# The Economic Impact of Low Income Housing Tax Credit Development Along Transit Corridors in Metro Denver

## Income, Jobs, and Taxes Generated

Prepared by the
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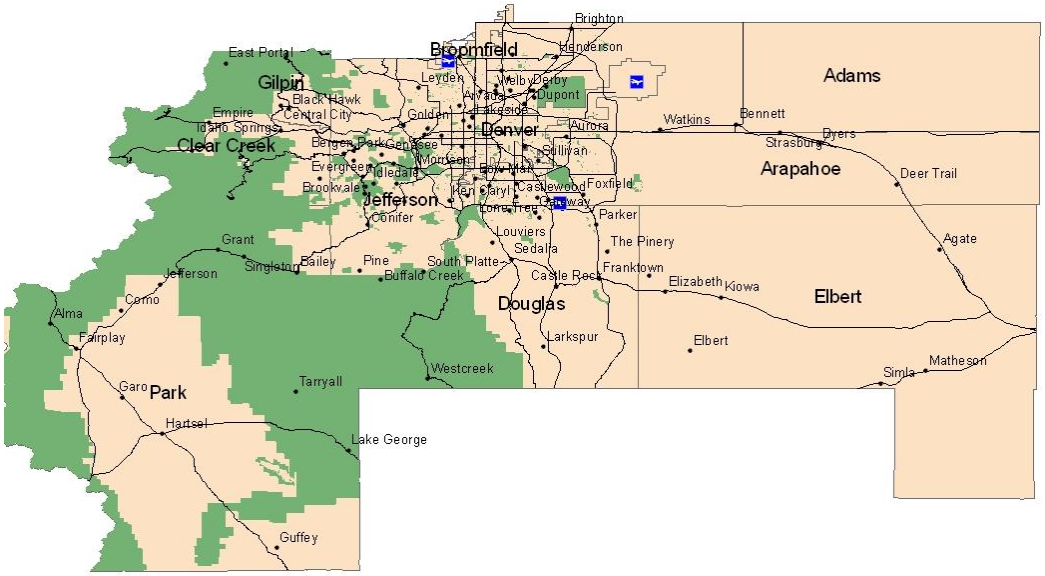
## Executive Summary

Home building generates substantial local economic activity, including new income and jobs for residents, and additional revenue for local governments. The National Association of Home Builders has developed a model to estimate the economic benefits. The model captures the effect of the construction activity itself, the ripple impact that occurs when income earned from construction activity is spent and recycles in the local economy, and the ongoing impact that results from new homes becoming occupied by residents who pay taxes and buy locally produced goods and services. In order to fully appreciate the positive impact residential construction has on a community, it is important to include the ripple effects and the ongoing benefits. Since the NAHB model was initially developed in 1996, it has been used to estimate the impacts of construction in over 600 projects, local jurisdictions, metropolitan areas, non-metropolitan counties, and states across the country.

One version of the NAHB model is designed to estimate the economic benefits of construction that uses the Low-Income Housing Tax Credit (hereafter, housing tax credit, or simply tax credit) program. Created as part of the Tax Reform Act of 1986, this housing tax credit is currently the federal government's largest program for helping the private sector build affordable rental housing. Under the housing tax credit program, federal income tax credits are awarded by state Housing Finance Agencies to a development under the condition that the rents and incomes of its tenants are restricted. The credits are shared among the owners of a community, typically investors recruited by syndicators through limited partnership agreements. The investors receive the credits for ten years, provided the property continues to comply with the rent and income restrictions. Federal law requires that the rents and incomes remain restricted for 15 years, but all states have now adopted extended use requirements that keep these units in the affordable housing stock for a minimum of 30 years. According to information reported by the Colorado Housing and Finance Authority and printed in the 2008 FactBook published by the National Council of State Housing Agencies, all of the units financed with housing tax credits in Colorado that year had extended affordable use requirements of at least 30 years, and 95 percent of them had extended use requirements of 40 years.

This report presents estimates of the metro area impacts of new units built using the housing tax credit during the six-year period starting in 2004 and running through 2009, in the five-county area (Adams, Arapahoe, Denver, Douglas, and Jefferson) in the Denver metropolitan area. The comprehensive nature of the NAHB model requires that the local area over which the benefits are spread be large enough to include the places where construction workers live and spend their money, as well as the places where the new home occupants are likely to work, shop, and go for recreation. In practice, this usually means a Metropolitan Statistical Area (MSA), as defined by the U.S. Office of Management and Budget (OMB). Based on local commuting patterns, OMB has identified the Denver MSA as a metro area consisting of the five counties mentioned above, plus five others (Broomfield, Clear Creek, Elbert, Gilpin, and Park) in Colorado (see map on the following page).

Denver, Colorado MSA




The five-county area from which the sample of new tax credit construction is drawn contains almost 96 percent of the population in this MSA, or 2,263,108 of the total 2,357,404 people. The report presents estimates of the impacts of building 615 tax credit apartments, based on the average number of housing units built per year under the housing tax credit program in the five-county area from 2004 through 2009.

The Home Builders Association of Metro Denver (HBA) commissioned this study in partnership with local non-profit the Urban Land Conservancy to better understand the economic impact of affordable housing along transit corridors in the Denver metropolitan region. While significant research has been done on the affordability gap in this region, there has been little focus on the local income and local jobs created by the construction of affordable housing. With this knowledge, we can truly understand the local economic impact of housing tax credit construction.

Just as important as understanding the economic impact of tax credit development is understanding who builds and who lives in tax credit developments. By the calculation of the Urban Land Conservancy (ULC), a local Denver organization, upwards of 57% of housing tax credit development in the Denver MSA is done by for-profit developers, as opposed to non-profit or governmental entities.[1] Through data acquired from property managers of tax credit developments in the Denver MSA, the ULC discovered that nearly half of residents in tax credit developments work in the service industry while the majority of the remainder are spread across the education, medical, and local and state government fields. Thus, these developments ensure a place to live for the essential workers that keep the local economy working.

The NAHB model produces impacts on income and employment in 16 industries and local government, as well as detailed information about taxes and other types of local government revenue. Aggregate results are summarized below. Subsequent sections of the report show detail by industry and type of tax or fee revenue generated.

- The estimated one-year metro area impacts of building 615 tax credit apartments in the 10-county Denver MSA include
    - $57.6 million in local income,
    - $5.0 million in taxes and other revenue for local governments, and
    - 732 local jobs.

  These are local impacts, representing income and jobs for residents of the Denver MSA, and taxes (and other sources of revenue, including permit fees) for all local jurisdictions within the metro area. They are also one-year impacts that include both the direct and indirect impact of the construction activity itself, and the impact of local residents who earn money from the construction activity spending part of it within the local area. Local jobs are measured in full time equivalents—i.e., one reported job represents enough work to keep one worker employed full-time for a year, based on average hours worked per week by full-time employees in the industry.

- The additional, annually recurring impacts of building 615 tax credit apartments in the Denver MSA include
    - $16.7 million in local income,
    - $2.3 million in taxes and other revenue for local governments, and
    - 192 local jobs.

  These are ongoing, annual local impacts that result from the new tax credit apartments being occupied and the residents paying taxes and otherwise participating in the local economy year after year. The ongoing impacts also include the effect of increased property taxes, based on the difference between the value of raw land and the value of the completed housing project on a finished lot, assuming that raw land would be taxed at the same rate as the completed project.

Central to how the Denver MSA Real Estate community thinks about affordable housing is the $6.5 Billion, 119 mile, and 60 station expansion of Denver MSA's light rail system over the next 20 years. In order to better understand affordable housing in the context of transit, 92% of the apartments that made up the underlying data of the study were taken from developments within ½ mile of light rail or ¼ mile of rapid bus transit, otherwise known as "Transit-Oriented Development (TOD)." This focus on TOD affordable housing allows us to better understand the impact of TOD affordable housing on the local economy as well as make informed policy decisions regarding the positive economic impact tax credits have along transit corridors.

These impacts were calculated assuming that new tax credit apartments built in the Denver MSA from 2004 through 2009 have an average market value of $147,518; embody an average raw land value of $18,547; require the builder and developer to pay an average of $73 in permit fees per unit to local governments; and incur an average annual property tax of $280 per unit.

Special thanks to the Urban Land Conservancy for their work with the underlying data of this study, as well as to the Colorado Housing and Finance Authority and the City and County of Denver for providing vital data for this study. Important Information was also provided by the Burgwyn Company, the Colorado Coalition for the Homeless, the Denver Housing Authority, NEWSED CDC, and Shaw Construction.

# The Economic Impact of Low Income Housing Tax Credit Development Along Transit Corridors in Metro Denver

## Income, Jobs, and Taxes Generated

## Detailed Tables on Income, Jobs, and Taxes

# Impact of Building 615 Tax Credit Apartments in Denver, Colorado

## Summary

Total One-Year Impact: Sum of Phase I and Phase II:

| Local Income | Local Business Owners' Income | Local Wages and Salaries | Local Taxes[1] | Local Jobs Supported |
|---|---|---|---|---|
| $57,617,300 | $16,886,100 | $40,731,700 | $4,999,500 | 732 |

Phase I: Direct and Indirect Impact of Construction Activity:

| Local Income | Business Owners' Income | Local Wages and Salaries | Local Taxes[1] | Local Jobs Supported |
|---|---|---|---|---|
| $39,057,900 | $10,668,600 | $28,389,300 | $2,762,100 | 486 |

Phase II: Induced (Ripple) Effect of Spending the Income and Taxes from Phase I:

| Local Income | Business Owners' Income | Local Wages and Salaries | Local Taxes[1] | Local Jobs Supported |
|---|---|---|---|---|
| $18,559,400 | $6,217,500 | $12,342,400 | $2,237,400 | 246 |

Phase III: Ongoing, Annual Effect that Occurs When New Homes are Occupied:

| Local Income | Local Business Owners' Income | Local Wages and Salaries | Local Taxes[1] | Local Jobs Supported |
|---|---|---|---|---|
| $16,672,700 | $7,296,400 | $9,376,500 | $2,315,200 | 192 |

[1] The term local taxes is used as a shorthand for local government revenue from all sources: taxes, fees, fines, revenue from government-owned enterprises, etc.

**Impact of Building 615 Tax Credit Apartments in Denver, Colorado**
**Phase I—Direct and Indirect Impact of Construction Activity**

A. Local Income and Jobs by Industry

| Industry | Local Income | Local Business Owners' Income | Local Wages and Salaries | Wages & Salaries per Full-time Job | Number of Local Jobs Supported |
|---|---|---|---|---|---|
| Construction | $27,211,700 | $7,017,700 | $20,194,000 | $60,000 | 337 |
| Manufacturing | $4,000 | $300 | $3,700 | $62,000 | 0 |
| Transportation | $63,200 | $8,600 | $54,600 | $51,000 | 1 |
| Communications | $403,700 | $123,400 | $280,300 | $91,000 | 3 |
| Utilities | $120,500 | $46,700 | $73,800 | $102,000 | 1 |
| Wholesale and Retail Trade | $3,940,600 | $721,200 | $3,219,400 | $44,000 | 73 |
| Finance and Insurance | $874,300 | $71,200 | $803,100 | $101,000 | 8 |
| Real Estate | $1,285,500 | $1,131,600 | $153,900 | $62,000 | 2 |
| Personal & Repair Services | $275,900 | $104,000 | $171,900 | $40,000 | 4 |
| Services to Dwellings / Buildings | $154,000 | $30,600 | $123,400 | $40,000 | 3 |
| Business & Professional Services | $3,806,800 | $1,136,400 | $2,670,400 | $70,000 | 38 |
| Eating and Drinking Places | $129,800 | $17,500 | $112,300 | $24,000 | 5 |
| Automobile Repair & Service | $130,900 | $40,600 | $90,300 | $40,000 | 2 |
| Entertainment Services | $22,500 | $4,600 | $17,900 | $55,000 | 0 |
| Health, Educ. & Social Services | $5,100 | $1,400 | $3,700 | $46,000 | 0 |
| Local Government | $38,600 | $0 | $38,600 | $65,000 | 1 |
| Other | $590,800 | $212,800 | $378,000 | $54,000 | 7 |
| Total | $39,057,900 | $10,668,600 | $28,389,300 | $58,000 | 486 |

B. Local Government General Revenue by Type

| TAXES: | | USER FEES & CHARGES: | |
|---|---|---|---|
| Business Property Taxes | $96,100 | Residential Permit / Impact Fees | $44,800 |
| Residential Property Taxes | $0 | Utilities & Other Govt. Enterprises | $276,200 |
| General Sales Taxes | $1,643,100 | Hospital Charges | $127,500 |
| Specific Excise Taxes | $12,800 | Transportation Charges | $219,600 |
| Income Taxes | $0 | Education Charges | $73,400 |
| License Taxes | $7,400 | Other Fees and Charges | $240,800 |
| Other Taxes | $20,400 | TOTAL FEES & CHARGES | $982,300 |
| TOTAL TAXES | $1,779,800 | TOTAL GENERAL REVENUE | $2,762,100 |

**Impact of Building 615 Tax Credit Apartments in Denver, Colorado**
**Phase II—Induced Effect of Spending Income and Tax Revenue from Phase I**

A. Local Income and Jobs by Industry

| Industry | Local Income | Local Business Owners' Income | Local Wages and Salaries | Wages & Salaries per Full-time Job | Number of Local Jobs Supported |
|---|---|---|---|---|---|
| Construction | $859,800 | $334,700 | $525,200 | $60,000 | 9 |
| Manufacturing | $3,800 | $300 | $3,500 | $62,000 | 0 |
| Transportation | $70,400 | $9,800 | $60,700 | $45,000 | 1 |
| Communications | $1,113,400 | $380,900 | $732,500 | $89,000 | 8 |
| Utilities | $594,400 | $234,400 | $360,100 | $102,000 | 4 |
| Wholesale and Retail Trade | $3,146,000 | $592,400 | $2,553,700 | $39,000 | 65 |
| Finance and Insurance | $786,300 | $71,100 | $715,200 | $90,000 | 8 |
| Real Estate | $3,309,800 | $2,913,700 | $396,100 | $62,000 | 6 |
| Personal & Repair Services | $670,200 | $308,200 | $362,000 | $40,000 | 9 |
| Services to Dwellings / Buildings | $161,400 | $32,100 | $129,300 | $40,000 | 3 |
| Business & Professional Services | $1,749,000 | $521,400 | $1,227,600 | $63,000 | 20 |
| Eating and Drinking Places | $922,000 | $124,000 | $798,000 | $24,000 | 33 |
| Automobile Repair & Service | $453,500 | $138,200 | $315,300 | $40,000 | 8 |
| Entertainment Services | $216,400 | $59,600 | $156,800 | $45,000 | 3 |
| Health, Educ. & Social Services | $2,557,400 | $320,000 | $2,237,400 | $59,000 | 38 |
| Local Government | $1,448,600 | $0 | $1,448,600 | $61,000 | 24 |
| Other | $497,000 | $176,700 | $320,400 | $43,000 | 8 |
| Total | $18,559,400 | $6,217,500 | $12,342,400 | $50,000 | 246 |

B. Local Government General Revenue by Type

| TAXES: | | USER FEES & CHARGES: | |
|---|---|---|---|
| Business Property Taxes | $441,200 | Residential Permit / Impact Fees | $0 |
| Residential Property Taxes | $0 | Utilities & Other Govt. Enterprises | $493,700 |
| General Sales Taxes | $541,100 | Hospital Charges | $167,000 |
| Specific Excise Taxes | $58,600 | Transportation Charges | $104,400 |
| Income Taxes | $0 | Education Charges | $34,900 |
| License Taxes | $6,000 | Other Fees and Charges | $296,700 |
| Other Taxes | $93,800 | TOTAL FEES & CHARGES | $1,096,600 |
| TOTAL TAXES | $1,140,700 | TOTAL GENERAL REVENUE | $2,237,400 |

**Impact of Building 615 Tax Credit Apartments in Denver, Colorado**
**Phase III—Ongoing, Annual Effect That Occurs Because Units Are Occupied**

A. Local Income and Jobs by Industry

| Industry | Local Income | Local Business Owners' Income | Local Wages and Salaries | Wages & Salaries per Full-time Job | Number of Local Jobs Supported |
|---|---|---|---|---|---|
| Construction | $342,200 | $123,100 | $219,100 | $60,000 | 4 |
| Manufacturing | $3,000 | $200 | $2,800 | $62,000 | 0 |
| Transportation | $74,800 | $10,500 | $64,300 | $42,000 | 2 |
| Communications | $950,300 | $327,400 | $623,000 | $89,000 | 7 |
| Utilities | $244,000 | $95,600 | $148,500 | $102,000 | 1 |
| Wholesale and Retail Trade | $2,603,700 | $490,900 | $2,112,700 | $39,000 | 54 |
| Finance and Insurance | $517,700 | $46,500 | $471,300 | $91,000 | 5 |
| Real Estate | $5,547,000 | $4,883,100 | $663,900 | $62,000 | 11 |
| Personal & Repair Services | $617,600 | $297,600 | $320,000 | $40,000 | 8 |
| Services to Dwellings / Buildings | $123,300 | $24,500 | $98,800 | $40,000 | 2 |
| Business & Professional Services | $1,312,700 | $387,100 | $925,600 | $61,000 | 15 |
| Eating and Drinking Places | $777,700 | $104,600 | $673,100 | $24,000 | 28 |
| Automobile Repair & Service | $337,000 | $102,700 | $234,300 | $40,000 | 6 |
| Entertainment Services | $173,600 | $49,700 | $123,900 | $46,000 | 3 |
| Health, Educ. & Social Services | $1,972,700 | $247,600 | $1,725,100 | $59,000 | 29 |
| Local Government | $784,800 | $0 | $784,800 | $61,000 | 13 |
| Other | $290,600 | $105,300 | $185,300 | $43,000 | 4 |
| Total | $16,672,700 | $7,296,400 | $9,376,500 | $49,000 | 192 |

B. Local Government General Revenue by Type

| TAXES: | | USER FEES & CHARGES: | |
|---|---|---|---|
| Business Property Taxes | $424,700 | Residential Permit / Impact Fees | $0 |
| Residential Property Taxes | $150,300 | Utilities & Other Govt. Enterprises | $461,700 |
| General Sales Taxes | $520,800 | Hospital Charges | $200,800 |
| Specific Excise Taxes | $56,400 | Transportation Charges | $93,800 |
| Income Taxes | $0 | Education Charges | $31,300 |
| License Taxes | $5,600 | Other Fees and Charges | $279,600 |
| Other Taxes | $90,300 | TOTAL FEES & CHARGES | $1,067,200 |
| TOTAL TAXES | $1,248,100 | TOTAL GENERAL REVENUE | $2,315,200 |

# The Economic Impact of Low Income Housing Tax Credit Development Along Transit Corridors in Metro Denver

## Income, Jobs, and Taxes Generated

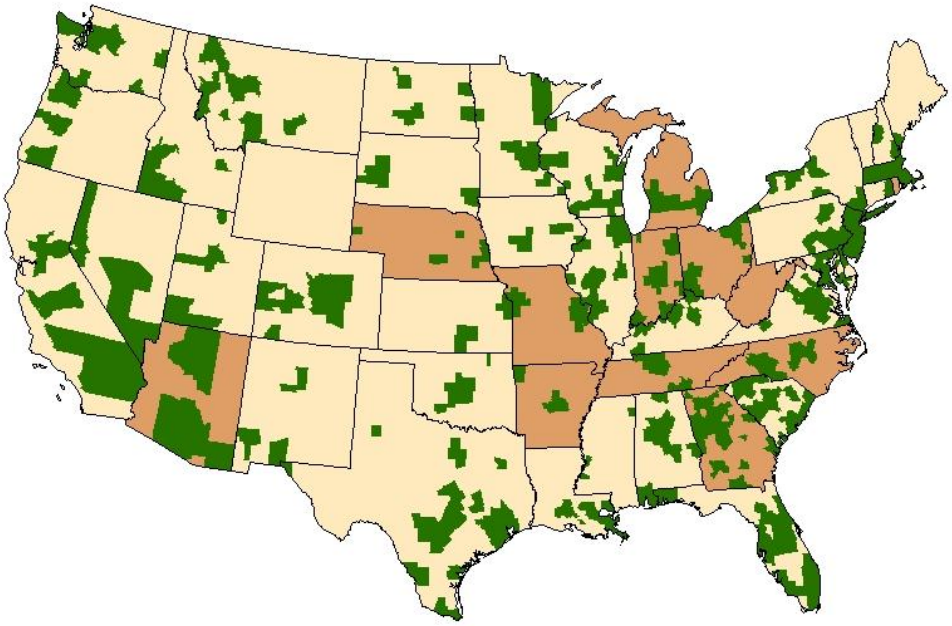
## Background and a Brief Description of the Model Used to Estimate the Economic Benefits

In 1996, the Housing Policy Department of the National Association of Home Builders (NAHB) developed an economic model to estimate the local economic benefits of home building. Although at first calibrated to a typical metropolitan area using national averages, the model could be adapted to a specific local economy by replacing national averages with specific local data for key housing market variables. The initial version of the model could be applied to single-family construction, multifamily construction, or a combination of the two.

Since 1997, NAHB has used the model to produce customized reports on the impact of home building in various parts of the country. As of June 2009, over 600 of these reports have been produced, analyzing residential construction in various metropolitan areas, non-metropolitan counties, and states (see map below).

**Areas Covered by NAHB Local Impact Studies**

The darkest shading indicates studies that covered metro areas and non-metro counties; the somewhat lighter shading indicates studies that were produced for an entire state.



The reports have analyzed the impacts of specific housing projects, as well as total home building in areas as large as entire states. In 2002, NAHB developed new versions of the model to analyze active adult housing projects and multifamily development financed with the Low-Income Housing Tax Credit, then in 2005 a version of the model that analyzes remodeling.

Results from NAHB's local impact model have been used by outside organizations such as universities, state housing authorities and affordable housing agencies:

- The Shimburg Center for Affordable Housing at the University of Florida used results from the NAHB model to establish that "the real estate taxes paid year after year are the most obvious long-term economic benefit to the community. Probably the second most obvious long-term economic benefit is the purchases made by the family occupying the completed home." www.shimberg.ufl.edu/pdf/Newslett-June02.pdf

- The Louisville Affordable Housing Trust Fund (AHTF) used results from the NAHB model to determine the initial one-year impact and the ongoing annual effect that occurs when new homes are occupied. This analysis was performed to help justify the creation of a commission to oversee the newly established AHTF to insure that it works at "finding creative ways to create a sustainable and renewable fund to provide affordable housing opportunities throughout the Louisville community." www.openthedoorlouisville.org/housing-trust/economic-growth

- The Illinois Housing Development Authority used the NAHB model to determine that "the Authority's new construction activity in single and multifamily housing….resulted in the creation of 4,256 full-time jobs in construction and construction-related industries." The Authority also used the NAHB impact model to determine the federal, state and local taxes and fees generated from new construction and substantial rehabilitation activity. www.ihda.org/admin/Upload/Files/94c0ecf7-a238-4be3-90bd-6043cfae81ea.pdf

- The Stardust Center at the Arizona State University used "the model used and developed by the NAHB to assess the immediate economic impacts of affordable housing" by phase including the construction effect, the construction ripple, and on-going impacts. This was done to show "that permanent, affordable and geographically accessible housing provides numerous benefits both to individual families and to the broader community." www.orangecountyfl.net/NR/rdonlyres/efo5wiffiqvqqgn2s35shus5i4lwdgqbcxpck2dddnds3msj5qs26ubzllsfl6s6rrwnmtkq4dypnjrdrdzei2llq5g/Socialeconomicimpacts.pdf

- The Center for Applied Economic Research at Montana State University used "results from an input-output model developed by the National Association of Home Builders to assess the impacts to local areas from new home construction." The results show that "the construction industry contributes substantially to Montana's economy accounting for 5.5 percent of Gross State Product."

- The Housing Education and Research Center at Michigan State University also adopted the NAHB approach: "The underlying basis for supporting the implementation of this [NAHB] model on Michigan communities is that it provides quantifiable results that link new residential development with commercial and other forms of development therefore illustrating the overall economic effects of residential growth."

- The Center for Economic Development at the University of Massachusetts found that "Home building generates substantial local economic activity, including income, jobs, and revenue for state and local governments. These far exceed the school costs-to-property-tax ratios. …these factors were evaluated by means of a quantitative assessment of data from the National Association of Home Builder's Local Impact of Home Building model."

- Similarly, the Association of Oregon Community Development Organizations decided to base its analysis of affordable housing on the NAHB model, stating that "This model is widely respected and utilized in analyzing the economic impact of market rate housing development," and that, compared to alternatives, it "is considered the most comprehensive and is considered an improvement on most previous models." www.aocdo.org/docs/EcoDevoStudyFinal.pdf

- The Boone County Kentucky Planning Commission included results from the NAHB model in its 2005 Comprehensive Report. The Planning Commission used values from the impact model to quantify the increase in local income, taxes, revenue, jobs, and overall local economic impacts in the Metro Area as a result of new home construction.

The NAHB model is divided into three phases. Phases I and II are one-time effects. Phase I captures the effects that result directly from the construction activity itself and the local industries that contribute to it. Phase II captures the effects that occur as a result of the wages and profits from Phase I being spent in the local economy. Phase III is an ongoing, annual effect that includes property tax payments and the result of the completed unit being occupied.

**Phase I: Local Industries Involved in Home Building**

**The jobs, wages, and local taxes (including permit, utility connection, and impact fees) generated by the actual development, construction, and sale of the home.** These jobs include on-site and off-site construction work as well as jobs generated in retail and wholesale sales of components, transportation to the site, and the professional services required to build a home and deliver it to its final customer.

**Phase II: Ripple Effect**

**The wages and profits for local area residents earned during the construction period are spent on other locally produced goods and services.** This generates additional income for local residents, which is spent on still more locally produced goods and services, and so on. This continuing recycling of income back into the community is usually called a ***multiplier*** or ***ripple*** effect.

**Phase III: Ongoing, Annual Effect**

**The local jobs, income, and taxes generated as a result of the home being occupied.** A household moving into a new home generally spends about three-fifths of its income on goods and services sold in the local economy. A fraction of this will become income for local workers and local businesses proprietors. In a typical local area, the household will also pay 1.25 percent of its income to local governments in the form of taxes and user fees, and a fraction of this will become income for local government employees. This is the first step in another set of economic ripples that cause a permanent increase in the level of economic activity, jobs, wages, and local tax receipts.

## Modeling a Local Economy

The model defines a local economy as a collection of industries and commodities. These are selected from the detailed benchmark input-output tables produced by the U.S. Bureau of Economic Analysis. The idea is to choose goods and services that would typically be produced, sold, and consumed within a local market area. Laundry services would qualify, for example, while automobile manufacturing would not. Both business-to-business and business-to-consumer transactions are considered. In general the model takes a conservative approach and retains a relatively small number of the available industries and commodities. Of the roughly 600 industries and commodities provided in the input-output files, the model uses only 87 commodities and 89 industries.

The design of the model implies that a local economy should include not only the places people live, but also the places where they work, shop, typically go for entertainment, etc. This corresponds reasonably well to the concepts of Metropolitan Statistical Areas and Metropolitan Divisions, areas defined by the U.S. Office of Management and Budget based on local commuting patterns. Outside of these officially defined metropolitan areas, NAHB has determined that a county will usually satisfy the model's requirements.

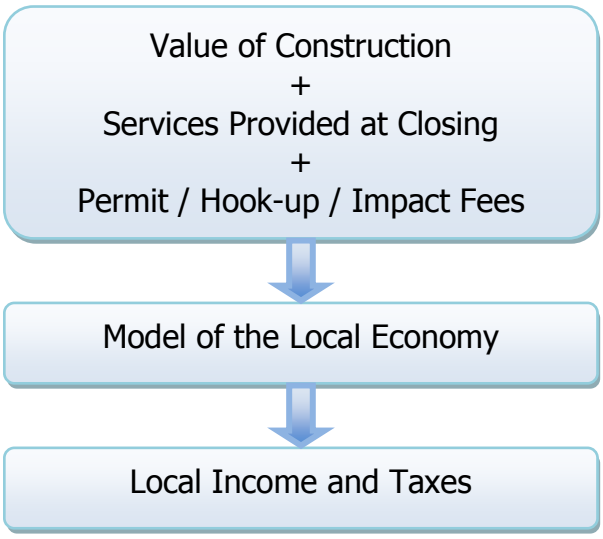
For a particular local area, the model adjusts the indirect business tax section of the national input-output accounts to account for the fiscal structure of local governments in the area. The information used to do this comes primarily from the U.S. Census Bureau's Census of Governments. Wages and salaries are extracted from the employee compensation section of the input-output accounts on an industry-by-industry basis. In order to relate wages and salaries to employment, the model incorporates data on local wages per job published by the Bureau of Economic Analysis.

## Phase I: Construction

In order to estimate the local impacts generated by home building, it is necessary to know the sales price of the homes being built, how much raw land contributes to the final price, and how much the builder and developer pay to local area governments in the form of permit, utility connection, impact, and other fees. This information is not generally available from national sources and in most cases must be provided by representatives from the area in question who have specialized knowledge of local conditions.

The model subtracts raw land value from the price of new construction and converts the difference into local wages, salaries, business owners' income, and taxes. This is done separately for all 95 local industries. In addition, the taxes and fees collected by local governments during the construction phase generate wages and salaries for local government employees. Finally the number of full time jobs supported by the wages and salaries generated in each private local industry and the local government sector is estimated.

Summary of Phase I




## Phase II: The Construction Ripple

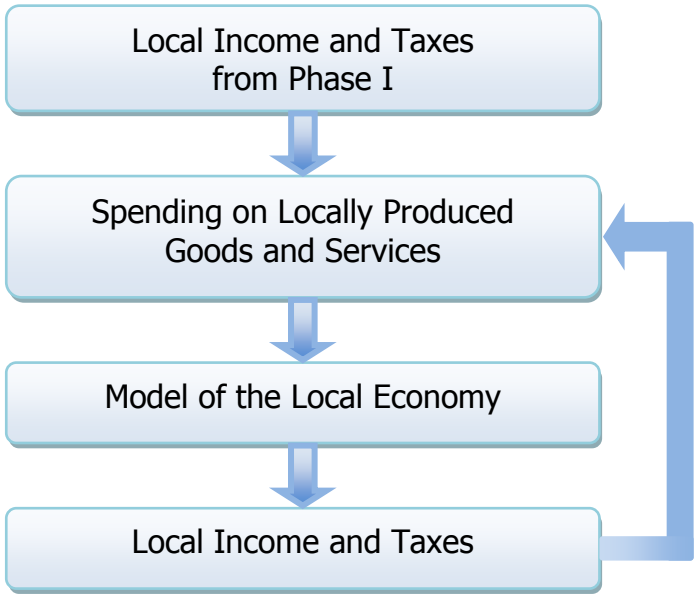
Clearly, the local residents who earn income in Phase I will spend a share of it. Some of this will escape the local economy. A portion of the money used to buy a new car, for example, will become wages for autoworkers that are likely to live in another city, and increased profits for stockholders of an automobile manufacturing company who are also likely to live elsewhere. A portion of the spending, however, will remain within, and have an impact on, the local economy. The car is likely to be purchased from a local dealer and generate income for a salesperson that lives in the area, as well for local workers who provide cleaning, maintenance, and other services to the dealership. Consumers also are likely to purchase many services locally, as well as to pay taxes and fees to local governments.

This implies that the income and taxes generated in Phase I become the input for additional economic impacts analyzed in what we call Phase II of the model. Phase II begins by estimating how much of the added income households spend on each of the local commodities. This requires detailed analysis of data from the Consumer Expenditure (CE) Survey, which is conducted by the U.S. Bureau of Labor Statistics primarily for the purpose of determining the weights for the Consumer Price Index. The analysis produces household spending estimates for 55 local commodities. The remainder of the 87 local commodities enter the model only as business-to-business transactions.

The model then translates the estimated local spending into local business owners' income, wages and salaries, jobs, and taxes. This is essentially the same procedure applied to the homes sold to consumers in Phase I. In Phase II, however, the procedure is applied simultaneously to 56 locally produced and sold commodities.

In other words, the model converts the local income earned in Phase I into local spending, which then generates additional local income. But this in turn will lead to additional spending, which will generate more local income, leading to another round of spending, and so on. Calculating the end result of these economic is a straightforward exercise in mathematics.

Summary of Phase II




## Phase III: The Ongoing Impacts

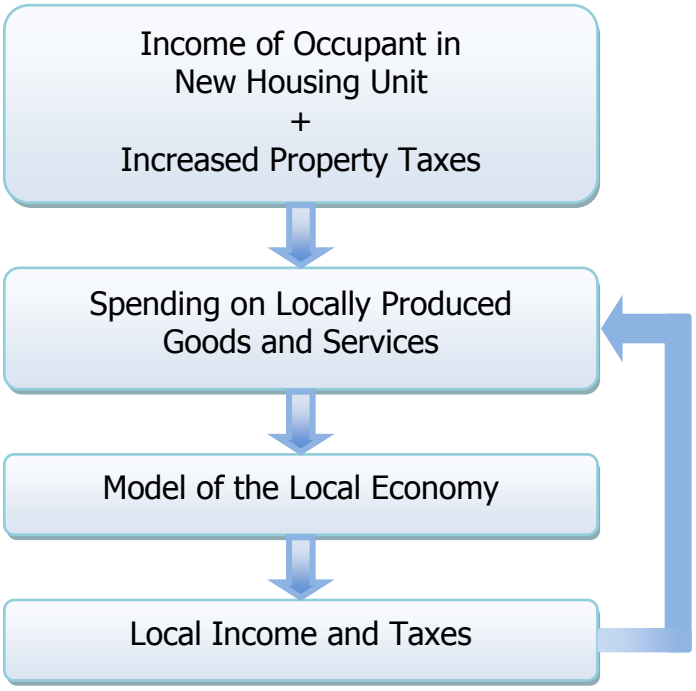
Like Phase II, Phase III involves computing the sum of successive ripples of economic activity. In Phase III, however, the first ripple is generated by the income and spending of a new household (along with the additional property taxes local governments collect as a result of the new structure). This does not necessarily imply that all new homes must be occupied by households moving in from outside the local area. It may be that an average new-home household moves into the newly constructed unit from elsewhere in the same local area, while average existing-home household moves in from outside to occupy the unit vacated by the first household. Alternatively, it may be that the new home allows the local area to retain a household that would otherwise move out of the area for lack of suitable housing.

In any of these cases, it is appropriate to treat a new, occupied housing unit as a net gain to the local economy of one household with average characteristics for a household that occupies a new home. This reasoning is often used, even if unconsciously, when it is assumed that a new home will be occupied by a household with average characteristics—for instance, an average number of children who will consume public education.

To estimate the impact of the net additional households, Phase III of the model requires an estimate of the income of the households occupying the new homes. The information used to compute this estimate comes from several sources, but primarily from an NAHB statistical model based on decennial census data. Phase III of the local impact model then estimates the fraction

of income these households spend on various local commodities. This is done with CE data and is similar to the procedure described under Phase II. The model also calculates the amount of local taxes the households pay each year. This is done with Census of Governments data except in the case of residential property taxes, which are treated separately, and for which specific information must usually be obtained from a local source. Finally, a total ripple effect is computed, using essentially the same procedure outlined above under Phase II.

Summary of Phase III




The details covered here provide a brief description of the model NAHB uses to estimate the local economic benefits of home building. For a more complete description, see the technical documentation at the end of the report. For additional information about the model, or questions about applying it to a particular local area, contact one of the following in NAHB's Economics and Housing Policy Group:

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# The Economic Impact of Low Income Housing Tax Credit Development Along Transit Corridors in Metro Denver

## Income, Jobs, and Taxes Generated

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June 2009

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# Technical Documentation for the NAHB Model Used to Estimate the Income, Jobs, and Taxes

The Housing Policy Department of the National Association of Home Builders (NAHB) maintains an economic model that it uses to estimate the local economic benefits of home building. The NAHB model is divided into three phases. Phases I and II are one-time effects. Phase I captures the effects that result directly from the construction activity itself and the local industries that contribute to it. Phase II captures the effects that occur as a result of the wages and profits from Phase I being spent in the local economy. Phase III is an ongoing, annual effect that includes property tax payments and the result of the completed unit being occupied.

The model can be customized to a specific local economy by replacing key housing market variables. This document explains describes the sources of data used and explains how the estimates are generated.

## Modeling a Local Economy

In the NAHB model, a local economy is defined as a collection of industries and commodities, selected from the 2002 benchmark input-output accounts produced by the U.S. Bureau of Economic Analysis (BEA). In these accounts, definitions are based on North American Industry Classification System (NAICS). The most detailed, 6-digit NAICS codes are used in order to parse industries and commodities as precisely as possible in an attempt to include only business and consumer activities that are generally local in nature. As they are adapted by BEA, there are 426 industries in the 2002 benchmark accounts. A complete list can be found in BEA's detailed item output file: http://www.bea.gov/industry/io_benchmark.htm#2002data. The local economy as defined in the NAHB model retains the following 89 industries:

| | ***NAICS*** | ***Detailed Industry Name*** |
|---|---|---|
| 1 | 111400 | Greenhouse and nursery production |
| 2 | 212320 | Sand, gravel, clay, and refractory mining |
| 3 | 221100 | Power generation and supply |
| 4 | 221200 | Natural gas distribution |
| 5 | 221300 | Water, sewage and other systems |
| 6 | 230101 | Nonresidential commercial and health care structures |
| 7 | 230103 | Other nonresidential structures |
| 8 | 230201 | Residential permanent site single- and multi-family structures |
| 9 | 230202 | Other residential structures (primarily dormitories, fraternity and sorority houses) |
| 10 | 230301 | Nonresidential maintenance and repair |
| 11 | 230302 | Residential maintenance and repair |
| 12 | 323120 | Support activities for printing |
| 13 | 339950 | Sign manufacturing |
| 14 | 420000 | Wholesale trade |
| 15 | 485000 | Transit and ground passenger transportation |
| 16 | 492000 | Couriers and messengers |
| 17 | 493000 | Warehousing and storage |
| 18 | 4A0000 | Retail trade |
| 19 | 511110 | Newspaper and publishers |

| | | |
|---|---|---|
| 20 | 515100 | Radio and television broadcasting |
| 21 | 515200 | Cable and other subscription programming |
| 22 | 517000 | Telecommunications |
| 23 | 519100 | Other information services |
| 24 | 518100 | Internet service providers and web search portals |
| 25 | 518200 | Data processing, hosting, and related services |
| 26 | 522A00 | Nondepository credit intermediation and related activities |
| 27 | 523000 | Securities, commodity contracts, investments |
| 28 | 524200 | Insurance agencies, brokerages, and related services |
| 29 | 525000 | Funds, trust, and other financial vehicles |
| 30 | 52A000 | Monetary authorities and depository credit intermediation |
| 31 | 531000 | Real estate |
| 32 | 532100 | Automotive equipment rental and leasing |
| 33 | 532230 | Video tape and disc rental |
| 34 | 532400 | Machinery and equipment rental and leasing |
| 35 | 532A00 | General and consumer goods rental except video tapes and discs |
| 36 | 533000 | Lessors of nonfinancial intangible assets |
| 37 | 541100 | Legal services |
| 38 | 541200 | Accounting and bookkeeping services |
| 39 | 541300 | Architectural and engineering services |
| 40 | 541400 | Specialized design services |
| 41 | 541511 | Custom computer programming services |
| 42 | 541512 | Computer systems design services |
| 43 | 54151A | Other computer related services, including facilities management |
| 44 | 541800 | Advertising and related services |
| 45 | 541920 | Photographic services |
| 46 | 541940 | Veterinary services |
| 47 | 5419A0 | All other miscellaneous professional and technical services |
| 48 | 561100 | Office administrative services |
| 49 | 561200 | Facilities support services |
| 50 | 561300 | Employment services |
| 51 | 561400 | Business support services |
| 52 | 561600 | Investigation and security services |
| 53 | 561700 | Services to buildings and dwellings |
| 54 | 561900 | Other support services |
| 55 | 562000 | Waste management and remediation services |
| 56 | 611100 | Elementary and secondary schools |
| 57 | 611B00 | Other educational services |
| 58 | 621600 | Home health care services |
| 59 | 621A00 | Offices of physicians, dentists, and other health practitioners |
| 60 | 621B00 | Other ambulatory health care services |
| 61 | 622000 | Hospitals |
| 62 | 623000 | Nursing and residential care facilities |
| 63 | 624400 | Child day care services |
| 64 | 624A00 | Individual and family services |
| 65 | 624200 | Community food, housing, and other relief services |
| 66 | 711100 | Performing arts companies |
| 67 | 711200 | Spectator sports |
| 68 | 712000 | Museums, historical sites, zoos, and parks |
| 69 | 713940 | Fitness and recreational sports centers |
| 70 | 713950 | Bowling centers |

| | | |
|---|---|---|
| 71 | 713A00 | Amusement parks, arcades, and gambling industries |
| 72 | 713B00 | Other amusement and recreation industries |
| 73 | 722000 | Food services and drinking places |
| 74 | 811192 | Car washes |
| 75 | 8111A0 | Automotive repair and maintenance, except car washes |
| 76 | 811200 | Electronic equipment repair and maintenance |
| 77 | 811300 | Commercial machinery repair and maintenance |
| 78 | 811400 | Household goods repair and maintenance |
| 79 | 812100 | Personal care services |
| 80 | 812200 | Death care services |
| 81 | 812300 | Dry-cleaning and laundry services |
| 82 | 812900 | Other personal services |
| 83 | 813100 | Religious organizations |
| 84 | 813A00 | Grant making and giving and social advocacy organizations |
| 85 | 813B00 | Civic, social, professional and similar organizations |
| 86 | S00201 | State and local government passenger transit |
| 87 | S00202 | State and local government electric service |
| 88 | S00203 | Other state and local government enterprises |
| 89 | S00500 | General government industry |

In contrast to the classification system used in some previous years, single-family and multifamily construction are combined into a single category. The Census Bureau maintains a description of what is included in each NAICS industry on its web site: http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2002. In BEA's system of input-output accounts, commodities generally conform to industry definitions. However, BEA does not include separate commodities for "state and local government passenger transit" or "state and local government electric service" (these commodities show up as passenger transit and electric service, irrespective of which industry produces them), so the local economy as defined in the NAHB model consists of 89 industries and 87 commodities.

This list includes trade, construction, and a number of industries under the general categories of finance, transportation, and services—but excludes virtually all manufacturing, mining, and agriculture, on the grounds that markets for manufactured products are at least regional—if not national or international—in nature.

The exclusion of many industries is a distinguishing feature of the NAHB local impact model and is consistent with the overall intent of the model: to analyze the impact of locating a housing unit and the household that occupies it in one place rather than another. From this perspective, a house built in Seattle, Washington should not cause additional airplanes to be built or additional software to be produced, even though the occupants of a home built in Seattle may use software produced in Seattle and travel on planes built in Seattle. Because these households would be likely to use these products the same way even if they lived in some other metropolitan area, use of these products is not a function of the home's location and. Hence, industries like software publishing and aircraft manufacturing are excluded from the model.

Based on the industries and commodities described above, a "total local requirements" matrix is constructed that shows the total output required from each of the local industries to produce $1 of each local commodities.

To illustrate the derivation of this matrix, let

$\boldsymbol{c}$ = an 87-element column vector of commodity outputs
$\boldsymbol{g}$ = an 89-element column vector of industry outputs
$\boldsymbol{V}$ = an 87×89 subset of the benchmark make table that shows how much of each commodity is produced by each industry
$\boldsymbol{h}$ = an 89-element column vector showing how much scrap is produced by each industry
$\boldsymbol{U}$ = a 89×87 subset of the benchmark use table that shows how much of each commodity used as an input by each industry. Coefficients for the wholesale trade commodity are set to zero, assuming that these transactions are often non-local in nature. The wholesale trade industry produces a considerable amount of the retail trade commodity. The effect of this is to retain retail trade in the model, irrespective of which industry produces it, but to exclude wholesale trade activities.

The following matrices can then be defined through standard input-output algebra:

$\boldsymbol{B} = \boldsymbol{U}\hat{\boldsymbol{g}}^{-1}$ the direct requirements matrix, showing the amount of each commodity needed as a direct input to produce $1 of each industry's output. (The symbol ˆ indicates a matrix created from a vector by placing the vector=s elements on the matrix diagonal.) This is simply the use table scaled by industry output.

$\boldsymbol{j} = \hat{\boldsymbol{g}}^{-1}\boldsymbol{h}$ a vector showing scrap as a fraction of each industry's output. Many of the elements of this vector are zero in the NAHB local impact model, which excludes most of the manufacturing sector.

$\boldsymbol{D} = \boldsymbol{V}\hat{\boldsymbol{c}}^{-1}$ an 87×89 market share matrix, or the make table scaled by commodity output. $\boldsymbol{D}$ shows the fraction of each commodity (excluding scrap) produced by each industry.

$\boldsymbol{F} = (\boldsymbol{I}-\hat{\boldsymbol{j}})^{-1}\boldsymbol{D}$ an 87×89 matrix showing, for $1 worth of each commodity, the fraction produced by each industry. In short, $\boldsymbol{F}$ is $\boldsymbol{D}$ adjusted for scrap. $\boldsymbol{F}$ is often called a transformation matrix, because it can be used to transform commodities into the output of industries and vice versa.

$$\textbf{\textit{Total Local Requirements}} = \boldsymbol{F}(\boldsymbol{I}-\boldsymbol{BF})^{-1}$$

The total local requirements matrix translates local commodities into the output of local industries. The NAHB model is designed to capture only a fraction of the output: the fraction that becomes either income for local households or revenue for local governments. These

fractions are estimated from a combination of value added components of the input-output tables, plus information taken from other BEA industry accounts. In the BEA accounts, the final price of a commodity is the sum of intermediate outputs plus value added by the industry. Retaining only the value added in each industry from a total requirements matrix avoids double counting and constrains the impact of selling a local commodity to be no more than the total price paid for the commodity.

The input-output accounts decompose value added into three components: compensation of employees, taxes on production and imports, and gross operating surplus. Other BEA industry accounts provide some additional on each component. The following table summarizes the information taken from these accounts that is used to help define a local economy.

| | Wages & Salaries per Dollar of Employee Compensation | Wages & Salaries per Full-Time job Equivalents | Other Corporate as a % of Gross Operating Surplus | Other Non-Corp. as a % of Gross Operating Surplus |
|---|---|---|---|---|
| Farms | 86.3% | 32,330 | 27.8% | 72.2% |
| Mining, except oil and gas | 77.9% | 61,399 | 62.7% | 15.0% |
| Utilities | 70.8% | 81,471 | 71.3% | 26.1% |
| Construction | 82.6% | 47,736 | 38.4% | 59.9% |
| Miscellaneous manufacturing | 69.9% | 49,708 | 46.0% | 52.1% |
| Wholesale trade | 84.3% | 61,935 | 81.4% | 15.8% |
| Retail trade | 85.0% | 30,328 | 69.2% | 27.3% |
| Transit and ground passenger transportation | 81.1% | 27,492 | 69.8% | 26.4% |
| Other transportation and support activities | 80.1% | 44,802 | 57.5% | 39.1% |
| Warehousing and storage | 83.7% | 39,941 | 83.3% | 15.9% |
| Publishing industries | 81.4% | 75,687 | 80.8% | 17.5% |
| Broadcasting and telecommunications | 80.3% | 69,858 | 68.3% | 30.2% |
| Information and data processing services | 86.3% | 82,011 | 58.4% | 39.8% |
| Federal Reserve banks, credit intermediation | 82.9% | 62,017 | 92.7% | 3.8% |
| Securities, commodity contracts and investments | 87.9% | 212,191 | 73.5% | 2.6% |
| Insurance carriers and related activities | 82.0% | 68,694 | 86.0% | 14.0% |
| Funds, trusts and other financial vehicles | 53.2% | 95,698 | 95.8% | 0.0% |
| Real estate | 86.3% | 49,838 | 3.2% | 74.9% |
| Rental leasing services & lessors of intangible assets | 85.1% | 42,238 | 64.0% | 33.8% |
| Legal services | 86.4% | 79,707 | 19.5% | 78.7% |
| Computer systems design and related services | 86.4% | 92,108 | 4.7% | 90.8% |
| Misc. professional, scientific, and technical services | 86.1% | 69,177 | 26.1% | 72.5% |
| Administrative and support services | 86.2% | 32,067 | 44.8% | 52.8% |
| Waste management and remediation services | 85.2% | 52,043 | 75.0% | 22.8% |
| Educational services | 86.9% | 36,521 | 53.5% | 40.9% |
| Ambulatory health care services | 85.3% | 56,174 | 40.8% | 56.7% |
| Hospitals and nursing and residential care facilities | 84.0% | 42,062 | 36.7% | 40.4% |
| Social assistance | 87.1% | 24,800 | 42.0% | 53.7% |
| Performing arts, spectator sports, museums | 83.5% | 73,462 | 32.0% | 66.7% |
| Amusements, gambling and recreation industries | 86.4% | 26,113 | 49.1% | 49.4% |
| Food services and drinking places | 86.4% | 19,492 | 68.1% | 30.3% |
| Other services, except government | 87.2% | 31,983 | 29.9% | 63.6% |
| State and local general government | 76.0% | 48,175 | NA | NA |
| State and local government enterprises | 77.1% | 52,160 | NA | NA |

In the NAHB model, local income is derived from two of the value-added components: compensation of employees and gross operating surplus, using other information from BEA industry accounts.

Due primarily to data limitations BEA, ratios from the relatively broad categories in the above table are sometimes applied to more narrowly defined local industries, For example, ratios for the broad categories "farms" and "mining" are each applied to a single, more narrowly defined local industry—"greenhouse and nursery production" and "sand, gravel, clay, and refractory mining," respectively.

The estimates of local income in the NAHB model exclude most corporate profits, based on the rationale that ownership of most corporations is national or international in scope. Even if a household living in Cleveland buys a product manufactured by a corporation located in Cleveland, profits derived from the sale are likely to be distributed to shareholders living in other locations.

The model makes an exception to this general rule for subchapter S corporations. S corporations tend to be smaller and more local and in this regard tend to resemble partnerships more than C corporations. S corporations also tend to be relatively common in particular industries, such as residential construction. The Internal Revenue Service (IRS) provides information on business receipts by form of business and industry (http://www.irs.gov/taxstats/bustaxstats/article/0,,id=152029,00.html) and this is used to decompose corporate profits into profits for S-corporations and C-corporations. The IRS tables provide relatively limited industry detail, so again percentages for a broadly defined industry are often applied to several of the more precisely defined 6-digit NAICS industries. The S-corporation profits by industry are then included as part of local income.

Local government revenue is estimated as a function of both local income and taxes on production and imports by industry. Across the country as a whole, BEA's national accounts show that taxes on production and imports collected by local governments (which consist largely of sales taxes) account for 36.1 percent of all TOPI (86.2 percent, for state and local governments are combined), and that the average effective state and local corporate income tax rate is 6.35 percent.

Up to this point, the local economy has been defined based on a technology that is location invariant. The fiscal structure of local governments is known to vary considerably across the country, however. At this stage, the model employs data from the most recent Census of Governments (http://www.census.gov/govs/www/gid2002.html). Census of Governments data are available for each of the roughly 87,000 units of government in the U.S., and these data can be used to customize the structure of local government finances to a particular area.

Aggregating personal taxes and fees over all local (or state and local) governments in the U.S. shows that these taxes and fees sum to 1.031 (4.466) percent of personal income. The NAHB model uses three local (or state and local) factors based on aggregate revenues divided by personal income, and the ratio of these measures for the area in question to the U.S. as a whole.

For a specific area,

Personal taxes =
1.0317% (or 4.446%) × Local Personal Income × Local Factor 1

Business taxes =
36.1% (or 86.2%) × TOPI in Local Industries × Local Factor 2 +
6.35% × Corporate Profits in Local Industries × Local Factor 3

where the three local factors are derived on a case by case basis from data in the most recent Census of Governments. These factors are applied to value added in each local industry. This preserves the industry detail in the input-output accounts while customizing the analysis to a local area by using data from the Census of Governments, which is a distinguishing feature of the NAHB local impact model.

In the case of corporate profits in local industries for a particular metropolitan area or nonmetropolitan county, Local Factor 3 will usually be zero. Very few local governments impose a tax on corporate profits, so this will usually have an impact only when the model is applied to an entire state.

## Phase I: Construction

As shown diagrammatically in "Background and a Brief Description of the Model Used to Estimate the Economic Benefits", Phase I of the model feeds the dollar amount of construction and ancillary locally produced items into the income and tax matrices derived from the model total local requirements. Accounting for everything that goes into building a home and delivering it to its customer is more complicated than it may at first appear.

For one thing, the Census Bureau subtracts several items from construction value before providing the numbers to BEA for use in the input-output and related GDP accounts. On new homes built for sale, the Census Bureau subtracts 1.1 percent of the sales price for landscaping, 0.5 percent for appliances, 2.9 percent for realtor and brokers fees, and 2.7 percent for marketing and finance costs. There are equivalent subtractions for custom homes (i.e., homes where the builder functions as a general contractor for a home built on the customer's lot).

However, the landscaping and purchases of appliances and marketing/broker services associated with a newly built home clearly are attributable to the construction of the home. Phase I of the NAHB model therefore accounts for these items as separate purchases of the local construction, retail trade, and real estate industries. For retail trade, only the gross margin of appliance purchases are counted. Gross margins for different types of retailers are available from the Census Bureau's Annual Retail Trade Survey (http://www.census.gov/svsd/www/artstbl.html).

In addition, there are settlement or closing costs associated with transferring property from a builder to the ultimate owner. In a typical case, these costs are shared between buyers and sellers. Construction value as defined in the input-output accounts includes closing costs if they are paid by the seller, but not the buyer. When the local impact model was first developed,

NAHB verified these details with economists at BEA.

In order to estimate both closing costs as a fraction of the home's price and the share of these costs the buyer pays, the NAHB model uses national average data compiled by the U.S. Department of Housing and Urban Development.[2] The share of settlement costs paid for by the buyer for loan origination and discount fees, title and private mortgage insurance, and legal fees are counted as output of the local depository credit intermediation, insurance, and legal services industries, respectively.

Another category of closing costs sometimes paid by the buyer is mortgage or deed transfer taxes. Phase I of the NAHB model does not automatically include an amount for transfer taxes. In most (but not all) instances, these taxes are imposed by state, rather than, local governments. To the extent that transfer taxes apply in a specific case, that information needs to be supplied by the local entity requesting the analysis.

If the local entity requesting an analysis provides information that sales taxes are imposed on construction material and supplies a local sales tax rate, the model captures these taxes as revenue generated for local governments assuming that materials account for 30 percent of the final price of a housing unit. The figure of 30 percent is taken from information reported in the April 2004 *Professional Builder*, which is generally consistent with results from construction cost surveys NAHB has conducted over the years.

## Phase II: The Construction Ripple

Phase I of the model translates home building activity into income for local workers and business proprietors, and revenue for local governments. This output serves as the input for Phase II, as part of the local income generated will be spent, generating more income, generating more spending, and so on. These spending ripples damp and eventually converge to a limit, which is the ultimate ripple or multiplier effect.

To convert local income to local spending, the model requires information about local household spending tendencies. Detailed spending information at the household level is available from the Consumer Expenditure (CE) Survey, produced by the U.S. Bureau of Labor Statistics (BLS) primarily for the purpose of determining the weights for the Consumer Price Index (http://www.bls.gov/cex/home.htm) [3]

[2] Report to Congress on the Need for Further Legislation in the Area of Real Estate Settlements, 1981, Exhibits II-1 and II-6.

[3] Technically, in the Consumer Expenditure Survey, the unit of measurement is actually not a household, but a *Consumer Unit*, a group of individuals who live in the same house and make joint purchasing decisions. There may be more than one Consumer Unit in a household.

The CE consists of two different types of surveys: 1) an interview survey that collects data on monthly expenditures as well as information on income and household characteristics, and 2) a diary survey that collects data on weekly expenditures of frequently purchased items. These are two separate surveys, each designed individually with weights that aggregate to an estimate of total spending in the U.S. When it estimates aggregate measures of consumer spending, BLS combines results from the two different types of surveys in a manner it does not disclose in detail to the public.

The NAHB local impact model uses only data from the interview survey, primarily to avoid the need for arbitrary decisions about which spending items to take from which survey. Based on its CE interview survey, BLS produces a public use microdata set consisting of quarterly files with household characteristics (including income), another set of quarterly files a record of income and other characteristics for each member of the household, and a set of fifty-one annual "EXPN" files with detailed information about various categories of expenditures.

These detailed files allow NAHB to maintain a conservative approach and exclude spending on items that may often be purchased from a vendor outside the local area. For example, BLS collects information on spending while on trips and vacations away from home in a separate "TRV" EXPN file. The NAHB local impact model does not include any spending information at all from the TRV file. NAHB processes the information from the EXPN files along with information on household characteristics and income to estimate spending tendencies on 47 locally produced commodities, as shown in the following table:

**Local Spending Extracted from the CE EXPN Files**

| | Local commodity | NAICS Code | EXPN File | Description of items included in local spending |
|---|---|---|---|---|
| 1 | Greenhouse and nursery production | 111400 | CRB | Costs of all items and services for planting shrubs or trees, or otherwise landscaping the ground of the housing unit in which the consumer unit lives. |
| 2 | Power generation and supply | 221100 | UTC | Electricity bills for the housing unit in which the consumer unit lives. |
| 3 | Natural gas distribution | 221200 | UTC | Gas bills for the housing unit in which the consumer unit lives. |
| 4 | Water, sewage and other systems | 221300 | UTC | Water and/or sewage bills for the housing unit in which the consumer unit lives. |
| 5 | New residential additions and alterations, nonfarm | 230130 | CRB | Costs of all items and services associated with building an addition to the house or a new structure including porch, garage or new wing; finishing a basement or an attic or enclosing a porch; remodeling one or more rooms; building outdoor patios, walks, fences, or other enclosures, driveways, or permanent swimming pools; or other improvements or repairs to the housing unit in which the consumer unit lives. |
| | Local commodity | NAICS Code | EXPN File | Description of items included in local spending |

| | | | | |
|---|---|---|---|---|
| 6 | Maintenance and repair of farm and nonfarm residential structures | 230310 | CRB | Costs of all items and services associated with repairing outdoor patios, walks, fences, driveways, or permanent swimming pools; inside painting or papering; outside painting; plastering or paneling; plumbing or water heating installations and repairs; electrical work; heating or air-conditioning jobs; flooring repair or replacement; insulation; roofing, gutters, or downspouts; siding; installation, repair, or replacement of window panes, screens, storm doors, awnings, etc.; and masonry, brick or stucco work for the housing unit in which the consumer unit lives. |
| 7 | Transit and ground passenger transportation | 485000 | EDA | Amount paid for private bus transportation to elementary or high school for members of the consumer unit. |
| | | | XPB | Costs for taxis, limousine service, and public transportation, except while on a trip. |
| 8 | Retail trade | 4A0000 | APA | Purchases of major appliances × 26.5% (gross margin for electronics and appliance stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | APB | Purchases of other households appliances and other selected items × 26.5% (gross margin for electronics and appliance stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | FRA | Purchases of home furnishings × 48.1% (gross margin for furniture and home furnishing stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | CLA | Purchases of clothing × 47.9% (gross margin for clothing and clothing accessories stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | CLB | Purchases of infants' clothing, watches, jewelry, and hairpieces × 47.9% (gross margin for clothing and clothing accessories stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | CLC | Purchases of sewing materials × 47.9% (gross margin for clothing and clothing accessories stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | OVB | Purchases of automobiles, including down payment and payment of principle on loans × 16.2% (gross margin for automobile dealers) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | VOT | Purchases of gasoline and other fuels and fluids used in vehicles × 16.4% (gross margin for gasoline stations) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | IHB | Share of health insurance premiums, after broker/agent share is subtracted, used to purchase prescription drugs and durable medical equipment × 30.8% (gross margin for health and personal care stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | Local commodity | NAICS Code | EXPN File | Description of items included in local spending |

| | | | | |
|---|---|---|---|---|
| | Retail trade (cont) | | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to purchase prescription drugs, other nondurable medical products, and durable medical equipment × 30.8% (gross margin for health and personal care stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | MDB | Direct purchases of glasses, hearing aids, prescription medication, convalescent equipment, or other medical equipment × 30.8% (gross margin for health and personal care stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | EDA | Purchases of books or other equipment for elementary or high school for members of the consumer unit × 39.8% (gross margin for sporting goods, hobby, book and music stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | ENT | Amount paid for CDs or audio tapes, photographic film, video cassettes or tapes or discs, and books, but not through a mail order club or subscription × 39.8% (gross margin for sporting goods, hobby, book and music stores) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | MIS | Expenses for flowers, potted plants, pet supplies and medicines, toys, and games, and computer or video hardware, software, and accessories × 43.8% (gross margin for miscellaneous store retailers) × 81% (adjustment for loss of local sales to internet and mail order business). |
| | | | XPA | Expenditure for food and nonfood items at grocery stores, and for food and beverages from places other than grocery stores × 29.4% (gross margin for food and beverage stores). |
| | | | XPB | Expenditures for cigarettes and other tobacco products × 31.4% (gross margin for all retailers excluding motor vehicle and parts dealers) × 81% (adjustment for loss of local sales to internet and mail order business). |
| 9 | Newspaper and publishers | 511110 | ENT | Expenses for newspapers and other periodicals not through a subscription. |
| 10 | Cable networks and program distribution | 513200 | UTI | Expenses for cable TV, satellite TV, and satellite radio services. |
| 11 | Telecommunications | 513300 | UTA | Telephone bills, irrespective of items included in service. |
| | | | UTP | Pre-paid phone card or public pay phone services. |
| 12 | Information services | 514100 | UTI | Expense for internet connection, excluding any away from home. |
| 13 | Nondepository credit intermediation and related activities | 522A00 | OVB | Interest payment on automobile loans. |
| | Local commodity | NAICS Code | EXPN File | Description of items included in local spending |
| 14 | Insurance agencies, brokerages, and other insurance related activities | 524200 | INB | Percent of premiums for all types of insurance other than health (percentage based on agent/brokers' share of industry). |

| | | | | |
|---|---|---|---|---|
| | | | IHB | Percent of premiums for health insurance (percentage based on agent/brokers' share of industry). |
| 15 | Monetary authorities and depository credit intermediation | 52A000 | HEL | Interest paid on lump sum home equity loans, based only on the home in which the consumer unit lives. |
| | | | OPH | Interest paid on home equity lines of credit, based only on the home in which the consumer unit lives. |
| | | | OPI | Penalty charges on special or lump sum mortgage payment. |
| | | | XPB | Charges for safe deposit boxes, checking accounts, and other banking services. |
| 16 | Real estate | 531000 | RNT | Total rental payments for the housing unit in which the consumer unit lives. |
| | | | OPI | ground or land rent, portion of condo fee for management services, special payments for property management services--all of these only for the property in which the consumer unit lives. |
| 17 | Automotive equipment rental and leasing | 532100 | RTV | Expenses for renting vehicles. |
| | | | LSD | Expenses for leasing vehicles. |
| 18 | Video tape and disc rental | 532230 | ENT | Amount paid for rental of video cassettes, tapes, or discs. |
| 19 | General and consumer goods rental except video tapes and discs | 532A00 | APA | Expenses for renting major appliances. |
| | | | APB | Expenses for renting other household appliances and selected items. |
| | | | FRB | Expenses for renting furniture. |
| | | | CLD | Expenses for renting clothing. |
| | | | MDB | Expenses for renting convalescent or other medical equipment. |
| 20 | Legal services | 541100 | MIS | Expenses for services of lawyers or other legal professionals. |
| 21 | Accounting and bookkeeping services | 541200 | MIS | Accounting fees. |
| 22 | Photographic services | 541920 | ENT | Amount paid for film processing or printing digital photographs. |
| | | | MIS | Amount paid for professional photography fees. |
| 23 | Veterinary services | 541940 | MIS | Veterinarian expenses for pets. |
| 24 | Investigation and security services | 561600 | MIS | Home security service fees. |
| 25 | Services to buildings and dwellings | 561700 | APA | Charges for installing major appliances. |
| | | | EQB | Costs for pest control or repairing and servicing heating and air conditioning equipment. |
| | | | MIS | Other home services and small repair jobs around the house. |
| 26 | Waste management and remediation services | 562000 | UTC | Trash/garbage collection bills for the housing unit in which the consumer unit lives. |
| | Local commodity | NAICS Code | EXPN File | Description of items included in local spending |
| 27 | Elementary and secondary schools | 611100 | EDA | Tuition and other expenses for elementary or high school for members of the consumer unit. |
| 28 | Home health care services | 621600 | IHB | Share of health insurance premiums, after broker/agent share is subtracted, used to pay for home health care. |

| | | | | |
|---|---|---|---|---|
| | | | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to pay for home health care. |
| 29 | Offices of physicians, dentists, and other health practitioners | 621A00 | IHB | Share of health insurance premiums, after broker/agent share is subtracted, used to pay for physician, clinical, and dental services. |
| | | | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to pay for physician, clinical, and dental services. |
| | | | MDB | Direct payments for eye care, dental care, or physician services. |
| 30 | Other ambulatory health care services | 621B00 | IHB | Share of health insurance premiums, after broker/agent share is subtracted, used to pay for other professional services. |
| | | | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to pay for other professional services. |
| | | | MDB | direct payments for services by medical professionals other than physicians, lab tests, and other medical care. |
| 31 | Hospitals | 622000 | IHB | Share of health insurance premiums, after broker/agent share is subtracted, used to pay for hospital care. |
| | | | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to pay for hospital care. |
| | | | MDB | Direct payments for hospital rooms or services. |
| 32 | Nursing and residential care facilities | 623000 | IHB | Share of health insurance premiums, after broker/agent share is subtracted, used to pay for nursing home care. |
| | | | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to pay for nursing home care. |
| | | | MDB | Direct payments for care in convalescent of nursing home. |
| 33 | Child day care services | 624400 | EDA | Expenses for nursery school or child day care centers for members of the consumer unit. |
| | | | MIS | Expenses for babysitting, nanny services, or child care in the consumer unit's or someone else's home. |
| 34 | Performing arts companies | 711100 | SUB | Theater or concert season tickets. |
| | | | ENT | Single admissions to movies, theaters, and concerts. |
| 35 | Spectator sports | 711200 | SUB | Season tickets to sporting events. |
| | | | ENT | Single admissions to spectator sporting events |
| | Local commodity | NAICS Code | EXPN File | Description of items included in local spending |
| 36 | Fitness and recreational sports centers | 713940 | EDA | Recreational lessons and instruction for members of the consumer unit. |
| | | | SUB | Expenses for membership in golf courses. Country clubs, health clubs, fitness centers, or other sports and recreational organizations. |
| | | | ENT | Fees for participating in sports. |

| | | | | |
|---|---|---|---|---|
| 37 | Other amusement, gambling, and recreation industries | 713A00 | MIS | Expenses for lotteries and games of chance. |
| 38 | Food services and drinking places | 722000 | XPA | Expenditures for food and beverages at restaurants, cafeterias, cafes, drive-ins, etc. |
| 39 | Automotive repair and maintenance, except car washes | 8111A0 | VEQ | Expenses for vehicle maintenance and repair. |
| | | | VOT | Expenses for towing and automobile repair service policies. |
| 40 | Electronic equipment repair and maintenance | 811200 | EQB | Cost for repairs and services related to computers. |
| 41 | Household goods repair and maintenance | 811400 | EQB | Costs for repairing or servicing appliances, tools, sound, video, photographic, sports, and lawn and garden equipment; or repairing computer-related equipment. |
| | | | FRB | Costs for repairing furniture. |
| | | | CLD | Costs for repairing or altering clothing and accessories, or repairing watches or jewelry. |
| 42 | Personal care services | 812100 | IHC | Number of persons covered by Medicare times average Medicare benefits per Medicare enrollee times the share of Medicare benefits used to pay for other personal care services. |
| | | | MIS | Expenses for adult day care centers, and home care for invalids, convalescents, handicapped, or elderly persons. |
| 43 | Death care services | 812200 | MIS | Expenses for funerals, burials, cremation, and purchase and upkeep of cemetery lots or vaults. |
| 44 | Dry cleaning and laundry services | 812300 | XPB | Expenses for clothing and other items at sent to drycleaners and laundry, as well as coin operated dry cleaning and laundry machines. |
| 45 | Other personal services | 812900 | CLD | Costs of clothing storage services. |
| | | | VOT | Fess for vehicle parking, boat docking and plane landing. |
| | | | MIS | Catering and pet services. |
| | | | XPB | Expenses for haircuts, hair styling, manicures, massages, and other salon services. |
| 46 | Religious organizations | 813100 | CNT | Contributions to religious organizations. |
| 47 | Civic, social, professional and similar organizations | 813B00 | SUB | Expenses for membership in civic, service, or fraternal organizations. |

For the items included in retail sales, only the gross margins are included, and in most cases a further adjustment is made to account for loss of local sales to internet and mail order business. The fraction is based on the *Report on Sales Taxes* produced by the Government Accountability Office (GAO) in June of 2000 (GAO/GGD/OCE-00-165). Using numbers from Marketing Logistics, GAO estimated that business-to-consumer remote sales in 2000 were 186 to 278 billion. A subsequent GAO update found no need to revise the analysis (March 28, 2002 press release). NAHB applied this sales loss estimate to personal consumption expenditures on durable and non durable goods from the GDP accounts in order to derive the factor used to deflate purchases and account for business local retailers lose due to remote sales through media such as the internet.

Insurance payments are separated into a share going to brokers and agents and the insurance companies, based on the proportional share of revenue reported in the latest Economic Census (http://www.census.gov/econ/census02/data/us/US000_52.HTM). The share going to brokers

and agents is counted as local income. However, it is also assumed that the share going to insurance companies comes back in some cases as these companies pay medical costs for policy holders that go to health care providers in the local area. This is estimated using "Personal Health Care Expenditures by object & Source of Payment" reported by the Census Bureau in the *Statistical Abstract of the United States* (Table 128 in the 2008 Abstract).

A similar calculation is made for expenses covered by Medicare. The CE data include the number of household members covered by Medicare. Payments made by Medicare to local health care providers are estimated using statistics on "Medicare Benefits by Types of Provider," "Medicare Enrollees," and "Medicare Disbursements by Type of Beneficiary" (Tables 134, 136 and 137, respectively in the 2008 *Statistical Abstract of the United States*)

The consumer spending variables used in the model are all in the form of average propensities to consume—that is, average fractions of before-tax income spent on various items. As shown in the table above, The EXPN files generate local consumer spending estimates for 47 of the first 85 local commodities listed on pages 2 and 3. The others enter the model only through local business-to-business transactions in the local total requirements matrix.

To this, the local impact model adds seven categories of local commodities produced by local government enterprises:

1 Local government electric service
2 Local government natural gas distribution
3 Local government water & sewerage
4 Local government passenger transit
5 Local government liquor stores
6 Local government sanitary services
7 Local government hospitals

The introduction of these commodities does not increase total local spending. Instead, as each of these seven commodities has a corresponding commodity produced by private sector industry, the local impact model allocates consumption spending between the publicly produced and privately produced commodities based on information from the Census of Governments. This enables the model to be consistent with both national household consumption patterns and revenue collected by all government enterprises in a particular local area.

To this is added one other local commodity, general government, to account for tax and fee payments (computed in Phase II primarily from BEA personal income estimates and Census of Governments revenue data).

The results can be collected in a matrix 2×55 matrix, ***A:***

$$\boldsymbol{A} = \begin{bmatrix} a_1 & a_2 & a_3 & \cdots & a_{54} & 0 \\ 0 & 0 & 0 & \cdots & 0 & 1 \end{bmatrix}$$

The elements in the first row of $\boldsymbol{A}$ show the average fraction of income spent on each of the 54 local commodities (including those produced by local government enterprises such as publicly owned utilities or hospitals). The "O"s and "1" in the second row indicates that no taxes are spent directly by the household on any of the first 54 commodities; 100 percent is spent on the local general government commodity. This two-row structure is designed to align with the output from Phase I of the model, which comes in the form of before-tax local income and local tax estimates.

Several other matrices and vectors derived from the above concepts are needed to calculate the Phase II ripple or multiplier effect:

$\boldsymbol{W}$: a 55×89 matrix that translates local commodities into local income,

$\boldsymbol{G}$: a 55×89 matrix that translates local commodities into local government general revenue collected from persons, and

$\boldsymbol{T}$: a 55×89 matrix that translates local commodities into local government general revenue collected from businesses

$\boldsymbol{L} = \begin{bmatrix} \boldsymbol{W} & \boldsymbol{G} & \boldsymbol{T} \end{bmatrix}$ therefore defines a 55×267 matrix

$\boldsymbol{x}$ = a two element column vector containing local income and local taxes generated in Phase I

$$\boldsymbol{Y} = \begin{bmatrix} \boldsymbol{i} & \boldsymbol{0} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{i} & \boldsymbol{0} \\ \boldsymbol{0} & \boldsymbol{0} & \boldsymbol{i} \end{bmatrix}$$ a 267×3 matrix where $\boldsymbol{i}$ is a 89-element unit column vector,

$$\boldsymbol{Z} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}$$

In summary, $\boldsymbol{x}$ is the income and tax output from Phase 1, $\boldsymbol{A}$ translates income and taxes into

spending on particular commodities, $\boldsymbol{L}$ translates the detailed commodity spending into income and taxes in each of 89 local industries, and $\boldsymbol{Y}$ and $\boldsymbol{Z}$ are technical devices for summing results. $\boldsymbol{Y}$ collapses the components of a 267-element vector into a 3-element vector of income, personal taxes, and business taxes. $\boldsymbol{Z}$ converts a 3-element vector of this form into a 2-element income and tax vector.

The row vector defined as $\boldsymbol{x'A}$ shows how much, in dollar terms, people who earn income during Phase I spend on each of the 55 local commodities, including local government.

The calculation $\boldsymbol{x'ALYZ}$ produces a 2-element local income and local tax vector of the same form as $\boldsymbol{x'}$. Postmultiplying a vector of this type by $\boldsymbol{ALYZ}$ will always produce a similar, 2-element income and tax vector. Either by construction, or by checking that both eigenvalues are smaller than 1, it is possible to show that $\boldsymbol{ALYZ}$ is a contracting matrix. This implies that the rounds below show successively smaller increments of income and taxes added to the local economy:

$$\begin{aligned}
&Round\,0: \ \boldsymbol{x'} \\
&Round\ 1: \ \boldsymbol{x'\,ALYZ} \\
&Round\ 2: \ \boldsymbol{x'\,ALYZ\ ALYZ} \\
&Round\ 3: \ \boldsymbol{x'\,ALYZ\ ALYZ\ ALYZ} \\
&\qquad\vdots \\
&Round\ K: \ \boldsymbol{x'} \prod_{k=1}^{K} \boldsymbol{ALYZ}
\end{aligned}$$

The terms of this sequence can be summed in the usual manner to create an infinite series. Because $\boldsymbol{ALYZ}$ is a contracting matrix, the result is a convergent series, the limit of which is

$$\boldsymbol{x'\ [I-ALYZ]^{-1}}$$

This is the final multiplied effect on local income and local taxes at the end of Phase II. The factor $\boldsymbol{[I-ALYZ]^{-1}}$ is a matrix version of the conventional Keynesian spending multiplier. Because $\boldsymbol{x'}$ is reported in Phase I, it is subtracted from the effect reported in Phase II.

For some purposes, especially estimating employment impacts, we are interested in tracking income in Phase II by industry. Calculations to accomplish this are based on the following sequence of 1×267 vectors:

$$\begin{aligned}
&Round\ 1: \ \boldsymbol{x'AL} \\
&Round\ 2: \ \boldsymbol{x'AL\,YZAL} \\
&\qquad\vdots \\
&Round\ K: \ \boldsymbol{x'AL} \prod_{k=1}^{K-1} \boldsymbol{YZAL}
\end{aligned}$$

Note that sequence begins with the spending vector $x'AL$—that is, it excludes the income and taxes that have already been captured in Phase I. The limit of the series defined based on this sequence is

$$x'AL\,[I-YZAL]^{-1}$$

This is a 267-element row vector, the first 89 elements containing the final, multiplied effect on local income by industry generated during Phase II. As explained above, income by industry can be separated into business owners' income and wages and salaries, and the wages and salaries converted to full-time job equivalents.

From the standpoint of local governments, it may be desirable to track individual sources of revenue, such as particular fees and taxes. To facilitate this, it is useful to have a three element local income and local tax vector, where the tax revenue is decomposed into taxes collected from persons and taxes collected from businesses.

Consider the following sequence of such 3-element vectors:

$$\begin{aligned} &Round\ 1: \ x'ALY \\ &Round\ 2: \ x'ALY\ ZALY \\ &\qquad\vdots \\ &Round\ K: \ x'ALY\ \prod_{k=1}^{K} ZALY \end{aligned}$$

This sequence begins after *Round 0*, implicitly excluding income earned and taxes paid during Phase I. The limit of the infinite series defined by this sequence is

$$x'ALY\,[I-ZALY]^{-1}$$

This is the final, multiplied effect on local income, local government revenue collected from persons, and local government revenue collected from businesses in Phase II of the model. The tax structure for a particular local area, derived primarily from Census of Governments data as described above, can be applied to this result in order to decompose local government revenue into particular types of taxes and fees.

## Phase III: The Ongoing Impacts

A distinguishing feature of the NAHB technique for estimating local impacts is the way it models characteristics and behavior of new housing unit occupants, depending on the particular type of unit being built. There are six basic variants of the NAHB model designed to accommodate different varieties of residential construction:

1. Generic Single-Family
2. Generic Multifamily
3. Active Adult
4. Family Low-Income Housing Tax Credit (LIHTC)
5. Elderly LIHTC
6. Remodeling

The remodeling version of the model does not in general incorporate ongoing impacts, so it requires no occupant income estimates. For the other five versions of the model, separate occupant income estimates are derived in a way that vary with location as well as with the type of units being built. The derivations are based on relationships between average income and standard variables that are typically available at the local level. The methods for establishing these relationships are summarized below.

**Generic Single-Family.** Regression of average income of home owners on area median family income and average value of the units using American Community Survey (ACS) microdata.

**Generic Multifamily.** Regression of average income of home owners on area median family income and average rent using ACS microdata.

**Active Adult.** Average income of movers into age-restricted owner occupied units and average income of all home buyers are computed from American Housing Survey (AHS) microdata the , and the ration of the two average incomes is formed/

**Family LIHTC.** Average incomes of all movers into rental units who have less than 60 percent of median family income for the U.S. as a whole, computed from CE data.

**Elderly LIHTC**. Average incomes of all elderly movers into rental units who have less than 60 percent of median family income for the U.S. as a whole, computed from CE data.

The ACS is the Census Bureau's replacement for the decennial Census long form (http://www.census.gov/acs/www/). The AHS, funded by the U.S. Department of Housing and Urban Development (HUD) and conducted by the Census Bureau, is the federal government's primary vehicle for collecting detailed information about housing units and their occupants at the national level (http://www.huduser.org/datasets/ahs.html).

The ratios and regression results listed above allow the model to be simultaneously customized to a particular area and a particular type of construction by inputting specific local information that is generally available. When customizing to a local area, median family income for that particular area is used. HUD produces median income estimates for all parts of the country in a timely fashion as part of the process it uses to establish income limits for various housing programs (http://www.huduser.org/datasets/il.html).

When it is necessary to translate rents into value or vice versa, a cap rate taken from the Residential Finance Survey (http://www.huduser.org/datasets/rfs.html), also funded by HUD and conducted by the Census Bureau, is used.

In addition to average income, estimated spending tendencies for movers into each type of construction are needed. Separate spending vectors are estimated for each using household information available in the CE data. The table on the following page shows average local propensities to consume computed from the 2006 CE.

This modeling of average spending by different types of households soon after they move in is another distinguishing feature of the NAHB local impact model. In addition to the function they serve in the local model, average spending tendencies computed from CE data have also proven to be of interest for their implications at the national level.[4]

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Compared to home buyers, renters tend to spend more of their incomes locally—partly due to the tendency of lower-income households to spend a greater fraction of their incomes on necessities, but also due to rental payments that go to a local owner, or owner employing a management company with a local presence. The equivalent housing expense for a home buyer would be a mortgage payment. Because mortgage payments typically are made to non-local owners of the mortgage through non-local servicers, they are excluded from the spending estimates in the NAHB local impact model.

Average propensities to spend on virtually all categories of local health care services are higher for households moving into construction designed for older residents (age-restricted active adult and elderly LIHTC).

As was described in Phase II, seven categories of commodities produced by local government enterprises are added to the model, and a share of local spending (which may be zero) is allocated to these enterprises instead of private producers based on revenues reported in the Census of Governments for each local government enterprises in the area.

Also as in Phase II, Census of Governments data are used to estimate most categories of tax and fee revenue generated for general (non-enterprise) governments in the area. The exemption is residential property taxes. Perhaps surprisingly, residential and non-residential property taxes are not reported separately. Moreover, some states have restriction on rate increases of other laws that tend to make property tax rates different on new construction. Particular developments (for example, those financed by the LIHTC program) may also be granted special forms of property tax relief.

[4] See, for example, the October Special Study in *Housing Economics*: "Spending Patterns of Home Buyers." http://www.nahb.org/generic.aspx?sectionID=734&genericContentID=106491&channelID=311

[5] See, for example, the October Special Study in *Housing Economics*: "Spending Patterns of Home Buyers." http://www.nahb.org/generic.aspx?sectionID=734&genericContentID=106491&channelID=311

## Example of Average Local Spending Computed from CE Data

| | Output of industry purchased locally | All House-holds | New Home Buyers | New Multifamily Renters | Active Adult Buyers | New Family LIHTC | New Elderly LIHTC |
|---|---|---|---|---|---|---|---|
| 1 | Greenhouse and nursery production | 0.157% | 0.481% | 0.000% | 1.052% | 0.002% | 0.000% |
| 2 | Power generation and supply | 2.998% | 2.802% | 0.014% | 3.979% | 0.014% | 0.000% |
| 3 | Natural gas distribution | 1.634% | 1.266% | 0.000% | 1.609% | 0.000% | 0.000% |
| 4 | Water, sewage and other systems | 0.701% | 0.728% | 0.000% | 1.011% | 0.000% | 0.000% |
| 5 | Residential permanent site construction | 2.095% | 1.962% | 1.699% | 4.289% | 0.003% | 0.008% |
| 6 | Residential maintenance and repair | 1.455% | 1.218% | 0.021% | 2.752% | 0.055% | 0.048% |
| 7 | Transit and ground passenger transportation | 0.225% | 0.018% | 0.100% | 0.026% | 0.795% | 0.723% |
| 8 | Retail trade | 12.321% | 9.591% | 13.058% | 12.455% | 17.559% | 14.564% |
| 9 | Newspaper and publishers | 0.050% | 0.026% | 0.021% | 0.029% | 0.103% | 0.082% |
| 10 | Cable and other subscription programming | 0.893% | 0.589% | 0.833% | 0.998% | 1.337% | 1.336% |
| 11 | Telecommunications | 3.956% | 2.721% | 3.156% | 3.476% | 5.937% | 4.753% |
| 12 | Internet service providers and web search portals | 0.149% | 0.127% | 0.209% | 0.168% | 0.191% | 0.062% |
| 13 | Nondepository credit intermediation and related | 0.621% | 0.722% | 0.566% | 0.630% | 0.565% | 0.222% |
| 14 | Insurance agencies, brokerages, and related | 0.473% | 0.408% | 0.364% | 0.568% | 0.389% | 0.395% |
| 15 | Monetary authorities and depository credit | 0.611% | 0.804% | 0.132% | 0.941% | 0.081% | 0.059% |
| 16 | Real estate | 8.088% | 1.250% | 23.185% | 1.092% | 34.079% | 35.198% |
| 17 | Automotive equipment rental and leasing | 1.021% | 2.148% | 0.250% | 0.877% | 0.195% | 0.102% |
| 18 | Video tape and disc rental | 0.090% | 0.086% | 0.147% | 0.124% | 0.129% | 0.032% |
| 19 | General and consumer goods rental | 0.042% | 0.014% | 0.004% | 0.010% | 0.074% | 0.035% |
| 20 | Legal services | 0.306% | 0.161% | 0.644% | 0.191% | 0.237% | 0.001% |
| 21 | Accounting and bookkeeping services | 0.124% | 0.120% | 0.096% | 0.233% | 0.178% | 0.296% |
| 22 | Photographic services | 0.076% | 0.094% | 0.050% | 0.065% | 0.073% | 0.010% |
| 23 | Veterinary services | 0.251% | 0.191% | 0.093% | 0.250% | 0.123% | 0.170% |
| 24 | Investigation and security services | 0.018% | 0.036% | 0.000% | 0.050% | 0.003% | 0.001% |
| 25 | Services to buildings and dwellings | 0.268% | 0.295% | 0.079% | 0.575% | 0.061% | 0.100% |
| 26 | Waste management and remediation services | 0.219% | 0.247% | 0.000% | 0.323% | 0.000% | 0.000% |
| 27 | Elementary and secondary schools | 0.232% | 0.291% | 0.043% | 0.255% | 0.291% | 0.000% |
| 28 | Home health care services | 0.619% | 0.255% | 0.310% | 0.987% | 1.047% | 3.004% |
| 29 | Offices of physicians, dentists, etc. | 3.440% | 2.515% | 3.049% | 6.274% | 4.172% | 10.280% |
| 30 | Other ambulatory health care services | 0.708% | 0.540% | 0.372% | 1.154% | 0.756% | 1.876% |
| 31 | Hospitals | 3.295% | 2.125% | 1.774% | 6.774% | 3.001% | 9.707% |
| 32 | Nursing and residential care facilities | 1.383% | 0.539% | 0.656% | 2.098% | 2.233% | 6.421% |
| 33 | Child day care services | 0.258% | 0.395% | 0.315% | 0.044% | 0.342% | 0.000% |
| 34 | Performing arts companies | 0.220% | 0.184% | 0.397% | 0.225% | 0.307% | 0.118% |
| 35 | Spectator sports | 0.084% | 0.060% | 0.145% | 0.045% | 0.114% | 0.021% |
| 36 | Fitness and recreational sports centers | 0.423% | 0.617% | 0.307% | 1.136% | 0.223% | 0.215% |
| 37 | Other amusement and recreation industries | 0.113% | 0.064% | 0.019% | 0.159% | 0.483% | 0.862% |
| 38 | Food services and drinking places | 3.777% | 2.979% | 4.791% | 3.847% | 5.381% | 2.685% |
| 39 | Automotive repair and maintenance | 1.690% | 1.226% | 1.478% | 1.278% | 1.950% | 1.009% |
| 40 | Electronic equipment repair and maintenance | 0.038% | 0.035% | 0.057% | 0.066% | 0.024% | 0.053% |
| 41 | Household goods repair and maintenance | 0.159% | 0.138% | 0.021% | 0.305% | 0.042% | 0.053% |
| 42 | Personal care services | 0.757% | 0.367% | 0.344% | 1.520% | 1.231% | 3.574% |
| 43 | Death care services | 0.233% | 0.059% | 0.000% | 0.180% | 0.055% | 0.057% |
| 44 | Dry cleaning and laundry services | 0.387% | 0.119% | 0.184% | 0.123% | 1.297% | 1.035% |
| 45 | Other personal services | 0.239% | 0.163% | 0.145% | 0.286% | 0.217% | 0.053% |
| 46 | Religious organizations | 0.828% | 0.943% | 0.668% | 1.573% | 0.630% | 1.033% |
| 47 | Civic, social, professional and similar organizations | 0.022% | 0.005% | 0.008% | 0.008% | 0.011% | 0.024% |

For these reasons, when customizing the local impact model to a specific area, information about property taxes on the units being built must be supplied by the entity requesting the analysis. Phase III of the model counts only property tax on the value of construction, assuming that the raw land would be taxed at the same rate if not developed.

Multifamily Phase III impacts are reduced to account for vacant units. By default, the single-family version of the model assumes that units are intended for owner-occupancy and have negligible vacancies. In the Census Bureau's Housing Vacancy Survey (HVS: http://www.census.gov/hhes/www/housing/hvs/hvs.html) homeowner vacancy rates are usually in the neighborhood of only one percent.

For multifamily units, the average multifamily rental annual vacancy rate over the prior decade and average annual multifamily homeowner vacancy rate over the prior decade are used, depending on whether the units are condominiums or rental apartments. In other respects, Phase III treats condo buyers the same as single-family home buyers (the income and spending tendencies discussed above being based on buyers of owner-occupied housing units, irrespective of structure type).

Although vacancy rates are known to fluctuate, the model estimates annual ongoing impacts that are expected to persist for an extended period, so a long-term "natural" measure of vacancy rates is more appropriate for Phase III than a very current, possibly anomalous, number. The reduction for vacancies is applied to all Phase III multifamily impacts except for property taxes, which are assumed to be paid by the owner of the property, whether the units are occupied or not.

Local spending and taxes (including fees and charges paid to local government entities) generate income for local residents, and this income will be spent and recycled in the local economy, much as in Phase II of the model.

Let $\boldsymbol{x}_{\mathrm{n}}$ denote the initial income and tax column vector for new home occupants, $\boldsymbol{A}_{\mathrm{n}}$ denote the matrix formed from the consumption spending patterns of new home occupants, and otherwise maintain the notation used in Phase II of the model. Then consider the following sequence:

$$\begin{aligned}
&\textit{Round } 0: \ \boldsymbol{x}_n' \\
&\textit{Round } 1: \ \boldsymbol{x}_n' \boldsymbol{A}_n \boldsymbol{LYZ} \\
&\textit{Round } 2: \ \boldsymbol{x}_n' \boldsymbol{A}_n \boldsymbol{LYZ}\ \boldsymbol{ALYZ} \\
&\textit{Round } 3: \ \boldsymbol{x}_n' \boldsymbol{A}_n \boldsymbol{LYZ}\ \boldsymbol{ALYZ}\ \boldsymbol{ALYZ} \\
&\qquad\qquad \vdots \\
&\textit{Round } K: \ \boldsymbol{x}_n' \boldsymbol{A}_n \boldsymbol{LYZ} \prod_{k=1}^{K} \boldsymbol{ALYZ}
\end{aligned}$$

The sum of these terms forms an infinite series that converges to the limit

$$\boldsymbol{x}_n' \ [\boldsymbol{I}+(\boldsymbol{A}_n - \boldsymbol{A})\boldsymbol{LYZ}][\boldsymbol{I}-\boldsymbol{ALYZ}]^{-1}$$

When results are reported for Phase III the income earned by the occupants is subtracted from the final multiplied effect, so that only income generated for occupants of housing units already existing in the area is counted.

Note that, were new home occupants to spend the same fraction of their incomes on the various local commodities as average households, $\boldsymbol{A}_{\mathrm{n}} = \boldsymbol{A}$ and the formula would simplify to

$$\boldsymbol{x}_n' \ [\boldsymbol{I}-\boldsymbol{ALYZ}]^{-1}$$

The formula that produces a 267-element vector, the first 89 of which contain the added income by industry, for Phase III is

$$\boldsymbol{x}_n' \ \boldsymbol{A}_n\boldsymbol{L} \ [\boldsymbol{I}-\boldsymbol{YZAL}]^{-1}$$

Again, the income in each industry can be disaggregated into business owners' income and wages and salaries, and the wages and salaries converted to full time jobs. These exclude any jobs filled by occupants of the new housing units.

The formula that produces a 3-element vector showing the final, multiplied effect on local income, local government general revenue from persons, and local general government revenue from business generated in Phase III is

$$\boldsymbol{x}_n' \ \boldsymbol{A}_n\boldsymbol{LY} \ [\boldsymbol{I}-\boldsymbol{ZALY}]^{-1}$$

As in Phase II, the last two elements of the final 3-element vector can be disaggregated to show revenue generated by particular types of taxes, fees, and charges. The primary difference in Phase III is that the increase in residential property tax revenue (which is introduced into the model as a separate input independent of the Census of Government computations) needs to be subtracted before the decomposition procedure can be applied.

## Final Notes

All of the matrix operations in the NAHB local impact model are performed using the O-Matrix package provided by Harmonic Software. The O-Matrix code used to generate Phase III impacts for single-family construction in 2005, and the code used to compute a local total requirements matrix the 1997 BEA input-output accounts are shown as examples of the use of the O-Matrix package on the Harmonic Software web site (http://www.omatrix.com/userstories.html).

The technical documentation on the NAHB model used to estimate the local income, jobs, and taxes generated by home building was prepared by Paul Emrath, Vice President of Survey and Housing Policy Research. For questions on the technical documentation, or on NAHB's impact of home building models in general, he may be contacted in NAHB's Economics and Housing Policy Group by phone at 202-266-8449, or by email at pemrath@nahb.com.

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