicit built-in feature of the D.C. program because the tax credit could be claimed only after the home purchase and on the year-end federal income tax return. However, these efficacy or wealth/income constraint removal effects could have been realized through some other channels and enhancement products. For example, a homebuyer could, in practice, use the tax credit as the de facto “collateral” to borrow as much as \$5,000 from relatives and friends in the form of gifts, which are acceptable to all mortgage lenders as legitimate personal funds. The other channel of using the tax credit directly toward the home purchase is that an important enhancement product has become available since 2000. The product was designed specifically to enable first-time homebuyers to convert the D.C. tax credit into cash, allowing them to use those funds toward the down payment or closing costs upfront. Backed by the secondary mortgage industry, Congresswoman Norton, and Mayor Williams, Crestar Bank (later merged into SunTrust Bank) and Chevy Chase Bank started in 2000 offering the two-year \$5,000 tax credit loans to eligible mortgage customers. In short, the D.C. first-time homebuyer credit, combined with the private-sector and individual innovative enhancements, is able to provide a substantial help for low/moderate-income renters to overcome the traditional homeownership barriers of wealth and income.

The D.C. homebuyer tax credit also serves as a remedy for another type of market imperfection, that is, the market distortions caused by the existing tax treatments to

homeownership. As discussed earlier, the existing homeownership tax regime (such as mortgage interest and real estate tax deductions) offers substantially fewer economic benefits and weak incentives for lower-income households while it primarily benefits wealthy homeowners. These differential tax incentives can have important implications for the long-term housing market equilibrium: They could have helped distort the market dynamics such that there may have been an over-investment and thus relatively strong price appreciation in the high-end housing market (larger properties, single-family units, etc.), compared to an under-investment and hence slow value growth in the low-end market (smaller properties, condos/townhouses, etc.). Now, with the D.C. homebuyer tax credit program in place, an eligible homebuyer could claim for the full tax credit of as much as \$5,000, no matter whether the income tax return is itemized or how small the purchased property is. Thus, a low/moderate-income renter could have a much stronger incentive to participate in homeownership in the District than ever before.

The third type of homeownership market imperfection concerns the attractiveness of urban housing markets. The joint effect of urban decay, the suburbanization movement, and “spatial mismatch” (new jobs are located in suburbs while population/housing is in the cities) is that the central cities have increasingly lost their population and thus housing attractiveness to the suburbs. Typically, although a central city is still the primary location to work within a metro area, its suburbs are where most of the population chooses to live. The D.C. homebuyer tax credit program is designed in part to reverse such population exodus, providing that an eligible “first-time” homebuyer is one who did not own a main residence in the District in the past 12 months. In other words, anyone who owned or is still owning a house in the suburbs can also claim for the

tax credit by becoming a homeowner in D.C..

In summary, the D.C. homebuyer credit program seems capable of correcting three types of homeownership market “imperfections” that are usually assumed away from the standard subsidy theory: The tax credit helps remove the market entry barriers of wealth and income, provides a remedy to the market distortions caused by the existing tax treatments to homeownership, and enhances the homeownership attractiveness in a central city setting. Consequently, one may ask if there is any empirical evidence to prove that the D.C. homeownership tax credit has indeed caused an unprecedented accessibility and attractiveness to the District’s homeowner market. If so, have these unique features been reflected in the owner-occupied housing demand in the District?

Indeed, the empirical evidence shows that the D.C. homebuyer tax credit has been extremely successful in attracting renters to access homeownership for the first time, with a rate unparalleled to any known data. As reported in the section discussing the IRS data, the tax credit claimants who are first-time homebuyers were estimated at 67.1 percent of all home purchasers in the District during the 1997-2001 period. This first-time homebuyer rate should be viewed in the following context: As shown in Table 31, which reports data from the 1997-1999 national samples of the American Housing Survey, the first-time buyer households accounted for 40 percent of all homebuyers in the United States. Among the central city homebuyers, 51 percent were first-time buyers. Therefore, the 67.1 percent first-time homebuyer rate (attributable to the D.C. homeownership tax credit) was about 27 percentage points higher than the national average and was 16 percentage points higher than the central city average! This finding is consistent with the literature that shows that borrowing constraints reduce the probability of homeownership

Table 31. American Housing Survey: Homebuyers by Buyer Status and Location, 1997-1999

LOCATION	Number of Households by Homebuyer Status			Percent by Homebuyer Status		
	Repeat-Buyer Households	First-Time Buyer Households	All Households	Repeat-Buyer Households	First-Time Buyer Households	All Households
Central city	1,544,161	1,599,548	3,138,306	18.2	28.3	22.2
Suburban	4,954,891	2,916,490	7,859,902	58.4	51.6	55.6
Nonmetro	1,985,350	1,136,075	3,124,170	23.4	20.1	22.1
Total	8,484,403	5,652,113	14,136,515	100.0	100.0	100.0

Percent by Homebuying Location		
Repeat-Buyer Households	First-Time Buyer Households	All Households
49.2	51.0	100.0
63.0	37.1	100.0
63.5	36.4	100.0
60.0	40.0	100.0

Source: Recalculated from the report titled "First-Time Homebuyers: Trends from the American Housing Survey" (U.S. Department of Housing and Urban Development 2001).

for young households by 10 to 20 percentage points (Haurin, Hendershott, and Wachter 1997).

The D.C. homeownership tax credit was also extremely successful in increasingly attracting individuals and families who previously resided in the suburbs to purchase their homes in the District. As developed in the IRS data analyses section, my estimations indicate that during the 1997-2001 period, about 14 percent of D.C.'s home purchasers each year were initial claimants of the tax credit whose previous addresses were in the suburbs. The 14-percent home purchase rate by previous suburban residents (as percent of all D.C. home purchasers) is indeed very high when compared to what was observed in the District in 1993 (prior to the tax credit intervention). According to the 1993 American Housing Survey, in Washington, D.C., there were 4,900 owner-occupied housing units where householders moved during the past year, of which only 400 units had records showing that householders moved from the same MSA but not in the central city. Thus, these data yield a 8-percent home purchase rate by previous suburban residents in 1993, or 6 percentage points lower than the rate estimated from the D.C. homeownership credit program data.

Not surprisingly, fueled by these two sorts of new/unconventional homebuyers (first-time buyers and suburban residents), the demand (as measured by sales volume) on owner-occupied housing in the District has grown tremendously over the impact period. As shown in Figure 25, the volume of home sales in the District barely exceeded a half of the average sales volume observed in its five surrounding suburban markets before 1991. Between 1992 and 1996, the volume was nearly flat, around the level of only about 36 percent of the average volume in the suburbs. However, it suddenly increased

Figure 25. Volume of Home Sales: Washington, DC vs. Surrounding Suburbs



substantially to 42 percent in 1997 when the D.C. homebuyer credit program took effect in August. The volume of home sales in D.C. soared to 50 percent (of the average suburban volume) in 1998—the first full year of the program—continued the explosive growth to about 58 percent in 1999, and stabilized at this high level in the subsequent years.

One may recall that this growth pattern of home sales volume mirrors the number and amount of the homebuyer credit claims, as well as rates of initial claims, first-time homeownership, and suburban residents' participation rates during the 1997-2001 period, as reported in the section for the IRS data analyses. It clearly suggests that the explosive growth of housing demand or sales volume in the District since 1997 did not appear just by chance. Rather, it was largely attributable to the D.C. homebuyer credit program's ability to attack the homeowner market "imperfections" successfully, thus bringing in new homebuyers who were previously either unable or unwilling to enter the District's homeownership market. This is a critical difference in practice and assumption that matters greatly in understanding why the substantial impact of the D.C. homebuyer credit program is not explainable by the standard theory of public subsidies but has been observed and verified empirically in this paper.

IX. The Impact on Home Equity Wealth, Local Tax Revenues and Neighborhood Stability

As mentioned earlier, house price appreciation is used as the most important indicator in part because it can also be directly translated into the impacts on wealth creation for homebuyers/owners and tax revenues for the District government. It also captures the potential impacts of the policy intervention on neighborhood stability and housing demand-supply dynamics, as well as homeownership. The following two sections seek to quantify these impacts based on house price appreciation and on four supplemental indicators obtained from other data sources.

The Impact on Home Equity Wealth and Tax Revenues

In the beginning of this study, I hypothesized that the District homebuyer credit intervention is effective in increasing urban housing values, thereby creating wealth for individuals and generating tax revenues for the government. With the amenity-adjusted house price appreciation rates already estimated from the previous two sections, I was able to complete this hypothesis testing by converting the house price appreciation rates into the growth of home equity wealth and residential real estate tax revenues.

Table 32 summarizes how the net impact of the homebuyer credit program on house prices is converted into the impact on home equity growth in Washington, D.C. during the 1998-2002 period. It shows that by the end of 2002 the home equity wealth grew by \$35.2 thousand dollars per unit (or household) due to the effect of targeted homebuyer tax credit intervention. By multiplying the number of total owner units, the

Table 32. The Impact on Home Equity Wealth Creation in Washington, DC

[in thousands of dollars unless indicated otherwise]

Year	Structure Type				Neighborhoods by Income				Neighborhoods by Race			
	Washington, DC	Single Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
Net Impact Measured by Annual Appreciation Rate (%)												
1998	4.9	1.7	9.2	7.3	3.1	4.4	5.7	4.4	4.4	11.3	4.0	
1999	130.4	186.5	112.0	115.0	295.0	127.3	95.0	275.0	123.0	100.0		
Median House Price Prior to Intervention (in 1997)												
House Price after Capitalizing the Impact of the First-Time Homebuyer Credit Program												
1998	136.8	195.6	117.5	120.6	309.5	133.5	99.7	288.5	129.0	104.9		
1999	143.5	205.2	123.2	126.5	324.6	140.1	104.5	302.6	135.3	110.0		
2000	150.6	215.3	129.3	132.7	340.5	146.9	109.7	317.4	142.0	115.4		
2001	157.9	225.8	135.6	139.3	357.2	154.1	115.0	333.0	148.9	121.1		
2002	165.7	236.9	142.3	146.1	374.7	161.7	120.7	349.3	156.2	127.0		
Impact on Home Equity Growth per Unit (by 2002)												
	35.2	50.4	30.3	31.1	79.7	34.4	25.7	74.3	33.2	27.0		
Number of Units or Households												
	56,936	23,509	18,180	15,247	17,064	10,884	28,988	20,073	4,652	32,211		
Overall Impact on Home Equity Wealth: All Units (in millions of dollars)												
	2,007	1,185	550	474	1,360	374	744	1,492	155	870		

aggregated home equity wealth created by the intervention was found to be more than \$2 billion in Washington, D.C.⁴³. This key information is illustrated in Figure 26.

However, it also shows that the net impact on home equity growth is not uniform across structure types and neighborhoods. On the one hand, the homebuyer credit intervention was effective in creating a large amount of home equity wealth for buyers/owners of townhouses and condos, as well as for low/moderate-income and minority neighborhoods in the District. The aggregate amounts of home equity growth were estimated at \$1 billion for owners of townhouses/condos, \$1.1 billion for low/moderate-income neighborhoods, and \$1 billion for predominately minority neighborhoods. On the other hand, a disturbing finding has emerged regarding the impact on more advantaged population groups and neighborhoods, for the sake of equity. The buyers or existing owners of single-family detached houses in Washington, D.C. reaped an estimated \$1.2 billion in aggregated home equity wealth due to the policy intervention by 2002, which is more than the gains by townhouse and condo owners combined at the same period. A similarly disturbing pattern is also shown by neighborhoods. The aggregate equity wealth created by the intervention alone was nearly \$1.4 billion and \$1.5 billion for high-income and predominately white neighborhoods, respectively, both of which are substantially higher than those for the low/moderate-income neighborhoods combined or high/moderate-minority neighborhoods combined.

⁴³ This is a very conservative estimate because I use the number of total owner units from the data set obtained from Win2Data, which is lower than the number produced by the census bureau. The primary reason of using this number is that this data set also allows generating numbers of total units by structure type, which are not available in the census. If using the number of total owner units from the 2000 Census, however, the overall impact on home equity wealth creation would be nearly \$3.67 billion in Washington, D.C. by 2002. By the same token, the impact on property tax revenues in the District (as discussed later) is also a conservative estimate as well.

The primary reason behind this disturbing phenomenon is simple: The wealthy, white neighborhoods and single-family detached houses alike had substantially higher house prices to begin with when the homebuyer credit intervention took effect. For instance, in 1997 the median house price in a typical high-income or white neighborhood was nearly 2-3 times the price in a typical low/moderate-income or minority neighborhood (see Table 8). Therefore, in terms of money amount of appreciation, the compounding effects on house price and home equity growth for the wealthy and white neighborhoods (and single family detached housing sub-market) would be still substantial substantially larger than those for the low/moderate-income and minority neighborhoods and townhouse/condo sub-markets, even though the policy intervention in the District had a larger impact on rates of price appreciation for the latter.

The impact on District tax revenues is also very large. As shown in Table 33 and Figure 27, aggregate residential real estate tax revenues due to the homebuyer credit effect was estimated at \$50.2 million in Washington, D.C., for 1998 through 2002 (or roughly \$44 million for the period of August 1997 to December 2001). While owners of single-family detached houses and those in wealthy, white neighborhoods contributed the most, the District government appeared to have benefited from the homebuyer credit program by also collecting a substantial amount of taxes from those owning townhouses/condos or from homeowners in low/moderate-income and minority neighborhoods. For instance, residential property tax revenues were estimated at \$18.6 million from low-income neighborhoods and \$21.8 million from high-minority neighborhoods. These estimates are made by converting the net impact on house price

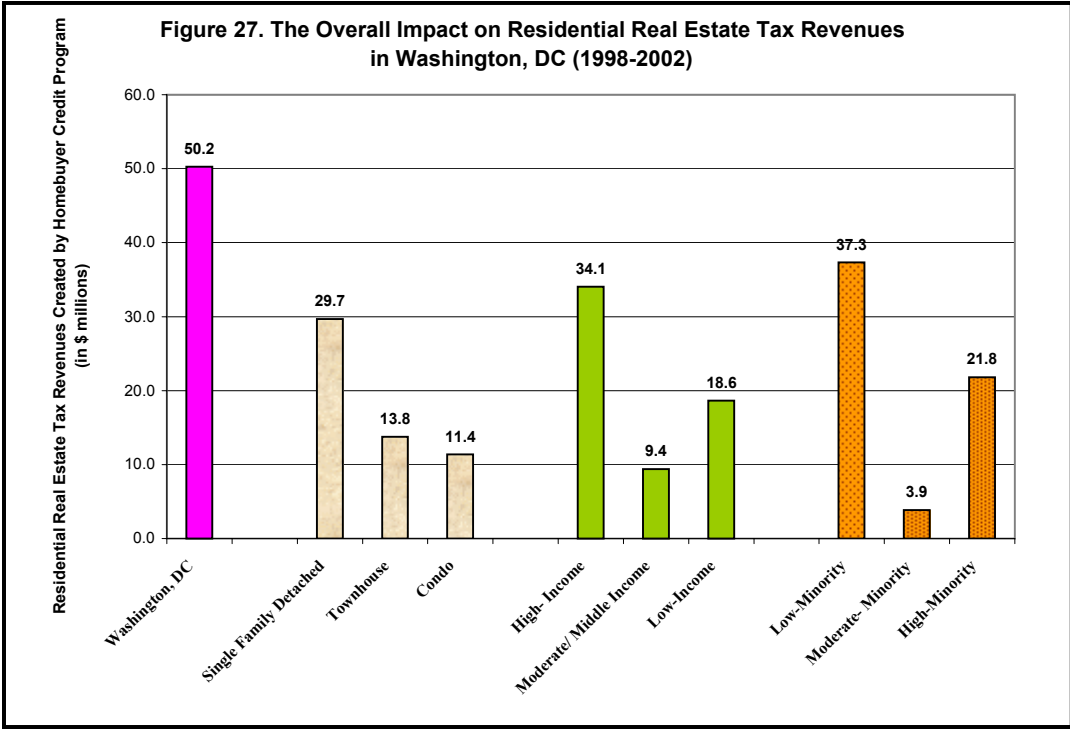
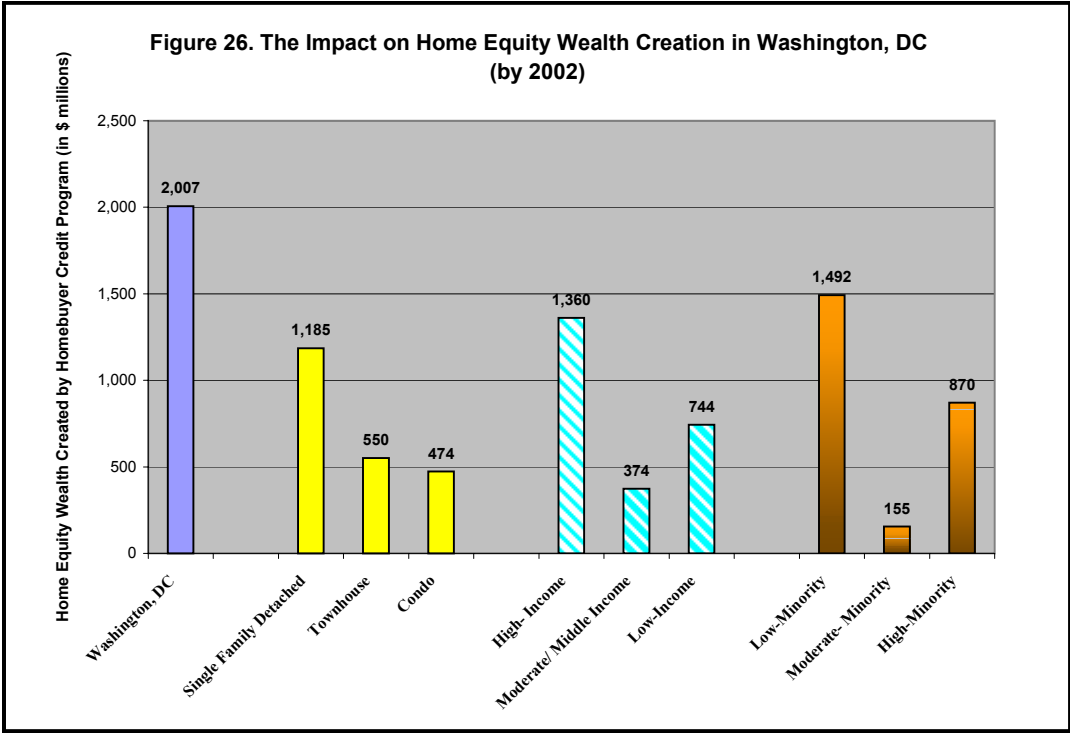
Table 33. The Impact on Residential Real Estate Tax Revenues in Washington, DC

[in thousands of dollars unless indicated otherwise]

Year	Washington, DC	Structure Type			Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority
Net Impact Measured by Annual Appreciation Rate (%)										
1998	4.9	1.7	9.2	7.3	3.1	4.4	5.7	4.4	11.3	4.0
1999	130.4	186.5	112.0	115.0	295.0	127.3	95.0	275.0	123.0	100.0
Median House Price Prior to Intervention (in 1997)										
House Price after Capitalizing the Impact of the First-Time Homebuyer Credit Program										
1998	136.8	195.6	117.5	120.6	309.5	133.5	99.7	288.5	129.0	104.9
1999	143.5	205.2	123.2	126.5	324.6	140.1	104.5	302.6	135.3	110.0
2000	150.6	215.3	129.3	132.7	340.5	146.9	109.7	317.4	142.0	115.4
2001	157.9	225.8	135.6	139.3	357.2	154.1	115.0	333.0	148.9	121.1
2002	165.7	236.9	142.3	146.1	374.7	161.7	120.7	349.3	156.2	127.0
Net Impact on House Price Appreciation										
1998	6.4	9.1	5.5	5.6	14.5	6.2	4.7	13.5	6.0	4.9
1999	13.1	18.7	11.2	11.5	29.6	12.8	9.5	27.6	12.3	10.0
2000	20.1	28.8	17.3	17.7	45.5	19.6	14.7	42.4	19.0	15.4
2001	27.5	39.3	23.6	24.3	62.2	26.8	20.0	58.0	25.9	21.1
2002	35.2	50.4	30.3	31.1	79.7	34.4	25.7	74.3	33.2	27.0
Net Impact on Assessment Value Growth*										
1998	5.7	8.2	4.9	4.9	13.0	5.6	4.2	12.1	5.4	4.4
1999	11.8	16.8	10.1	9.9	26.6	11.5	8.6	24.8	11.1	9.0
2000	18.1	25.8	15.5	15.3	40.9	17.6	13.2	38.1	17.0	13.9
2001	24.7	35.3	21.2	20.9	55.9	24.1	18.0	52.1	23.3	18.9
2002	31.7	45.3	27.2	26.8	71.6	30.9	23.1	66.7	29.8	24.3
Estimated Tax Revenues** Collected from Assessed Value Increase due to the Intervention Effect (in dollar)										
1998	55.1	78.8	47.3	46.6	124.6	53.8	40.1	116.2	52.0	42.2
1999	112.9	161.4	96.9	95.4	255.3	110.2	82.2	238.0	106.5	86.6
2000	173.5	248.1	149.0	146.7	392.5	169.3	126.4	365.9	163.6	133.0
2001	237.1	339.1	203.6	200.5	536.3	231.4	172.7	500.0	223.6	181.8
2002	303.9	434.5	260.9	256.9	687.2	296.5	221.3	640.6	286.5	233.0
Aggregate Impact on Tax Revenues per Unit (1998-2002), (in dollar)										
Number of Units or Households	882.5	1,261.8	757.8	746.0	1,995.9	861.1	642.8	1,860.6	832.2	676.6
Overall Impact on Residential Real Estate Tax Revenue: All Units (in millions of dollars)	56,936	23,509	18,180	15,247	17,064	10,884	28,988	20,073	4,652	32,211
	50.2	29.7	13.8	11.4	34.1	9.4	18.6	37.3	3.9	21.8

Note: * The overall real property assessment/sales ratio in the District was 89.8% in tax year 2001, with the ratio of 86.1% for condominium. Assuming that these ratios were largely unchanged, they are used to convert house price growth into assessed value increase throughout the 1998-2002 period.

** The latest tax rate for residential real property (or class 1) in the District is \$0.96 per \$100 of assessed value. This rate is used to estimate tax revenues growth resulting from the homebuyer credit program.



growth into assessed value and then multiplying it by the District tax rate of \$0.96 per \$100 assessed value (for class 1 property)^{44 45}.

Caution should be excised in interpreting these numbers, however. On one hand, these are only rough estimates without taking into account of various tax credits and rebates offered by the District government. On the other hand, these estimates are solely based on the impact on residential real estate taxes and thus they are merely part of the tax revenues that the District government could have collected due to the intervention effects. By attracting more people into the city for homeownership, the first-time homebuyer credit program is expected to also have impacts on the other two main sources of tax revenues, namely, sales and state income taxes⁴⁶.

The Impact on Neighborhood Stability

With amenity-adjusted house price appreciation rates estimated from the previous sections, they also allow me to extract this information to create statistical measures to assess the changes in the volatility of house price movements in the city and by neighborhoods between the pre-intervention and impact periods. The volatility of house prices, as measured by coefficient of variation in annual price appreciation, is used to test hypothesis 3 that the policy intervention in the form of first-time homebuyer credit in the

⁴⁴ The overall real property assessment/sales ratio in the District was 89.8% in tax year 2001, with the ratio of 86.1% for condominium. Assuming that on average these ratios were largely unchanged, they are used to convert house price growth into assessed value increase throughout the 1998-2002 period.

⁴⁵ Since the District of Columbia uses an annual assessment cycle, all real property is valued for property tax purposes annually. However, the city is divided into three groups that have approximately the same number of parcels and assessable base. One group of properties is physically inspected each year while the other two-thirds is valued via mass appraisal models. In sum, these net gains in tax revenues from the increased residential values due to the homebuyer credit intervention should be expected to have already realized on an annual basis in the District of Columbia.

District is effective in stabilizing the central city and especially distressed communities. The coefficient of variation (CV), also known as coefficient of dispersion, is able to gauge the fluctuation of house price movements from time to time, thereby providing conclusive evidence on the stability of a housing market at the city or neighborhood level.

In the case of Washington, D.C., if the targeted homebuyer credit program that took effect in late 1997 did have a significant impact on city and neighborhood stability, one would expect to see that the intervention, or interruption in a time series starting 1998, would have dramatically changed the dynamics of house price movements in the form of volatility. This is essentially the same concept as the previous sections that discuss the empirical research design for estimating the impact on rates of price appreciation. Therefore, the assessment of the program's impact on house price volatility or market stability is similarly carried out through a simplified three-stage procedure under the difference-in-differences framework.

First, based on the annual rates of house price appreciation for Washington, D.C. and its comparison markets as reported earlier, I calculated their coefficients of variation⁴⁷ for each of these markets by county/city and sub-markets for two time periods: the pre-intervention period of 1987-1997 and the impact period of 1998-2002. These results are documented in Table 34.

⁴⁶ These estimates are not developed in this paper because of data availability and also the fact that they are largely beyond the scope of this study.

⁴⁷ Coefficient of variation, also known as coefficient of dispersion, is calculated as follows: $CV = \text{standard deviation} / \text{mean of annual appreciation rates}$.

Table 34a. Volatility of Annual Price Appreciation Rates in Washington, DC and Suburban Maryland Markets

Year	Structure Type					Neighborhoods by Income			Neighborhoods by Race		
	All	Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income		Low-Income	Low-Minority	Moderate-Minority	High-Minority
						Middle Income	Income				
Washington, DC											
Pre-intervention: 1987 - 1997											
Mean (%)	2.1	2.9	2.0	0.8	2.6	1.8	2.0	2.3	0.8	2.3	2.3
Standard Deviation	7.4	8.3	8.0	6.4	9.2	6.9	7.0	8.3	7.0	7.4	7.4
Coefficient of Variation	3.5	2.9	3.9	7.5	3.6	3.7	3.5	3.7	8.4	3.3	3.3
Impact Period: 1998 - 2002											
Mean (%)	15.6	13.2	17.9	17.9	13.6	14.3	17.2	14.3	20.1	16.1	16.1
Standard Deviation	5.5	4.4	5.2	8.5	4.0	5.0	7.1	4.6	9.4	6.3	6.3
Coefficient of Variation	0.3	0.3	0.3	0.5	0.3	0.3	0.4	0.3	0.5	0.4	0.4
Montgomery County, MD											
1987 - 1997											
Mean (%)	3.1	3.1	3.4	2.7	3.2	2.8	3.6	3.1	3.3	3.0	3.0
Standard Deviation	7.2	7.8	6.2	6.7	8.2	6.4	7.2	7.3	7.0	7.8	7.8
Coefficient of Variation	2.3	2.5	1.8	2.5	2.5	2.3	2.0	2.4	2.1	2.6	2.6
1998 - 2002											
Mean (%)	10.9	11.6	9.9	9.6	11.3	10.4	11.2	10.8	10.9	12.6	12.6
Standard Deviation	5.7	5.6	6.8	7.7	5.2	6.5	8.0	5.8	6.1	6.6	6.6
Coefficient of Variation	0.5	0.5	0.7	0.8	0.5	0.6	0.7	0.5	0.6	0.5	0.5
Prince Georges County, MD											
1987 - 1997											
Mean (%)	3.2	3.1	3.8	3.0	1.9	3.4	2.9	3.2	3.0	3.2	3.2
Standard Deviation	4.4	4.5	4.9	8.4	6.1	4.8	3.4	6.3	4.7	3.8	3.8
Coefficient of Variation	1.4	1.4	1.3	2.8	3.2	1.4	1.2	2.0	1.6	1.2	1.2
1998 - 2002											
Mean (%)	6.7	7.1	5.0	4.3	7.9	6.7	6.2	7.5	7.1	6.1	6.1
Standard Deviation	5.3	5.6	5.6	9.0	4.3	5.2	5.9	5.9	5.4	5.0	5.0
Coefficient of Variation	0.8	0.8	1.1	2.1	0.5	0.8	0.9	0.8	0.8	0.8	0.8

Note: The volatility of annual appreciation rates is measured by coefficient of variation (CV). CV is calculated from the following formula: CV = standard deviation/mean.

Table 34b. Volatility of Annual Price Appreciation Rates in Washington, DC and Suburban Virginia Markets

Year	Structure Type					Neighborhoods by Income				Neighborhoods by Race		
	All	Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority		
Alexandria City, VA												
1987 - 1997												
Mean (%)	2.9	2.8	3.1	2.8	3.8	2.7	2.6	3.6	3.4	0.6		
Standard Deviation	7.3	6.6	9.2	9.5	9.1	7.7	11.5	8.1	8.1	10.0		
Coefficient of Variation	2.6	2.4	3.0	3.3	2.4	2.8	4.5	2.2	2.4	17.1		
1998 - 2002												
Mean (%)	12.1	12.2	11.6	8.4	10.9	12.9	12.5	11.0	11.7	16.9		
Standard Deviation	6.3	5.6	8.3	9.0	4.7	7.3	9.7	5.7	7.9	10.0		
Coefficient of Variation	0.5	0.5	0.7	1.1	0.4	0.6	0.8	0.5	0.7	0.6		
Arlington County, VA												
1987 - 1997												
Mean (%)	2.6	3.8	4.0	1.3	4.0	2.2	1.7	2.7	1.9	2.7		
Standard Deviation	6.4	7.5	10.1	6.3	8.6	5.4	7.5	6.2	6.5	8.4		
Coefficient of Variation	2.5	2.0	2.5	4.8	2.1	2.5	4.3	2.3	3.4	3.1		
1998 - 2002												
Mean (%)	13.8	13.9	11.0	14.5	13.1	13.2	15.7	13.5	13.8	15.1		
Standard Deviation	7.6	5.4	10.9	9.2	5.1	7.0	12.4	6.9	9.6	11.4		
Coefficient of Variation	0.5	0.4	1.0	0.6	0.4	0.5	0.8	0.5	0.7	0.8		
Fairfax County, VA												
1987 - 1997												
Mean (%)	2.5	2.9	2.6	1.7	2.7	2.5	1.3	2.6	2.3	1.0		
Standard Deviation	6.8	7.3	6.5	6.2	7.0	6.6	7.2	6.7	7.2	6.2		
Coefficient of Variation	2.7	2.5	2.5	3.6	2.6	2.7	5.5	2.6	3.2	6.1		
1998 - 2002												
Mean (%)	10.4	11.0	10.3	11.0	10.6	10.4	9.5	10.5	9.3	10.1		
Standard Deviation	4.6	3.7	6.3	7.9	4.0	5.5	8.5	4.6	5.8	8.7		
Coefficient of Variation	0.4	0.3	0.6	0.7	0.4	0.5	0.9	0.4	0.6	0.9		

Note: The volatility of annual appreciation rates is measured by coefficient of variation (CV). CV is calculated from the following formula: CV = standard deviation/mean.

Second, I calculated the geographic difference in house price volatility between Washington, D.C. (treatment group) and each of its surrounding suburban markets (comparison groups) for the two time periods respectively. The difference is expressed as CV ratio, or ratio of coefficient of house price variation observed in Washington, D.C. to coefficient of variation observed in its comparison markets. A ratio of 1 indicates equality of price volatility between the pair. As shown in Table 35, the geographic differences in CV ratios were mostly above 1 during the 1987-1997 period, indicating that the house price movement was more volatile in Washington, D.C. than in its suburbs prior to the homebuyer credit intervention. In contrast, during the 1998-2002 period these differences were substantially below 1 in nearly all comparison categories, an unmistakable sign of consistently smaller house price volatility in the District at this impact period.

Third, on the basis of the geographic differences, I further calculated the inter-temporal difference or difference in differences. The difference in differences is also expressed by CV ratio, or ratio of the geographic difference observed during the impact period to the geographic differences observed during the pre-intervention period. As also illustrated in Figure 28, the difference in differences was 0.43 for Washington, D.C., meaning that the homebuyer credit intervention was so successful and effective that, on average, the house price movements observed during the impact period was 43 percent as volatile as those observed during the pre-intervention period.

The impact on the District's neighborhood stability, or house price volatility at the neighborhood level, is also substantial and almost across the board. Except for the high-minority neighborhoods, all other types of neighborhoods had a value of difference in differences at or below 0.5, indicating a substantially smaller volatility and more stability

Table 35. Difference in Difference in Price Appreciation Volatility in Washington, DC and Suburban Markets

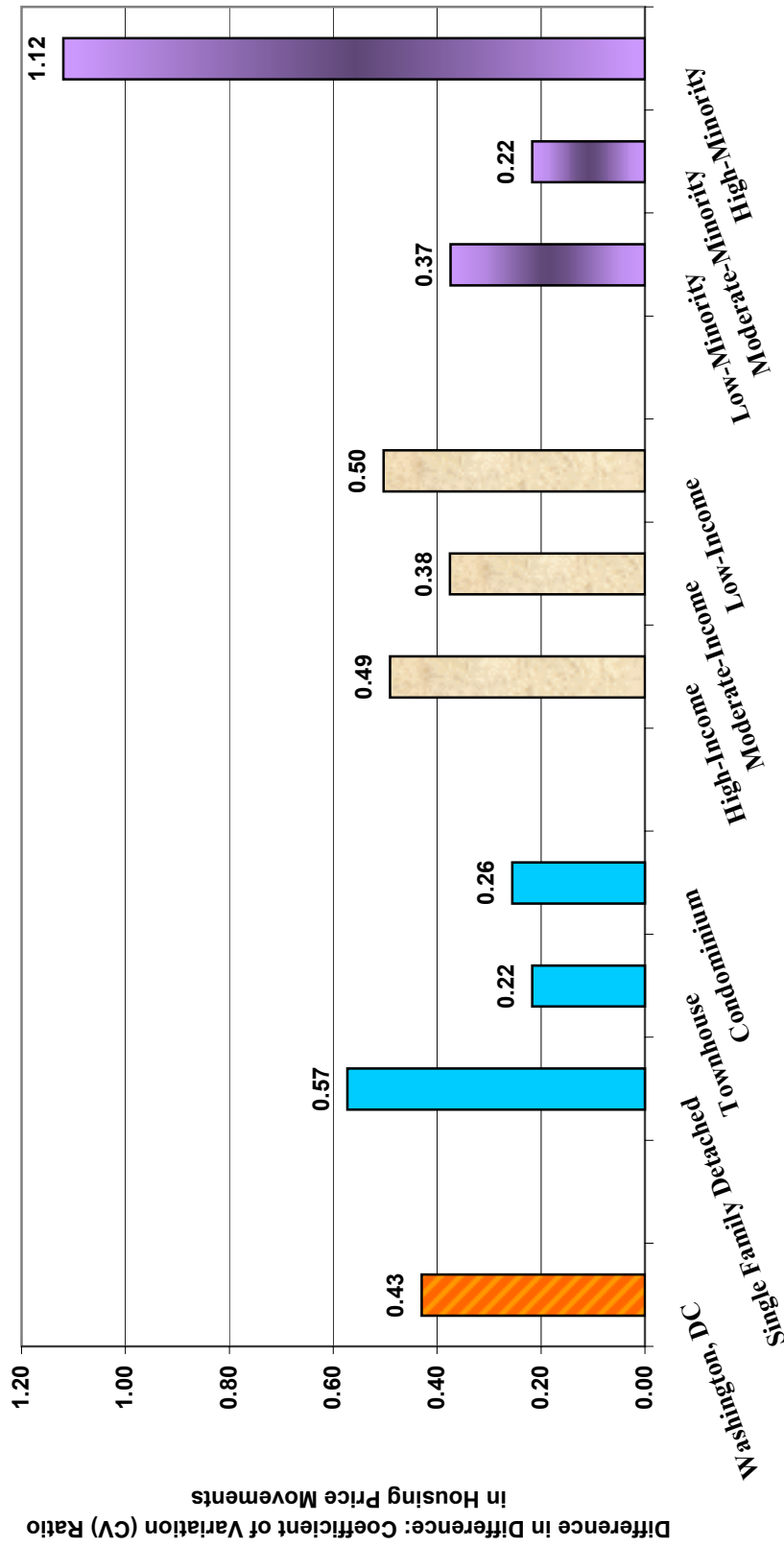
	Structure Type					Neighborhood Income			Neighborhood Racial Composition		
	All	Single Detached	Family Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
Geographic Difference* by CV Ratio: Pre-intervention Period (1987 - 1997)											
DC vs. Montgomery**	1.52	1.15	2.16	3.01	1.40	1.62	1.80	1.57	3.96	1.25	
DC vs. Prince Georges	2.52	2.02	3.03	2.64	1.10	2.62	2.97	1.87	5.21	2.79	
DC vs. Alexandria	1.37	1.21	1.32	2.25	1.48	1.31	0.79	1.65	3.55	0.19	
DC vs. Arlington	1.41	1.47	1.54	1.56	1.67	1.51	0.82	1.58	2.46	1.05	
DC vs. Fairfax	1.32	1.14	1.56	2.10	1.39	1.41	0.64	1.43	2.62	0.54	
Geographic Difference by CV Ratio: Impact Period (1998 - 2002)											
DC vs. Montgomery	0.67	0.70	0.42	0.59	0.65	0.55	0.58	0.59	0.83	0.75	
DC vs. Prince Georges	0.44	0.43	0.26	0.23	0.55	0.44	0.44	0.41	0.61	0.47	
DC vs. Alexandria	0.67	0.72	0.40	0.44	0.69	0.62	0.54	0.61	0.69	0.66	
DC vs. Arlington	0.64	0.86	0.29	0.75	0.77	0.66	0.53	0.62	0.67	0.52	
DC vs. Fairfax	0.79	1.00	0.47	0.66	0.79	0.65	0.46	0.73	0.76	0.46	
Inter-temporal Difference*** between Impact and Pre-intervention Periods											
DC vs. Montgomery	0.44	0.60	0.20	0.20	0.46	0.34	0.32	0.38	0.21	0.60	
DC vs. Prince Georges	0.17	0.21	0.09	0.09	0.50	0.17	0.15	0.22	0.12	0.17	
DC vs. Alexandria	0.49	0.59	0.31	0.20	0.47	0.47	0.67	0.37	0.20	3.49	
DC vs. Arlington	0.45	0.58	0.19	0.48	0.46	0.43	0.64	0.39	0.27	0.49	
DC vs. Fairfax	0.60	0.87	0.30	0.31	0.57	0.46	0.72	0.51	0.29	0.85	
DC vs. Surrounding Markets (mean)	0.43	0.57	0.22	0.26	0.49	0.38	0.50	0.37	0.22	1.12	

Note: * Geographic difference is measured by the ratio of coefficient of variation (CV) in DC to CV in the surrounding market.

** A ratio of greater than 1 indicates that the annual price appreciation in the District is more volatile than that in its surrounding market. A ratio of less than 1 indicates smaller volatility in the District. A ratio of 1 indicates the equality of volatility.

*** Inter-temporal difference is measured by the ratio of CV observed during the impact period to CV observed during the pre-intervention period. For instance, the ratio of DC to surrounding markets (mean) is 0.43, meaning that, even after comparing to all surrounding markets, the District's annual price appreciation volatility as observed in the impact period was merely 43% as much as that observed in the pre-intervention period.

**Figure 28. House Price Volatility:
The Net Impact on Neighborhood Stability in Washington, DC**



Note: The difference in difference is expressed by the ratio of house price CV observed during the impact period to the house price CV observed during the pre-intervention period after separating out the geographic differences between DC and suburbs.

observed during the impact period. In particular, the moderate-minority and moderate-income neighborhoods stood out as bigger winners than the white and high-income neighborhoods. House prices in the moderate-minority neighborhoods during the impact period were only 22 percent as volatile as those prior to the intervention. And the moderate-income neighborhoods exhibited a post-intervention volatility that accounted for only about 38 percent of what was observed before the intervention. With an average difference in differences of 1.12, the District's predominately minority neighborhoods apparently did not receive many benefits of neighborhood stability from the homebuyer credit program. Although it is caused largely by comparing to an exceptional stability performance in the high-minority neighborhoods of Alexandria City, still, the homebuyer credit program's impact on the stability of the District's high-minority neighborhoods was less evident and significant than others.

Additionally, all housing sub-markets by structure type exhibited smaller volatility and more stability during the intervention period. The impact on the stability of townhouse and condo sub-markets is, however, clearly larger than what was observed in the single-family detached housing sub-market in Washington.

X. Supplemental Indicators: the Impact on Homeownership, Housing Supply/ Vacancy, and Affordability

The purpose of this section is to examine several important indicators developed from other data sources to supplement the two key benchmarks of the impact (house price appreciation rate and volatility) discussed above. Using administrative data from the Bureau of Census, it is designed to test hypothesis 4 that the targeted homebuyer tax incentive program is effective in helping to solve core urban problems including low homeownership rates, disinvestment, and high vacancy. Since the two house-price-related key benchmarks reveal that the tax credit intervention was indeed effective and successful in lifting the stagnated housing prices and stabilizing District neighborhoods, the same force should also help increase homeownership, increase residential investment and owner housing supply, and reduce vacant units. Therefore, these supplemental indicators also serve as a validation of the two house-price-related benchmarks. However, except for the building permits, all other supplemental indicators capture information on only two points of time, 1990 and 2000. In this regard, they should be treated only as suggestive and partial, rather than conclusive, evidence of the impact of the District homebuyer tax credit program.

Additionally, this section also includes an examination of potential detrimental impact on housing affordability in the District. With a rapid growth in house prices and a presumably increase in the owner housing supply, it is possible that they could have taken place at the expenses of housing affordability for both renters and future homebuyers.

The Impact on Homeownership

Table 36 and also Figure 29 show that the District's homeownership rate indeed increased substantially, from 38.9 percent in 1990 to 40.8 percent in 2000. The 1.9 percentage point increase is particularly remarkable for Washington, D.C. when compared to its surrounding suburbs where the average growth rate was at 1.1 percentage points. Moreover, although homeownership growth in the District's minority neighborhoods did not perform as well as those in its suburb, the District's low- and moderate-income neighborhoods substantially outpaced its suburban counterparts.

In the 1990s, the District's low-income neighborhoods increased their homeownership rates by 2.9 percentage points, or 2.7 percentage points higher than the increase in the suburbs. The moderate-income neighborhoods in Washington were even more remarkable in that their homeownership rates changed from 52.3 percent in 1990 to 58.6 percent in 2000, an astonishing growth of 6.3 percentage points, or 8.4 percentage points higher than the change observed in the suburban moderate-income neighborhoods.

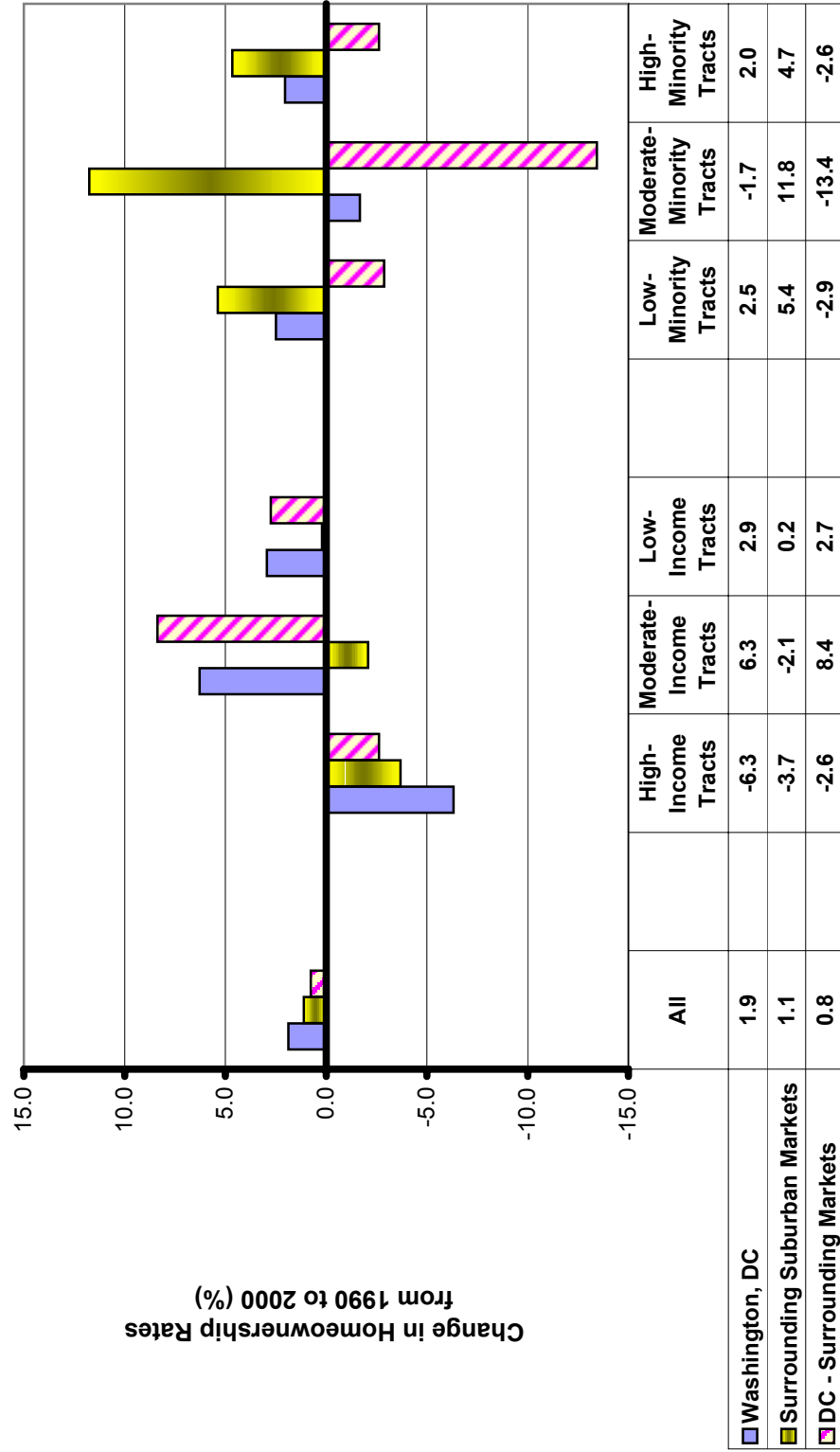
The Impact on Housing Supply and Vacancy

Although housing demand and supply may not move in tandem, they reach new market equilibrium by adjusting to each other sooner or later. The District first-time homebuyer credit program is a demand-driven intervention, but its success should also be capitalized somewhat in an increased owner housing supply through new construction, rehabilitation, and conversions of rental properties into owner units (including vacant units). The supplemental indicators reported below suggest that this is exactly what has happened in the District.

Table 36. Homeownership Rates (%) in Washington, DC and Surrounding Suburban Markets

	All			Non-Hispanic Whites			Minority		
	1990	2000	1990-2000	1990	2000	1990-2000	1990	2000	1990-2000
Washington, DC	38.9	40.8	1.9	46.1	48.5	2.4	34.9	36.8	1.8
Surrounding Suburban Markets	63.0	64.1	1.1	69.2	72.7	3.5	46.3	52.0	5.7
Alexandria City, VA	40.5	40.0	-0.5	46.7	50.9	4.2	20.8	21.1	0.3
Arlington County, VA	44.6	43.3	-1.3	49.1	51.6	2.4	23.3	24.2	0.9
Fairfax County, VA	70.8	70.9	0.2	74.0	77.1	3.1	51.2	55.2	4.0
Montgomery County, MD	67.9	68.7	0.8	73.3	77.0	3.7	46.1	52.7	6.5
Prince Georges County, MD	58.9	61.8	3.0	69.7	74.3	4.6	49.5	57.0	7.5
<i>DC - Surrounding Markets</i>	<i>-24.1</i>	<i>-23.3</i>	<i>0.8</i>	<i>-23.1</i>	<i>-24.2</i>	<i>-1.1</i>	<i>-11.3</i>	<i>-15.2</i>	<i>-3.9</i>
	High-Income Tracts			Moderate-Income Tracts			Low-Income Tracts		
	1990	2000	1990-2000	1990	2000	1990-2000	1990	2000	1990-2000
Washington, DC	56.1	49.8	-6.3	52.3	58.6	6.3	29.9	32.8	2.9
Surrounding Suburban Markets	83.3	79.6	-3.7	64.3	62.2	-2.1	33.3	33.5	0.2
Alexandria City, VA	65.4	63.3	-2.1	43.4	37.1	-6.3	18.6	25.4	6.8
Arlington County, VA	71.8	55.0	-16.7	42.6	35.8	-6.8	26.1	26.4	0.3
Fairfax County, VA	84.1	80.5	-3.6	64.3	58.6	-5.6	38.5	33.1	-5.4
Montgomery County, MD	84.9	84.4	-0.5	66.5	62.9	-3.5	31.5	28.5	-3.0
Prince Georges County, MD	88.7	87.9	-0.8	74.1	72.8	-1.4	36.1	38.6	2.5
<i>DC - Surrounding Markets</i>	<i>-27.3</i>	<i>-29.9</i>	<i>-2.6</i>	<i>-12.0</i>	<i>-3.6</i>	<i>8.4</i>	<i>-3.4</i>	<i>-0.7</i>	<i>2.7</i>
	Low-Minority Tracts			Moderate-Minority Tracts			High-Minority Tracts		
	1990	2000	1990-2000	1990	2000	1990-2000	1990	2000	1990-2000
Washington, DC	45.6	48.1	2.5	34.9	33.3	-1.7	36.8	38.9	2.0
Surrounding Suburban Markets	73.7	79.1	5.4	51.2	63.0	11.8	48.8	53.4	4.7
Alexandria City, VA	58.7	63.6	4.8	33.3	33.5	0.1	26.4	30.4	4.0
Arlington County, VA	54.6	57.1	2.5	34.0	32.3	-1.7	27.5	30.5	3.0
Fairfax County, VA	75.5	84.2	8.6	51.7	65.7	14.0	43.4	50.8	7.3
Montgomery County, MD	78.9	81.3	2.4	56.4	71.0	14.6	31.0	51.6	20.6
Prince Georges County, MD	69.7	85.1	15.4	60.5	68.4	7.9	54.6	59.7	5.1
<i>DC - Surrounding Markets</i>	<i>-28.2</i>	<i>-31.1</i>	<i>-2.9</i>	<i>-16.3</i>	<i>-29.7</i>	<i>-13.4</i>	<i>-11.9</i>	<i>-14.5</i>	<i>-2.6</i>

Figure 29. Change in Homeownership Rates in Washington, DC and Surrounding Suburban Markets from 1990 to 2000



First, I collected data on the housing units authorized by building permits from the Residential Construction Branch of the Census Bureau. This data set provides information on residential building permits on an annual basis for Washington, D.C. and its five surrounding suburban jurisdictions for 1983 through 2002. This information should provide conclusive empirical evidence indicating the trend in private investment on new housing construction before and after the homebuyer credit intervention in the District, as compared to its comparison markets. As illustrated in Figure 30 and documented in tables 37a and 37b, housing units authorized by permits in the District reached 881 per year during the 1998-2002 impact period, which more than doubled the 376 permits per year issued prior to the intervention. The year 1998 saw a huge spike in the building permits issued in this first full year of the program (15 permits in 1997 vs. 429 permits in 1998). In contrast, the average building permits issued in the surrounding suburbs during 1998-2002 were about 700 less than those issued each year during the 1983-1997 period. A largely similar pattern can also be seen for single-family (detached and attached) and for multifamily units.

Then, I conducted an interrupted time series, in which the ratio of building permits in the District to permits in the suburbs is used as the dependent variable while the homebuyer credit intervention is included as the input dummy variable (see Table 37c and also Figure 37). The results indicate that the difference in the permit ratio between the impact and pre-intervention periods was positive, significant, and large for all units and for single-family units. The difference for multifamily units was insignificant but very large. Specifically, for every 100 housing units authorized in the suburbs, there were 16.3 more units authorized in the District per year during the impact period than the units

Table 37a. Housing Units Authorized by Building Permits in Washington, DC and Surrounding Suburban Markets (1983-2002)

	Suburban Surrounding Markets							Difference between D.C. and Surrounding Markets (by Ratio)
	Washington, DC	AVERAGE	Alexandria	Arlington	Fairfax	Montgomery	Prince Georges	
Total Units								
1983	164	5,404	333	636	11,786	10,879	3,386	3.0%
1984	393	5,156	536	292	13,108	8,639	3,205	7.6
1985	590	5,217	333	878	11,150	9,946	3,780	11.3
1986	640	5,172	178	1,341	11,170	7,509	5,661	12.4
1987	1,198	5,680	1,495	910	13,247	7,119	5,629	21.1
1988	852	4,935	499	2,218	11,138	5,768	5,051	17.3
1989	410	4,787	2,013	2,506	7,904	6,710	4,801	8.6
1990	368	3,021	54	1,024	4,199	5,077	4,752	12.2
1991	333	2,202	104	585	3,806	3,276	3,237	15.1
1992	132	2,827	84	496	5,434	3,485	4,638	4.7
1993	305	3,186	263	251	6,937	3,141	5,339	9.6
1994	210	3,251	285	344	7,795	3,590	4,242	6.5
1995	35	3,072	251	618	7,226	3,682	3,584	1.1
1996	0	3,205	603	1,299	7,898	3,062	3,162	0.0
1997	15	3,019	1,300	57	6,698	3,682	3,360	0.5
1998	429	3,719	1,300	459	7,144	5,315	4,376	11.5
1999	683	3,284	1,090	970	7,494	4,253	2,615	20.8
2000	806	3,227	1,100	811	5,816	4,950	3,456	25.0
2001	896	3,334	1,329	920	6,121	5,249	3,049	26.9
2002	1,591	2,963	1,244	17	5,979	5,013	2,563	53.7
Sub-Periods								
1983-1997 (Mean)	376	4,009	555	897	8,633	5,704	4,255	8.7
1998-2002 (Mean)	881	3,305	1,213	635	6,511	4,956	3,212	27.6

Table 37b. Housing Units Authorized by Building Permits by Structure Type in Washington, DC and Surrounding Suburban Markets (1983-2002)

	Washington, DC	Suburban Surrounding Markets						Difference between D.C. and Surrounding Markets (by Ratio)
		AVERAGE	Alexandria	Arlington	Fairfax	Montgomery	Prince Georges	
Single-Family Units								
1983	54	4,409	85	622	9989	8321	3030	1.2%
1984	88	4,260	195	235	10123	7563	3184	2.1
1985	152	4,487	123	252	9533	9007	3520	3.4
1986	142	4,183	164	267	9137	6507	4838	3.4
1987	286	3,967	97	243	8557	6622	4318	7.2
1988	253	3,535	116	273	7314	4922	5051	7.2
1989	91	2,643	311	174	4455	3848	4427	3.4
1990	180	1,935	34	128	2746	2494	4273	9.3
1991	83	1,721	104	108	3430	2081	2882	4.8
1992	92	2,424	84	110	4791	2889	4248	3.8
1993	99	2,761	157	241	6047	2707	4655	3.6
1994	96	2,564	189	168	5688	2976	3800	3.7
1995	35	2,259	215	328	4446	2833	3474	1.5
1996	0	2,087	160	152	4436	2616	3072	0.0
1997	11	2,084	667	57	4586	2333	2775	0.5
1998	255	2,481	680	117	4436	3548	3622	10.3
1999	319	2,087	646	143	4220	3467	1959	15.3
2000	187	2,075	386	59	3818	2931	3179	9.0
2001	131	2,062	401	171	3498	3,191	3049	6.4
2002	383	1,755	380	17	2982	2,909	2485	21.8
Sub-Periods								
1983-1997 (Mean)	111	3,021	180	224	6,352	4,515	3,836	3.7
1998-2002 (Mean)	255	2,092	391	101	3,791	3,209	2,859	12.6
Multi-Family Units								
1983	110	995	248	14	1797	2558	356	11.1%
1984	305	896	341	57	2985	1076	21	34.0
1985	438	730	210	626	1617	939	260	60.0
1986	498	989	14	1074	2033	1002	823	50.3
1987	912	1,713	1,398	667	4690	497	1311	53.3
1988	599	1,400	383	1945	3824	846	0	42.8
1989	319	2,144	1,702	2332	3449	2862	374	14.9
1990	188	1,086	20	896	1453	2583	479	17.3
1991	250	481	0	477	376	1195	355	52.0
1992	40	403	0	386	643	596	390	9.9
1993	206	425	106	10	890	434	684	48.5
1994	114	687	96	176	2107	614	442	16.6
1995	0	813	36	290	2780	849	110	0.0
1996	0	1,118	443	1147	3462	446	90	0.0
1997	4	936	633	0	2112	1349	585	0.4
1998	174	1,238	620	342	2708	1767	754	14.1
1999	364	1,197	444	827	3274	786	656	30.4
2000	619	1,152	714	752	1998	2019	277	53.7
2001	765	1,272	928	749	2623	2058	0	60.2
2002	1208	1,209	864	0	2997	2104	78	100.0
Sub-Periods								
1983-1997 (Mean)	266	988	375	673	2,281	1,190	419	27.4
1998-2002 (Mean)	626	1,214	896	534	2,720	1,747	353	51.7

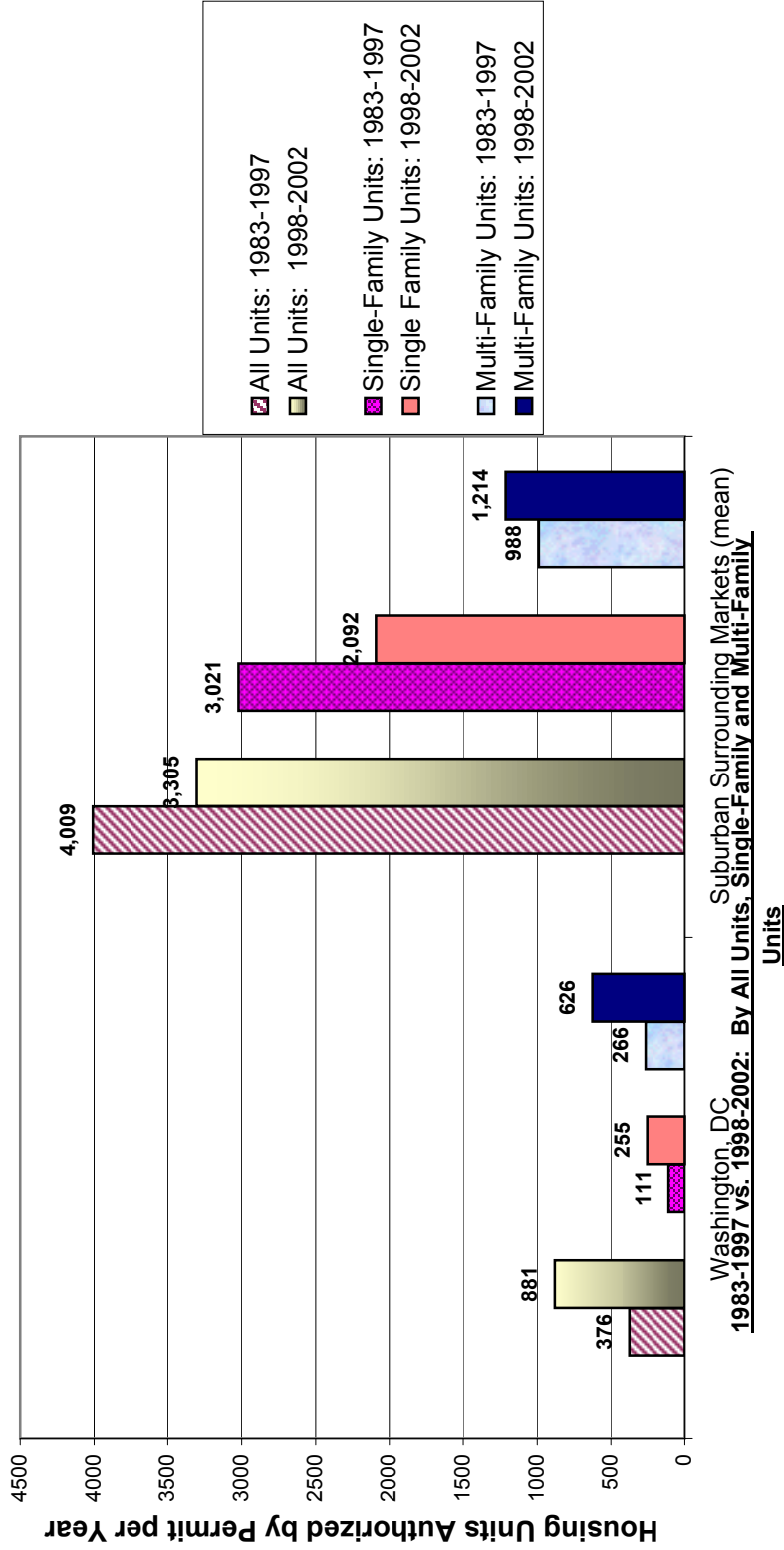
**Table 37c. Interrupted Time Series Analysis (ARIMA) of
Annual Residential Building Permit Ratio:**

Washington, DC vs. Surrounding Suburban Markets (1983-2002)

Total Housing Units Authorized by Permits				
Conditional Least Squares Estimation	Parameter	Standard Error	t Value	Approx Pr > t
Estimated Mean	9.788	2.838	3.5	0.003
Moving Average Factor	-1.000	0.185	-5.4	<.0001
Autoregressive Factor	-0.334	0.410	-0.8	0.428
Intervention ("input" dummy variable)	16.331	5.183	3.2	0.006
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq
	6	3.76	4	0.098
	12	9.97	10	0.443
Single-Family Units Authorized by Permits				
	Parameter	Standard Error	t Value	Approx Pr > t
Estimated Mean	3.199	1.245	2.6	0.021
Moving Average Factor	1.000	1.992	0.5	0.623
Autoregressive Factor	0.978	2.111	0.5	0.650
Intervention ("input" dummy variable)	8.456	4.287	2.0	0.066
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq
	6	3.46	4	0.483
	12	10.54	10	0.394
Multi-Family Units Authorized by Permits				
	Parameter	Standard Error	t Value	Approx Pr > t
Estimated Mean	27.233	11.693	2.3	0.033
Moving Average Factor	0.105	0.621	0.2	0.868
Autoregressive Factor	0.594	0.570	1.0	0.312
Intervention ("input" dummy variable)	28.234	24.316	1.2	0.263
Autocorrelation Check for White Noise	To Lag	Chi-Square	DF	Pr > ChiSq
	6	4.52	4	0.340
	12	13.17	10	0.214

Note: 1. Dependent variable is the geographic difference between Washington, DC and surrounding suburban markets, which is measured by the ratio of annual permits authorized in DC to average annual permits in the surrounding markets.
 2. The intervention or input variable has a value of 1 if the ratio is observed in or after 1998; 0 otherwise.
 3. There are 20 observations/residuals analyzed in each model.

Figure 30. Housing Units Authorized by Building Permits (1983-2002)



NOTE: Difference in difference for building permit ratio in the District is 16.3% for all units, 8.5% for single-family, and 28.2% for multi-family units

authorized prior to the intervention. The impact for new single-family construction was 8.5 more permits in the District for every 100 permits issued in the suburbs. The impact was even larger for multifamily building permits that were estimated at 28.2 per 100 suburban permits.

Nevertheless, the above results regarding the building permits should be interpreted with caution. As a measure of overall residential investments from both public and private sectors, it seems to be conclusive. It is not accurate, however, if used to measure the new construction response only from the private sector. The difference is that, as discussed earlier, the HOPE VI program was also active in the District of Columbia during most of the 1990s. HOPE VI rehabilitation projects contributed about 3,138 new residential units (and hence building permits) in the District between 1993 and 2001. Specifically, HOPE VI helped the District to build 147 new townhomes for the Ellen Wilson project in 1993, 314 units for the Wheeler Creek project in 1997, 600 new units for the Henson Ridge project in 1999, 515 new units for the New East Capital project in 2000, and 1,562 new units for the Arthur Capper/Carrollsborg project in 2001.

These led to an average of 535 building permits per year from the HOPE VI program that were issued during the 1998-2002 period, compared to 31 building permits per year between 1983 and 1997. Therefore, incorporating these numbers into all types of building permits issued, the private sector contributed merely 346 building permits per year during the 1998-2002 period, compared to 345 permits per year prior to 1998. In short, the supply response from new construction during the 1998-2002 impact period was very significant if considering both private and public investments; however, it was

not significant at all (and essentially unchanged from the pre-intervention period) if excluding the new construction activities initiated from the HOPE VI public funds⁴⁸.

Another indicator to housing supply is housing units by tenure. According to 1990 and 2000 censuses, Washington, D.C., lost 3,644 housing units in the 1990s. However, there is a sharply different picture of changes in housing units by tenure. While rental units dramatically decreased by 9,441 units, owner units increased by 4,220 units from 1990 to 2000. As measured by share (percent of total housing units), owner units in the District increased by 2.01 percentage points in the 1990s, or 0.3 points higher than owner unit share in the suburbs. In contrast, rental unit share in the District declined by 2.65 percentage points, compared to a decline of 2.11 percentage points in the suburbs. (See Table 38 and Figure 31). This information seems to suggest that a dramatic shift from rental properties to owner units has been taking place in the District. And this shift may well be a market response to a huge housing demand and rapidly appreciating owner housing market that is created in part by the homebuyer credit program.

As shown in Table 39 and Figure 32, total vacant units were indeed substantially reduced in Washington, D.C., from 28,855 vacant units in 1990 to 26,507 units in 2000. The net reduction was 2,348 units. While the suburbs also had substantial reductions at the same period, the District still had 43 more vacant units of reduction than in the suburbs. More importantly, it is clear that the reduction of vacant units in the District exclusively came from vacant units for rent, which had a decline by 4,016 units. In

⁴⁸ Isolating the impact of HOPE VI program on the overall building permits was suggested by Jacqueline Rogers of the University of Maryland at College Park.

Table 38. Housing Units by Tenure: Washington, DC vs. Surrounding Suburban Markets (1990-2000)

	Total Housing Units			Owner Units			Rental Units		
	1990	2000	1990-2000	1990	2000	1990-2000	1990	2000	1990-2000
<u>Number of Units</u>									
Washington, DC	278,489	274,845	-3,644	100,015	104,235	4,220	165,767	156,326	-9,441
Surrounding Markets	203,376	230,220	26,844	123,503	143,849	20,346	77,170	82,508	5,338
Alexandria	58,252	64,251	5,999	22,298	24,984	2,686	34,796	38,073	3,277
Arlington	84,847	90,426	5,579	35,903	37,632	1,729	47,161	50,182	3,021
Fairfax	307,966	359,411	51,445	210,779	250,264	39,485	93,250	104,282	11,032
Montgomery	295,723	334,632	38,909	194,908	225,028	30,120	97,216	105,023	7,807
Prince Georges	270,090	302,378	32,288	153,627	181,336	27,709	113,427	114,980	1,553
DC - Surrounding Markets	75,113	44,625	-30,488	-23,488	-39,614	-16,126	88,597	73,818	-14,779
<u>Share of Housing Stock (%)*</u>									
Washington, DC				35.9	37.9	2.0	59.5	56.9	-2.6
Surrounding Markets				60.7	62.5	1.8	37.9	35.8	-2.1
Alexandria				38.3	38.9	0.6	59.7	59.3	-0.5
Arlington				42.3	41.6	-0.7	55.6	55.5	-0.1
Fairfax				68.4	69.6	1.2	30.3	29.0	-1.3
Montgomery				65.9	67.2	1.3	32.9	31.4	-1.5
Prince Georges				56.9	60.0	3.1	42.0	38.0	-4.0
DC - Surrounding Markets				-24.8	-24.6	0.3	21.6	21.0	-0.5

* % of total housing units.

Table 39. Vacant Housing Units in Washington, DC and Surrounding Suburban Markets

	Total Vacant Units			Vacant Units for Sale			Vacant Units for Rent		
	1990	2000	1990-2000	1990	2000	1990-2000	1990	2000	1990-2000
All									
Washington, DC	28,855	26,507	-2,348	2,930	3,021	91	13,218	9,202	-4,016
Surrounding Markets (average)	10,499	8,194	-2,305	2,086	1,623	-463	5,710	2,708	-3,002
Alexandria City, VA	4,972	2,362	-2,610	737	239	-498	3,077	929	-2,148
Arlington County, VA	6,327	4,074	-2,253	894	262	-632	3,650	1,200	-2,450
Fairfax County, VA	15,621	8,697	-6,924	3,897	1,444	-2,453	7,787	2,388	-5,399
Montgomery County, MD	13,495	10,067	-3,428	3,136	2,011	-1,125	6,760	3,475	-3,285
Prince Georges County, MD	12,079	15,768	3,689	1,767	4,159	2,392	7,276	5,547	-1,729
<i>DC - Surrounding Markets</i>	<i>18,356</i>	<i>18,313</i>	<i>-43</i>	<i>844</i>	<i>1,398</i>	<i>554</i>	<i>7,508</i>	<i>6,494</i>	<i>-1,014</i>
By Census Tract Income									
High-Income									
Washington, DC	3,994	4,427	433	655	365	-290	1,377	1,035	-342
Surrounding Markets (average)	2,379	2,730	351	785	549	-235	767	629	-138
Alexandria City, VA	508	551	43	106	88	-18	169	136	-33
Arlington County, VA	730	1,989	1,259	127	158	31	246	548	302
Fairfax County, VA	5,973	4,836	-1,137	1,930	859	-1,071	2,261	1,084	-1,177
Montgomery County, MD	3,973	4,221	248	1,460	861	-599	936	1,066	130
Prince Georges County, MD	709	2,053	1,344	301	781	480	222	309	87
<i>DC - Surrounding Markets</i>	<i>1,615</i>	<i>1,697</i>	<i>82</i>	<i>-130</i>	<i>-184</i>	<i>-55</i>	<i>610</i>	<i>406</i>	<i>-204</i>
Moderate-Income									
Washington, DC	3,721	1,671	-2,050	549	275	-274	1,627	505	-1,122
Surrounding Markets (average)	4,948	2,917	-2,031	1,026	642	-384	2,675	894	-1,781
Alexandria City, VA	2,271	1,067	-1,204	329	69	-260	1,542	469	-1,073
Arlington County, VA	3,924	961	-2,963	682	38	-644	2,048	241	-1,807
Fairfax County, VA	7,904	2,925	-4,979	1,816	467	-1,349	4,518	949	-3,569
Montgomery County, MD	6,415	4,411	-2,004	1,339	948	-391	3,426	1,575	-1,851
Prince Georges County, MD	4,227	5,223	996	965	1,689	724	1,839	1,236	-603
<i>DC - Surrounding Markets</i>	<i>-1,227</i>	<i>-1,246</i>	<i>-19</i>	<i>-477</i>	<i>-367</i>	<i>110</i>	<i>-1,048</i>	<i>-389</i>	<i>659</i>
Low-Income									
Washington, DC	21,140	20,409	-731	1,726	2,381	655	10,214	7,662	-2,552
Surrounding Markets (average)	3,172	2,546	-626	275	431	156	2,269	1,185	-1,083
Alexandria City, VA	2,193	744	-1,449	302	82	-220	1,366	324	-1,042
Arlington County, VA	1,673	1,124	-549	85	66	-19	1,356	411	-945
Fairfax County, VA	1,744	936	-808	151	118	-33	1,008	355	-653
Montgomery County, MD	3,107	1,435	-1,672	337	202	-135	2,398	834	-1,564
Prince Georges County, MD	7,143	8,492	1,349	501	1,689	1,188	5,215	4,002	-1,213
<i>DC - Surrounding Markets</i>	<i>17,968</i>	<i>17,863</i>	<i>-105</i>	<i>1,451</i>	<i>1,950</i>	<i>499</i>	<i>7,945</i>	<i>6,477</i>	<i>-1,469</i>
By Census Tract Racial Composition									
Low-Minority									
Washington, DC	5,746	3,955	-1,791	915	294	-621	2,280	899	-1,381
Surrounding Markets (average)	5,171	1,934	-3,237	1,394	342	-1,052	2,226	408	-1,818
Alexandria City, VA	835	503	-332	200	83	-117	362	116	-246
Arlington County, VA	3,529	1,675	-1,854	672	139	-533	1,784	430	-1,354
Fairfax County, VA	12,227	3,223	-9,004	3,506	586	-2,920	5,699	577	-5,122
Montgomery County, MD	7,474	3,936	-3,538	2,246	813	-1,433	2,499	811	-1,688
Prince Georges County, MD	1,788	333	-1,455	345	87	-258	786	107	-679
<i>DC - Surrounding Markets</i>	<i>575</i>	<i>2,021</i>	<i>1,446</i>	<i>-479</i>	<i>-48</i>	<i>431</i>	<i>54</i>	<i>491</i>	<i>437</i>
Moderate-Minority									
Washington, DC	2,481	1,235	-1,246	374	112	-262	1,218	469	-749
Surrounding Markets (average)	2,860	2,034	-826	366	310	-56	1,811	653	-1,158
Alexandria City, VA	3,175	597	-2,578	267	41	-226	2,139	291	-1,848
Arlington County, VA	1,636	1,696	60	131	70	-61	983	469	-514
Fairfax County, VA	2,860	3,285	425	331	466	135	1,749	937	-812
Montgomery County, MD	4,275	3,090	-1,185	791	623	-168	2,794	1,275	-1,519
Prince Georges County, MD	2,352	1,500	-852	312	350	38	1,390	293	-1,097
<i>DC - Surrounding Markets</i>	<i>-379</i>	<i>-799</i>	<i>-420</i>	<i>8</i>	<i>-198</i>	<i>-206</i>	<i>-593</i>	<i>-184</i>	<i>409</i>
High-Minority									
Washington, DC	20,628	21,317	689	1,641	2,615	974	9,720	7,834	-1,886
Surrounding Markets (average)	2,469	4,226	1,757	326	971	645	1,673	1,647	-26
Alexandria City, VA	962	1,262	300	270	115	-155	576	522	-54
Arlington County, VA	1,162	703	-459	91	53	-38	883	301	-582
Fairfax County, VA	534	2,189	1,655	60	392	332	339	874	535
Montgomery County, MD	1,746	3,041	1,295	99	575	476	1,467	1,389	-78
Prince Georges County, MD	7,939	13,935	5,996	1,110	3,722	2,612	5,100	5,147	47
<i>DC - Surrounding Markets</i>	<i>18,159</i>	<i>17,091</i>	<i>-1,068</i>	<i>1,315</i>	<i>1,644</i>	<i>329</i>	<i>8,047</i>	<i>6,187</i>	<i>-1,860</i>

Figure 31. Housing Units by Tenure in Washington, DC and Surrounding Suburban Markets from 1990 to 2000

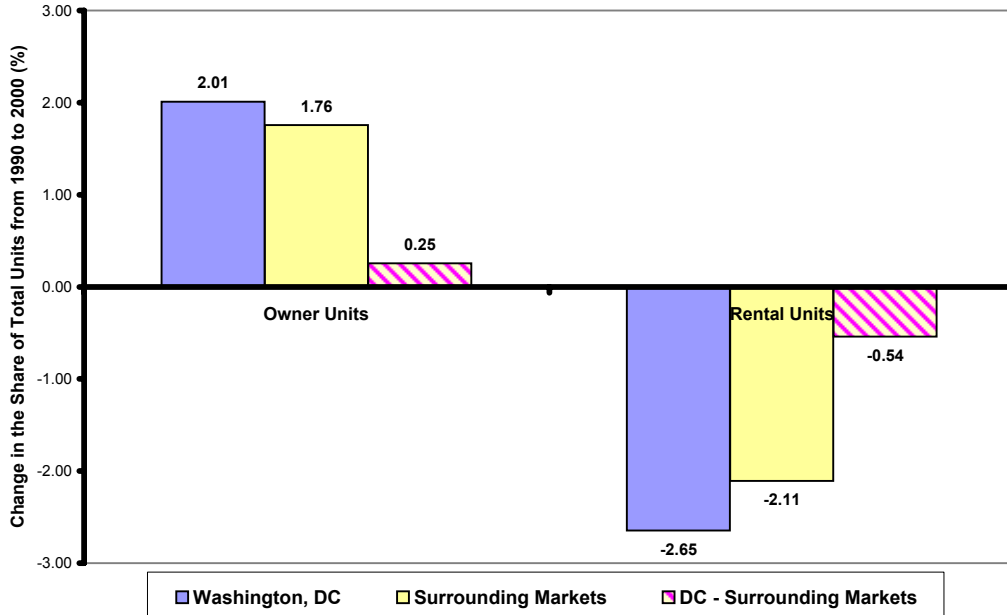
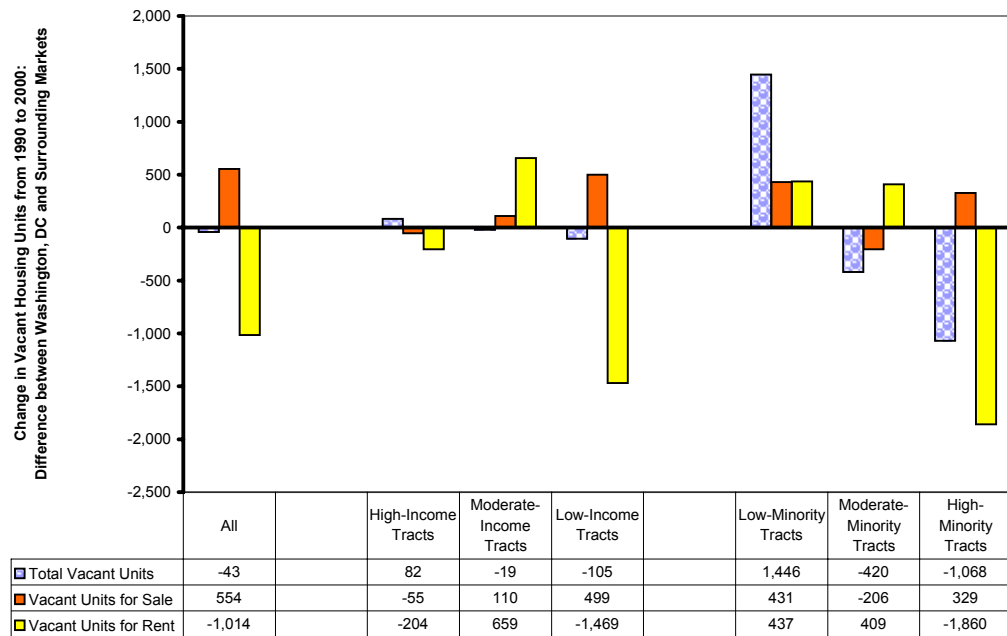


Figure 32. Change in Vacant Housing Units in the 1990s: Washington, DC vs. Surrounding Suburban Markets



contrast, despite the overall decrease of housing stock and vacancy in the District, vacant units for sale had a net gain of 91 units in the 1990s.

Further, the decline of vacant units for rent as well as the increase of vacant units for sale was mostly found in the low-income and high-minority neighborhoods in the District, even considering the difference with its suburbs. Therefore, there appeared to be, once again, a dramatic shift that may have been taking place from vacant units for rent to vacant units for sale in the District in general and low-income and high-minority neighborhoods in particular. This finding suggests that the homebuyer credit program may indeed have an impact on owner housing supply not through new construction but conversion of rental properties (occupied and vacant) to owner units (occupied and vacant).

The Impact on Housing Affordability

The rapid increase in house prices during the impact period, along with a supply response in which a large number of rental properties were converted into owner units, suggests that the D.C. homebuyer tax credit may have an adverse effect on neighborhood gentrification and housing affordability in the District⁴⁹. The adverse effect is two-fold: Both renters and future homebuyers are at risk of being priced out of the affordable markets, especially in the gentrifying and gentrified neighborhoods where house prices went up more rapidly and/or vacant units for rent were converted into owner units in a larger quantity. Although there is no hard evidence as to how many future homebuyers could be adversely affected, the substantial price increase attributable to the D.C.

⁴⁹ The potential adverse effect on gentrification and existing D.C. residents was strongly suggested by Mark Lopez of the University of Maryland at College Park.

homebuyer credit program in the past five years should be self-explainable for the detrimental impact in this regard.

Information collected from the *1993-1998 American Housing Survey* gives a close look at the potential adverse effect on the District's renters. Theoretically, if the D.C. homebuyer credit program did generate any adverse effect on renters, it would be reflected through at least two types of renter displacements: (1) renters who had to move because of involuntary displacement imposed by private landlords or government agencies, and (2) renters who moved or were displaced voluntarily because the previous rental units were no longer affordable. Table 40 compares the 1993 and 1998 AHS data on reasons for the move and choice of current residence for householders who moved during the past year⁵⁰. The findings suggest that a large portion of the District's renters were voluntarily displaced for increased rental and financial burdens during the first 12 months after the D.C. homebuyer credit program took effect.

Specifically, the AHS data show that from 1993 to 1998, there was no increase in District renters who moved during the previous year because of private or government displacement. This was also true in the Washington, DC metro and two surrounding suburban counties, Prince George's and Fairfax. Hence, the empirical evidence does not support the assumption that the D.C. homebuyer credit program might have an effect on the involuntary displacement for District renters.

⁵⁰ The data for the AHS Metro is generally collected in the second half of the year when the survey is carried out. Thus, while the 1993 movers (during the past year) were those moved between the 2nd half of 1992 and 2nd half of 1993, the 1998 movers were those moved between the 2nd half of 1997 and 2nd half of 1998. In other words, the latter roughly corresponds to the householders moved during the first 12-month period immediately after the D.C. homebuyer credit took effect in August 1997.

Table 40. Reasons for Move and Choice of Current Residence for Householders Moved During Past Year

(number in thousands)

	Owner-Occupied Units			Renter-Occupied Units			
	1993	1998	Share Growth (%)	1993	1998	1993-98 Increase (%)	Share Growth (%)
Washington, DC-MD-VA MSA							
Reasons for Leaving Previous Unit							
Private Displacement	2.4	1.3	-1.6	12.7	7.1	-44.1	-2.9
Government Displacement	0.5	2.1	1.4	3.0	1.3	-56.7	-0.9
To Be Closer to Work/School/Other	4.8	10.2	4.0	33.4	31.7	-5.1	-1.9
To Establish Own Household	16.2	23.4	3.1	31.2	37.2	19.2	1.6
Change from Owner to Renter				1.5	2.5	66.7	0.4
Change from Renter to Owner	18.7	19.5	-3.7				
Wanted Lower Rent or Maintenance	1.5	3.5	1.6	14.6	15.7	7.5	0.0
Choice of Present Neighborhood							
Convenient to Job	24.6	32.6	1.8	77.1	71.0	-7.9	-5.3
Convenient to Public Transportation	6.6	7.0	-1.2	29.8	36.7	23.2	2.0
Choice of Present Home: Financial Reasons	40.0	31.6	-17.6	86.0	95.9	11.5	1.4
Comparison to Previous Neighborhood							
Better Neighborhood	46.9	47.6	-10.5	78.7	70.2	-10.8	-6.4
Worse Neighborhood	8.2	7.8	-2.3	41.9	38.6	-7.9	-2.9
About the Same	24.1	35.9	5.6	73.1	93.0	27.2	6.3
Same Neighborhood	2.1	1.7	-0.9	12.0	9.5	-20.8	-1.5
Total Respondents	83.5	104.2		210.3	226.5	7.7	
District of Columbia							
Reasons for Leaving Previous Unit							
Private Displacement	0.0	0.0	0.0	2.8	2.2	-21.4	-2.0
Government Displacement	0.0	0.0	0.0	1.5	0.9	-40.0	-1.7
To Be Closer to Work/School/Other	0.5	2.2	20.4	9.4	7.9	-16.0	-5.7
To Establish Own Household	1.3	0.9	-8.8	7.4	7.7	4.1	-1.0
Change from Owner to Renter				0.0	0.9		2.1
Change from Renter to Owner	1.3	1.7	1.5				
Wanted Lower Rent or Maintenance	0.0	0.5	6.4	1.0	3.8	280.0	6.3
Choice of Present Neighborhood							
Convenient to Job	2.0	2.6	2.1	11.7	9.1	-22.2	-8.7
Convenient to Public Transportation	0.8	1.8	10.6	4.9	9.7	98.0	10.0
Choice of Present Home: Financial Reasons	1.5	1.3	-6.8	12.8	20.5	60.2	14.9
Comparison to Previous Neighborhood							
Better Neighborhood	3.2	2.6	-16.7	13.3	10.8	-18.8	-8.9
Worse Neighborhood	1.2	0.8	-8.5	9.5	7.9	-16.8	-5.9
About the Same	1.8	2.7	6.5	13.1	18.7	42.7	10.0
Same neighborhood	0.0	0.0	0.0	2.4	3.6	50.0	2.2
Total Respondents	6.4	7.8		39.2	43.1	9.9	
Princes George's County, MD							
Reasons for Leaving Previous Unit							
Private Displacement	1.2	0.0	-9.2	3.0	0.9	-70.0	-4.4
Government Displacement	0.0	0.4	2.7	1.0	0.0	-100.0	-2.3
To Be Closer to Work/School/Other	0.6	1.8	7.7	3.5	4.0	14.3	3.3
To Establish Own Household	2.9	6.0	18.7	6.7	6.8	1.5	3.9
Change from Owner to Renter	0.0			0.6	0.0	-100.0	-1.4
Change from Renter to Owner	3.2	2.6	-6.7				
Wanted Lower Rent or Maintenance	0.3	0.0	-2.3	2.8	3.2	14.3	2.7
Choice of Present Neighborhood							
Convenient to Job	4.9	2.2	-22.4	13.6	8.7	-36.0	-6.6
Convenient to Public Transportation	0.5	0.9	2.3	2.9	5.0	72.4	7.5
Choice of Present Home: Financial Reasons	5.5	3.9	-15.5	15.8	13.1	-17.1	0.8
Comparison to Previous Neighborhood							
Better Neighborhood	8.5	5.6	-26.8	18.3	11.5	-37.2	-9.5
Worse Neighborhood	1.2	0.5	-5.8	7.6	8.4	10.5	6.4
About the Same	3.4	6.5	18.3	13.1	13.5	3.1	8.2
Same neighborhood	0.0	0.9	6.1	2.7	0.9	-66.7	-3.7
Total Respondents	13.1	14.7		43.3	35.1	-18.9	
						-100.0	
Fairfax County, VA							
Reasons for Leaving Previous Unit							
Private Displacement	0.4	0.0	-1.9	2.2	1.2	-45.5	-2.9
Government Displacement	0.0	0.0	0.0	0.5	0.0	-100.0	-1.3
To Be Closer to Work/School/Other	0.6	0.8	0.3	4.9	4.9	0.0	-0.9
To Establish Own Household	4.4	3.2	-8.2	5.9	4.6	-22.0	-4.3
Change from Owner to Renter	0.0			0.0	0.4		1.0
Change from Renter to Owner	2.9	5.4	7.2				
Wanted Lower Rent or Maintenance	0.3	0.4	0.1	2.3	2.5	8.7	0.1
Choice of Present Neighborhood							
Convenient to Job	6.6	11.6	13.7	14.6	16.6	13.7	2.2
Convenient to Public Transportation	1.6	1.8	-0.5	2.9	4.9	69.0	4.4
Choice of Present Home: Financial Reasons	9.6	6.9	-18.1	13.2	15.0	13.6	1.9
Comparison to Previous Neighborhood							
Better Neighborhood	11.6	13.5	-2.2	14.4	15.7	9.0	0.5
Worse Neighborhood	1.8	2.6	1.6	4.7	6.1	29.8	2.6
About the Same	7.5	7.2	-7.2	16.0	15.4	-3.8	-4.5
Same neighborhood	0.7	0.0	-3.2	1.6	0.4	-75.0	-3.3
Total Respondents	21.6	26.2		37.7	40.6	7.7	

Nevertheless, the data also show that voluntary displacement was clearly happening. In 1993, only 1,000 renters in the District moved during the previous year because they “*wanted lower rent.*” This number dramatically jumped to 3,800 renters in 1998—a year after the homebuyer credit program began, resulting in a 280-percent increase. In comparison, the increase was merely 7.5 percent in the Washington metropolitan area, 14.3 percent in Prince George’s County, Maryland, and 8.7 percent in Fairfax County, Virginia. Using the share of all movers, renters who were displaced by higher rent still had a 6.3-percent growth in the District from 1993 to 1998, compared to a growth rate of 0 percent in the Washington MSA, 2.7 percent in Prince George’s County, and 0.1 percent in Fairfax County.

Another indicator— “*choice of present home: financial reasons*” —verifies the displacement impact of the D.C. homebuyer credit program. The data show that the number of the District’s renters who moved for financial reasons grew substantially from 12,800 in 1993 to 20,500 in 1998, an increase of 7,700 renters or 60.2 percent. The change was merely 11.5 percent in Washington metro area, -17.1 percent in Prince George’s County, and 13.6 percent in Fairfax County. Similarly, the growth rate by share of all movers was the highest in the District at 14.9 percent, compared to 1.4 percent in the Washington metro area, 0.8 percent in Prince George’s County, and 1.9 percent in Fairfax County.

In summary, the findings indicate that the D.C. homebuyer credit program appears to have generated an adverse effect on the District’s homeownership and especially rental affordability. In particular, the empirical evidence points out that the District’s renters had substantially higher rates of voluntary displacement in 1998 because of rent and financial

reasons. This outcome should not be surprising. After all, among renters in the Washington, D.C., metropolitan area, the District's renters (especially low-income renters) are the most vulnerable to any significant increase in housing costs and reduction in rental supply: According to the *1998 American Housing Survey*, median household income for renters in 1998 was merely \$21,263 in the District, compared to \$36,231 in the Washington metro area, \$32,592 in Prince George's County, and \$47,049 in Fairfax County. Since the D.C. homebuyer credit intervention had a substantial, positive and significant impact on house prices and also helped reduce the number of vacant units for rent, these impacts must have been translated into a large increase in rents, thus pricing out many renters from the existing units. This detrimental impact on rental affordability is expected to be more evident and serious in some of the low/moderate-income and moderate-minority neighborhoods because they experienced a more significant growth in house prices and reduction in rental units and were, therefore, more likely to be gentrified.

XI. Conclusion: Key Findings and Implications for Policy and Research

This study is motivated by the need to identify public policy interventions that address two critical problems facing the United States. One is urban decline and central city neighborhood distress, while the other is the inequality of the nation's most important housing policy—the home mortgage interest and real estate tax deductions. After an extensive literature review of these problems and analysis of various policies and programs, a targeted homeownership tax credit program as implemented in the District of Columbia stands out. By targeting specific income levels and first-time homebuyers, this innovative homeownership tax credit intervention intentionally or unintentionally impacts the intersection of both problems at the same time.

Data from the Internal Revenue Services only released to this author indicate that the D.C. homebuyer credit program was indeed successful and popular and was increasingly so over time, regardless of the number of returns claiming for the credit, amount of the claims, and estimated rate of initial claims. The credit was extremely successful in attracting the renters or first-time homebuyers. It was also effective in reversing the population exodus by retaining existing D.C. residents and luring homebuyers with previous residences in the District's suburban areas. Moreover, the distributional effect of the credit beneficiaries by income was also positive and substantial. The pyramid-shaped income distribution was centered on the low-income homebuyers or those well below the area median income.

Based on a unique database that compiles the transaction-assessment records, census information, and other administrative data sets, I conducted a three-stage intervention analysis in the framework of difference-in-differences approach to examine

the impact of the District homebuyer credit program on amenity-adjusted house prices. This approach was supplemented and verified by a cross-border median price comparison and two other verification methods. Using house price appreciation rate as a key measure of the impact, the empirical findings indicate that the price impact and distributional effects of the targeted homeownership tax credit programs were significant, positive, and large. Using house price volatility as the other benchmark, I found that the targeted homebuyer credit intervention was indeed effective in stabilizing the central city neighborhoods, as well as the overall housing market.

Data from a number of supplemental indicators suggest a consistent picture that the policy intervention in Washington, D.C., seemed to have stimulated overall investments on new construction, increased the demand and supply on owner units, increased homeownership rates, and reduced vacant units in the city. However, the results also suggest an insignificant supply response from private residential investments, as well as an adverse effect on housing affordability, especially for the District's renters.

Summary of empirical evidence from the Internal Revenue Services

The D.C. homebuyer tax credit is very successful and popular. Based on the IRS data released only for this study, 21,821 claims, in the amount of \$76.7 million, were filed for the tax credit from 1997 to 2001. (The estimated amount of the credit during the 1998-2002 period was about \$89.5 million). The annualized averages were 4,643 returns/claims in the amount of \$3,507 per year. On average, the program participants or initial claimants accounted for about 77 percent of all home purchasers in the District each year studied. Moreover, the number of returns, amount, and rate of initial claims

generally exhibit a rising trend over time, with substantial growth observed in 1998 and 1999 and high levels maintained in years 2000-2001.

The participants' first-time homeownership rate (or rate of purchasers of their first homes ever owned) was estimated at 67.1 percent of all home purchasers in the District per year. This first-time homebuyer rate was 27 percentage points higher than the national average (40 percent) and 16 percentage points higher than the central city average in the United States (51 percent). The D.C. homebuyer credit program was also effective in stabilizing the population base for the District by retaining D.C. residents and attracting homebuyers from suburbs. While the vast majority of the credit claimants (i.e., beneficiaries) were D.C. residents, the homeownership credit also attracted a sizable number of homebuyers whose previous addresses were in District suburbs. Specifically, the initial claimants of the credit with previous D.C. addresses accounted for about a half (47.5 percent) of all home purchasers in the District. The homebuyers with previous residence in the District's suburban areas accounted for an average of 14 percent of all home purchasers in the District. Both the first-time homebuyer rate and rates of participation by the existing D.C. residents and previous suburban residents also exhibit a trend of steady growth over time.

The results also meet the prior expectations that the distributional effect of the D.C. homeownership credit beneficiaries, as classified by adjusted gross income, was very positive and substantial. The income distribution of the credit claimants, by both number and amount of claims, has a typical pyramid-shape centered on low-income households and vastly supported by low/moderate-income households. The IRS data indicate that the largest cluster of the credit beneficiaries was low-income homebuyers or

those with incomes between \$30,000 and \$50,000, which correspond to only 42 to 69 percent of the area median income. The top beneficiary groups were low/moderate-income households, or those earning an annual income between \$20,000 and \$75,000, which corresponds to 28 to 104 percent of the area median income. In terms of average amount of claims by income, however, the results indicate that the higher the income, the higher amount per claim each year. There was a rising trend over time observed for all these patterns.

Summary of key findings on house price appreciation

Controlling for both observed price determinants (including housing unit characteristics, location, events, and neighborhood-based developments) and unobserved factors, the District's amenity-adjusted house prices increased by an additional 4.9 percentage points per year above its five comparison suburban markets during the impact period of 1998-2002. This finding is further verified by comparing the median house prices and median price per square foot for three geographic samples (census tracts adjacent to the District/Maryland border, D.C. vs. five surrounding suburbs, and D.C. vs. Baltimore City). The robustness of this finding is also checked by examining a number of other potential factors that took place concurrently with the homebuyer credit program and thus might have also affected the District's housing market. These outcomes and robustness checks indicate that such a substantial price increase was largely, though not exclusively, attributable to the targeted homebuyer credit program as implemented in Washington, D.C., since August 1997. Therefore, these findings provide a strong justification for the targeted homebuyer credit intervention on the ground of efficiency.

The findings also indicate that the targeted homeownership credit intervention is justified for the sake of equity or distributional effect. The income-targeted homebuyer tax credit program may explain most of the following distributional effects, which are both statistically significant and strong: As compared to more expensive single-family detached houses that are more likely owned by high-income and other advantaged population groups, townhouse and condominium units are significantly lower-priced and therefore more likely owned by low-income and other disadvantaged households. However, the findings indicate that the District homebuyer credit program was a major contributor of a net house price appreciation of 9.2 and 7.3 percentage points per year for a typical townhouse and condo, respectively, as compared to merely 1.7 percentage points for a typical single-family detached. These distributional effects are also similarly reflected in the comparisons of various neighborhood housing markets by income and race.

A typical low- and moderate-income neighborhood in the District had a stronger net impact than a typical high-income neighborhood did. Their annual rates of house price growth were 5.7, 4.4, and 3.1 percentage points, respectively. When comparing the effects by neighborhood racial composition, the results are mixed. A typical low-minority (predominately white) neighborhood had a net effect of 4.4 percentage points per year in house price appreciation during the 1998-2002 period, whereas a typical high-minority neighborhood had an annual net effect of only 4 percentage points. However, the moderate-minority neighborhoods stood out as the biggest beneficiary of the program among all housing sub-markets. The net effect on such a typical neighborhood was 11.3 percentage points per year in the amenity-adjusted house price appreciation.

Other direct and secondary impacts

There are a number of important direct or secondary impacts that are derived from the targeted homeownership tax credit programs as examined in this paper.

First, the targeted homeownership tax credit program directly built wealth for existing homeowners and first-time homebuyers through the growth of their home equity. The aggregate home equity wealth is estimated at more than \$2 billion for the years 1998 through 2002. And this wealth-building effect in the District was felt not only by homeowners in rich or white neighborhoods but also by those in poor or minority neighborhoods. In addition, not just owners of single-family detached houses increased their home equity through the rapid price appreciation, but the same also occurred for owners of lower-priced townhouses/rowhouses and condominiums. On the other hand, the findings indicate that the policy intervention created substantially more home equity wealth for the homeowners of single-family detached houses and for the high-income and white neighborhoods. This is because these homeowners had a much higher base of house prices to begin with, and their compounding effects make important differences over time. This highlights the importance and timeliness of such policy interventions as the District homebuyer credit program that may raise price appreciation rates more rapidly for the disadvantaged than the advantaged. As a result, one would expect to see that over time the gap between the two would gradually become smaller.

Second, the District homebuyer credit program was also effective in stabilizing all types of neighborhoods (except for high-minority neighborhoods) and the urban market as a whole. For instance, the difference in differences in volatility of house price movement (as expressed by coefficient of variation ratio) is estimated at 0.43 for Washington, D.C.,

during the impact period. This means that the policy intervention was so successful that the price volatility observed during the impact period was merely 43 percent as volatile as those observed prior to the intervention.

Third, the targeted homebuyer credit intervention stimulated housing demand and increased homeownership rates in the District. The increase in homeownership rates in the low- and moderate-income neighborhoods was particularly striking, estimated at a range of 2.7 to 8.4 percentage points higher than in its suburbs from 1990 to 2000. Moreover, in reaching a new equilibrium, a stronger housing demand in turn stimulated housing supply in the urban and neighborhood markets, thereby increased the levels of overall level of new construction (measured by residential building permits), conversion of rental properties into owner units, and possibly rehabilitation and home improvements. As a result, many vacant units in the District, especially vacant units for rent, have been eliminated from the rental housing stock due to this effect.

Nevertheless, although the homebuyer credit program had a significant impact on the number of residential building permits issued for both public and private investors, the supply response from the private investments was insignificant, excluding the new units funded by the HOPE VI revitalization program. Moreover, the empirical evidence also suggests that the homebuyer credit program could have generated some unintended consequences and adverse effects on housing affordability for both future homebuyers and renters in the District. In particular, the District's renters who moved or were displaced because of rent burdens increased by 2,800 households from 1,000 in 1993 to 3,800 in 1998 (a year after the homebuyer credit program in place). The increase was equivalent to a 6.3 percent growth as expressed by the share of all householders who

moved during the past 12 months, compared to no change in the Washington metro area during the same time period.

Fourth, the homebuyer credit program also contributed directly to the city's property tax bases and thus government revenues. In the case of Washington, D.C., the increased property tax revenues were generated not only from the increased residential property value in one type of neighborhood or structure but also across all types of neighborhoods and structures, including traditionally lower-priced condos and townhouses and homes in underserved low-income and minority neighborhoods. The overall impact on the District's residential real estate tax revenues is conservatively estimated at \$50.2 million for 1998 through 2002.

The results of these secondary impacts include the following:

- The increased home equity coupled with historically low rates of home mortgages contributed to the local economy through a refinance boom. Cash-out has been recognized as a primary factor that stabilizes the economy both locally and nationally.
- A financially better-off city government would be able to provide more public goods and provide better government services, including schools, police, public transportation, etc. These further improve the attractiveness of the city to potential homeowners who are future taxpayers for properties.

Implications for public policies and research

A significant and largely positive impact and distributional effect of the D.C. homeownership tax credit suggest that this innovative tax instrument with income-targeting can indeed serve as a viable supplement or remedy to existing tax treatments for

affordable homeownership. It also represents an innovative approach to reviving central cities and stabilizing distressed neighborhoods. This study of the program's overall effectiveness, enormous economic impact, positive distributional effect, and weaknesses should provide important insights on possible improvements of the D.C. homebuyer credit program itself and on any future policy designs around these themes and their potential impacts.

For instance, an income-targeted homeownership tax credit has recently been proposed in Congress. Senators Gordon Smith and Debbie Stabenow proposed a first-time homebuyer tax credit of up to \$6,000. According to *the Housing Affairs Letter* published on June 6, 2003, the proposed Homeownership Tax Credit Act (S 1175) would allow qualified homebuyers within the 27 percent tax bracket or lower to claim the credit. It could be a \$3,000 credit for single buyers. First-time homebuyers would claim the tax credit in the year following their home purchase. The proposal immediately picked up the support of the Mortgage Bankers Association of America.

In a broad public policy perspective, three other important implications can be drawn from the experiences of the targeted homebuyer tax credit program. First, if designed well, a public policy intervention can become one stone that kills two birds at the same time. The conventional wisdom holds that the principal role of government or public policies in general should be tilted toward accomplishing social goals or addressing concerns related to social justice. Accordingly, the success or effectiveness of a government program or policy is often judged by its impact on equity, that is, whether and to what extent it helps "disadvantaged" populations in the society. While these

normative principles have dominated public policy debates and policy practices, they have struggled to balance the concerns on economic efficiency.

As demonstrated in this paper, a policy intervention can be successful in meeting both the equity and efficiency criteria. The District First-Time Homebuyer Credit program was effective in not only promoting social justice through its sizable and significant distributional effects but also producing substantial net benefits to society. A simple benefit/cost ratio can be calculated as home equity wealth of more than \$2 billion (created by the program) divided by costs of tax credits of about \$89.5 million⁵¹ for years 1998 through 2002. This yields 22.3, greatly more than 1 as required by the standard cost-benefit analysis. Even applying a discount rate or other costs to the equation, one would reasonably expect that they would not be able to significantly alter the outcome of substantial net benefits. Plus, there are many other types of social benefits that are not easily quantifiable and therefore not incorporated into the benefit/cost ratio equation as well, such as the benefits of stable neighborhoods, increased homeownership rates, and housing producers' surplus.

The second implication is that the targeted homeownership tax credit program also facilitated two types of income and wealth redistribution that advance social goals of resource allocation. One is income/wealth redistribution from high-income to low/moderate-income households. By targeting only certain homebuyers, the program was able to benefit substantially low-income families who were renters or other types of homebuyers, as well as low/moderate-income neighborhoods. The benefits are realized through both direct tax credits (up to \$5,000) in qualified homebuyers' income tax returns

and higher rate of price appreciation for properties in low/moderate-income neighborhoods and for lower-priced townhouse/condos. For instance, the largest cluster of the credit beneficiaries was made up of those earning annual incomes between only \$30,000 and \$50,000. This group made a total of 8,104 claims in the amount of \$26.3 million over the 1997-2001 tax years.

The second form of income/wealth transfer takes place from suburbs to central cities or from federal government to state/local governments. The District of Columbia homebuyer credit is solely financed by the federal government at the expense of federal income tax revenues, including those from suburban areas. However, the beneficiary is only Washington, D.C., since its government was able to levy at least \$50.2 million in property taxes in the period of 1998-2002 because of substantial increases of residential property values resulting from the homebuyer credit program. Additionally, if one compares the revenue loss of about \$89.5 million to the IRS with the revenue gains of more than \$50.2 million to the District government, the fiscal impact to governments as a whole may be substantial. However, the loss may be offset by the gains from other tax revenues, such as sales and income taxes, which may have also resulted from the impact of the homebuyer credit intervention.

The third public policy implication is that, while all homebuyers and existing homeowners are winners in the District, there are still losers from the implementation of the program. The losers are renters and future or potential homebuyers in the District. Basically, an unintended effect of the homebuyer tax credit program on the District's housing market dynamics is that "haves" and "have nots" are now facing dramatically

⁵¹ The estimate of \$89.5 million for tax credits for years 1998 through 2002 is derived from the 1997-2001

different financial and housing situations. Affordability and hence displacement have become serious problems for low-income renters facing an even more tightened rental housing supply and increased rents in the District. With a substantial rise of house prices, homeownership becomes even less affordable than before for future homebuyers in the District. In short, both renters and future homebuyers are at the risk of being priced out from the District market because of the substantial impact of the homebuyer credit program on overall housing market dynamics. These unintended detrimental impacts require some policy actions to deal with in the future. On one hand, the worsening affordability and displacement for renters seem to be suggesting that a homeownership policy intervention would be more justified on the equity ground if it could also contain or be accompanied by a form of compensation for renters who can be adversely affected by the spillover effect from homeowner market. On the other hand, the results indicate that the D.C. homebuyer credit program had little impact on the short-run supply from private investments on new construction. This implies that a supply-side policy intervention may be warranted to accompany this demand-side homeownership tax credit program so that any adverse effect on homeownership affordability for future homebuyers could be minimized. These should be important questions for researchers to further explore and represent a tough trade-off for policy analysts and decision-makers in the future.

There are several important and specific implications for future policy designs with a similar theme. Although the targeted homeownership credit program as

IRS data as discussed in the “empirical evidence from IRS” section.

implemented in the District is clearly a success in many measures, it still contains some weaknesses that any future policy/program design should attempt to avoid.

One of the greatest strengths of the D.C. homeownership tax credit is that its targets mainly low/moderate-income homebuyers in a central city setting. While the national homeownership rate has been continuously pushed to higher levels in the last decade or so, significant gaps in homeownership rates exist between low-income, minority households and high-income white households and between central cities and their suburban areas. Central cities generally feature young, low/moderate-income renters who are eager to establish their households and own a piece of property for the American Dream. Therefore, low/moderate-income households in central cities represent perhaps the best niche market for further increasing homeownership rates for this country, which is exactly one of the reasons why the D.C. homebuyer credit program has proven to be so successful and popular.

Another strength of the D.C. homebuyer credit program and its enhancements is its ability to attract first-time homebuyers. As discussed in this paper, an important reason that the substantial impact of the homeownership credit is not explainable by the standard subsidy theory is its unique feature of subsidizing first-time homebuyers' housing investment. While the program itself does not explicitly offer any built-in capacity of removing or reducing market "imperfections" such as the entry barriers of wealth and income to homeownership market, its individual and private-sector innovative enhancements did allow first-time homebuyers to use the D.C. tax credit toward the down payment or closing costs. Therefore, it is very important that any homeownership tax credit design in the future should explicitly include a mechanism that enables homebuyers

to convert the tax credit into cash for down payment or closing costs at the time of home purchase through, for instance, directly transferring the tax credit to their mortgage lenders or other players involved in the home-buying process.

The empirical evidence from the D.C. housing market also indicates that the predominately minority neighborhoods received fewer benefits, in terms of house price appreciation and neighborhood stability, from the D.C. homebuyer credit intervention than the moderate-minority and white neighborhoods. Thus, combining income-targeting with neighborhood-targeting appears to be crucial for any future policy design. On one hand, any future program/policy in this regard should replicate the District model to provide a tax incentive to lower-income households for buying homes in the entire city (not just one place or another). On the other, the future intervention should also include a larger incentive to attract homebuyers to the targeted neighborhoods, especially predominately minority neighborhoods. By doing so, the distressed, predominately minority neighborhoods would be able to enjoy the maximum benefits of the intervention.

Currently, the District homebuyer credit program can be carried forward to a claimant's subsequent tax returns. However, these tax credits are not refundable and hence less attractive to the very low-income households who have few tax liabilities. For instance, the IRS data indicate that only 1,001 credit claims were made by the very low-income homebuyers earning under \$20,000, which was just about 5 percent of the total returns claiming for the D.C. homebuyer credit during the 1997-2001 period. Therefore, if the tax credit were refundable, this policy intervention would strongly stimulate and

encourage very low-income households to participate in homeownership, preventing them from missing more opportunities to build wealth through homeownership.

This study has important implications for research. It substantially improves our understanding of public subsidies and their actual values in a reality where the assumptions of the standard subsidy theory are no longer held. Such an improvement makes an important contribution to the literatures of public policies, public/welfare/urban economics, and housing markets. The research also makes an important contribution to the literature by generating, for the first time, a systematic cross-sectional/inter-temporal analysis of house price dynamics by income and race at the census tract level, by neighborhoods, and by structure type.

Moreover, the empirical approach used in this study, a three-stage intervention analysis (including hedonic regressions and interrupted time series models) in the framework of difference-in-differences approach represents a methodological advance that improves our understanding of the dynamic interplay between urban property markets and public policy interventions. This innovative methodology, as well as its three verification methods (particularly the cross-D.C./Maryland border comparisons in median house price per square foot), can be used to assess the effectiveness and impact of many other urban and housing policy interventions.

Furthermore, this study also provides a number of important indicators that can be used as standardized and testable benchmarks in evaluating the effectiveness of many other urban policy interventions in a similar setting. The key benchmarks related to the interventions' overall effectiveness and distributional effect are the rate of initial credit claims, first-time homebuyer rate, rate of participation by the previous suburban residents,

and income profiles of beneficiaries. The key benchmarks related to housing markets are the *rates of house price appreciation* used to evaluate the economic impact and distributional effect on housing markets and *house price volatility* (as measured by coefficient of variation) to evaluate neighborhood stability. The supplemental benchmarks include (1) homeownership rate, (2) number of housing units authorized by building permits to measure the impact on housing supply (especially the trends on new construction), (3) growth of owner vs. rental units as measured by their shares in the overall housing stock, (4) number of vacant units, and (5) involuntary and voluntary displacement rates for renters.

Appendix Table 1. Estimates Based on the Greater Washington Research Center's Survey on DC First-Time Homebuyer Credit*

	Number	Percent
Total Survey Mailed**	1,600	100.0
Valid Responses Received	529	33.1
No Response Received	960	60.0
Returned Mails	111	6.9
Purchasers Claiming the Homebuyer Credit***	371	70.1
Of Those Claiming the Credit****:		
Credit Caused Purchasers to Buy at This Time	189	50.9
Credit Caused Purchasers to Buy in the District	158	42.6
Purchasers with Previous Address in the District	79	50.0
Purchasers with Previous Address outside the District	79	50.0
Their Previous Address Was:		
In the District	228	61.5
In the Suburbs	68	18.3
Out of the Metro Area	72	19.4
Homebuyer Credit Claimants by Previous Homeownership Status****		
Claimants with Previous Address in the District		
First Home Ever Owned	228	61.5
Owned Home in Previous Address or Elsewhere	0	0.0
Claimants with Previous Address outside the District		
First Home Ever Owned	94	25.3
Owned Home in Previous Address or Elsewhere	46	12.5
Purchasers Claiming the Credit by Sales Price Bracket****:		
Less Than \$200,000	230	61.9
\$25,000 - \$100,000	90	24.2
\$100,000 - \$150,000	86	23.3
\$150,000 - \$200,000	53	14.4
Over \$200,000	142	38.2

* With support from the Fannie Mae Foundation, Local Initiatives Support Corporation and others, the Greater Washington Research Center conducted the survey in the end of 1998 and early 1999.

** The denominator for calculating "percent" is total surveys mailed.

*** The denominator for calculating "percent" is valid responses received.

**** The denominator for calculating "percent" is purchasers claiming the homebuyer credits.

Appendix Table 2a. Descriptive Statistics: Median Sales Prices in Montgomery County, MD

(Sales prices in \$1,000)

Year	Structure Type				Neighborhoods by Income				Neighborhoods by Race			
	Montgomery County, MD	Single Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
1987	139	161	93	66	193	109	93	93	148	127	110	
1988	160	190	113	67	235	126	115	115	167	149	137	
1989	182	225	125	76	275	145	133	133	190	171	150	
1990	184	220	132	80	267	150	129	129	190	170	158	
1991	180	216	135	94	255	149	137	137	188	165	165	
1992	190	225	140	101	258	154	135	135	202	168	165	
1993	188	222	140	92	262	155	134	134	204	170	157	
1994	189	226	135	89	266	155	136	136	205	170	156	
1995	187	225	135	78	270	149	130	130	205	162	154	
1996	189	223	136	72	256	150	135	135	205	162	149	
1997	194	229	141	68	269	152	130	130	215	163	147	
1998	200	234	143	70	279	154	130	130	223	172	155	
1999	210	250	149	81	293	162	140	140	226	180	172	
2000	228	275	159	85	330	172	150	150	245	203	179	
2001	250	315	178	95	376	193	160	160	261	237	210	
2002	276	341	197	112	400	225	188	188	290	250	250	

Appendix Table 2b. Descriptive Statistics: Median Sales Prices in Prince Georges County, MD

(Sales prices in \$1,000)

Year	Prince Georges County, MD		Structure Type			Neighborhoods by Income			Neighborhoods by Race		
	Year	Sales Price	Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	High-Minority	Moderate-Minority	High-Minority
1987	90	90	90	87	50	122	93	77	101	102	83
1988	101	102	102	96	56	143	106	84	118	114	90
1989	112	115	115	104	67	163	118	92	134	130	98
1990	123	125	125	113	69	183	128	99	142	139	108
1991	125	125	125	117	70	166	129	104	138	137	111
1992	125	129	129	119	70	168	130	110	137	145	116
1993	128	130	130	121	70	170	132	110	140	145	118
1994	128	130	130	119	73	167	132	106	140	143	116
1995	128	130	130	122	66	173	133	107	139	146	116
1996	130	131	131	122	69	175	135	109	138	145	119
1997	130	131	131	123	65	173	135	106	140	147	118
1998	130	130	130	123	61	188	133	107	140	150	118
1999	136	139	139	127	67	199	140	113	150	160	123
2000	139	142	142	129	65	200	145	113	155	160	124
2001	148	152	152	134	69	220	155	117	173	165	129
2002	157	162	162	140	79	224	165	130	186	177	138

Appendix Table 2c. Descriptive Statistics: Median Sales Prices in Alexandria City, VA

(Sales prices in \$1,000)

Year	Structure Type				Neighborhoods by Income				Neighborhoods by Race			
	Single Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority		
1987	155	145	80	187	124	160	160	181	125	153		
1988	171	160	98	256	133	160	160	229	144	107		
1989	213	195	102	280	153	195	195	256	158	142		
1990	220	211	116	280	183	230	230	258	165	213		
1991	205	185	114	273	170	190	190	243	163	178		
1992	210	179	115	275	172	198	198	249	169	179		
1993	210	189	108	285	174	184	184	248	169	165		
1994	210	200	114	284	160	195	195	260	164	164		
1995	225	224	109	285	186	168	168	257	195	151		
1996	202	200	103	265	170	164	164	240	178	104		
1997	219	201	102	292	173	186	186	271	190	110		
1998	232	219	103	329	198	192	192	284	204	168		
1999	240	230	108	336	210	228	228	305	229	176		
2000	265	252	110	351	232	282	282	320	258	195		
2001	306	286	122	404	250	321	321	354	306	199		
2002	350	346	150	450	299	359	359	420	335	235		

Appendix Table 2d. Descriptive Statistics: Median Sales Prices in Arlington County, VA

(Sales prices in \$1,000)

Year	Arlington County, VA				Structure Type				Neighborhoods by Income				Neighborhoods by Race			
	Single Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Income	Low-Income	High-Minority	Moderate-Minority	Low-Minority	High-Minority	Moderate-Minority	Low-Minority	High-Minority		
1987	129	162	175	103	186	126	91	140	115	87	115	140	115	87		
1988	138	198	183	110	246	137	102	150	126	93	126	150	126	93		
1989	160	235	218	115	279	155	119	173	137	118	137	173	137	118		
1990	165	220	222	125	262	160	128	173	148	135	148	173	148	135		
1991	169	222	223	120	258	161	121	191	150	117	150	191	150	117		
1992	180	220	230	132	252	171	133	200	154	135	154	200	154	135		
1993	175	221	229	139	258	168	150	197	157	145	157	197	157	145		
1994	178	227	234	134	265	166	142	190	157	128	157	190	157	128		
1995	161	224	219	115	270	168	64	190	148	50	148	190	148	50		
1996	185	226	222	133	275	173	127	208	155	100	155	208	155	100		
1997	185	227	244	130	275	171	132	201	162	95	162	201	162	95		
1998	199	244	219	138	299	185	132	216	177	102	177	216	177	102		
1999	202	267	240	141	316	192	127	230	179	100	179	230	179	100		
2000	225	309	293	148	375	207	145	257	180	149	180	257	180	149		
2001	250	360	345	171	417	235	165	283	210	155	210	283	210	155		
2002	299	419	443	205	485	282	230	340	258	203	258	340	258	203		

Appendix Table 2e. Descriptive Statistics: Median Sales Prices in Fairfax County, VA

(Sales prices in \$1,000)

Year	Fairfax County, VA				Structure Type				Neighborhoods by Income				Neighborhoods by Race			
	Single Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Income	Low-Income	High-Minority	Moderate-Minority	Low-Minority	High-Minority	Moderate-Minority	Low-Minority	High-Minority		
1987	145	185	120	80	178	120	70	149	112	71						
1988	163	220	138	91	205	137	78	170	122	78						
1989	175	244	154	97	222	150	85	185	129	84						
1990	173	238	154	105	220	150	91	180	139	90						
1991	173	229	150	105	213	150	103	179	143	114						
1992	178	231	151	100	220	150	92	183	144	105						
1993	180	238	153	99	225	150	90	185	136	127						
1994	184	250	156	99	231	152	99	190	138	109						
1995	181	241	155	100	225	153	98	189	132	107						
1996	183	241	155	105	227	156	98	190	140	105						
1997	185	245	154	100	230	155	97	191	135	110						
1998	191	253	155	96	235	161	101	199	148	114						
1999	199	272	165	98	243	169	105	205	166	125						
2000	211	315	177	106	270	178	99	220	170	113						
2001	237	355	205	122	302	200	120	245	187	129						
2002	254	375	233	139	324	217	119	265	199	129						

Appendix Table 3. Descriptive Statistics: Structure Traits, Neighborhood Characteristics and Neighborhood Events in Comparison Markets in Maryland and Virginia¹

Explanatory Variables	Montgomery County, MD		Prince Georges County, MD		Alexandria City, VA		Arlington County, VA		Fairfax County, VA	
Housing Unit Characteristics										
Lot Size (1,000 S. F.)	13.2	29.2	11.9	25.7	4.5	5.1	75.4	209.6	15.0	1455.5
Living Space (1,000 S. F.)	1.9	0.9	1.4	0.6	1.8	0.8	1.3	0.6	1.8	0.8
Number of Bedroom							2.2	1.1	3.3	0.9
Number of Bathroom	2.8	1.1	2.3	0.9	2.5	1.1	2.0	1.0	3.0	1.0
Total Rooms									7.5	2.1
Number of Story	1.7	0.5	1.7	0.5	2.1	0.6	1.5	0.6	1.8	0.4
Age of Unit When Sold (years)	23.0	20.2	26.8	21.3	42.9	37.9	35.9	22.7	14.3	13.4
Owner-occupied (%)	92.7		90.5		86.0		84.7		92.3	
Presence of Fireplace (%)	68.4		55.7		68.3		47.4		74.8	
Presence of Patio (%)	8.4		14.3		12.0		13.9		2.8	
Presence of Deck (%)	48.7		46.0		43.0		28.5		37.2	
Presence of Balcony (%)							18.5			
Type of Porch (%)										
Porch	26.8		19.8		27.0		25.3		16.6	
Screened Porch					5.5		6.2		3.6	
None					67.5		68.5		79.9	
Type of Basement (%)										
Basement	84.7		66.5		24.7				0.9	
Finished					39.4					
Walk-out							28.6			
Full							1.4		26.9	
Partial									3.3	
Daylight									6.6	
Partial Daylight									31.7	
None					35.9		70.0		30.6	
Parking Type (%)										
Garage (detached or attached)	25.1		85.8		5.7		13.7		34.9	
Basement	9.4		6.2		28.5		7.9		12.2	
Carport	4.7		6.5		3.9		2.0		3.9	
Build-In or Covered	12.9		1.5						1.3	
None	47.9				61.9		76.4		47.7	
Structure Type (%)										
Single-Family Detached	70.8		85.5		68.1		43.2		49.3	
Townhouse	24.1		14.5		31.9		4.9		34.1	
Condo	5.1		0.0		0.0		51.9		16.7	
Quality/Condition (%)										
Luxury	0.2									
Excellent	1.1									
Good	29.1		1.0							
Average	61.6		15.0							
Fair	2.9		83.7							
Other	5.1		0.2							
Exterior Wall Material (%)										
Aluminum/Brick									18.2	
Aluminum/Vinyl or Aluminum Siding	20.4				12.4		7.5		20.6	
Wood Siding									6.5	
Shingle	0.5				1.1		2.6			
Brick or Stone	26.4		27.2		78.1		84.2		18.0	
Brick/Shingle									0.7	
Frame	39.1		71.1		5.5					
Frame Wood/Brick	7.9		1.7						7.7	
Stucco	0.5						1.2		6.6	
Wood							3.7		19.0	
Block or Block/Alum									0.4	
Other	5.2				2.9		0.8		2.3	
Heat System (%)										
Forced Air					66.8		36.9			
Heat Pump			19.7		5.8		12.3		29.6	
Hot Air	89.0		72.4				1.3		67.0	

Hot water	1.4					11.2		1.9		
Radiant	3.9	6.1	24.1							
Electric Baseboard	0.4	1.7						1.3		
Gravity										
Warm Air						5.8				
Other	5.3	0.2	3.3			32.6		0.3		
Type of Air Conditioning (%)										
Central/Building Air Conditioning			84.4			42.0		98.0		
Separate System	1.7									
Split System	84.2	83.3								
Other	14.1									
Roof Materials (%)										
Built-up	0.8									
Asphalt Shingle			51.7			42.1				
Asbestos						1.3		0.9		
Composition Shingle/Roll Composition	85.1	99.5	9.3					88.8		
Slate	3.1		5.8			2.5				
Tar & Gravel								4.7		
Wood shake	5.2					1.0		4.4		
Other	5.8		33.1			53.1		1.2		
Locational Accessibility										
Workers whose travel time to work <25 minutes (%)	45.8	41.0	56.0			56.5		40.6		
Workers whose travel time to work 25-45 minutes (%)	31.4	34.5	30.3			33.9		33.6		
Workers whose travel time to work >45 minutes (%)	22.8	24.4	13.7			9.6		25.9		
Census Tract Characteristics										
Median family income (\$1,000)	68.2	20.4	52.1	10.8	59.2	19.1	57.2	15.6	66.9	14.9
Share of nonwhite population (%)	24.4		52.7		32.2		25.7		19.9	
Poverty rate (%)	3.5		4.8		7.3		7.1		2.9	
Affordability (%)	12.5		12.5		11.5		8.6		15.2	
Foreign-borns (%)	16.7		8.1		11.7		19.7		13.7	
Population aged 65 or older (%)	9.0		7.6		11.1		11.3		5.1	
Homeownership rate (%)	78.6		72.3		54.1		47.5		74.5	
Household size	2.9	0.3	3.0	0.3	2.3	0.3	2.1	0.4	2.8	0.4
Turnover (% owner households moved since 1985)	45.7		36.2		41.3		46.9		58.4	
Vacancy rate (%)	3.8		3.9		7.6		8.2		5.4	
Events & Neighborhood Developments (%)										
Low-Income Housing Tax Credit Projects ²	0.2		0.1		0.1		0.1		0.1	
No. of Observations	164,023	107,611	16,471		29,186		263,615			

1. Mean values and standard deviations are reported here, unless noted otherwise.

Appendix Table 4. Hedonic Regressions for Comparison Housing Markets in Suburban Maryland
(Dependent Variable: Log of Nominal Transaction Price)

Variable	Montgomery County		Prince Georges County	
	Coefficient	T	Coefficient	T
Intercept	10.449 ***	365.4	11.067 ***	336.0
Housing Unit Characteristics				
Lot Size (1,000 S. F.)	0.0004 ***	11.1	0.001 ***	21.5
Living Space (1,000 S. F.)	0.174 ***	92.9	0.155 ***	49.2
Number of Bathroom	0.059 ***	45.2	0.050 ***	26.7
Number of Story	0.002	0.6	0.002	0.6
Age of Unit When Sold (years)	-0.005 ***	-36.6	-0.007 ***	-39.1
Unit Age Squared	0.00005 ***	35.7	0.00004 ***	21.2
Owner-occupied ¹	0.058 ***	18.6	0.066 ***	18.1
Presence of Fireplace ²	0.095 ***	42.9	0.046 ***	18.4
Presence of Basement	0.093 ***	31.6	0.054 ***	21.0
Presence of Porch ²	0.020 ***	9.9	0.025 ***	8.2
Presence of Patio	-0.011	-3.4	-0.006	-1.5
Presence of Deck ²	0.054 ***	29.7	0.038 ***	15.2
Parking Type²				
Garage (detached or attached)	0.122 ***	45.5	-0.020 ***	-4.4
Basement	0.139 ***	44.6	0.026 ***	4.2
Build-In	0.022 ***	5.7	-0.073 ***	-7.4
Carport	0.044 ***	10.6		
Structure Type³				
Townhouse	-0.228 ***	-70.9	-0.124 ***	-30.3
Condo	-0.012	-0.3		
Quality/Condition⁴				
Luxury	0.168 ***	9.4		
Excellent	0.142 ***	16.8		
Good	0.082 ***	38.2	0.170 ***	15.1
Fair	-0.119 ***	-23.0	-0.073 ***	-18.0
Other	-0.346 ***	-11.8	-0.319 ***	-13.7
Exterior Wall Material⁵				
Shingle	0.003	0.3		
Brick/stone, brick/siding or stone/siding	0.043 ***	13.4	0.033 ***	11.3
Frame	-0.001	-0.4		
Frame/brick or frame/stone	0.032 ***	8.1	-0.008 ***	-0.9
Stucco	0.029 *	2.5		
Other	-0.015	-0.6	-0.053 ***	-0.6
Heat System⁶				
Heat Pump			-0.030 ***	-8.7
Hot water	0.022 **	3.0		
Radiant	0.056 ***	9.8	0.025 ***	4.8
Electirc baseboard	0.011	0.8	-0.051 ***	-6.1
Other	0.009	0.6	-0.104 ***	-3.7
Roof Materials⁷				
Composition shingle	0.026 **	2.9	-0.102 ***	-6.8
Slate	0.143 ***	13.8		

Wood shake	0.094 ***	9.6		
Other	0.083 ***	6.2		
Air Conditioning				
Split System	-0.034 ***	-4.4	0.083 ***	22.8
Other	-0.080 ***	-10.9		
Locational Accessibility				
Workers whose travel time to work <25 minutes (%)	0.008 ***	34.1	-0.001 ***	-6.5
Workers whose travel time to work 25-45 minutes (%)	0.007 ***	25.6	-0.002 ***	-6.5
Neighborhood Characteristics				
Median family income (\$1,000)	0.006 ***	73.6	0.007 ***	34.0
Share of nonwhite population (%)	-0.003 ***	-21.9	-0.002 ***	-23.1
Poverty rate (%)	0.004 ***	9.4	0.002 ***	7.2
Affordability	0.002 ***	7.1	-0.001 *	-2.2
Foreign-borns (%)	0.007 ***	36.2	0.004 ***	22.6
Population aged 65 or older (%)	0.004 ***	13.8	0.008 ***	19.4
Homeownership rate (%)	-0.001 ***	-8.4	-0.002 ***	-28.4
Household size	-0.107 ***	-27.3	0.002	0.3
Turnover (% owner households moved since 1985)	0.000 ***	6.3	0.001 ***	6.8
Vacancy rate (%)	-0.004 ***	-10.0	-0.005 ***	-11.3
Events & Neighborhood Developments				
Low-Income Housing Tax Credit Projects ²	-0.006 ***	-3.8	0.002	0.7
September 11 Terrorist Attack ⁸	0.047 ***	5.9	0.040 ***	4.0
Transaction Date⁹				
1988	0.159 ***	34.6	0.097 ***	15.5
1989	0.304 ***	64.2	0.198 ***	32.1
1990	0.321 ***	65.4	0.262 ***	42.7
1991	0.293 ***	60.8	0.259 ***	40.9
1992	0.298 ***	63.8	0.288 ***	46.6
1993	0.301 ***	65.7	0.298 ***	49.1
1994	0.308 ***	66.2	0.299 ***	49.0
1995	0.285 ***	60.3	0.306 ***	49.8
1996	0.272 ***	58.6	0.313 ***	50.8
1997	0.286 ***	62.0	0.302 ***	50.2
1998	0.318 ***	71.5	0.318 ***	47.5
1999	0.396 ***	89.3	0.389 ***	59.4
2000	0.496 ***	112.1	0.415 ***	70.8
2001	0.630 ***	136.0	0.482 ***	80.0
2002	0.796 ***	163.6	0.623 ***	98.9
Adjusted R²	0.713		0.466	
Number of Observations	164,023		107,611	

Note: 1. Omitted variable is renter-occupied. 2. Omitted variable is "none." 3. Omitted variable is single family detached. 4. Or 5. Omitted variable is "aluminum siding/vinyl." 6. Omitted variable is "heat pump". 7. Omitted variable is "built-up." 8. The variable is 1 if the sales took place in Oct. and Nov. of 2001, 0 otherwise. 9. Omitted variable is "1987".

*** p<0.001, ** p<0.01, * p<0.05, +p<0.1.

Appendix Table 5. Hedonic Regressions for Comparison Housing Markets in Suburban Virginia
(Dependent Variable: Log of Nominal Transaction Price)

Variable	Alexandria City		Arlington County		Fairfax County	
	Coefficient	T	Coefficient	T	Coefficient	T
Intercept	11.278 ***	86.7	11.022 ***	98.1	11.336 ***	680.9
Housing Unit Characteristics						
Lot Size (1,000 S. F.)	0.0103900 ***	14.9	-0.0000263 +	-1.9	0.0000003	1.1
Living Space (1,000 S. F.)	0.231 ***	38.5	0.195 ***	30.7	0.175 ***	140.1
Number of Bedroom			0.067 ***	22.0	0.018 ***	17.8
Number of Bathroom	0.053 ***	13.1	0.080 ***	21.6	0.052 ***	61.9
Total Rooms					0.017 ***	34.0
Number of Story	0.026 ***	4.4	0.047 ***	9.1	-0.019 ***	-11.3
Age of Unit When Sold (years)	-0.001 *	-2.4	-0.014 ***	-36.4	-0.015 ***	-125.3
Unit Age Squared	0.000010 ***	7.6	0.000132 ***	27.0	0.000172 ***	85.6
Owner-occupied ¹	0.057 ***	8.1	0.084 ***	14.7	0.032 ***	17.9
Central/Building Air Conditioning ²	0.081 ***	10.6	0.080 ***	9.3	-0.002 ***	-0.5
Presence of Fireplace ²	0.171 ***	24.3	0.059 ***	9.9	0.091 ***	69.3
Presence of Patio ²	0.008	0.9	0.030 ***	3.9	0.012 ***	4.1
Presence of Deck ²	0.018 **	3.1	0.034 ***	5.1	0.020 ***	18.1
Presence of Balcony ²			0.061 ***	8.8		
Type of Porch ²						
Porch	0.027 ***	4.1	0.033 ***	4.9	0.017 ***	13.0
Screened Porch	0.054 ***	4.8	0.064 ***	6.5	0.050 ***	19.5
Type of Basement ²						
Basement	0.017	1.6			0.084 ***	16.2
Finished	-0.056 ***	-8.7				
Walk-out			0.051 ***	7.6		
Full			0.035 +	1.7	0.044 ***	26.9
Partial					0.063 ***	22.1
Daylight					0.076 ***	31.0
Partial Daylight					0.070 ***	39.9
Parking Type ²						
Garage (detached or attached)	0.064 ***	5.2	0.035 ***	4.8	0.071 ***	37.6
Basement	0.086 ***	9.2	0.054 ***	5.6	0.090 ***	51.7
Carport	0.069 ***	5.3	0.053 ***	3.6	0.045 ***	16.5
Build-In or Covered					0.274 ***	60.3
Structure Type ³						
Townhouse	-0.065 ***	-10.5	-0.283 ***	-21.8	-0.217 ***	-95.4
Condo			-0.409 ***	-26.8	-0.445 ***	-157.4
Exterior Wall Material ⁴						
Aluminum/Vinyl or Aluminum Siding	0.039 **	3.0			-0.028 ***	-17.3
Wood Siding					0.014 ***	6.4
Shingle	0.033	1.3	0.083 ***	5.7		
Brick or Stone	0.075 ***	6.5	0.150 ***	16.6	0.004 *	2.3
Brick/Shingle					0.025 ***	4.3
Frame Wood/Brick					0.024 ***	11.2
Stucco			0.090 ***	4.5	-0.029 ***	-13.1
Wood			0.088 ***	6.8	-0.019 ***	-12.4
Block or Block/Alum					0.009	1.1
Other	0.057 **	3.2	0.090 ***	3.8	-0.010 **	-2.7
Heat System ⁵						
Heat Pump	0.076 ***	6.5	-0.150 ***	-8.0	0.005	0.6
Hot Air					-0.007	-0.8
Hot water			-0.005	-0.4	0.011	1.2
Radiant	0.017 *	2.3				
Electric Baseboard					-0.027 **	-2.8
Forced Air			-0.057 ***	-3.9		
Gravity			0.043 ***	4.6		
Warm Air			-0.187 ***	-18.0		

Other	-0.008	-0.6				
Roof Materials ⁵					0.026 ***	5.2
Asbestos			0.119 ***	6.4		
Roll Composition	-0.069 ***	-7.0				
Slate	0.106 ***	9.1	0.106 ***	7.8		
Tar & Gravel					-0.023 ***	-8.3
Wood shake			0.060 **	2.8	0.094 ***	38.6
Other	0.080 ***	11.3	-0.036 **	-3.0	-0.050 ***	-11.4
Locational Accessibility						
Workers whose travel time to work <25 minutes (%)	-0.003 **	-3.2	0.008 ***	6.8	0.001 ***	12.2
Workers whose travel time to work 25-45 minutes (%)	-0.005 ***	-4.2	0.010 ***	8.4	0.003 ***	16.5
Neighborhood Characteristics						
Median family income (\$1,000)	0.003 ***	6.5	0.007 ***	11.3	0.007 ***	105.3
Share of nonwhite population (%)	-0.003 ***	-4.8	-0.001	-1.5	-0.003 ***	-30.1
Poverty rate (%)	-0.001	-0.9	-0.012 ***	-8.0	0.001 *	2.4
Affordability	0.014 ***	17.0	-0.002 *	-2.4	0.002 ***	9.1
Foreign-borns (%)	-0.011 ***	-19.6	0.002 **	2.7	0.007 ***	50.5
Population aged 65 or older (%)	0.009 ***	6.5	-0.024 ***	-24.9	0.007 ***	32.3
Homeownership rate (%)	-0.005 ***	-13.2	-0.001 *	-2.5	-0.003 ***	-36.2
Household size	-0.016	-0.8	-0.194 ***	-16.2	-0.139 ***	-61.0
Turnover (% owner households moved since 1985)	0.003 ***	4.5	-0.002 ***	-6.7	-0.002 ***	-30.4
Vacancy rate (%)	0.004 ***	4.3	0.003 ***	6.7	-0.004 ***	-28.9
Events & Neighborhood Developments						
Low-Income Housing Tax Credit Projects ²	-0.043 ***	-3.6	-0.028 ***	-4.7	0.023 ***	16.5
September 11 Terrorist Attack ⁷	0.064 **	2.8	0.080 ***	4.2	0.041 ***	8.7
Transaction Date⁸						
1988	0.170 ***	10.4	0.121 ***	10.4	0.163 ***	62.1
1989	0.284 ***	16.9	0.253 ***	21.0	0.276 ***	101.7
1990	0.317 ***	18.9	0.269 ***	21.6	0.276 ***	96.3
1991	0.256 ***	14.8	0.238 ***	19.0	0.242 ***	85.4
1992	0.268 ***	16.8	0.252 ***	20.9	0.228 ***	83.9
1993	0.254 ***	16.1	0.274 ***	23.8	0.224 ***	83.8
1994	0.276 ***	17.7	0.225 ***	18.8	0.247 ***	93.0
1995	0.274 ***	17.6	0.191 ***	15.9	0.237 ***	85.2
1996	0.241 ***	15.4	0.232 ***	19.1	0.232 ***	85.0
1997	0.260 ***	17.4	0.238 ***	20.0	0.233 ***	86.1
1998	0.325 ***	22.5	0.291 ***	25.9	0.270 ***	103.8
1999	0.387 ***	27.3	0.380 ***	32.3	0.344 ***	130.6
2000	0.509 ***	35.6	0.503 ***	44.7	0.463 ***	174.8
2001	0.624 ***	42.3	0.647 ***	55.7	0.603 ***	218.2
2002	0.823 ***	55.7	0.874 ***	75.9	0.725 ***	206.6
Adjusted R²	0.704		0.691		0.811	
Number of Observations	16,471		29,186		263,615	

Note: 1. Omitted variable is renter-occupied. 2. Omitted variable is "none." 3. Omitted variable is single family detached. 4. Omitted variable is "frame" for Alexandria City, "aluminum siding/vinyl" for Arlington County, and "aluminum/brick" for Fairfax County. 5. Omitted variable is "forced air" for Alexandria City and "heat pump" for both Arlington and Fairfax Counties. 6. Omitted variable is "asphalt shingle" for Alexandria City and Arlington County, and "roll composition" for Fairfax County. 7. The 9/11 dummy variable has a value of 1 if the sales took place in Oct. and Nov. of 2001, 0 otherwise. 8. Omitted variable is "1987".
*** p<0.001, ** p<0.01, * p<0.05, +p<0.1.

Appendix Table 6. Cumulative Price Appreciation Rate in Comparison Markets: Montgomery County, MD

Year	Montgomery County, MD	Structure Type				Neighborhoods by Income				Neighborhoods by Race			
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	High-Minority	Moderate-Minority	Low-Minority
Cumulative Appreciation Rate													
Since 1987 (%)**													
1988	17.3	19.3	11.6	6.9	19.9	14.4	15.3	17.0	18.6	17.6			
1989	35.5	38.1	30.3	23.7	39.3	31.1	36.5	35.7	35.5	36.9			
1990	37.8	38.1	36.9	32.1	38.4	36.3	37.3	38.2	36.9	42.8			
1991	34.0	33.1	34.5	35.9	31.4	34.2	39.8	33.1	35.2	42.6			
1992	34.7	32.4	38.6	35.6	32.2	33.8	43.8	33.1	37.9	38.6			
1993	35.1	34.2	35.3	32.5	34.1	32.0	44.8	33.2	39.3	39.9			
1994	36.1	36.1	34.8	43.2	35.1	34.1	41.9	35.2	39.0	37.6			
1995	33.0	32.7	35.5	35.1	32.5	30.9	42.6	31.9	38.0	35.3			
1996	31.3	31.0	34.7	33.4	29.2	30.8	43.4	29.9	36.8	36.4			
1997	33.1	32.5	37.9	27.8	33.7	29.4	40.1	32.7	36.1	30.8			
1998	37.4	38.2	39.8	28.8	39.0	33.1	42.0	37.0	40.4	36.5			
1999	48.5	50.1	47.6	36.0	50.5	43.2	53.5	47.2	52.7	53.3			
2000	64.1	67.3	62.1	46.2	69.7	54.1	70.4	62.6	68.8	67.3			
2001	87.8	92.0	85.0	76.4	94.9	77.2	90.8	87.6	88.9	92.5			
2002	121.7	128.0	119.4	100.3	127.4	111.0	135.7	120.6	126.6	134.9			

Note: ** The appreciation rate shown in this table is calculated as the antilog (to base e) of the coefficient on time dummies minus 1. For example, 121.7% for 2002 (for Montgomery County) is calculated from the antilog of 0.79604 (2.21675) minus 1. This is consistent with the work of Halvorsen and Palmquist (1980) and explained in Gujarati (1995: page 525).

Appendix Table 7. Cumulative Price Appreciation Rate in Comparison Markets: Prince Georges County, MD

Year	Prince Georges County, MD				Neighborhoods by Income				Neighborhoods by Race				
	Single Family Detached	Townhouse	Condo*	Structure Type	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	Low-Minority	Moderate-Minority	High-Minority
1988	10.2	10.5	9.2		7.5	12.4	5.6	14.6	9.8	8.8			
1989	21.9	22.2	20.7		20.1	24.6	15.0	30.1	22.4	18.5			
1990	30.0	30.5	29.6		29.3	32.4	23.3	37.1	30.4	27.3			
1991	29.5	29.5	32.3		16.2	31.3	27.5	31.3	27.4	29.6			
1992	33.3	32.5	36.2		20.5	34.4	31.2	33.9	31.1	33.6			
1993	34.7	33.4	43.2		21.2	36.3	32.0	32.5	32.5	36.1			
1994	34.8	35.4	35.1		19.8	37.0	30.9	36.4	32.0	35.3			
1995	35.8	35.2	43.0		20.4	39.0	30.6	37.7	31.8	36.2			
1996	36.7	36.3	43.9		19.0	39.7	33.2	35.1	34.0	38.5			
1997	35.3	34.9	43.4		18.6	38.0	32.1	34.7	32.6	36.8			
1998	37.5	37.3	44.4		21.4	40.1	33.4	35.6	34.0	39.9			
1999	47.5	48.9	43.9		31.0	50.6	42.0	48.8	46.4	47.4			
2000	51.4	52.6	51.4		37.7	54.6	45.1	52.2	52.6	50.6			
2001	62.0	63.5	60.1		53.1	65.1	53.3	67.6	61.2	59.8			
2002	86.5	89.0	82.2		72.6	89.6	77.6	92.4	85.8	83.1			

Note: ** Except for condo, the appreciation rate shown in this table is calculated as the antilog (to base e) of the coefficient on time dummies minus 1. For example, 86.5% for 2002 (for PG County) is calculated from the antilog of 0.62327 (1.865) minus 1. This is consistent with the work of Halvorsen and Palmquist (1980) and explained in Gujarati (1995; page 525).

* Saving for condo, all rates have been adjusted for housing unit traits, location accessibility, neighborhood characteristics, as well as events and neighborhood-based housing developments. Because the assessor's office provides little information about physical characteristics of condominium units in this county, their appreciation rates are therefore calculated directly from transaction prices without controls for quality and other characteristics.

Appendix Table 8. Cumulative Price Appreciation Rate in Comparison Markets: Alexandria City, VA

Year	Alexandria City, VA	Structure Type				Neighborhoods by Income				Neighborhoods by Race			
		Single Detached	Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
Cumulative Appreciation Rate													
Since 1987 (%)**													
1988	18.6	15.6	26.1	23.9	24.2	19.8	6.4	20.7	23.9	8.2			
1989	32.9	30.0	40.0	28.1	42.8	32.1	15.7	38.1	34.6	21.0			
1990	37.4	35.4	42.6	45.3	36.8	41.2	24.6	43.1	38.3	26.3			
1991	29.2	28.3	33.7	43.9	34.0	35.8	-1.1	33.8	38.3	4.1			
1992	30.7	30.6	32.0	44.7	36.0	30.8	17.0	34.9	33.5	18.8			
1993	29.0	28.1	31.1	35.8	35.6	31.8	8.0	33.8	32.9	14.0			
1994	31.8	31.1	33.6	43.7	42.2	30.8	19.8	38.7	33.9	18.5			
1995	31.5	28.7	35.1	37.1	37.8	35.7	9.4	36.5	39.3	5.9			
1996	27.2	25.9	32.0	29.6	34.9	29.9	12.2	34.4	33.2	6.7			
1997	29.7	29.0	31.3	27.7	40.2	27.5	21.5	38.8	36.7	1.2			
1998	38.4	39.5	33.2	29.6	46.8	38.6	16.8	44.4	38.8	26.6			
1999	47.2	48.9	41.2	35.8	60.2	46.2	35.3	57.4	48.7	27.7			
2000	66.3	68.8	60.1	38.3	76.3	65.7	55.4	73.7	69.3	52.8			
2001	86.7	88.6	82.1	53.5	99.9	86.5	76.5	94.2	92.3	74.4			
2002	127.6	128.3	124.3	88.7	134.4	132.5	115.2	132.7	135.5	117.5			

Note: ** The appreciation rate shown in this table is calculated as the antilog (to base e) of the coefficient on time dummies minus 1. For example, 127.6% for 2002 (for Alexandria City) is calculated from the antilog of 0.82259 (2.27638) minus 1. This is consistent with the work of Halvorsen and Palmquist (1980) and explained in Gujarati (1995: page 625).

Appendix Table 9. Cumulative Price Appreciation Rate in Comparison Markets: Arlington County, VA

Year	Arlington County, VA	Structure Type			Neighborhoods by Income				Neighborhoods by Race			
		Single Family Detached	Townhouse	Condo	High- Income	Middle Income	Moderate/ Income	Low- Income	Low- Minority	Moderate- Minority	High- Minority	
Cumulative Appreciation Rate												
Since 1987 (%)**												
1988	12.8	19.0	15.1	8.0	23.6	9.9	11.9	15.5	6.8	13.4		
1989	28.8	38.2	35.0	24.5	41.1	24.2	30.4	29.5	25.6	33.9		
1990	30.9	39.9	35.8	24.2	36.5	26.1	35.9	29.4	29.4	42.3		
1991	26.9	34.8	29.6	22.3	31.1	23.1	30.6	25.5	24.1	34.1		
1992	28.6	36.1	24.6	23.6	31.8	24.9	27.2	27.5	23.8	30.4		
1993	31.5	36.9	40.3	22.8	38.9	26.9	22.1	31.2	20.1	27.6		
1994	25.2	35.9	33.7	15.6	38.0	20.3	20.9	27.1	16.5	17.0		
1995	21.1	37.2	18.3	11.7	40.0	20.1	13.0	26.4	15.8	15.2		
1996	26.1	37.8	25.7	16.7	42.3	21.1	17.3	29.1	14.1	22.1		
1997	26.9	42.0	41.6	12.1	44.0	22.6	15.9	28.1	18.9	26.9		
1998	33.7	53.0	31.6	16.6	55.0	28.7	20.5	36.4	23.2	31.4		
1999	46.2	71.9	48.8	25.4	68.6	43.1	27.7	49.6	38.5	33.5		
2000	65.4	96.4	63.5	43.5	94.7	57.7	51.5	68.6	49.6	64.3		
2001	91.1	121.3	94.6	72.1	121.0	83.3	74.3	92.0	74.3	104.5		
2002	139.6	171.3	133.8	117.9	165.4	126.4	135.2	139.3	124.2	150.7		

Note: ** The appreciation rate shown in this table is calculated as the antilog (to base e) of the coefficient on time dummies minus 1. For example, 141.4% for 2002 (for Arlington County) is calculated from the antilog of 0.88128 (2.41399) minus 1. This is consistent with the work of Halvorsen and Palmquist (1980) and explained in Gujarati (1995: page 525).

Appendix Table 10. Cumulative Price Appreciation Rate in Comparison Markets: Fairfax County, VA

Year	Fairfax County, VA	Structure Type				Neighborhoods by Income				Neighborhoods by Race			
		Single Family Detached	Townhouse	Condo	High-Income	Middle Income	Moderate/Low Income	Low Income	Low-Minority	Moderate-Minority	High-Minority		
1988	17.7	19.8	16.4	12.6	19.1	16.5	15.5	17.7	18.1	11.9			
1989	31.8	33.0	31.1	27.2	32.1	31.6	27.9	31.9	32.3	21.7			
1990	31.8	29.9	31.9	32.7	29.8	32.7	36.4	31.0	36.9	30.8			
1991	27.3	24.4	28.5	28.8	25.4	28.3	32.4	26.9	31.4	25.2			
1992	25.6	24.1	27.1	26.5	24.3	26.6	27.2	25.3	29.6	22.5			
1993	25.1	25.8	24.9	21.1	24.2	26.4	20.3	25.0	26.9	15.8			
1994	28.0	30.4	27.1	20.6	28.7	27.3	21.2	28.2	27.5	16.9			
1995	26.7	28.7	27.1	19.4	27.6	26.1	18.0	27.1	24.9	15.8			
1996	26.1	28.3	26.3	18.6	27.0	26.1	13.9	26.4	26.0	9.5			
1997	26.3	29.7	26.8	16.9	28.3	25.5	11.3	27.0	22.4	8.9			
1998	31.0	37.0	28.7	17.9	34.4	29.2	7.9	31.9	25.1	5.8			
1999	41.1	51.0	36.4	23.7	46.0	37.7	18.0	42.1	32.0	16.3			
2000	58.9	73.7	54.0	39.5	66.5	54.1	27.5	60.6	45.3	26.4			
2001	82.8	97.7	79.2	66.5	90.0	78.7	53.6	84.5	70.1	53.0			
2002	106.4	117.8	105.5	94.7	112.1	104.7	72.7	108.9	90.2	74.1			

Note: ** The appreciation rate shown in this table is calculated as the antilog (to base e) of the coefficient on time dummies minus 1. For example, 106.4% for 2002 (for Fairfax County) is calculated from the antilog of 0.72476 (2.06424) minus 1. This is consistent with the work of Halvorsen and Palmquist (1980) and explained in Gujarati (1995; page 525).

Appendix Table 11. Annual Price Appreciation Rate in Comparison Markets: Montgomery County, MD**

Year	Montgomery County	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
Appreciation Rate¹											
1988	17.3	19.3	11.6	6.9	19.9	14.4	15.3	17.0	18.6	17.6	
1989	15.6	15.7	16.7	15.7	16.2	14.6	18.4	16.0	14.3	16.3	
1990	1.7	0.0	5.1	6.8	-0.7	3.9	0.6	1.8	1.0	4.4	
1991	-2.7	-3.6	-1.7	2.9	-5.1	-1.5	1.8	-3.6	-1.3	-0.2	
1992	0.5	-0.5	3.0	-0.2	0.7	-0.3	2.8	0.0	2.0	-2.8	
1993	0.3	1.3	-2.4	-2.3	1.4	-1.4	0.7	0.1	1.0	1.0	
1994	0.7	1.4	-0.4	8.1	0.8	1.6	-2.0	1.5	-0.2	-1.6	
1995	-2.3	-2.5	0.6	-5.6	-2.0	-2.4	0.4	-2.4	-0.8	-1.7	
1996	-1.3	-1.3	-0.6	-1.3	-2.5	-0.1	0.6	-1.5	-0.8	0.8	
1997	1.4	1.2	2.4	-4.2	3.5	-1.1	-2.3	2.1	-0.5	-4.1	
1998*	3.3	4.3	1.4	0.8	3.9	2.9	1.4	3.2	3.1	4.4	
1999*	8.1	8.6	5.6	5.6	8.3	7.6	8.1	7.4	8.7	12.3	
2000*	10.5	11.4	9.8	7.5	12.7	7.6	11.0	10.5	10.6	9.1	
2001*	14.4	14.8	14.1	20.6	14.9	15.0	12.0	15.4	11.9	15.0	
2002*	18.0	18.8	18.6	13.6	16.7	19.1	23.5	17.6	20.0	22.1	
Arithmetic Return (%)	5.7	5.9	5.6	5.0	5.9	5.3	6.2	5.7	5.8	6.2	
Standard Deviation	7.5	8.1	6.9	7.5	8.1	7.3	8.1	7.6	7.5	8.6	
Sub-periods											
1987 - 1997											
Arithmetic Return (%)	3.1	3.1	3.4	2.7	3.2	2.8	3.6	3.1	3.3	3.0	
Standard Deviation	7.2	7.8	6.2	6.7	8.2	6.4	7.2	7.3	7.0	7.8	
1998 - 2002											
Arithmetic Return (%)	10.9	11.6	9.9	9.6	11.3	10.4	11.2	10.8	10.9	12.6	
Standard Deviation	5.7	5.6	6.8	7.7	5.2	6.5	8.0	5.8	6.1	6.6	

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $rt = (Rt - Rt-1)/(1+Rt-1)$ or $rt = (1 + Rt)/(1 + Rt-1) - 1$
 Where, r_t is annual appreciation rate for year t , R_t is cumulative price appreciation rate for year t , and R_{t-1} is cumulative price appreciation rate for year $t-1$.
 * This period of time is identical to the "impact period" in Washington, DC.

Appendix Table 12. Annual Price Appreciation Rate in Comparison Markets: Prince Georges County, MD**

Year	Prince Georges County	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
<u>Appreciation Rate¹</u>											
1988	10.2	10.5	9.2	12.0	7.5	12.4	5.6	14.6	9.8	8.8	
1989	10.6	10.6	10.5	20.5	11.8	10.8	9.0	13.6	11.5	8.9	
1990	6.6	6.8	7.4	1.7	7.6	6.2	7.2	5.4	6.5	7.4	
1991	-0.3	-0.7	2.1	1.3	-10.1	-0.9	3.4	-4.2	-2.3	1.8	
1992	2.9	2.4	3.0	0.6	3.7	2.4	2.9	1.9	2.9	3.0	
1993	1.1	0.7	5.1	-0.3	0.6	1.4	0.6	-1.0	1.1	1.9	
1994	0.0	1.5	-5.7	4.2	-1.2	0.6	-0.9	2.9	-0.4	-0.6	
1995	0.7	-0.2	5.9	-9.3	0.5	1.4	-0.2	1.0	-0.1	0.7	
1996	0.7	0.8	0.6	4.3	-1.2	0.5	1.9	-1.9	1.7	1.6	
1997	-1.0	-1.1	-0.3	-5.4	-0.3	-1.2	-0.8	-0.3	-1.1	-1.2	
1998*	1.6	1.8	0.7	-6.8	2.4	1.5	1.0	0.7	1.1	2.3	
1999*	7.3	8.4	-0.3	10.6	7.9	7.5	6.4	9.7	9.3	5.4	
2000*	2.7	2.5	5.2	-3.0	5.1	2.7	2.1	2.3	4.2	2.1	
2001*	7.0	7.2	5.7	6.2	11.2	6.7	5.7	10.1	5.7	6.1	
2002*	15.2	15.6	13.8	14.5	12.7	14.9	15.9	14.8	15.2	14.5	
Arithmetic Return (%)	4.3	4.4	4.2	3.4	3.9	4.5	4.0	4.6	4.3	4.2	
Standard Deviation	4.9	5.1	5.0	8.3	6.1	5.0	4.5	6.3	5.2	4.3	
<u>Sub-periods</u>											
1987 - 1997											
Arithmetic Return (%)	3.2	3.1	3.8	3.0	1.9	3.4	2.9	3.2	3.0	3.2	
Standard Deviation	4.4	4.5	4.9	8.4	6.1	4.8	3.4	6.3	4.7	3.8	
1998 - 2002											
Arithmetic Return (%)	6.7	7.1	5.0	4.3	7.9	6.7	6.2	7.5	7.1	6.1	
Standard Deviation	5.3	5.6	5.6	9.0	4.3	5.2	5.9	5.9	5.4	5.0	

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $rt = (Rt - Rt-1)/(1 + Rt-1)$ or $rt = (1 + Rt)/(1 + Rt-1) - 1$
 Where, r_t is annual appreciation rate for year t , R_t is cumulative price appreciation rate for year t , and R_{t-1} is cumulative price appreciation rate for year $t-1$.
 * This period of time is identical to the "impact period" in Washington, DC.

Appendix Table 13. Annual Price Appreciation Rate in Comparison Markets: Alexandria City, VA**

Year	Alexandria City	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
Appreciation Rate¹											
1988	18.6	15.6	26.1	23.9	24.2	19.8	6.4	20.7	23.9	8.2	
1989	12.1	12.5	11.0	3.4	14.9	10.3	8.6	14.5	8.6	11.8	
1990	3.3	4.1	1.8	13.4	-4.2	6.9	7.7	3.6	2.8	4.4	
1991	-5.9	-5.3	-6.2	-1.0	-2.1	-3.8	-20.6	-6.5	0.0	-17.6	
1992	1.2	1.8	-1.3	0.5	1.5	-3.7	18.3	0.9	-3.5	14.2	
1993	-1.4	-1.9	-0.7	-6.1	-0.3	0.8	-7.6	-0.8	-0.4	-4.1	
1994	2.2	2.4	1.9	5.8	4.9	-0.7	10.8	3.6	0.7	3.9	
1995	-0.2	-1.8	1.1	-4.6	-3.1	3.7	-8.7	-1.5	4.0	-10.6	
1996	-3.2	-2.2	-2.3	-5.5	-2.1	-4.2	2.5	-1.5	-4.3	0.8	
1997	1.9	2.5	-0.5	-1.5	3.9	-1.8	8.3	3.3	2.6	-5.1	
1998*	6.7	8.1	1.5	1.5	4.8	8.7	-3.8	4.0	1.6	25.1	
1999*	6.4	6.7	6.0	4.8	9.1	5.5	15.8	9.0	7.1	0.9	
2000*	13.0	13.4	13.4	1.8	10.0	13.4	14.8	10.3	13.9	19.6	
2001*	12.2	11.7	13.7	11.0	13.4	12.5	13.6	11.8	13.5	14.1	
2002*	21.9	21.1	23.2	23.0	17.2	24.6	22.0	19.8	22.5	24.7	
Arithmetic Return (%)	5.9	5.9	5.9	4.7	6.2	6.1	5.9	6.1	6.2	6.0	
Standard Deviation	8.1	7.6	9.5	9.4	8.5	8.8	11.6	8.0	8.7	12.5	
Sub-periods											
1987 - 1997											
Arithmetic Return (%)	2.9	2.8	3.1	2.8	3.8	2.7	2.6	3.6	3.4	0.6	
Standard Deviation	7.3	6.6	9.2	9.5	9.1	7.7	11.5	8.1	8.1	10.0	
1998 - 2002											
Arithmetic Return (%)	12.1	12.2	11.6	8.4	10.9	12.9	12.5	11.0	11.7	16.9	
Standard Deviation	6.3	5.6	8.3	9.0	4.7	7.3	9.7	5.7	7.9	10.0	

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $rt = (Rt - Rt-1)/(1+Rt-1)$ or $rt = (1 + Rt)/(1 + Rt-1) - 1$
 Where, r_t is annual appreciation rate for year t , R_t is cumulative price appreciation rate for year t , and R_{t-1} is cumulative price appreciation rate for year $t-1$.
 * This period of time is identical to the "impact period" in Washington, DC.

Appendix Table 14. Annual Price Appreciation Rate in Comparison Markets: Arlington County, VA**

Year	Arlington County	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
		Single Family Detached	Townhouse	Condo	Moderate/Middle Income	High Income	Low Income	Low-Minority	Moderate-Minority	High-Minority	
Appreciation Rate¹											
1988	12.8	19.0	15.1	8.0	23.6	9.9	11.9	15.5	6.8	13.4	
1989	14.2	16.1	17.3	15.2	14.2	13.0	16.5	12.1	17.7	18.1	
1990	1.6	1.3	0.6	-0.2	-3.3	1.6	4.2	-0.1	3.0	6.3	
1991	-3.1	-3.7	-4.6	-1.6	-3.9	-2.4	-3.9	-3.0	-4.1	-5.8	
1992	1.4	0.9	-3.9	1.1	0.6	1.5	-2.6	1.5	-0.2	-2.8	
1993	2.2	0.6	12.6	-0.7	5.3	1.6	-4.0	2.9	-2.9	-2.1	
1994	-4.7	-0.7	-4.7	-5.8	-0.6	-5.2	-1.0	-3.1	-3.0	-8.3	
1995	-3.3	1.0	-11.5	-3.4	1.4	-0.1	-6.5	-0.5	-0.6	-1.6	
1996	4.1	0.4	6.3	4.4	1.7	0.8	3.7	2.1	-1.4	6.0	
1997	0.6	3.1	12.6	-3.9	1.2	1.2	-1.2	-0.8	4.2	3.9	
1998*	5.4	7.7	-7.1	3.9	7.7	5.0	3.9	6.5	3.6	3.6	
1999*	9.3	12.4	13.0	7.6	8.7	11.2	6.0	9.7	12.4	1.6	
2000*	13.1	14.2	9.9	14.4	15.5	10.2	18.6	12.7	8.1	23.1	
2001*	15.5	12.7	19.0	19.9	13.5	16.2	15.0	13.8	16.5	24.5	
2002*	25.4	22.6	20.1	26.6	20.1	23.5	34.9	24.7	28.6	22.6	
Arithmetic Return (%)	6.3	7.2	6.3	5.7	7.0	5.9	6.4	6.3	5.9	6.8	
Standard Deviation	8.5	8.3	10.6	9.5	8.6	7.9	11.2	8.2	9.3	10.9	
Sub-periods											
1987 - 1997											
Arithmetic Return (%)	2.6	3.8	4.0	1.3	4.0	2.2	1.7	2.7	1.9	2.7	
Standard Deviation	6.4	7.5	10.1	6.3	8.6	5.4	7.5	6.2	6.5	8.4	
1998 - 2002											
Arithmetic Return (%)	13.8	13.9	11.0	14.5	13.1	13.2	15.7	13.5	13.8	15.1	
Standard Deviation	7.6	5.4	10.9	9.2	5.1	7.0	12.4	6.9	9.6	11.4	

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $r_t = (R_t - R_{t-1}) / (1 + R_{t-1})$ or $r_t = (1 + R_t) / (1 + R_{t-1}) - 1$
 Where, r_t is annual appreciation rate for year t , R_t is cumulative price appreciation rate for year t , and R_{t-1} is cumulative price appreciation rate for year $t-1$.
 * This period of time is identical to the "impact period" in Washington, DC.

Appendix Table 15. Annual Price Appreciation Rate in Comparison Markets: Fairfax County, MD**

Year	Structure Type				Neighborhoods by Income			Neighborhoods by Race		
	Fairfax County	Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority
Appreciation Rate¹										
1988	17.7	19.8	16.4	12.6	19.1	16.5	15.5	17.7	18.1	11.9
1989	12.0	11.0	12.6	12.9	10.9	13.0	10.7	12.0	12.1	8.8
1990	0.0	-2.3	0.7	4.3	-1.7	0.8	6.6	-0.6	3.5	7.5
1991	-3.4	-4.2	-2.6	-2.9	-3.4	-3.3	-2.9	-3.2	-4.0	-4.3
1992	-1.3	-0.3	-1.1	-1.8	-0.9	-1.4	-3.9	-1.3	-1.4	-2.1
1993	-0.4	1.4	-1.7	-4.3	0.0	-0.2	-5.5	-0.2	-2.1	-5.5
1994	2.3	3.6	1.8	-0.4	3.6	0.7	0.7	2.5	0.5	0.9
1995	-1.0	-1.3	0.0	-0.9	-0.8	-0.9	-2.6	-0.8	-2.0	-1.0
1996	-0.5	-0.3	-0.6	-0.7	-0.5	0.0	-3.4	-0.6	0.9	-5.4
1997	0.2	1.1	0.4	-1.4	1.0	-0.5	-2.3	0.5	-2.9	-0.5
1998*	3.8	5.6	1.5	0.9	4.8	2.9	-3.0	3.8	2.2	-2.8
1999*	7.7	10.2	6.0	4.9	8.6	6.6	9.4	7.7	5.5	9.9
2000*	12.7	15.0	12.9	12.7	14.1	12.0	8.0	13.1	10.1	8.7
2001*	15.0	13.8	16.4	19.4	14.1	15.9	20.5	14.8	17.1	21.1
2002*	12.9	10.2	14.7	17.0	11.7	14.6	12.5	13.2	11.8	13.8
Arithmetic Return (%)	5.2	5.6	5.1	4.8	5.4	5.1	4.0	5.3	4.6	4.1
Standard Deviation	7.1	7.3	7.2	7.9	7.1	7.2	8.3	7.1	7.4	8.1
Sub-periods										
1987 - 1997										
Arithmetic Return (%)	2.5	2.9	2.6	1.7	2.7	2.5	1.3	2.6	2.3	1.0
Standard Deviation	6.8	7.3	6.5	6.2	7.0	6.6	7.2	6.7	7.2	6.2
1998 - 2002										
Arithmetic Return (%)	10.4	11.0	10.3	11.0	10.6	10.4	9.5	10.5	9.3	10.1
Standard Deviation	4.6	3.7	6.3	7.9	4.0	5.5	8.5	4.6	5.8	8.7

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $rt = (Rt - Rt-1)/(1+Rt-1)$ or $rt = (1 + Rt)/(1 + Rt-1) - 1$
 Where, r_t is annual appreciation rate for year t , R_t is cumulative price appreciation rate for year t , and R_{t-1} is cumulative price appreciation rate for year $t-1$.
 * This period of time is identical to the "impact period" in Washington, DC.

Appendix Table 15. Annual Price Appreciation Rate in Comparison Markets: Fairfax County, MD**

Year	Structure Type					Neighborhoods by Income			Neighborhoods by Race		
	Fairfax County	Single Family Detached	Townhouse	Condo	High-Income	Moderate/Middle Income	Low-Income	Low-Minority	Moderate-Minority	High-Minority	
Appreciation Rate¹											
1988	17.7	19.8	16.4	12.6	19.1	16.5	15.5	17.7	18.1	11.9	
1989	12.0	11.0	12.6	12.9	10.9	13.0	10.7	12.0	12.1	8.8	
1990	0.0	-2.3	0.7	4.3	-1.7	0.8	6.6	-0.6	3.5	7.5	
1991	-3.4	-4.2	-2.6	-2.9	-3.4	-3.3	-2.9	-3.2	-4.0	-4.3	
1992	-1.3	-0.3	-1.1	-1.8	-0.9	-1.4	-3.9	-1.3	-1.4	-2.1	
1993	-0.4	1.4	-1.7	-4.3	0.0	-0.2	-5.5	-0.2	-2.1	-5.5	
1994	2.3	3.6	1.8	-0.4	3.6	0.7	0.7	2.5	0.5	0.9	
1995	-1.0	-1.3	0.0	-0.9	-0.8	-0.9	-2.6	-0.8	-2.0	-1.0	
1996	-0.5	-0.3	-0.6	-0.7	-0.5	0.0	-3.4	-0.6	0.9	-5.4	
1997	0.2	1.1	0.4	-1.4	1.0	-0.5	-2.3	0.5	-2.9	-0.5	
1998*	3.8	5.6	1.5	0.9	4.8	2.9	-3.0	3.8	2.2	-2.8	
1999*	7.7	10.2	6.0	4.9	8.6	6.6	9.4	7.7	5.5	9.9	
2000*	12.7	15.0	12.9	12.7	14.1	12.0	8.0	13.1	10.1	8.7	
2001*	15.0	13.8	16.4	19.4	14.1	15.9	20.5	14.8	17.1	21.1	
2002*	12.9	10.2	14.7	17.0	11.7	14.6	12.5	13.2	11.8	13.8	
Arithmetic Return (%)	5.2	5.6	5.1	4.8	5.4	5.1	4.0	5.3	4.6	4.1	
Standard Deviation	7.1	7.3	7.2	7.9	7.1	7.2	8.3	7.1	7.4	8.1	
Sub-periods											
1987 - 1997											
Arithmetic Return (%)	2.5	2.9	2.6	1.7	2.7	2.5	1.3	2.6	2.3	1.0	
Standard Deviation	6.8	7.3	6.5	6.2	7.0	6.6	7.2	6.7	7.2	6.2	
1998 - 2002											
Arithmetic Return (%)	10.4	11.0	10.3	11.0	10.6	10.4	9.5	10.5	9.3	10.1	
Standard Deviation	4.6	3.7	6.3	7.9	4.0	5.5	8.5	4.6	5.8	8.7	

Note: ** The annual appreciation rates are converted from cumulative rates using the following formula: $rt = (Rt - Rt-1)/(1+Rt-1)$ or $rt = (1 + Rt)/(1 + Rt-1) - 1$
 Where, r_t is annual appreciation rate for year t, R_t is cumulative price appreciation rate for year t, and R_{t-1} is cumulative price appreciation rate for year t-1.
 * This period of time is identical to the "impact period" in Washington, DC.

Appendix Table 16. Housing Age, Income and Racial Compositions of the 1990 Census Tracts Neighboring the District of Columbia, Prince Georges and Montgomery Counties (Maryland)

	DC Tracts Neighboring PG				PG Tracts Neighboring DC				DC Tracts Neighboring Montgomery				Montgomery Tracts Neighboring DC						
	Tract Income		% Owner		Tract Income		% Owner		Tract Income		% Owner		Tract Income		% Owner				
	As % of Area	% Tract	Units Built	Before 1950	As % of Area	% Tract	Units Built	Before 1950	As % of Area	% Tract	Units Built	Before 1950	As % of Area	% Tract	Units Built	Before 1950			
Census Tract	Median Income	Minorities			Census Tract	Median Income	Minorities			Census Tract	Median Income	Minorities			Census Tract	Median Income	Minorities		
73.04	47	99	56	8014.03	124	72	1	9.01	231	13	55	7017.01	84	37	92				
74.08	31	99	66	8015.00	90	77	21	9.02	154	18	61	7018.00	88	53	74				
74.09	35	100	70	8016.00	64	97	17	10.01	153	14	88	7025.00	47	70	64				
74.30	36	100	100	8017.04	70	95	17	11.00	185	13	78	7026.01	70	67					
75.02	36	98	35	8018.06	75	92	6	14.01	150	15	92	7026.02	73	56	45				
76.03	84	82	74	8025.00	68	93	40	15.00	169	16	69	7027.00	86	53	31				
77.07	61	99	51	8026.00	72	93	29	16.00	156	75	75	7052.00	195	8	54				
78.07	51	100	32	8027.00	77	90	34	17.01	92	91	58	7053.00	264	5	86				
78.08	39	100	75	8029.01	86	96	31	17.02	87	78	76	7056.01	147	8	79				
78.60	48	99	57	8030.01	62	99	54					7056.02	116	19	14				
90.01	79	100	3	8031.00	70	99	72					7057.02	232	7	19				
90.02	85	100	79	8043.00	55	82	39					7058.00	167	11	34				
91.10	70	95	74	8044.00	74	55	61												
94.10	88	95	86	8047.00	79	58	71												
95.03	119	87	64	8048.00	56	80	100												
95.05	84	95	62	8049.00	83	82	57												
95.07	80	98	34	8050.00	78	87	16												
95.08	92	99	15	8052.01	73	91	39												
96.01	75	99	59	8052.03	91	50	63												
97.00	30	100	3																
98.06	36	100	16																
98.08	46	100																	
99.02	88	96	56																
99.03	42	100	63																
99.05	52	100	68																
MEAN	62	98	54		76	84	40		163	37	72		131	33	54				
MEDIAN	52	99	61		74	90	39		154	16	75		102	28	54				

Supplemental Table 1. Median Sales Prices by Zip Code: Washington, DC

Ranked by percent change of the median sales prices (1987-2002)

(Sales prices in \$1,000)

Zip Code	Income (% of AMI)	Non-white Population (%)	Year														% Change (1987-2002)			
			1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000		2001	2002	
20001	54	94	59	66	81	85	88	90	76	81	75	78	81	96	109	127	148	210	9	257
20009	70	51	96	110	113	117	130	143	143	130	130	123	141	152	163	187	246	306	15	218
20005	56	73	83	108	85	101	133	111	65	88	91	76	85	118	117	136	160	255	13	206
20010	53	86	87	95	94	115	107	97	100	108	111	105	119	127	125	140	171	235	10	171
20003	83	70	90	105	125	130	118	121	108	108	100	109	115	126	135	142	210	242	11	168
20016	177	15	176	235	280	280	250	238	255	255	269	265	274	295	315	350	395	466	18	166
20037	139	18	100	71	78	152	138	128	207	182	123	114	81	177	154	183	205	249	12	149
20024	109	51	122	130	150	167	157	188	150	150	129	128	126	133	165	188	250	292	14	140
20002	70	82	72	83	97	102	92	95	89	91	90	95	92	106	117	125	144	170	4	136
20015	166	15	235	285	321	318	298	292	311	311	290	295	307	319	370	429	466	547	20	133
20011	79	94	83	95	106	115	114	117	119	120	118	115	120	121	130	136	155	185	8	124
20018	71	93	79	90	95	100	112	118	92	102	117	80	110	115	110	115	118	175	6	121
20012	114	83	150	160	182	196	180	170	166	190	177	187	169	193	200	220	250	330	17	120
20007	185	13	241	275	275	250	279	277	285	283	274	312	310	330	340	395	480	530	19	120
20036	79	34	82	98	82	69	83	71	77	102	83	92	90	91	80	110	125	180	7	120
20008	156	17	158	200	170	171	237	291	265	260	230	201	268	269	243	311	310	326	16	106
20017	98	87	89	99	110	124	124	117	120	119	120	125	107	120	130	135	150	175	5	97
20019	55	99	60	64	70	78	81	79	80	83	78	76	76	79	78	85	94	101	1	68
20020	69	94	67	71	75	80	83	80	91	90	87	80	86	82	93	94	106	111	3	65
20032	46	98	69	69	73	83	78	80	72	75	81	82	75	70	87	100	90	101	2	47

* Note: The areas with zip codes 20004 and 20006 are excluded from this table because they had only a small number of transactions took place there each year.

Supplemental Table 2a. Median Sales Prices by Neighborhoods: Washington, DC

Ranked by affordability or median sales prices in 2002

(Sales prices in \$1,000)

Neighborhoods	Income (% of AMI)	Non-white Population (%)	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Affordability	% Change (1987-2002)
Marshall Heights	53	100	56	58	63	68	64	63	76	73	69	70	71	60	69	78	82	83	1	49
Anacostia	53	97	60	60	66	55	57	74	62	47	58	63	46	66	72	68	96	86	2	43
Deanwood	48	100	60	65	72	72	84	79	78	71	66	65	68	71	74	80	88	96	3	61
Trinidad	51	99	60	66	66	69	72	70	75	81	54	72	63	72	76	95	84	97	4	61
Congress Heights	46	98	66	68	73	83	77	80	71	75	70	78	74	70	87	99	90	100	5	52
Randle Heights	49	98	76	76	84	71	80	88	86	93	94	89	93	81	99	92	99	115	6	52
Fort Dupont Park	67	98	68	70	75	85	86	82	88	90	82	88	88	89	94	96	110	115	7	69
Lily Ponds	64	99	60	67	73	75	82	81	77	82	85	86	84	80	79	84	102	122	8	105
Hillcrest	87	89	73	81	80	92	105	93	100	120	95	100	125	130	118	136	131	139	9	92
Riggs Park	91	96	83	94	105	112	108	116	117	110	112	119	105	115	118	129	140	148	10	79
Foggy Bottom	131	17	71	71	75	116	76	121	85	65	86	78	71	112	110	103	125	160	11	125
Petworth	70	98	76	87	96	109	103	101	105	104	102	101	100	102	115	119	142	169	12	122
Brookland	86	83	82	93	100	120	116	116	110	112	114	120	105	113	125	129	137	170	13	107
Takoma	85	86	92	88	88	116	115	119	100	119	120	107	125	133	122	135	145	188	14	105
Columbia Heights	48	97	75	77	88	100	96	83	95	97	100	90	95	103	122	130	148	191	15	155
Eckington	63	97	53	72	80	94	87	83	83	85	91	86	84	99	100	125	150	195	16	268
Brightwood	82	94	94	111	119	135	129	129	123	135	140	140	129	150	142	160	170	196	17	109
Michigan Park	116	88	122	125	143	179	177	155	150	162	152	158	161	165	172	178	217	225	18	84
Old City No. 1	73	79	81	95	112	110	105	109	98	97	96	100	100	120	129	140	178	225	19	178
Chillum	84	96	91	109	128	127	122	135	125	128	119	128	140	125	142	153	190	228	20	151
Ledroit Park	64	94	68	85	108	99	113	96	90	97	100	128	104	109	117	148	160	239	21	249
Old City No. 2	65	62	74	87	85	95	96	102	84	110	85	90	106	119	124	140	180	240	22	224
Central	60	57	100	86	90	93	83	121	197	157	127	120	107	139	136	157	195	243	23	143
Forest Hills	135	17	92	114	113	105	114	165	114	163	157	109	160	146	125	148	215	252	24	174
Wesley Heights	214	12	157	180	205	143	210	175	221	190	124	193	195	208	225	240	205	265	25	69
Kalorama	128	23	115	147	143	169	170	176	176	149	160	137	184	206	179	199	225	276	26	140
R.L.A. (S.W.)	109	51	122	130	150	167	157	188	150	150	129	127	126	133	165	190	250	292	27	140
16th Street Heights	78	89	104	143	150	165	154	188	148	151	156	142	155	159	171	215	279	295	28	184
Garfield	149	16	130	115	168	140	166	144	268	234	129	141	175	172	190	257	263	301	29	132
Cleveland Park	152	22	126	156	187	162	145	162	164	167	215	170	168	173	170	211	287	327	30	160
Capital Hill	130	17	119	151	135	180	157	170	203	158	194	177	178	203	193	239	319	355	31	199
Mt. Pleasant	53	66	130	165	120	151	175	185	168	172	176	172	175	190	215	250	313	396	32	204
Shepherd Park	156	75	173	229	270	270	258	234	204	225	228	235	226	235	286	300	370	424	33	146
Observatory Circle	172	17	106	193	183	134	140	187	212	117	189	133	199	208	161	266	245	448	34	322
Palisades	155	16	202	267	285	240	275	294	238	285	225	275	290	307	320	336	460	465	35	131
Wakefield	133	18	199	280	350	249	268	308	298	278	266	263	288	331	445	360	390	480	36	141
Colonial Village	156	75	230	292	406	352	363	365	290	325	288	340	304	320	344	385	500	490	37	113
Hawthorne	169	16	250	289	275	318	359	349	365	366	250	298	325	325	420	425	480	494	38	98
Crestwood	148	71	217	315	293	305	393	317	275	285	272	265	241	270	345	433	380	515	39	137
North Cleveland Park	138	19	230	272	315	310	328	314	294	295	282	264	298	329	377	435	498	517	40	125
Georgetown	196	12	248	264	275	240	300	277	285	250	278	319	318	337	352	405	480	535	41	116
Chevy Chase	167	15	230	285	324	316	300	291	309	312	290	296	305	317	364	423	459	538	42	134
American University Park	153	14	223	271	310	305	301	275	288	273	297	290	290	314	375	430	460	556	43	149
Berkley	187	13	516	675	586	570	458	397	400	496	390	490	535	529	458	710	725	560	44	9
Kent	201	15	352	395	410	525	415	389	438	485	385	375	386	424	451	525	610	575	45	45
Foxhall	140	14	201	270	309	283	280	281	240	298	295	295	265	316	355	416	460	581	46	169
Spring Valley	231	13	515	650	588	500	600	659	625	612	555	483	589	535	645	635	700	728	47	41

* Note: The following DC neighborhoods are excluded from this table because they had a very small number of transactions took place there each year: Barry Farms, Brenwood, Brightwood, Massachusetts Avenue Heights, R.L.A. (N.W.), Woodley, and Woodridge.

Supplemental Table 2b. Median Sales Prices by Neighborhoods: Washington, DC

Ranked by percent change of the median sales prices (1987-2002)

(Sales prices in \$1,000)

Neighborhoods	Year	Income (% of AMI)	Non-white Population (%)	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Affordability	% Change (1987-2002)	
Observatory Circle	17	172		106	193	183	134	140	187	212	117	189	133	199	208	161	266	245	448	34	322	
Eckington	63	97	53	72	80	94	87	83	83	83	85	91	86	84	99	100	125	150	195	16	268	
LeDroit Park	64	94	68	85	108	99	113	113	96	90	97	100	128	104	109	117	148	160	239	21	249	
OK City No. 2	65	62	74	87	85	95	96	102	84	110	110	85	90	106	119	124	140	180	240	22	224	
Mt. Pleasant	53	66	130	165	120	151	175	185	168	172	176	175	170	178	180	215	250	313	396	32	204	
Capital Hill	130	17	119	151	135	180	157	170	203	158	194	177	178	203	193	239	319	355	31	199		
Foxhall	140	14	201	270	309	283	280	281	240	298	295	285	285	316	385	416	460	581	46	189		
16th Street Heights	78	89	104	143	150	165	154	157	148	151	156	142	155	159	171	215	279	285	28	184		
OK City No. 1	73	79	81	95	112	110	105	109	98	97	96	100	100	120	129	140	178	225	19	178		
Forest Hills	135	17	92	114	113	105	114	165	114	153	157	109	160	160	146	125	148	215	252	24	174	
Cleveland Park	152	22	126	156	187	162	145	162	164	187	187	215	170	188	173	170	211	287	327	30	160	
Columbia Heights	48	97	75	77	88	100	96	83	95	97	100	90	90	95	103	122	130	148	191	15	155	
Chillum	84	96	91	109	128	127	122	135	125	128	119	128	140	125	142	153	190	228	20	151	151	
American University Park	153	14	223	271	310	305	301	275	288	273	287	290	290	314	375	430	460	556	43	149	149	
Shepherd Park	156	75	173	229	270	270	258	234	204	225	228	235	226	235	286	300	370	424	33	146	146	
Central	60	57	100	86	90	93	83	121	197	157	157	127	120	107	139	136	157	195	243	23	143	
Wakefield	133	18	199	280	350	249	268	308	298	278	266	263	288	331	445	360	390	480	36	141	141	
Kalorama	128	23	115	147	143	169	170	176	176	176	149	160	137	184	206	179	199	225	276	26	140	
R.L.A. (S.W.)	109	51	122	130	150	167	157	188	150	150	150	129	127	126	133	165	190	250	292	27	140	
Crestwood	148	71	217	315	283	305	383	317	275	285	272	285	241	270	345	433	380	515	39	137	137	
Chevy Chase	167	15	230	285	324	316	300	291	309	312	290	296	305	317	364	423	459	538	42	134	134	
Garfield	149	16	130	115	168	140	166	144	268	234	129	141	175	172	190	257	263	301	29	132	132	
Palisades	155	16	202	267	285	240	275	294	238	285	225	225	275	290	307	320	336	460	465	35	131	131
Foggy Bottom	131	17	71	71	75	116	116	76	121	85	65	86	78	71	112	110	103	125	160	11	125	125
North Cleveland Park	138	19	230	272	315	310	328	314	284	295	282	284	298	329	377	435	498	517	40	122	122	
Petworth	70	98	76	87	96	109	103	101	105	104	102	101	100	100	102	115	119	142	169	12	116	116
Georgetown	196	12	248	264	275	240	300	277	285	250	278	319	318	318	337	352	405	480	535	41	116	116
Colonial Village	156	75	230	292	406	352	363	365	290	325	288	340	320	344	385	500	490	37	113	113	113	
Brightwood	82	94	94	111	119	135	129	129	123	135	140	140	140	129	150	142	160	170	196	17	109	109
Brookland	86	83	82	93	100	120	116	116	116	110	112	114	120	105	113	125	129	137	170	13	107	107
Lily Ponds	64	99	60	67	73	75	82	81	77	82	85	86	84	80	79	84	102	122	8	105	105	
Takoma	85	86	92	88	88	116	115	119	119	100	119	120	107	125	133	122	135	145	188	14	105	105
Hawthorne	169	16	250	289	275	318	359	349	365	366	366	250	288	325	325	420	425	480	484	38	96	96
Hillcrest	87	89	73	81	80	92	105	93	100	120	95	100	125	130	130	118	136	131	139	9	92	92
Michigan Park	116	88	122	125	143	179	177	155	150	162	152	158	161	165	172	172	178	217	225	18	84	84
Riggs Park	91	96	83	94	105	112	108	116	116	117	110	112	119	105	115	118	129	140	148	10	79	79
Fort Dupont Park	67	98	68	70	75	85	86	82	88	90	82	88	88	88	89	94	96	110	115	7	69	69
Wesley Heights	214	12	157	180	205	143	210	175	221	190	124	193	195	208	225	240	205	265	25	45	69	69
Kent	201	15	352	395	410	525	415	389	438	485	385	385	375	386	424	451	525	610	575	45	63	63
Trinidad	51	99	60	66	66	69	72	72	84	79	78	71	66	63	72	74	95	84	97	4	61	61
Deanwood	48	100	60	65	72	72	72	80	88	86	93	94	89	93	81	74	80	88	96	3	61	61
Randall Heights	49	98	76	76	84	71	80	88	86	86	86	94	89	83	81	89	92	98	115	6	52	52
Congress Heights	46	98	66	68	73	83	77	80	71	75	70	78	74	70	87	99	99	100	100	5	52	52
Marshall Heights	53	100	56	58	63	68	64	63	76	73	69	70	71	60	69	78	82	83	1	49	49	
Anacostia	53	97	60	60	66	55	57	74	62	47	58	63	46	66	72	68	68	96	86	2	43	43
Spring Valley	231	13	515	650	588	500	600	659	625	612	555	555	589	535	645	635	700	728	47	43	43	
Berkeley	187	13	516	675	586	570	458	397	400	496	390	490	490	535	529	458	710	725	560	44	9	9

* Note: The following DC neighborhoods are excluded from this table because they had a very small number of transactions book place there each year: Barry Farms, Brentwood, Massachusetts Avenue Heights, R.L.A. (N.W.), Woodley, and Woodridge.

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