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Bartik Benefit-Cost Model of Business Incentives: A User’s Guide

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ABSTRACT

This "user's guide" explains a model for evaluating state or local business incentives. These incentives include tax breaks provided by state and local governments to business, to encourage local job growth. The model is intended to be used by state legislative audit bureaus, state and local economic development agencies, university centers for business research, economic development consulting firms, or any group that wants to evaluate an overall economic development program, or individual economic development projects. Users provide information on the incentives provided, and the incented jobs, and the model then produces estimates of the effects of the program on jobs, on different types of income, and the incomes of different income groups. Estimates are customized to a particular state and program/project start year. The model is currently implemented as an Excel workbook, and also as software that uses Python software, but does not require the user to know Python. This user's guide explains the model's structure, how the user should enter inputs, and how to interpret model outputs.

JEL Classification Codes: R15, R23, H71

Key Words: Business incentives; benefit-cost analysis; local labor markets

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INTRODUCTION

This User's Guide explains the Bartik Benefit-Cost Model of Business Incentives, which can be used to evaluate a state or local area's economic development incentives. This guide explains the model's logical structure, describes what inputs can be provided by model users, explains the specific steps users must take to implement the model, discusses options for modifying the model, and helps users interpret the model's output. Possible model uses are illustrated with examples.

The Bartik Model estimates the effects of incentives on various types of income for different groups of local residents. The model can analyze incentive impact using either "micro data" on incentives provided for a specific firm or "aggregate data" on an entire incentive program. Individual firm data is preferable, as it enables the evaluator to provide an assessment of what project characteristics are associated with a higher benefit-cost ratio. However, frequently only aggregate program data are available. The incentive data provided can be either historical data or prospective data. From a research standpoint, historical data are preferable, as it shows how the program actually operated. However, for policy purposes, being able to predict a program's benefit-cost ratio based on program rules and state characteristics may provide useful policy advice.

The Bartik Model produces its simulations by using research-based estimates of how state and local economies adjust to different economic events or public policies. It includes estimates of how labor markets and housing markets adjust to shocks to employment and population, as well as estimates of how state and local government revenues and expenditures adjust to changes in local employment, income, and population. A key variable in model simulation is the percentage of incented jobs that are actually induced by the incentives; that is, they would not have been created locally "but for" the incentives. The model allows two options for simulating this "but for" percentage: 1) basing the "but for" percentage on the economics research literature on how firms and local employment respond to taxes and incentives, and applying this research to user-provided inputs for the incentive's size; 2) allowing the user to assign a "but for" percentage by assumption, and then see how sensitive benefits and costs for state residents are to different assumed "but for" percentages.

The Bartik Model is adjusted to the characteristics of a particular state or local economy. The relevant characteristics of the state or local economy include the preexisting state/local unemployment rate and employment to population ratio; preexisting wage rates and housing prices; how housing prices in the local housing market adjust to increases in population; what revenue sources state and local governments rely on, and how those revenue sources respond to a changing economy. The model currently allows the user to specify a state and a starting year for the simulation, and the model then automatically enters in the relevant state-average characteristics. Users can also on their own add in characteristics of a particular local economy, for more precise, location-specific analysis.

As summary outputs, the model produces:

- an 80-year benefit-cost ratio, which is the ratio of the present value of program benefits for state residents over 80 years, to the present value of incentive costs;
- a 10-year benefit-cost ratio;
- a 10-year ratio of the present value of fiscal benefits to the present value of incentive costs;
- a 10-year ratio of the present value of additional state and local government revenue to the present value of incentive costs.

Fiscal benefits are defined as the present value of state and local tax revenues occurring due to the incentives, minus the present value of required additional spending to keep public service quality constant as population grows. Overall benefits (either over 80 years or 10 years) include all increases or decreases in state residents' income. This includes fiscal benefits, but also includes increases in real earnings (local inflation adjusted earnings), due to higher employment rates and real wages, as well as including capital gains income due to increased property values.

The model also breaks down the net 80-year benefits by income quintile, that is, by households divided into five equally sized groups by their household income. The net income effect for each quintile represents the net increase, after taxes, in earnings and capital gains for each group. These net effects represent the positive effects of labor demand shocks on incomes of different income groups, minus negative effects of paying for the incentives.

In addition to summary outputs, the model provides a wide variety of outputs by year, for each year up to 80 years after the incentive program or project is initiated. These outputs include changes in total employment in the state or local economy; changes in income of various types for various groups in the state or local economy; changes in state and local tax revenue or required public spending.

The model was originally written as an Excel workbook.[1] The model was subsequently written as a Python program; however, the user does not need to know Python to implement that version. This User's Guide is meant to accompany the Excel workbook, but also serves as background for the Python version. The Excel workbook has the advantage of showing all the intermediate output, so users can better understand the workings of the model. But the Excel workbook can only estimate one project at a time; this project-by-project simulation can be

[1] The Excel workbook requires that the Excel version have the XLOOKUP function. This requires an Excel version more recent than Excel 2019.

cumbersome for an evaluation that is seeking to examine a program with many individual projects. In contrast, the Python software is set up so that the program user can quickly run simulations on multiple projects, but with less ability to examine the intermediate output.

The minimum required of the User is to specify some data for the incentive project or program: the state and starting year for the incentive project or incentive program; incentive costs by year; jobs by year; the firm's industry (for an individual firm project) or the industry mix (for a program).[2] The model then does the rest. However, the user can also more extensively specify various input options for either the incentive project/program, or for the state and local economy. Users may also modify the economic assumptions of the model from default values.

This 2023 Bartik Model is adapted from a prior model exhaustively described in Bartik (2018), and then extensively used in Bartik (2019). Appendix B describes the key differences between the 2018 Model and the 2023 Model, which may be useful for those familiar with the earlier model. Appendix C updates the key model description portions of Bartik (2018) to reflect the changes made for the 2023 model, which may be more useful to those new to the model. Appendix D updates the 2018 report's Appendix C, which describes some of the mechanics of the model in great detail, to reflect the 2023 model's changes.

Brief Description of Simulation Model[3]

This section outlines the model's logic, by which incentives affect the well-being of local residents. Ultimately, the model's goal is to measure the effects of incentives on the net real

[2] In addition, as detailed below, the user must specify the project's input-output multiplier, whether the firm is an export-base firm, whether the firm pays a "wage premium" over the wages typically paid by workers of those credentials, and whether the firm is locally owned. If the evaluation is of a program, not a specific firm project, these variables would be the average for the program. However, this User's Guide suggests defaults for these variables if the user does not have specific information on these variables.

[3] For more detail, see Bartik (2019). For more exhaustive detail, see this report's Appendix B, Appendix C, and Appendix D, or Bartik (2018).

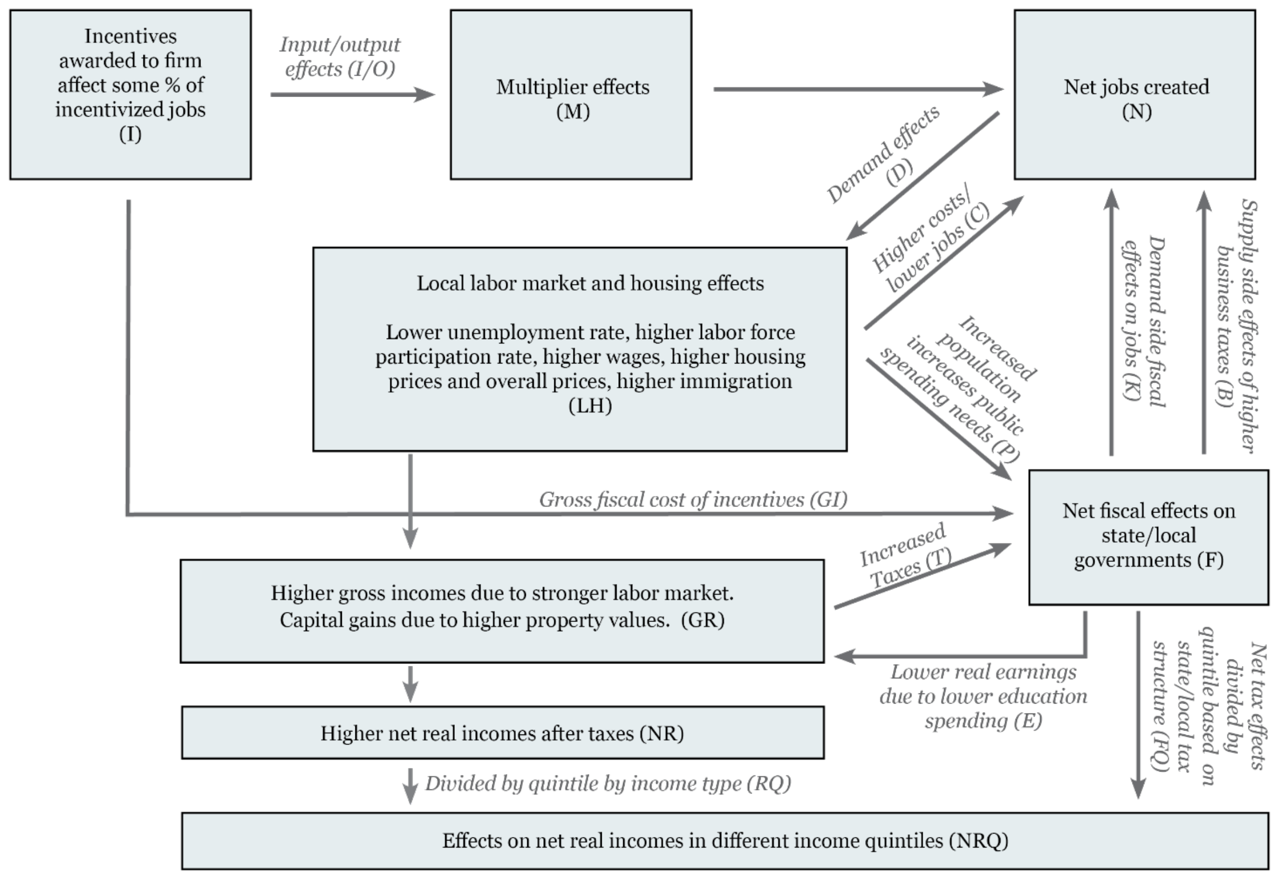
incomes of various groups of local residents. Effects outside the state or local economy are ignored.

To help visualize this complex model, the description below is shown in Figure 1. This figure shows in rectangles various intermediate effects, by way of which incentives have their impacts on local residents' net real incomes. Arrows show the causal connection from one type of effect to another. The rectangles of effects and arrows are labeled with various letters, to help link the depiction in the figure to the discussion below.

The model imagines a stream of incentives over time provided to some project or program that creates jobs (rectangle I). Based on the magnitude of the incentives, compared to the magnitude of the project or program, the model default is to assign some "but for" to the project or program. For an individual project, this "but for" is the probability that the project jobs were actually induced by the incentives; that is, the probability that the project would not have occurred "but for" the incentives. This probability, times the number of jobs in the project, represents the "expected" job creation due to the incentives offered to the project. For a large sample of projects or an entire program, the "but for" can be interpreted as the proportion of the program-incented jobs that were induced by the incentives. The remainder of the incented jobs would have been created anyway.

More incentives, compared to the size of the project, result in larger "but for" percentages. Of course, higher cost incentives not only have higher costs, but may also have higher adverse economic effects beyond their explicit financial costs to the state or local government. These adverse effects begin with incentives being part of what affects the net fiscal situation of state and local governments (changes in net tax revenue minus changes in public

Figure 1: How Incentives Affect Local Incomes



service needs), which is shown in arrow GI, which then goes on to affect net fiscal effects in rectangle F.

The model multiplies the incented jobs by the “but for” percentage to calculate directly induced jobs. One could argue that for any specific project, either the incented jobs were all induced or none were induced. But averaged over many projects, this calculation yields the expected number of induced jobs.

The induced jobs in turn have some multiplier effects on the state or local economy (rectangle M). These multiplier effects are due in part to effects on suppliers to the firm or firms that are incented. Multiplier effects are also due to workers in the induced jobs, and workers in the supplier jobs, spending more in the local economy, which will increase jobs at local retailers and service providers.

The induced jobs and multiplier jobs have the direct effect of increasing net jobs in the state/local economy (rectangle N). As will be mentioned later, there also are some feedback effects that will also affect net jobs.

Any net job increase will have some “demand shock” effects on the local labor and housing market (arrow D, going to rectangle LH). The net job increase from incentives will tend to increase local labor force participation rates and lower local unemployment rates, as well as induce some in-migration. Induced jobs and multiplier jobs will also increase various local prices: local real estate capital values and rental prices, due to added local employment and more importantly added local population; local wages, due to both higher local consumer prices and some upward pressure of the added labor demand on real wages; and other local prices, due to higher costs of both real estate and wages. These effects—on labor force participation rates, unemployment rates, in-migration, local real estate prices, local real and nominal wages, and local prices—will evolve over time. The available research suggests that effects on unemployment and real wages will die out within a modest time period, but that effects on local real estate prices, local overall prices, local wages, and local labor force participation rates will persist for a long time. Prices are persistently higher because demand for land is higher relative to its fixed supply, and this spills over into other prices and into wages. Labor force participation is persistently higher because the extra employment in the short run builds workers' skills and reduces their social problems (e.g., substance abuse and family issues). Greater skills and fewer problems increase workers' employability in the long run.

Preexisting state or local characteristics will tend to alter these effects. For example, if there are lower local employment to population ratios, meaning more nonemployed residents are available, a given increase in jobs will have more effect on labor force participation rates. Lower unemployment rates may lead to job increases having a greater effect on real wages. Different local economies are known to have significantly different reactions of housing supply and housing prices to an increase in population; population's effects on housing supply and hence housing prices will vary due to local housing regulations, as well as natural geographical features.

Higher local prices and wages will raise business costs. These higher costs will reduce local employment, with such employment-reducing feedback effects increasing in the long-run (arrow C).

The higher employment and population, as well as higher real wages, will increase real incomes (rectangle GR, for "gross real income"), which in turn will increase state and local tax revenues (arrow T). Local property tax revenues will also be increased by higher local property values. In addition, state and local public spending must also increase to maintain the same public services quality, despite the higher in-migration and higher population that is part of the labor market reaction to the demand shock (arrow P). For example, with more population, there will be more schoolchildren, so more teachers must be hired to keep class sizes the same. Depending on how state and local revenues respond to higher incomes and property values, and how public spending needs respond to population, the net effect may be either fiscal benefits—revenues exceeding extra required costs—or fiscal costs. These fiscal benefits or fiscal costs, when added to the direct governmental costs of the incentives, yield the net fiscal effects of the incentive program on state and local governments (rectangle F).

How much state and local revenues go up may depend on the features of state and local tax systems. For example, if a state relies more on highly progressive income taxes, compared to a state that relies more on narrowly based sales taxes, a given boost to income may more greatly affect state revenues.

The incentive costs—minus any net fiscal benefits or plus any net fiscal costs—must be paid for by some combination of state and local tax increases and public spending cuts, as state and local governments must balance their budgets. Either tax increases or public spending cuts have negative "demand effects" on the state economy; higher taxes or public spending cuts reduce the net incomes of state residents, resulting in less spending by residents on goods and services, including less spending on locally produced goods and services (arrow K, for "Keynesian effects"). Tax increases and public spending cuts might also have some negative "supply-side" effects on a state or local economy, by making an area less attractive to business or less productive. The model allows for only two possible supply-side effects.[4] First, the model

[4] As discussed in Bartik (2018, p. 24) and in Appendix B, a user could also come up with ad hoc ways of introducing other supply-side effects. For example, if other supply-side cuts in spending had effects with lags similar to K–12 spending, the user could allow for this by upping the percentage of spending cuts with negative supply-side

allows business tax increases to have negative effects on businesses choosing to expand or locate in the state (arrow B). These effects will tend to grow over time. Second, the model allows cuts in public school spending to have negative effects on state residents' future real wages, by reducing their productivity (arrow E).[5] Most of these negative effects of education cuts will occur many years in the future, when K–12 students as adults are in their peak earnings years (ages 40–55 or so). These long-run effects of school spending cuts are the main reason the model follows a state economy for 80 years: without such a long-run simulation, the model would be unable to capture these education cuts' full life-cycle effects. The model's default is to assume that incentive costs, adjusted for fiscal benefits and costs, will be divided half and half between tax increases and spending cuts. The proportion of tax increases taking place in business taxes, and the proportion of spending cuts taking place in K–12 cuts, are based on state-specific averages.

Considering these likely effects on net jobs, most of the feedback effects on net jobs are negative: negative effects of higher local costs, and negative effects due to both demand-side and supply-side effects of the net fiscal effects of the incentives on jobs created. These negative effects from fiscal effects occur because the net fiscal effects of incentives are likely negative: incentives do NOT pay for themselves, once one fully accounts not just for the tax revenue raised, but for the increased public service needs due to a growing population.

After the tax revenue is collected, local residents are left with some effects on after-tax real incomes (rectangle NR). In addition, because state and local governments must balance their

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effects beyond the percent of spending or K–12. Alternatively, if one thought that the "supply-side" effects of spending cuts would occur immediately, and would be mediated through negative effects on jobs, a user could allow for cuts in spending to have a lower ratio of spending cuts to jobs than is assumed in the model.

[5] These cuts in earnings also have some negative demand-side effects on net jobs created, which is allowed for in the model, but not shown in Figure 1.

budgets, the net fiscal effects of the program must be paid for through increased tax rates and/or reduced spending, which also has some real income effects (arrow FQ).[6]

The model uses all these simulation mechanisms to estimate effects on net real income (adjusted for local prices and national inflation and subtracting tax changes) of different types, for different groups of state residents (rectangle NR). These different groups include workers, whose real earnings go up due to higher employment rates and higher real wage rates caused by higher labor demand, and down due to negative effects of education cuts on future wages. Residents who pay taxes and use public services, many of whom are also workers, are affected by changes in taxes or public services spending, due to both incentives and any net fiscal costs or benefits. Business taxes imposed on out-of-state business owners are "exported" and not counted as a cost, or equivalently are counted as a "benefit" that offsets the net fiscal costs that occur due to the incentive program.[7] Property owners, both homeowners and locally owned businesses, get capital gains on property they own, minus increased property taxes paid. Locally owned businesses that sell to an export-base market face increased local costs, which they cannot pass on to a national market given that national prices are assumed fixed, so they lose some profits. Locally owned businesses that sell locally are assumed to be able to raise their local prices to cover increased costs.[8] If some incentives are received by locally owned businesses, the value of

[6] This change in taxes is conceptually different from the increase in taxes due to higher real incomes at the same tax rates, as the net fiscal effects are paid for in part by higher tax rates.

[7] It is only completely equivalent if one defines the benefit-cost ratio so that the present value of gross incentive costs is always in the denominator, and all other benefits (or costs) are part of gross benefits in the numerator. If one instead does a calculation similar to Hendren and Sprung-Keyser (2020), of the "Marginal value of public funds," then all fiscal costs are consolidated in the denominator, and other benefits and costs are in the numerator. In the current context, putting incentive costs in the denominator appears preferable, for two reasons. First, this approach adopts the perspective of an economic development agency, which is seeking the greatest ratio of benefits to the costs it oversees. Second, the gross incentive costs will be fixed regardless of economic assumptions about the workings of the economy and baseline economic parameters, whereas other fiscal effects will depend on the assumptions made.

[8] These higher prices are accounted for in the model, in terms of impacts on local residents receiving out-of-state income, and for local workers, as the measures for local workers focus on effects of demand shocks on real wages.

such incentives is counted as a boost to the income of these state residents who own these businesses.[9] Higher local prices, due to higher local real estate prices and higher real and nominal wages, erode the real value of non-labor income that comes from outside the local economy, such as national income transfer programs (Social Security, SSI, etc.) and dividends and interest on stocks and bonds. Higher local prices may also adversely affect non–locally owned businesses, but any such effects are not counted as a cost, as they do not directly affect real incomes of state residents; they do have indirect effects, as noted above, by discouraging employment growth, which will adversely affect employment rates and real wages and property values.

The model also divided up all these real income effects on state residents by "income quintile" (arrow RQ going to rectangle NRQ). Households are ordered by their income, adjusted for household size, and divided into five groups with equal population in each group, based on data from the Congressional Budget Office. The effects of labor demand shocks on real earnings are divided by income quintile based on studies that show that such demand shocks are distributed in a "modestly progressive" fashion, that is the percentage increase in real earnings and income is higher for lower income quintiles, but the dollar effect goes up with the household's income. Capital gains on property are divided up by income quintile based on data on the distribution of home ownership and home values by income quintile, and information on how the ownership of business property is distributed by quintile. As one might guess, such capital gains are a higher percentage of income for upper income groups. Tax increase effects by income quintile are distributed based on information on the incidence of taxes and how it affects different income groups in each state, based on the structure of state and local taxes in that state

[9] Logically this should involve an arrow from the incentives rectangle (I) to the higher gross real income rectangle (GR).

(arrow FQ). In most states, these tax increase effects are modestly regressive; that is, they are a somewhat higher percentage of the income of lower income groups. The effects of education spending cuts are distributed by income quintile based on information that the dollar effect of such spending cuts is similar for different income groups, which means the cuts have a much larger percentage impact on lower income groups (arrow FQ). The effects of other public spending cuts are distributed across quintiles based on data on how much of spending is public goods versus income transfers, and data on how income transfers are distributed by quintile (arrow FQ). Given the importance of income transfers in public spending, public spending cuts tend to be a greater percent of income for lower income groups. Any effects on local businesses due to receiving incentives, paying extra costs that are not passed on in higher prices, etc., are divided by quintile based on information on how ownership of business capital varies by quintile, so tend to affect upper income groups more (arrow RQ). The declining real value of outside income transfers and capital income, due to higher local prices, is divided by quintile based on how transfers and capital income are together divided by quintile (arrow RQ). As transfers go more to lower income households, and capital income more to upper income households, together this declining real value happens to be close to a constant percentage of each quintile's income.

The overall benefit-cost analysis sums together the net effects on real incomes plus the net fiscal benefits. Together these constitute the net "efficiency benefits" of the incentives. These net efficiency benefits are added to gross incentive costs to get gross incentive benefits. These gross incentive benefits are divided by gross incentive costs to get the benefit-cost ratio for a given incentive project or program.

Because these incentive costs and benefits occur over many years, future incentive costs and benefits must be discounted to get a present value. Present values are calculated as of the starting year of the incentive project or program. Flows are calculated up to 80 years after the starting year. This large number of future years are considered because many of the effects of education spending cuts do not occur for 40 or 50 years or more, and so considering a shorter time period might yield a misleading estimate of net benefits or benefit-cost ratios.

In addition, as outlined below, these net benefits are divided by income quintile. This calculation also includes information on how each quintile's net real income effects are divided among different types of income (e.g., labor market income versus capital gains on property).

Operating the Model: The "Incentive Inputs" Worksheet

To operate and interpret the model, the user must learn to use two key worksheets: the "Incentive inputs" worksheet and the "Economic inputs and outputs" worksheet. The former enters the key information about a particular incentive project or program; the latter enters other economic data relevant to the project or program's impact, and also reports the key outputs of the model.

This section explains the "Incentive inputs" worksheet. Table 1 provides an outline of the key inputs the user must make and their role in the model. The below discussion refers to input variables by the number in the table.

The "Incentive inputs" worksheet is the model's key input page. The user enters information about the characteristics of the incentive program, and the model then simulates effects on state residents. Outputs are then provided on the "Economic inputs and outputs" worksheet, to be explained later. (The "Economic inputs and outputs" worksheet also allows some characteristics of the state's economy and fiscal structure to be modified, if needed, but the

Table 1 Summary of Incentive Inputs

Variable number	Variable description	Where found on "Incentive inputs" worksheet	Role in model	Comments
Mandatory incentive input variables				
1	State	B120	Uses state-specific info to customize model	
2	Starting year of project or program	B121	Used to customize model	
3	Actual jobs in incented project or program	C129:C208	Used in projecting impact and "but for"	User must decide project jobs after incentives are over.
4	Nominal incentives	D129:D208	Used in projecting impact and "but for"	In nominal dollars. Model converts to 2019 national dollars.
5	Industry of project/program, zero-one indicator or share	B124:CM124	Used in projecting industry value-added for "but for"	Options include average "export-base" industry
6	Multiplier	B125	Used in calculating gross multiplier	Use BEA, Implan, or default to 2.4 for state, 1.8 local
7	Wage premia of incented jobs	B126	Adds benefits from "good jobs"	Set to zero unless strong evidence
8	Locally owned firm	F126	Adds extra local purchase multiplier, and also adds extra real income effects on local owners	Zero-one or proportion
9	Incentive effectiveness to cost ratio	H126	Allows incentives to have greater "but for"	Set at 1 unless good evidence.
10	Percentage of incented firms that are export base	L126	Determines direct displacement effect of incented jobs	Zero-one or proportion
11	Choice of "but for" to use	B6	Determines which of 5 possible "but for" values to use in cell A3	
Optional incentive variables				
12	Nominal wage rate per hour, actual data	E129:E208	Allows alternative "but for" calculation	Scenario 2 "but for"
13	Planned jobs for project or hypothetical program jobs	H129:H208	Allows "but for" to be determined by project plan or program design.	Actual jobs and incentives still used for impacts; this just affects possible "but for" in scenarios 3 or 4
14	Nominal wage rate per hour, planned data	K129:K208	Allows alternative planned or designed "but for"	Scenario 3 "but for"

Table 1 (Continued)

Variable number	Variable description	Where found on "Incentive inputs" worksheet	Role in model	Comments
15	Nominal incentives by year, if no wage data, for planned or hypothetical scenarios	I129:I208	For hypothetical project or planned project, assumes that user calculates incentives without using wage data, and so calculated the project or program's value-added using industry ratios of value-added to FTE, not value-added to payroll.	Scenario 3 "but for"
16	Nominal incentives by year, for case where wage data is available, for planned or hypothetical scenarios	J129:J208	For planned project, uses wage data to calculate incentives. .	Scenario 4 "but for"
17	Arbitrarily assumed "but for"	F3	User assigns "but for." Activated by choosing scenario = 5 in cell B6	Allows determination of minimum "but for" to get B/C>1.

user can also just go with model defaults.) This section explains which inputs are provided on the Incentive Inputs worksheet and how they are used. A later section of this User's Guide gives more specific nitty-gritty details on exactly what cells of the Incentive Inputs worksheet must be altered by the user.

The user-entered characteristics begin with the state (variable 1 in Table 1, cell B120 on Incentive Inputs worksheet) and starting year (variable 2, cell B121) of the incentives project. This state and starting year are used to assign state-average economic and fiscal characteristics for that state-year, and the subsequent years in the model. These economic and fiscal characteristics alter how a state's economy and fiscal situation responds to shocks to jobs and incomes. The state and starting year information is also used to convert any nominal dollars, which is what is entered by the user into the model, into 2019 national dollars. That is, state-specific price indices and national price indices are used to convert dollars, for example, in Michigan in 1992, or New York in 2025, into national dollars in 2019. This conversion into national dollars allows results to be compared across different states. Some users may want model outputs to be in their state's prices for some year other than 2019. To do so, the user can readily use data from BEA on regional price parities (https://www.bea.gov/data/prices-inflation/regional-price-parities-state-and-metro-area) and BLS Consumer Price Index data to convert data in 2019 national prices into data in the prices of any particular state or metro area and year.

The model then aims at letting the user only have to enter readily available information into the model. The user is required to enter in the jobs associated with the project, and the incentives, in nominal dollars, for each of 80 years after the project begins. The jobs data is variable 3 in Table 1, cells C129:C208 of "Incentive inputs" worksheet. The incentives data is variable 4 in Table 1, cells D129:D208 of the "Incentive inputs" worksheet. At a minimum, these would be the jobs and incentives that are actually observed to occur, or that are assumed to actually occur pursuant to some plan.

For most projects, jobs data will not be available for all 80 years, only for a specified number of years during which the project is active and incentives are provided. Therefore, the user must make some assumptions about what happens to project jobs after the project incentives are over. One possible assumption—arguably a "neutral" assumption—is that jobs continue as is from the last year of the project incentives. Yes, some projects may depreciate over time, and plants will close. On the other hand, sometimes a plant is later expanded. In addition, if a plant closes, the infrastructure and labor left behind may attract some similar number of later jobs.[10] Users may use this neutral assumption, of jobs staying the same after the incented period.

[10] One important area of future research is what typically happens to projects after the end of the incentive agreement, and the extent to which incented projects tend to expand or contract over time.

Alternatively, users may compare this neutral assumption with assumptions about some depreciation or appreciation of project jobs after the incentive period.

In addition, the model is based on full-time equivalent (FTE) jobs, not just any job. Therefore, the user should convert any raw jobs data to FTE jobs, using either actual data or some assumption about what percentage of jobs are half time, for example.

The nominal incentives paid per year for the project may be given by the project contract. Alternatively, the project may have particular property tax abatement percentages and terms, some job credit per job, or job credit as a percentage of payroll, or an investment tax credit as a percent of investment. The user will have to obtain data on all these incentive types and calculate what is likely to occur in terms of total dollars of incentives provided per year for the project. If the program has specific program rules—for example, incentives are some percentage of investment dollars, or some dollar amount per job—then such calculations are simply applying the rules. Alternatively, if the incentives are "discretionary," in that they vary project by project, the user may need to examine program data to ascertain some "implicit rules." For example, if a program has a discretionary grant per job, the program may still tend to usually award grants of around $*x* per job, and this may be apparent in program data.

The jobs data helps determine the job shock that actually occurs due to the project. In particular, the jobs data is multiplied by the project's "but for" percentage to determine the expected number of project jobs that would not have been created "but for" the incentives. (How the "but for" percentage is calculated is explained below.) These induced project jobs are then multiplied by the project multiplier to determine total number of jobs directly created by the project. The project multiplier would be jobs that occur in local suppliers to the project, or in local retailers that sell goods and services to workers holding the project's directly induced jobs or these multiplier-induced jobs. (We explain below how the multiplier might be determined and where the user enters it.) Various feedback effects, such as increased local wages and local real estate costs, or the need to finance incentive costs with increased taxes or reduced public spending, may end up reducing the net jobs that actually occur in the state economy, below those directly created by project-induced jobs and their multiplier effects.

The incentive dollar amounts enter into the model directly, in determining some of the project's economic costs and consequences. The nominal incentive dollars are converted into 2019 national dollars. These incentive dollars have some economic effects, in that paying for these incentive dollars through higher taxes or lower public spending has some negative effects on the state economy. In addition, paying for the incentive costs reduces the net benefits of the project to state residents, to the extent to which they pay higher taxes or receive lower public services to finance the incentives.

Calculating "but for"

The jobs data and incentive dollar amounts are also part of the inputs used to estimate the "but for" for the project—the proportion of the project's jobs that would not have existed in the state "but for" the incentives—or the probability that the incentive was decisive. In this project's model, the impact of incentives depends on their present value, relative to the present value of the project's real "value-added." The present value of incentives is simply calculated by taking the real national value of the incentives in 2019 dollars for each year, and discounting these incentives to the starting year using the firm's assumed real annual discount rate for future dollars. The default of the model is to assume firms use a very high annual real discount rate, of 12 percent per year, based on research that firms are very focused on short-term profits and stock prices in making investment decisions.[11] This rate is much higher than typical "social discount rates" that are advocated for governments to use in benefit-cost analyses. Such social discount rates are typically around 3 percent per year, as will be discussed later.

But what about "value-added"? What is it, and how are users supposed to calculate it? Value-added is economists' usual measure of the true addition of the firm to the value of economic output. Value-added is defined as equal to the dollar value of a firm's sales minus the dollar value of the firm's purchases of its non-labor and capital inputs. For example, the value-added of a steel firm would be what it sells the steel for, minus what the firm pays for the coal and iron inputs used to make the steel. Alternatively, value-added can also be measured as the firm's payments to labor plus payments to capital (either interest payments on borrowing for investments, or profits paid to owners). This alternative value-added measure equals the original concept of value-added because whatever a firm sells in turn is used to buy inputs of goods and services, or to pay labor, and what is left after input purchases and labor payments is used to either pay off loans on capital investments or pay the stockholders. The idea is that value-added is what the firm's capital and labor "adds to" the economy's total value of goods and services, by this capital and labor converting various material and service inputs into something more valuable.

To calculate value-added, the model requires users to enter in the project's industry (variable 5 in Table 1, cells B124:CM124 in the "Incentive inputs" worksheet).[12] The model provides two alternative ways of calculating value-added. The simplest is that the model takes

[11] As will be discussed later, this firm discount rate can be altered on the "Economic inputs and outputs" worksheet. The high discount rate of a 12 percent annual real discount rate is based on Poterba and Summers (1995).

[12] Note that the sum of all these industry cells must equal 1. For a project, the industry of the project would be indicated as a 1, all other industries zero. For a program, the user would ideally enter proportions of program incentives provided to each industry. Alternatively, if the program was simply provided to "manufacturing," or to "export-base industries" these cells also have entries that will calculate averages for these industry mixes.

the project's employment numbers, and industry-specific and year-specific ratios of real value-added per employee by industry, and uses them to estimate the project's real value-added by year. The model then calculates the discounted present value of value-added for the project over its 80 years, using the firm's discount rate. In other words, the user just specifies the industry, and the model does the rest.

In one possible version of the model, the ratio of the present value of incentives to the ratio of the present value of the project's value-added are then combined with the model's assumption about how sensitive firms are to costs in making location or expansion decisions. The default elasticity, based on research on how firm location and expansion decisions respond to state and local business taxes and incentives, is 10. This roughly means, for the majority of incentives that are a modest percentage of value-added, that the proportion incentives are of value-added is multiplied by 10 in determining the "but for" percentage. Thus, if the present value of incentives is 1 percent of value-added, the "but for" percentage would be estimated to be around 10 percent.[13]

One interpretation of this "but for" percentage: without the incentives, 90 percent of the time the firm's location or expansion decision at this site would have been unaltered, so only 10 percent of the jobs were actually induced to occur at this site due to the incentive being provided. An alternative interpretation: even if this specific firm would not have located or expanded without the incentive, 90 percent of these jobs would be expected to be created anyway by some other firm, as that particular real estate site and the project's utilized labor would then have been

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[13] The actual formula is somewhat more complicated and adjusts the "but for" percentage so it can never exceed 100 percent. We assume $\ln(E_a/E_b) = (-R) \times \ln(C_a/C_b)$, where E_a is employment with incentives, E_b without incentives, and C_a and C_b are costs (measured as value-added) with and without incentives. R is sensitivity to costs. Then $C_a/C_b = (1-s)$, where s is subsidy as proportion of value-added. A little manipulation shows that "but for" is $(E_a - E_b)/E_a = 1 - 1/[(1-s) \wedge (-R)]$. For small s, this is approximately equal to $s \times R$.

available to other firms. The model treats the "but for" as if only the "but for" percentage of jobs times incented jobs are counted in determining economic impacts. Of course, in the real world, one could argue that for a specific project, either 100 percent of the jobs were induced or zero percent were—the incentive either tipped the location or expansion decision or it did not. In that case, the model can be viewed as expressing the "expected number of jobs created" for the project, and the economic impacts that result will then be "expected economic impacts." Averaged over large numbers of projects, these expected impacts would tend to converge to be equal to the actual impacts.

The user can change this cost sensitivity elasticity on the "Economic inputs and outputs" worksheet, as we will detail below.

Using wage data to calculate "value-added" and "but for"

The model also provides an alternative way of calculating the project's "value-added." This alternative requires the user to be able to enter in wage data on the project that represents the project's actual average wage rate per hour, for all FTE workers (variable 12 in Table 1, cells E129:E208 in "Incentive inputs" worksheet).[14] In this case, the calculation of project value-added is based on the model providing ratios of value-added to payroll costs for each of the project's industries, and using the user's information on FTE jobs and wages per FTE job to calculate payroll.

Although in theory this "payroll approach" might allow better project-specific value-added estimates—within an industry, projects with higher wages per FTE are likely to have higher value-added per FTE as well—in practice, this approach may often underestimate value-

[14] This wage data should be straight-time nominal wages per hour, without benefits. The model converts the state's nominal wages to 2019 national wages, and the industry calculations of value-added are based on ratios of value-added to payroll calculated as FTE times wages.

added. The reason? When figures are provided on a project's wages per FTE, they often don't include all labor at the firm; for example, the wage figures may only include production workers. Therefore, average wages per hour may frequently be understated, as the wages of more highly paid executives are not included. As a consequence of understating value-added, this approach may then lead to overstating the "but for." Therefore, we recommend that users only use the payroll approach to estimate value-added and "but for" if it yields a higher value-added and lower "but for "than generated by the "value-added to FTE" ratio approach—or if the user is confident that their estimates of wages per hour for FTE workers include all the project's workers, not just production workers or typical workers. If the "value-added to payroll" approach yields higher value-added than the "value-added to FTE" approach, then it probably means that in fact the project has a relatively high value-added per FTE within that industry, but otherwise, it may be safer to rely on the "value-added per FTE" approach.

Planned vs. actual data: when they might differ

The discussion so far has implicitly assumed that we are analyzing projects before they are undertaken. At that point, the user should probably simply assume that both planned and actual jobs and incentives are the same—the project contract calls for certain payments to be made and certain jobs to be created as of particular years, and in the absence of better information, it is simplest to assume that plans will be fulfilled. The model always requires that actual jobs and incentives be entered into the "Incentive inputs" worksheet, as these data are used to generate the model's economic impacts.

But after the project has been funded, and the project proceeds, we have the jobs incented and the incentives provided that actually occurred, versus the jobs incented and the incentives provided that were planned. In the model, the actual jobs incented and actual incentives provided are used to determine economic impact. But what should be used to determine “but for”: the actual jobs and incentives, or the planned jobs and incentives?

Assuming that the firm’s managers sincerely believed in the project as stated, then the planned jobs and incentives should be used to determine “but for.” This is what the managers believed would happen, and the comparison between the incentives provided vs. the calculated value-added should determine the probability that the incentives induced this investment decision.

On the other hand, a cynic might say that the firm may have known that its promised jobs would not be realized, and that therefore it might not receive all promised incentives. In that case, the actual incentives and jobs should be used to calculate “but for.”

As we will see, in real world cases, the distinction between planned vs. actual jobs and incentives is most acute for “failed projects.” By “failed projects,” we mean projects that fell far short of job creation planned and may even have closed down after a few years. In this case, using the actual data to project “but for” may result in very high “but fors” if the state did not recover all the paid-out incentive dollars, and the jobs were only created for a few years—the value-added will be very low, so the “but for” will be high. In contrast, if we use the more modest “but for” from planned data, then the failed project will in fact have a much more unfavorable benefit-cost ratio. On the whole, it seems more reasonable and neutral to assume that the planned project in fact represented what the firm intended with the investment, or at least does so better than the actual data.

Planned data in Table 1 would be variables 13 through 16, entered into worksheet “Incentive inputs” in cells H129:J208. Note that the worksheet gives two ways of determining the planned incentives. The first way assumes that one does not know the project’s wage rate in calculating incentives. The second way assumes that one does know the project's wage rate. The project's wage rate might, for example, be relevant if one component of the incentive package is a credit for job creation that is some percentage of the project's payroll, or a tax credit for wages in excess of some minimum level.

Program data instead of project data

So far, we have assumed that the user has specific data on individual projects.[15] What if instead the user just has aggregate data on an incentive program? For example, suppose the user just knows total incentives paid under a program by year, and cumulative jobs provided incentives by year, for some period of years?

In that case, the model can still be used, under certain assumptions. Specifically, if we assume that the average "but for" for the program is roughly similar over time, and the benefit-cost ratio of different projects are similar over time, we can treat the entire program as if it were just one project. This is shown more formally in Appendix A.

Under this assumption, the user could just enter in program data: for each year, the incentives provided that year, and the cumulative FTE jobs incented. (Average wage data could be used as well, but in this case, it seems highly unlikely that any such data would in fact reflect all workers.) In this case, one possible default is to assume that actual vs. planned jobs are the same, as it is unlikely that the user has data on the original planned incentives and jobs. The user would also enter in the percentage of incented jobs in each of the model's industries (variable 5 in Table 1, cells B124:CM124).[16]

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[15] For an aggregate program with a large number of projects, the model would be rerun for each project, and the results added up. This can be done with the Excel version of the model, but is cumbersome. The Python version of the model automates this process.

[16] The user should make sure these percentages add up to 100 percent, or the proportions add to 1. This is checked by the model in cell B119 of the "Incentive inputs" worksheet.

An alternative for program data is that the user could utilize the columns for "planned data" as an alternative way of calculating the project's "but for." That is, the actual program's incentives and jobs would be used to generate economic impacts, but the "but for" could instead be based on applying hypothetical data to an imaginary project. How to do so is illustrated below, in discussing the MEGA program in Michigan.

Imposing a "but for"

So far, we have four possible ways of choosing the "but for": using either planned or actual data; projecting value-added using either employment or payroll. But the user also has the opportunity to simply *impose* a particular "but for."

Why would the user do this? Largely to do a sensitivity test. One can impose a "but for" and see how various benefits versus costs change. One can compare two projects or two programs based on what minimum "but for" is needed to achieve a particular benefit-cost ratio, for either overall benefits for 80 years or benefits over a shorter period of time, or for a narrower category of benefits, such as fiscal benefits over 10 years. For example, in the model, if the prime-age employment rate is lower, projects and programs will tend to have higher benefit-cost ratios. Therefore, if we simply impose a "but for," we find that projects or programs in distressed local areas will need a lower "but for" to achieve a desired benefit-cost ratio than projects in booming areas.

The "but for" choice is variable 11 in Table 1, cell B6 in the "Incentive inputs" worksheet. The user enters which of five "but for" choices to use: 1) actual data without wage data, 2) actual data with wage data, 3) planned project or program without wage data, 4) planned project or program with wage data, or 5) arbitrarily chosen "but for." The user would enter one of these five numbers at cell B6. The arbitrarily chosen "but for," variable 17 in Table 1, can be entered in at cell F3 of the "Incentive inputs" worksheet.

Other incentive inputs

On the "Incentive inputs" worksheet, the user also has other inputs that can be provided, or the user can just use some default values.

Multiplier. The user should supply a multiplier for the incented jobs (variable 6 in Table 1, entered in at cell B125 on "Incentive inputs" worksheet). This should be some input-output multiplier that reflects effects of the directly induced jobs, due to the incentives, on local suppliers and retailers. For a particular project, such multipliers can be purchased from the U.S. Bureau of Economic Analysis (BEA) for a particular state or local economy and industry, or from the private firms IMPLAN or REMI. For a program that is a mix of industries, the user can base the multiplier on a weighted average of these industry-specific multipliers. Alternatively, the user can use some defaults. At the state level, an average input-output multiplier for export-based industries might be 2.4; at the local level, perhaps 1.8 (Bartik and Sotherland 2019).[17]

Wage premia for incented firm. The user has the option of specifying that the incented firm pays some "wage premia" above or below the usual wages expected for workers who meet the job's usual education and experience credentials (variable 7 of Table 1, cell B126 on Incentive Inputs worksheet). The burden of proof should be on any claims of wage premia, because frequently a firm that has "good wages" also does much more screening of prospective employees, and therefore may not really pay any wage premia, relative to employee credentials.

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[17] Why use default multipliers when what appear to be more economically sophisticated multipliers are available? In part, because the typical multipliers produced by input-output and related models are only to a modest degree empirically based. For example, the models typically are based only to a limited degree on real data on what proportion of supplies and retail goods are regionally produced and purchased.

If there is a wage premium, it will tend to produce some extra earnings benefits for state residents.

Locally owned firm. For an incentives project, the user has the option of designating that the firm is locally owned (variable 8 in Table 1, cell F126 in "Incentive inputs" worksheet). For an incentives program, the user has the option of designating what percentage of the incented jobs are in locally owned firms. Local ownership of incented firms will tend to increase the benefits for state residents in two ways. First, with local ownership, the direct benefits of the incentive cash go to the state residents who own the firm. Because the model counts all benefits to state residents, and only state resident benefits, the extra profits of giving cash to a business are counted only if the incented firms are locally owned. These direct cash benefits of incentives to owners in general will accrue to upper income groups, as that is who tends to own businesses. Second, locally owned firms tend to use local suppliers more often, which will increase local multipliers (Civic Economics 2007, 2013).

Incentive effectiveness-to-cost ratio. The user has the option of specifying that the incentives are more effective than one would think based on the cost to the government (variable 9 in Table 1, cell H126 in "Incentive inputs" worksheet). For incentives that provide cash (tax incentives, cash grants), the user's default, unless strong evidence is provided to the contrary, should be that this ratio is 1.00: $*x* of cash is worth $*x* to the firm in swaying location or expansion decisions. One could argue for greater effectiveness if the government somehow knows which firms would otherwise choose another state, but this requires economic developers to be mind readers, which they are not. On the other hand, for economic development incentive packages that include public services—infrastructure, customized job training, business advice—

the value of such services to the firm might frequently exceed the costs to the government. Some studies have found that these services have an effectiveness to cost ratio of 5 (e.g., Bartik 2020a).

For example, business advice from a manufacturing extension service office, which might include helping a business target new markets, may be extremely valuable to a small- or medium-size manufacturer, and enable it to add many jobs, yet be relatively cheap to provide (Jarmin 1998, 1999). Why can't the manufacturer find equally valuable advice, for an equally low cost, in the private market, without any publicly-run manufacturing extension advice program? The underlying problem is the "market failure" of imperfect information. Precisely because the manufacturer does not know how to best target new markets, the manufacturer also does not know how to evaluate the quality of privately-provided business advice on this topic. A reliable, trustworthy publicly-supported manufacturing extension service can help overcome this market failure.[18]

Ideally, the user would have some evidence on the specific effectiveness of these customized services in inducing job creation or expansion. Absent that, the user might choose to rely on prior studies, and assume some average effectiveness of any services provided as part of the incentive package. The user can then calculate, based on the mix of cash versus services, an average effectiveness to cost ratio. An example is provided later, for the Amazon Headquarters II project in Virginia.

Percentage of incented firms that are export base. This is variable 10 in Table 1, and is entered in at cell L126 in the "Incentive inputs" worksheet. For a project or program, the user

[18] Similar market failure problems occur with other customized services. The quality of training can be hard to evaluate, and firms may fear losing trained workers, so high-quality customized training services may be under-provided by the private market. Infrastructure and land development services involve extensive public regulation, so the public sector will need to be provided to ensure that an adequate supply of suitable land for business development is available. Benefits could well exceed costs due to this public regulation. For more on the market failures involved with state and local economic development programs, see Bartik (1990).

must decide what percentage of the incented firm or firms' output is sold to out of state buyers; if its output instead is sold to in-state buyers, the output competes in a national market so that these in-state sales replace "imported" goods or services from out-of-state producers. In other words, the key issue is: when and if the incented firm expands its sales, to what extent do its sales reduce sales of other local firms, and to what extent do its sales reduce sales of out-of-state firms? If x percent of the incented firm's sales reduce sales at other local firms, the export-base percentage should be set at $(1-x)$ percent.

Typically, this export-base percentage will be close to 100 percent for manufacturers and service industries, such as software, that sell to a national market. If the export-base percentage was zero, then the incented firm's increased jobs and output, if any, comes at the expense of other local firms. As a result, with a zero export-base percentage, the net direct and multiplier effects of incentives will be close to zero, even if the incented firm's own jobs are 100 percent induced by the incentives.

Some nitty-gritty details on entering data on incentives: A summary

In the revised Incentives Simulation Model, the user enters the following information, on the Incentive inputs worksheet, principally in cells A120 through CM208.[19] See Table 1 for an alternative summary.

- The state (cell B120) in which the program or project is located, and the year (cell B121) in which the program or project begins. This state and year information cascades through the model, and is used to assign housing price elasticities, property values, prime-age employment rates and unemployment rates, state and local fiscal variables, wages per FTE worker and value-added per FTE worker, and many other variables. The model also

[19] These data can be copied and linked or pasted in from other worksheets. For example, in the later-given examples, the Virginia Amazon with services scenario, the MEGA scenario, and the two MBDP scenarios are all described on other worksheets. Those worksheets have entries on their cells A120 through CM208 that can be directly copied and linked to the "Incentive inputs" worksheet. The model workbook provides a mostly blank "Template" worksheet that allows cells A120 through CM208 to be prepared, and then copied and linked into the "Incentive inputs" worksheet. Users are advised to save the original workbook downloaded in case some cells are accidentally overwritten.

uses this to assign relative price variables to adjust all dollar figures to 2019 national dollars.

- The user must enter in information, in cells A128 to E208, on actual incentives provided, in nominal dollars, and jobs incented, by year for up to 80 years after the incented project began, or up to 80 years after data is available on the program. The user also may provide information, if available, on the nominal wage rate per hour for the incented jobs.[20] The user also may provide information in cells F128 to K208 on the planned incentives, planned jobs, and wage rate per hour (if available) for up to 80 years.
- The user must enter in data about the industry mix of the incentive project or program in in cells A122 to CM124. In cells B124 to CM124, the user enters in a dummy variable for the incentive firm's industry, if this is an individual project. If it is a program, the user enters in weights, summing to 1, on the proportion of jobs by industry in the program. If it is not known what mix of jobs by industry are in the program, there is an option (cell M124) to indicate all jobs are in manufacturing, or (cell CM124) to indicate all jobs are in export-base industries.
- The user must enter in more information about the incented project or program in cells A125 to M126. This includes information about the multiplier for the project or program (cell B125), the wage premia for incented jobs (cell B126), whether the firm is locally owned (cell F126), the incentive effectiveness ratio (cell H126), and the percent of incented firms that are export-base (cell L126).
- The actual jobs data, and the actual incentive dollars data, are then automatically fed into the rest of the model to determine economic impact. Both the actual and the planned data, with and without the wage data, are used to provide at least four alternative ways of calculating "but for" percentages. These "but for" calculations are done in the rest of the Incentive Inputs sheet, from A13 to AZ94. The user chooses which "but for" calculation to use in cell B6, choosing one of five scenarios. The fifth scenario is an arbitrarily set "but for" percentage, which may be entered in at cell F3.

Economic Input Variables the User Might Want to Change

Beyond the specifics of the incented project or program, the users might want to change other features of the model, which I label "economic inputs." These other economic inputs change how a state or local economy adjusts to a given incentive project or program. Some of these economic inputs might change due to different ways of designing an incentive program—for example, if the program is more targeted at distressed areas of the state, or if the program makes special efforts to encourage local hiring, or if the incentive program is paid for by various

[20] The model will use the state and year to convert to 2019 national dollars.

budget adjustments. Other economic inputs reflect different views on how state and local economies behave. One goal of this model is to allow users to adjust their version of their model to reflect their view about what the research says about how state and local economies behave, rather than imposing Tim Bartik's views on all users.

Table 2 provides a list of 51 variables that can be readily changed. They are classified into eight groups: 1) local market variables, which reflect the characteristics of the local labor market and housing market in which the project is operated, and not the state averages used by default; 2) local labor market dynamics variables, which reflect how local labor market outcomes such as wages, labor force participation, and unemployment respond to labor demand shocks; 3) financing variables, which reflect how the incentive project or program or other fiscal consequences of the program are assumed to be paid for by some combination of increased taxes and reduced public spending; 4) elasticities of expenditure and revenue variables, which reflect how the state/local public expenditure needed to keep public quality constant responds to increases in population, and how state and local tax revenue responds to increases in state personal income; 5) business sensitivity to costs variables, which reflect how incented businesses respond to incentives, as well as how other businesses respond to increases in wages, real estate prices, business taxes, and other local cost changes; 6) other spending and tax effects, which reflect how the economy responds to budget changes in state and local taxes and spending, including changes in spending on the K–12 education system; 7) social welfare variables, which reflect some user choices about how to value various aspects of the model; and 8) miscellaneous variables.

Our recommendation for model users is that if data are available, the user should change the local market variables. Better estimates occur if the user divides projects or the program by

Table 2 Economic Input Variables That Can Be Readily Changed in Model

Var #	Variable description	Where found (EIO is "Economic inputs and outputs" worksheet)	Role in model	Comments
Local market variables				
18	Prime-age employment rate	Choose local option at G28 of EIO; local prime-age Erates at K16:K95 of worksheet "UnRate&PAEmpRate"	Determines sensitivity of labor force participation rate to employment shocks	Local customization desirable using CPS or ACS
19	Unemployment rate	Choose local option at G28 (EIO), and local unemployment rate in cells L16:L95 in worksheet "UnRate&PAEmpRate"	Determines sensitivity of wages and unemployment rate to employment shocks	Local customization desirable using BLS data
20	Housing elasticity	Cell L2 in worksheet "state housing p-elasticity"	Determine sensitivity of housing prices to population shocks	Local customization desirable, can use metro data from Saiz (2010), found in worksheet "Saiz elasticities w/ state"
21	Property tax	Cell F3 in worksheet "Prop tax calcs for revenue"	Helps determine fiscal effects of incentives, and helps determine net after-tax real income gains	Local customization desirable
Local labor market dynamics				
22	Wage elasticity	Cell G32 (EIO)	Determines average response of local real wages to demand shocks to local jobs	Do not change unless new research evidence
23	Slope of wage effect	Cell G31 (EIO)	Determines how wage response to demand shock changes as UR changes	Do not change unless new evidence
24	Depreciation of wage effect	Cell G33 (EIO)	How fast wage effect depreciates per year	Do not change unless new evidence
25	Labor force participation rate elasticity	Cell G34 (EIO)	Determines average response of local LFPR to labor demand shocks	Can be increased if local area has policies that increase hiring hard-core unemployed
26	Slope of LFPR effect	Cell G35 (EIO)	Determines how LFPR effect of demand shocks is altered as prime-age employment rate changes	Do not change unless new evidence
27	Depreciation of LFPR effect	Cells G41 & G42 (EIO)	Determines depreciation of LFPR over time	Do not change unless new evidence

Table 2 (Continued)

Var #	Variable description	Where found (EIO is "Economic inputs and outputs" worksheet)	Role in model	Comments
28	Employment/labor force elasticity	Cell G36 (EIO)	Determines how unemployment rate responds to demand shocks	Can be increase if local area has policies to increase hiring unemployed.
29	Slope of E/LF effect	Cell G39 (EIO)	Determines how unemployment rate effect changes with baseline unemployment rate	Do not change unless new evidence
30	Depreciation of E/LF effect	Cell G43 in worksheet "Economic inputs"	Determines annual depreciation of unemployment rate effect. Annual depreciation is 1 minus this figure.	Do not change unless new evidence
Financing				
31	Tax vs. spending financing	Cell G4 (EIO).	Determines how incentives financed & disposition of fiscal benefits.	Default is "neutral" 50; do not change without strong reasons
32	Business tax percentage	Cell G6 (EIO).	Determines what % of tax changes occur via business taxes (vs personal taxes)	Default is Ernst and Young figures for business taxes as % of state/local taxes. Do not change w/o strong reasons.
33	Share of personal taxes in state paid by bottom 90% in income	Cell G7 (EIO)	Determines what % of personal tax changes borne by those in bottom 90% of income distribution, which alters demand-side effects of taxes	Default is state figure from ITEP (2020). Do not alter unless good reason.
34	K–12 spending as % of total state/local spending	Cell G23 (EIO)	Determines % of spending changes financed by K–12, which affects future earnings.	Default is state figure from Census of Governments; do not change unless good reason.
Elasticities of expenditure and revenue				
35	Expenditure elasticity in response to population	Cell G49 (EIO)	Determines how spending needs respond to population shocks	Default is 1.0. Consider revising down/up in declining/booming areas.
36	Elasticity of intergovernmental revenue to population	Cell G51 (EIO)	Determines how federal aid varies with state population	Default is 1.0. Do not change w/o better model of federal grants.
37	Elasticity of personal income tax revenue in response to personal income per capita	Cell X20 in worksheet "excerpted&processed stloc fin"	Helps determine fiscal benefits and marginal tax rates.	Based on Bruce/Fox/Tuttle (2006) state-specific elasticities. Do not change unless new evidence.

Table 2 (Continued)

Var #	Variable description	Where found (EIO is "Economic inputs and outputs" worksheet)	Role in model	Comments
38	Elasticity of sales and other tax revenue in response to personal income per capita	Cell X21 in worksheet "excerpted&processed stloc fin"	Helps determine fiscal benefits and marginal tax rates.	Based on Bruce/Fox/Tuttle (2006) state-specific elasticities. Do not change unless new evidence.
Business sensitivity to costs				
39	Cost elasticity	Cell C17 (EIO)	Determines how sensitive firms are to incentives, business taxes, & other costs in making job creation decisions	Default elasticity is 10 (1% cost change as % of value-added causes job change of 10% in other direction). Do not change unless new evidence.
40	Firm discount rate	Cell C26 (EIO)	Determines real discount rate that firms use to discount future cash flows	Default is 12%. Do not change unless new evidence.
41	Real wage sensitivity	Cell C32 (EIO)	Adjusts cost sensitivity of firms to real wage changes to lower level than other cost changes	Default is 0.3, based on research. Do not change unless new evidence.
42	Real estate cost sensitivity	Cell C33 (EIO)	Adjust cost sensitivity of firms to real estate costs compared to overall costs	Default is 1—all costs have same impact. Do not change unless new evidence.
43	Business tax costs	Cell C34 (EIO)	Adjusts cost sensitivity of firms to business tax changes above or below other costs	Default is 1—all costs have same impact. Do not change unless new evidence.
Other spending and tax effects				
44	Demand-side effects of changes in public spending	Cell G5 (EIO)	Determines demand-side effect of increasing or cutting public spending, as cost per job.	Default is $38,303 per job. Do not change unless new evidence.
45	Demand-side effects of changes in taxes on bottom 90% of income distribution.	Cell G8 (EIO)	Determines demand-side effects of increasing or cutting taxes on bottom 90%, in costs per job created or destroyed.	Default is state-specific number, close to national average of $45, 178. (See Appendix B). Do not change unless new evidence.
46	Demand-side effects of changes in taxes on top 10% of income distribution	Cell G9 (EIO)	Assumes this has no demand-side effect, based on Zidar (2019)	Default is very large cost per job to yield zero demand effect. Do not change unless new evidence.

Table 2 (Continued)

Var #	Variable description	Where found (EIO is "Economic inputs and outputs" worksheet)	Role in model	Comments
47	Supply-side effects of changes in education spending on future earnings, direct effects on those educated	Cell G21 (EIO)	Determines future direct earnings effects of changes in K−12 spending	Default is 1% reduction/increase in spending yields 0.7743% increase/reduction in earnings. Do not change unless new evidence.
48	Local spilloves of changes in skills due to direct education effects	Cell G22 (EIO)	Determines addded "spillover" effects of direct education spending effects.	Default spillover is 86% of direct effect, based on Moretti (2004). Do not change unless new evidence.
Social welfare variables				
49	Social discount rate	Cell C27 (EIO)	Determines annual real discount rate at which all benefits and costs are evaluated by society in assessing present values	Real rate of 3% is conventional in benefit-cost analysis.
50	Direct parent benefit of education	Cell G24 (EIO)	Adds in parent benefit of education spending, not just earnings loss for children.	Default is that parents value child care and other benefits of education beyond future earnings effects at education's costs. Do not change unless new evidence.
Miscellaneous input variables				
51	Adjustment rate of businesses to cost changes	Cell C18 (EIO)	Determines how rapidly businesses adjust to cost changes	Default is 9% annually. Do not change unless new evidence.
52	Multiplier adjustment rate	Cell C24 (EIO)	Determines how rapidly input-output full multiplier achieved.	Default is 50% per year. Do not change unless new evidence.
53	Assumed ratio of export-base of locally owned firms to overall average	Cell C30 (EIO)	Determines locally owned export-base firms that suffer profit loss due to increased local costs that they cannot pass on in higher prices. Part of change in local incomes.	Default is 0.50, which implies local firms are 22% export-base. Do not change unless new research.
54	Calculated share of business costs shipped out of state	Cell C31 (EIO)	Determines % of business cost changes for export-base businesses that are paid by out of state residents.	Default is 74%, based on assumed local ownership % (cells G14 & G15 in EIO). Do not change unless new evidence.

Table 2 (Continued)

Var #	Variable description	Where found (EIO is "Economic inputs and outputs" worksheet)	Role in model	Comments
55	% of owner-occupied housing that is locally owned	Cell G13 (EIO)	These property ownership percentages in G13, G14, and G15 are used to determine whether capital gains and property taxes are paid by local residents, who are only ones counted in model.	Default is 100%. Do not change unless new evidence.
56	% of of nonfinancial corporations that are locally owned	Cell G14 (EIO)	See above.	Default is 50%
57	% of nonfinancial unincorporated bizs that are locally owned	Cell G15 (EIO)	See above.	Default is 10%
58	Local purchasing advantage	Cell G18 (EIO)	Adds in extra multiplier for local businesses given incentives due to greater propensity to use local suppliers and personal spending of owners	Default is 0.25. Do not change unless new evidence.
59	Share of local businesses among displaced	Cell G19 (EIO)	Allows for locally incented business to displace other local businesses if incented local business is non-export base	Default is local incented businesses displaces 25% locally owned, 75% outside owned. Do not change unless new evidence.
60	Marginal propensity local consumption	Cell G25 (EIO)	Used to determine job effects of spending from increased local property values.	Half of increased local consumption from increased property values is assumed spent locally. Do not change unless new evidence.
61	Future growth rate of real wages, value-added, other real variables	Cell G27 (EIO)	Used to determine baseline values of many real variables into future	Default is annual growth rate of all real variables of 1.12%. Do not change unless new evidence.
62	Long Run UR	Cell G29 (EIO)	Used to determine what local unemployment converges to.	Default is 3.0%. Do not change unless new evidence.
63	UR rate of convergence	Cell G30 (EIO)	Used to determine how fast local unemployment converges to LR rate.	Default is 20%/year. Do not change unless new evidence.

Table 2 (Continued)

Var #	Variable description	Where found (EIO is "Economic inputs and outputs" worksheet)	Role in model	Comments
64	Share of total after tax and transfer spending that is erodible non-labor income	Cell G53 (EIO)	Determines state income that comes from external transfers or capital income, and is eroded by local price increases.	Default is 26.22% Do not change unless new evidence.
65	Share of total after tax and transfer spending that is labor income	Cell G54 (EIO)	Determines nominal wage changes needed to keep real wages same as local prices change.	Default is 60.01%. Do not change unless new evidence.
66	Income elasticity of housing demand	Cell G56 (EIO)	Determines how property tax revenues respond to increased local incomes.	Default is 0.702. Do not change unless new evidence.
67	Price elasticity of housing demand	Cell G57 (EIO)	Determines how property tax revenue responds due to demand response to higher local housing prices.	Default is −0.700. Do not change unless new evidence.
68	Share of business taxes paid by top 10%	Cell P36 (EIO)	Determines demand effects of changes in business taxes.	Default is 66.8%. Do not change unless new evidence.

different local labor/housing markets, as a given incentive project will have a different impact in Flint compared to Ann Arbor, or Grand Rapids compared to the Upper Peninsula. Statewide averages will be less accurate. As for the other groups of variables, the user may have some good reasons for some incentive projects or programs to change the local labor dynamics or financing variables. Some projects or programs may have provisions that allow a given increase in jobs to have greater impacts on employing local workers. And the political context may justify changing assumptions about how the project is financed.

For the remaining five groups of variables, group 4 through group 8, we do not recommend changes unless the user has strong reasons to change these variables, for example, a change is supported by new research or research that the user believes to be more reliable.

The recommendation to consider changes in the first three groups of variables may substantially affect incentives' benefit-cost ratio. We discuss below some of these possible effects, for different possible changes. Some empirical illustrations of how benefit-cost ratios change with different assumptions are presented later, in Table 11.

Local market variables

As detailed in Table 2, the user can choose to disregard the state averages used by default, and instead substitute local values for different local labor market and housing market variables (variables 18 through 21, entered in various cells on various worksheets, as indicated in Table 2). These local labor market and housing market variables includes baseline values of the prime-age employment rate and the unemployment rate, and the housing price response to shocks to population and the property tax rate.

The prime-age employment rate and the unemployment rate predict, along with the labor market dynamic variables, how wages, labor force participation rates, and unemployment rates will *change* in response to the "labor demand" shocks to employment brought about by an incentive program that has a "but for" greater than zero percent. The values of these in a local labor market will give more accurate predictions of how these labor market outcomes will change than relying on statewide averages.

The housing price elasticity affects how much local housing prices respond to shocks to local population. In turn, these increases in local housing prices will affect local residents' capital gains, a component of local residents' real income. In addition, the magnitude of the increase in local housing prices will affect how much local prices and local wages go up. These increases in local costs will feed back into some reductions in other local employment. In addition, increases in local prices will reduce the real value of some nominal income flows, for example, the real income of local residents who rely on Social Security income or dividends and interest from out-of-state companies.

Higher housing prices also will increase local residents' property taxes. The magnitude of this increase in property taxes will also depend on the local property tax rate. How property taxes change will alter the fiscal effects of the economic shock brought about by incentives, as well as altering the after-tax real incomes of residents.

For past history, local unemployment rates are readily obtainable from the U.S. Bureau of Labor Statistics. Historical data on local prime-age employment rates can be calculated by using micro-data from the U.S. Current Population Survey (CPS), or from published tables from the American Community Survey (ACS).[21]

What about the future? Future projections can use reasonable assumptions about how unemployment rates and prime-age employment rates will evolve over time. One alternative for users is to follow the assumptions made in the default state data used in the model. In the state data, the model projects future unemployment rates for states by assuming that the state unemployment rate in the last year of history converges to a 3 percent unemployment rate in the long run, adjusting one-fifth of the way to that long-run equilibrium each year. In addition, as described in Appendix B, these changes in the local unemployment rate are assumed to predict changes in the prime-age employment rate, with an estimated effect of ln(1−UR) on ln(prime-age employment rate) of around one. The user could make similar assumptions about the future evolution of local unemployment rates and prime-age employment rates.[22]

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[21] The published ACS data report the ratio of prime-age CIVILIAN employment to prime-age TOTAL population. However, using other census tables, it is possible to adjust the denominator to subtract out military population. See appendix to Bartik (2020a).

[22] Users should examine the resulting time series of unemployment rates and prime-age employment rates, and make sure it seems plausible as a forecast. In addition, users should make sure that the last year of history has accurate measures of unemployment rates and prime-age employment rates, as this otherwise affects these forecast relative rates going forward. If a user has later data on the unemployment rate than on the prime-age employment rate, the prime-age employment rate should be forecast to follow reasonable relationships with the unemployment rate. If alternatively the user allows the unemployment rate to dramatically go up or down without corresponding changes in the prime-age employment rate, this is likely to result in inaccurate forecasts.

Note that the net effect of these assumptions for future state or local labor market variables is that local unemployment, and hence how real wages and unemployment rates respond to labor demand shocks, tends after several years to be similar in all local areas, and thus future demand shocks will have similar effects everywhere. On the other hand, differences across local labor markets in the prime-age employment rate tend to be persistent. And these prime-age employment rate differences are large—differences across local labor markets in a state in the prime-age employment rate of 4 percentage points or more are very common (Bartik 2022). Therefore, the effects of demand shocks on labor force participation rates may vary quite a bit across different local labor markets in a state, even in the long run.

For the housing price elasticity in response to population shocks, the user can get metro area housing price elasticities from estimates by Saiz (2010). These metro elasticities are reported in one of the Excel worksheets in the Excel version of the model, on the worksheet entitled "Saiz elasticities w state."[23] The user can figure out what metro area the project is located in, and use the housing price elasticity from column P in that worksheet.[24] For non-metro areas, one would generally assume that housing price elasticities are toward the lower end of metro area price elasticities in a state.

For property tax rates, in most states it is possible to get real local property tax rates, based on nominal tax rates and state equalization rates.

Local labor market dynamics market variable

As detailed in Table 2, the user can also alter how various labor market outcomes respond to labor demand shocks (variables 22 to 30 in Table 2). For wages, labor force participation

[23] I appreciate Professor Saiz's willingness to provide me with the complete set of his estimated housing supply elasticities.

[24] The state elasticities used as a default are population-weighted averages of each state's metro area elasticities.

rates, and the unemployment rate, the user inputs include the average or typical elasticity, how that elasticity changes in response to changes in baseline labor market conditions, and how rapidly any effects depreciate over time. These variables are then combined with the state or local labor market variables used to determine what elasticity actually governs the outcome. Wage and unemployment rate elasticities depend on the baseline state or local unemployment rate, and the labor force participation rate elasticities depend on the baseline state or local prime-age employment rate.

Note that based on the research used to generate these elasticity-determining parameters, the labor force participation rate elasticity depreciates far more slowly than the other two elasticities. Therefore, changes in assumptions about this elasticity tend to yield bigger changes in how the model behaves.[25]

Users might want to consider changing the labor force participation rate elasticities or unemployment rate elasticities for some projects or program. These elasticities depend in part on the hiring pattern of the incented firms. If the incented firms end up hiring more of the long-term unemployed, either due to the nature of the firms or due to public policies that encourage such hiring, then the labor force participation rate elasticity that might be most appropriately used may be larger than is typical (variable 25). If the incented firms end up hiring more of the short-term unemployed, then the unemployment rate elasticity might appropriately be adjusted upward somewhat (variable 28). On the other hand, if the incented firms are going to mostly bring in

[25] As noted in Table 2 (variable 27), cells G41 and G42 allow users to control the annual depreciation of the labor force participation rate effect. The default of the model is to set G42 to one and G41 to zero. Setting G42 to one allows the model to base depreciation of the LFP rate effect on the proportion of labor force participants as of a given year after a demand shock who are *not* dead or out of state. If G42 is instead set to zero, then this labor force participation rate depreciation is turned off, and the entry at G41 then controls the annual depreciation rate of the LFPR effect.

employees from other states, then the labor force participation rate and unemployment elasticities perhaps should be adjusted downward from their default values (variables 25 and 28).

The other labor market dynamics variables seem less likely to change due to what firms are incented or what local hiring policies are adopted to accompany incentives. Users should only change these variables if they believe that their interpretation of the best current research supports other elasticity variation with local labor market conditions or over time.

Financing variables

Table 2 also includes four input variables that allow the user to change how the incentives are financed (variables 31 through 34). The default assumption of the model is that incentive costs are paid for 50 percent through tax increases, and 50 percent through spending cuts. This seems like a neutral assumption, rather than assuming 100 percent financing by either tax increases or spending cuts. Out of the tax increases, the share that is due to business tax increases is set based on state-specific information on what percent of state and local taxes are borne by business. Out of the spending cuts, the share that is due to K–12 spending cuts is set based on state-specific information on what percentage of state and local spending goes to K–12.

The model assumes that these same percentages also apply to all fiscal effects that occur in the model. As tax revenue changes and public spending needs change in the model, state and local governments end up temporarily running budget deficits or surpluses, which must be corrected, as state and local governments are generally required to balance their budgets. Therefore, these temporary budget deficits or surpluses are then assumed to result in subsequent tax and budget adjustments, according to this same assumed pattern, as was true for incentive financing.[26] The implicit assumption is that whatever political dynamics result in a particular pattern for incentive financing will result in similar patterns for other state and local budget adjustments.

In the model, spending cuts tend to have both higher demand-side and supply-side effects on state and local economies. On the demand side, the effects of a given dollar change in spending on jobs, via affecting local labor demand, is greater than that of the same dollar change in taxes (see variables 44 and 45, discussed further below). On the supply side, cuts in education spending have very negative long-run effects on earnings (variables 47 and 48, discussed further below). Increases in business taxes also have negative supply-side effects on jobs, by making business job creation less profitable, but these effects are less.

Because of the large negative supply-side effects of education spending cuts, financing a greater share of any spending cuts by education spending cuts tends to reduce social benefits in the model. With respect to taxes, shifting the mix of taxes between personal taxes and business taxes has mixed effects. On the one hand, more financing through business tax increases results in greater discouragement of business job creation. On the other hand, more financing through business tax increases results in more of the cost of any incentive package (and any fiscal effects) being borne by business owners who live outside the state. Because the model only counts changes in real income of those living in the state or local area, "exporting" business taxes to out-of-state owners tends to increase benefits in the model. In addition, personal tax increase financing tends to have greater demand-side effects than business tax financing, as households consume more local goods and services.[27]

[26] The model assumes that the budget deficits or surpluses realized in a given year lead to budget adjustments in the next year. This is done partly to reduce problems of simultaneity in the model, but is also probably more realistic.

[27] The model does allow for local goods and services consumption by locally owned businesses.

Users should only change these default percentages from taxes or spending, or from different types of taxes or spending, if it is apparent from the state and local political context that other financing percentages are more plausible than are assumed by default in this model. For example, perhaps it is clear in some state political context that the state legislature would have cut overall business taxes by more if the business incentive program had not been adopted. Or perhaps the incentive program is a property tax abatement that has large effects on local school finances, and the political context makes it clear that most of these negative effects were not offset by state aid or other local aid. In cases where the source of financing clearly deviates from the model's default, assuming 100 percent business tax increase financing, or 100 percent K–12 school cut financing, might be appropriate.[28]

Elasticities of expenditure and revenue

The user can also change assumptions about how state and local expenditure needs and tax revenue change in response to how population changes and how personal income changes (variables 35 to 38 in Table 2). The changes in expenditure needs and tax revenue help determine the fiscal effects of the incentive program, that is, whether the program results in budget deficits or surpluses beyond its direct costs. These fiscal effects in turn have other consequences for the model. Fiscal effects must be paid for, which has economic effects and also affects local residents' real incomes.

In addition, the marginal effects on various types of tax revenue in responses to personal income shocks affects the marginal tax rates applied to overall real income changes in the model.

[28] Given the way the model is structured, this also means that all fiscal effects are financed in the same way. However, in the model, net fiscal effects are typically much smaller than incentive costs, so imposing these assumptions on these other fiscal effects is of lesser importance. In addition, if the political dynamics are such that incentive costs come at the expense of a particular group, it is defensible to assume this political dynamic holds more generally.

These marginal tax rates affect after-tax real incomes of various groups, which affects the overall benefit-cost analysis. Therefore, for example, increases in marginal tax rates on the one hand have directly negative effects on after-tax real income, but on the other hand also have directly positive effects on fiscal benefits, which has positive effects on real incomes.

The model default is to assume that state and local public expenditure needs increase by the same percentage as the population. These "needs" are assumed to be required to keep public service quality constant as population expands.

The tax revenue elasticities are derived from a study by Bruce et al. (2006) of how state income tax revenue and sales tax revenue respond to personal income shocks. States with more progressive income tax regimes tend to have a greater income tax response. States with more comprehensive sales tax coverage tend to have greater sales tax responses. In general, the personal income tax responses tend to be greater than the sales tax responses, so marginal tax effects tend to be greater in states with more reliance on income taxes.[29]

These fiscal effects assumptions are important, but it is unclear whether there is research that provides a good basis for deviating from the model's default assumptions. For example, there is not a great deal of reliable research showing how much expenditure must change to keep public service quality constant as population increases. Some places, particularly those that have experienced recent declines in population, might have excess capacity in existing infrastructure, so they might be able to keep public service quality constant without huge increases in expenditure. On the other hand, many places might have paid for existing infrastructure with

[29] Some details include that I apply the sales tax response in Bruce et al. (2006) to "all other revenue" as well as to sales tax revenue. In addition, I assume that the marginal tax responses of Bruce et al. are to personal income shocks brought about by changes in per capita income. Therefore, these elasticities are only applied to the portion of the shock to state personal income that is due to per capita income changes. A change in state population, with no change in per capita income, would be assumed to have the same percentage impact on state and local tax revenue as the percentage change in state or local population. Finally, some of the extreme values of Bruce et al. for different states are bounded.

federal grants that are no longer readily available, so infrastructure upgrades might be far more expensive than current average costs of infrastructure. Similarly, how exactly state and local tax revenue responds to shocks to the state's economy is not fully understood in most states. If the user is confident that they have a "fiscal impact" model for their state or local area that can improve on the expenditure and revenue elasticities used as a default here, they should use that fiscal impact model. In the absence of such information, the default assumptions of the model should be used.

For both government revenue and public spending needs, the model does not separate out state government versus local governments. A state versus local breakdown might be added in future versions of the model. There are some challenging issues in separating out state versus local governments in looking at revenue and expenditure. As is well-known, local governments are "creatures of the state," meaning that their powers, including revenue-raising powers and spending authority, are controlled by state government. For example, if job growth and population growth in a state pushed up the need for public school spending, and strained local budgets due to restrictions on local property taxes, while at the same time this growth increased state revenue, it seems likely that political pressure would result in some increased state support for local schools. Therefore, existing law may not be a guide to how the fiscal impact of growth is divided between the state and local governments.

Business sensitivity to costs

Users can also adjust how sensitive businesses are to costs (variables 39 to 43 in Table 2). These cost sensitivities affect how incented firms respond to incentives (the "but for"), as well as how all businesses in a state respond to changes in taxes, real wages, and cost changes induced by real estate price increases.

As already described, the default for the model is that firms use a 12 percent real discount rate in evaluating the present value of incentives, and to then calculate what percentage this incentive present value comprises of the present value of the project's value-added, with the value-added also discounted to a present value using this same 12 percent real discount rate. The model then assumes that this incentive percentage of value added determines the percentage point reaction of firms to incentives, at a 10-to-1 ratio. This 10-to-1 ratio means that if there is a cost change due to incentives of 1 percent of value-added, this causes a 10 percent change in jobs—for example a 10 percent change in the probability of making that location or expansion decision.

By default, this same cost sensitivity is applied to most other costs. In particular, it is assumed that increases in real estate costs, and in nominal wage increases needed to compensate workers for local price increases, also lead businesses to have long-run employment responses that reflect this same cost sensitivity. In addition, if the incentives and the fiscal benefits result in some change in business taxes, it is assumed that such changes in business taxes also have a long-run effect of the same magnitude—that is, a business tax increase that is 1 percent of value-added will in the long run reduce business employment in a state by 10 percent.

Applying this same cost sensitivity forces users of the model to realize that if firms are assumed to be very responsive to business incentives, because costs matter, then this cost sensitivity also implies that other firms will respond to the effects of local growth in increasing business costs. Any fair model of economic effects of business incentives should impose some such consistency.

The one exception is real wages. The cost sensitivity of firms in response to real wage increases is set at 30 percent of the cost sensitivity to all other costs. This is based on evidence that businesses seem far less responsive to wage increases than to cost increases caused by business taxes (Bartik 1991). In addition, such a real wage cost sensitivity is consistent with the consensus real wage elasticity of labor demand in the research literature (see Appendix B). Such a lower real wage elasticity may be due to "efficiency effects" of higher real wages; that is, higher real wages may increase worker productivity and reduce worker turnover, which makes such cost increases less of a deterrent to business job creation.

Users can manipulate variables 39–43 to decouple the cost sensitivity of incented firms from how other firms respond to costs. However, it is more direct to do this by simply imposing a desired "but for" on the "Incentive inputs" worksheet. Users should not change variables 39–43 without strong research evidence for doing so.

Other spending and tax effects

Users can also adjust the effects of other spending and tax input variables (variables 44–48 in Table 2). These economic input variables affect how sensitive jobs are due to the demand-side effects of public spending (variable 44), how sensitive jobs are due to the demand-side effects of changing taxes on the bottom 90 percent[30] and the top 10 percent of the income distribution (variables 45–46), and how sensitive future earnings are to changes in K–12 public spending (variables 47–48).

These economic input variables alter how the local economy responds to changes in state and local budgets brought about by either the direct effects of incentives on state and local budgets, or by the indirect effects of incentives in providing fiscal benefits or having fiscal costs.

[30] As explained in Appendix B, the demand-side effects of tax changes are adjusted slightly to state-specific numbers based on differences in baseline state/local tax rates.

These particular economic inputs are based on research studies. Users should not change these economic inputs unless they have some strong research evidence to the contrary.[31]

Social welfare variables

The default real social discount rate in calculating present values from the viewpoint of policymakers is 3 percent per year (variable 49). This is a fairly conventional social discount rate, but some people prefer lower or higher social discount rates.[32] Such a discount rate discounts the future in part because of the assumption that real wages and real incomes will grow at 1.12 percent per year (variable 61), and therefore dollars in the future are not quite as valuable as values today, when we are poorer. In addition, this discount rate reflects, probably realistically, some inherent time preference for a more certain present over a more uncertain future.

In addition, the model assumes that parents value public education at least at its costs (variable 50), which seems a conservative assumption.

Miscellaneous input variables

The "Economic inputs and outputs" worksheet also includes 18 other variables that the user can change (variables 51–68). In general, change is not recommended unless the user has some research evidence for the change.

[31] For example, Zuo (2020) presents research evidence suggesting that programs such as the federal Community Development Block Grant program (CDBG) create jobs at a cost of less than $14,000 per job. This almost surely reflects "supply-side" as well as "demand-side" effects of this spending. If an incentive program and its fiscal effects were assumed to be financed in large part by reductions in public spending that have as large jobs effects as CDBG, then a user might want to lower the cost per job from $38,303 to a much lower number.

[32] For example, the federal government typically uses either 3 percent or 7 percent. Alternative discount rates that might be used are discussed in Bartik (2011, Appendix 7A). See also Moore et al. (2013). In general, social discount rates of 3 percent or less seem warranted, based on the research literature.

OUTPUT FROM THE MODEL

Summary Output

Summary output from the model is provided in cells A79 to D82 of the "Economic inputs and outputs" worksheet. This output includes: ratio of present value of gross benefits to incentive costs over 80 years; same ratio but over 10 years; ratio of present value of state/local fiscal benefits over 10 years to present value of incentive costs; ratio of present value of state and local revenue increases over 10 years to present value of incentive costs.

In these calculations, the ratio of present value of incentive costs is always calculated over all 80 years, even when the numerator is over 10 years. Why this difference? The rationale is that the incentive costs in the denominator are relatively certain and predictable. These incentive costs have been agreed upon in the incentive contract or are controlled by relevant tax law. In contrast, the benefits are less certain, and although they can be predicted, one can always wonder whether these future benefits will occur. Therefore, it seems preferable to look at what benefits of various types would be thought to occur over 10 years and compare them with all costs. In addition, this formulation allows one to immediately see the ratios of various types of gross benefits; for example, 10-year benefits to total benefits. Given the voluminous output described below, and reported in the Excel workbook on the "Economic inputs and outputs" worksheet, the user can easily adjust the denominator to only report 10 years of incentive costs, or adjust the numerator and denominator to only count benefits and costs up to any arbitrary number of years from 1 through 80.

These four benefit measures are chosen in part to emphasize that many of the benefits and costs of incentive policies are long term, after 10 years. In addition, these four benefit measures include both fiscal effects and revenue effects, because these government budget effects are frequently emphasized by economic development policymakers. In most runs of the model, it becomes apparent that either the fiscal effects or the revenue effects are only modest portions of overall benefits.

This same summary output is provided on the "Incentive inputs" worksheet at I2 through L3, and A114 through D115, and on the "Economic inputs and outputs" worksheet in cells A35 through cell D41. This allows users to immediately "see" how summary output changes if changes are made to various incentive inputs without switching to a different worksheet, or in the case of economic inputs, without switching to a different portion of the same worksheet.

Why Eighty Years

Despite these arguments, some users may be wondering the following: "Isn't it questionable that we can see 80 years into the future? What makes Tim Bartik think that this model can project at all accurately over this time frame?"

In response, what needs to be understood is that the model does not seek to forecast the economy over an 80-year period. Rather, it seeks to forecast how a particular incentive project or program might cause the forecast, over this time period, to *change*.

If a policy maker ignores this model's output after 10 years, or some other shorter time period, they are also implicitly assuming that they can forecast how this incented project or program changes the future. Implicitly, they are assuming they know that this project or program will *not* change the future after the last time period considered. Assuming zero future effects after some time period of today's projects or programs is as strong an assumption as making reasonable predictions of expected future effects.

Furthermore, in the current model, the social discount rate of a 3 percent discount rate per year already heavily discounts future effects, in part because of future income growth and in part because of uncertainty. At such a social discount rate, one dollar 40 years now, even after controlling for inflation, is worth less than 31 cents today, and one dollar 80 years from now is worth less than 10 cents today. For these long-run effects, the present value will only be large if the expected dollar effects are sustained at a high level for many years.

In the present model, such large and sustained long-run effects mainly occur due to effects of financing incentives via cuts in public spending that is highly productive, such as K–12 spending. These K–12 cuts affect former students for many years by a large amount. Ignoring such large and sustained long-run effects amounts to assuming that K–12 spending does not have large effects on future economic productivity. The model's options allow users to make such an assumption if they choose, but users should explicitly make such an assumption and own both what backing they find for it and its implications. Users should not be encouraged to implicitly ignore education spending cuts by arbitrarily limiting the scope of their evaluation to only a few future years. Again, users can do this if they wish—all the output is there for users to truncate the analysis, after 10 years, 20 years, or any arbitrarily chosen number of years—is the right answer 42? But the model does encourage going up to 80 years out, in order to capture potentially important effects of changes in education spending.

Incentive Summary Impact on Incomes by Income Type and Quintile

On the "Economic inputs and outputs" worksheet, cells A84 to H101 report the impact on different types of income, and by income quintile. Note that "net local budget costs" reflects *negative* effects on income. Income figures are present values in 2019 national dollars.

These impacts by different types of income are included to emphasize the mechanisms by which incentives affect the real incomes of local residents: net effects on local budget costs (incentive costs plus net fiscal costs or benefits), labor market benefits (higher net real labor income after taxes due to higher employment rates or real wages), property value effects (capital gains for local property owners minus increased property taxes), education cutbacks (adverse effects on future real earnings due to any financing of incentive costs and fiscal costs by cuts in K–12 spending), net effects on local businesses (adverse effects of higher local costs, offset sometimes by benefits if incentives go to locally owned businesses), and a lower real value of non-labor income due to higher local prices (e.g., transfers and capital income from outside the state will have a lower real value due to higher local prices).

In addition, these impacts by different types of local incomes will have a very different distributional impact across different income quintiles. The model distributes various types of income and fiscal effects across different income quintiles, labeled as quintile 1 (lowest income) to quintile 5 (highest income). Cells C84:H84 list the percentages of baseline income in each income quintile, ranging from 5.08 percent for the lowest income quintile to 51.96 percent for the highest income quintile, an approximately 10-to-1 ratio for average income comparing the top to the bottom quintile.

Of particular interest are the percentages below, in cells B93:H101, which show how various types of income are distributed by income quintile. The lower income quintiles tend to be affected the most by budget costs, labor market benefits, and education cutbacks. Upper income quintiles are affected more by property value changes and effects on local business. Effects on the real value of non-labor income are distributed roughly proportionately to income by group.

Why this pattern? Budget costs at the state and local level are financed by relatively regressive taxes; hence, the lower income quintiles tend to pay more than their baseline income shares. Labor market benefits tend to go to the bottom three income quintiles, which tend to have the most non-employed labor that can benefit from higher employment rates. Education cutbacks tend to affect all students by a similar dollar amount, which results in roughly equal percentage effects across quintiles—but which is much higher relative to baseline income shares for lower income quintiles. Upper income quintiles tend to own more property and businesses, and thus are more affected by changes in these sectors. Finally, as it turns out, the non-labor income, whose value is eroded by higher prices, tends to be distributed similarly to baseline income percentages—this income includes external income transfers, such as Social Security, which tend to go more to lower income groups, as well as dividends and interest, which tend to go to upper income groups.[33]

Job Impacts

On the "Economic inputs and outputs" worksheet, Table E1 and Table E2 show job impacts, which are also shown in the accompanying figure E1. Table E1 shows the present value of different types of "job-year" impacts (cells A131:D150). This "present value" discounts job impacts in future years by using the social discount rate. These different job impacts emphasize several things: the initial job impact is only a modest "but for" percentage of the incented firm's jobs; the economic impacts of the model, due to higher costs or the costs of paying for the incentives, offset much of the gross multiplier effects of the direct job creation.

Table E2 (cells A152:K233) and the accompanying Figure E1 show job impacts by year, both overall and for different types of job impacts. These impacts by year show that some of these negative effects, due to higher local costs and higher local budget costs, tend to increase somewhat over time.

[33] See discussion in Appendix B of the research supporting these assumptions.

Local Residents' Income Impacts

Tables E3 and E4 on the "Economic inputs and outputs" worksheet, and the two accompanying figures (Figure E2 and Figure E3), show effects on residents' real incomes, in 2019 national dollars. Table E3 shows the present value of various income effects, broken down by various types of income (cells A236:E258). This breakdown is in more detail than what is presented in the quintile breakdown. This more detailed breakdown allows users to see that the typically small net fiscal cost or benefit is often composed of offsetting large revenue and required spending effects. Similarly, the benefits of higher local property values are in many cases largely offset by what the resulting higher local prices do to erode the real value of outside-derived transfer and capital incomes.

Table E4 shows impact on various types of resident income by year, for each of the 80 years after the incentive program is initiated (cells A260:AN341). These year-by-year impacts are further illustrated in the two figures. One of the main points that comes out of these figures, for many incentive programs, is that long-run impacts tend to be modestly negative. The direct positive effects of the initial job creation on improving labor market outcomes and yielding capital gains tend to dissipate after time, while there are continuing increases in property tax rates, lower real earnings due to some education cutbacks, and lower real values of some non-labor income due to higher local prices.

ILLUSTRATIVE EXAMPLES OF ENTERING IN AND INTERPRETING INCENTIVES DATA

This section provides four case study illustrations of how to use the model in practice. I first consider two individual incented projects, one that "succeeded" (the jobs persisted) and the other that failed (the jobs went away after the incentives were paid out). I then consider the case of the Amazon HQ2 facility location decision in Virginia. Finally, I consider the case where only aggregate program data are available. In this section, I focus on how to enter inputs and the summary benefit-cost ratios. The following section will consider in more detail the benefits and costs by quintile, and job impacts and income effects over time, for the case of the Amazon HQ2 facility.

Michigan Business Development Program, Case 1: An Overachieving Project

For our first two cases, we consider specific projects. These specific projects are roughly based on projects funded under the Michigan Business Development Program (MBDP), which was evaluated using a version of this model in Bartik (2018).[34] To preserve case confidentiality, all the details of these two cases are altered: the specific jobs, the incentives, the industry, etc. But despite changing these details, the program's structure remains: the program typically provided a one-time payment of around $10,000 per job, for jobs created during a two- or three-year contract period, with some agreed upon number of jobs subsidized. The program also had a limited clawback for a few follow-up years if created jobs were destroyed. In this User's Guide, the first case considered is a hypothetical MBDP project that was highly successful; the second case considered is a hypothetical MBDP project that failed.

Case 1, the hypothetical successful MBDP project, is a case of "overachievement": the project ends up creating more jobs than were promised, and therefore more jobs than were provided incentives. This project is described on the worksheet labeled "MBDP Case 1 data." As this shows, the planned project was to create 100 jobs in year 1, followed by another 150 jobs in year 2, for a total of 250 jobs. Due to these promised jobs, incentives of $10,000 per job were part of the MBDP project, or a payment of $1 million in year 1, followed by a payment of $1.5

[34] For an overall evaluation of MBDP using this model, see Bartik et al. (2019).

million in year 2. But the project is assumed to create more jobs than were promised, with the plant expanding over time to 500 jobs by year 6, after which it continues at that level. The project is assumed to be in the auto industry but to have a small multiplier of 1.5, possibly due to being a supplier, which will have fewer subsequent supplier links and lower wages. The assumed nominal wages at the start were $16 per hour, which are assumed to grow 3.12 percent per year to reflect both inflation and real wage growth over time. All of these entries are on the "MBDP case 1 data" worksheet at cells C2 to T87, and the same information is repeated in somewhat different format from cells A120 to CM208.[35] The latter cells are copied and linked to in cells A120 to CM208 on the "Incentive inputs" worksheet (see Table 3).

As shown on the "Incentive inputs" worksheet, cells B3:E3, the project has a "but for" using the planned jobs data—only the 250 jobs—of 6.7 percent using the value-added to FTE ratio, and 11.5 percent using the value-added to payroll ratio. This reflects that the wage rate is below average for the industry. The "but for" is lower when we use the actual jobs data, which reflects that the firm's jobs and value-added increased over time beyond the promised jobs. The "but for" using actual jobs data is 3.9 percent using the ratio of value-added to FTE, and 6.7 percent using the ratio of value-added to payroll. (See cells A2 to E3 on the "Incentive inputs" worksheet.)

On the whole, I think it's wiser to use the most conservative assumption here, which is to use the 3.9 percent "but for" derived by using the actual jobs data, and the ratio of value-added to FTE. This reflects the difficulty in ruling out that the firm might have anticipated that its actual job creation would exceed what it promised in the first two years. In addition, the reported $16

[35] In addition, the project is assumed to be owned by non-locals and to be an export-base firm, with no wage premia. Furthermore, the incentives are assumed to be valued at their cost to the government.

Table 3 "Successful" MBDP Project

State: Michigan
Starting year: 2016
Multiplier: 1.5
Wage premia of incented jobs: 0.0%
Locally owned firms: 0%
Incentive effectiveness to cost ratio: 1.0
Industry: Autos

		Actual			Planned	
Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)	FTE jobs	Nominal incentives paid under program rules ($)
2016	1	100	1,000,000	16.00	100	1,000,000
2017	2	250	1,500,000	16.50	250	1,500,000
2018	3	300	-	17.02	250	-
2019	4	350	-	17.56	250	-
2020	5	450	-	18.11	250	-
2021	6	500	-	18.68	250	-
2022	7	500	-	19.26	250	-
2023	8	500	-	19.87	250	-
2024	9	500	-	20.49	250	-
2025	10	500	-	21.14	250	-
2026	11	500	-	21.80	250	-
2027	12	500	-	22.49	250	-
2028	13	500	-	23.19	250	-
2029	14	500	-	23.92	250	-
2030	15	500	-	24.67	250	-
2031	16	500	-	25.45	250	-
2032	17	500	-	26.25	250	-
2033	18	500	-	27.07	250	-
2034	19	500	-	27.92	250	-
2035	20	500	-	28.80	250	-
2036	21	500	-	29.71	250	-
2037	22	500	-	30.64	250	-
2038	23	500	-	31.60	250	-
2039	24	500	-	32.60	250	-
2040	25	500	-	33.62	250	-
2041	26	500	-	34.68	250	-
2042	27	500	-	35.77	250	-
2043	28	500	-	36.89	250	-
2044	29	500	-	38.05	250	-
2045	30	500	-	39.25	250	-
2046	31	500	-	40.48	250	-
2047	32	500	-	41.75	250	-
2048	33	500	-	43.06	250	-
2049	34	500	-	44.42	250	-
2050	35	500	-	45.81	250	-
2051	36	500	-	47.25	250	-
2052	37	500	-	48.74	250	-
2053	38	500	-	50.27	250	-
2054	39	500	-	51.85	250	-
2055	40	500	-	53.48	250	-
2056	41	500	-	55.16	250	-

Table 3 (Continued)

		Actual			Planned	
Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)	FTE jobs	Nominal incentives paid under program rules ($)
2057	42	500	-	56.89	250	-
2058	43	500	-	58.68	250	-
2059	44	500	-	60.52	250	-
2060	45	500	-	62.42	250	-
2061	46	500	-	64.39	250	-
2062	47	500	-	66.41	250	-
2063	48	500	-	68.50	250	-
2064	49	500	-	70.65	250	-
2065	50	500	-	72.87	250	-
2066	51	500	-	75.16	250	-
2067	52	500	-	77.52	250	-
2068	53	500	-	79.96	250	-
2069	54	500	-	82.47	250	-
2070	55	500	-	85.06	250	-
2071	56	500	-	87.73	250	-
2072	57	500	-	90.49	250	-
2073	58	500	-	93.33	250	-
2074	59	500	-	96.27	250	-
2075	60	500	-	99.29	250	-
2076	61	500	-	102.41	250	-
2077	62	500	-	105.63	250	-
2078	63	500	-	108.95	250	-
2079	64	500	-	112.37	250	-
2080	65	500	-	115.91	250	-
2081	66	500	-	119.55	250	-
2082	67	500	-	123.30	250	-
2083	68	500	-	127.18	250	-
2084	69	500	-	131.18	250	-
2085	70	500	-	135.30	250	-
2086	71	500	-	139.55	250	-
2087	72	500	-	143.93	250	-
2088	73	500	-	148.46	250	-
2089	74	500	-	153.12	250	-
2090	75	500	-	157.93	250	-
2091	76	500	-	162.90	250	-
2092	77	500	-	168.02	250	-
2093	78	500	-	173.30	250	-
2094	79	500	-	178.74	250	-
2095	80	500	-	184.36	250	-

NOTE: This is a hypothetical MBDP project, although derived from actual successful projects. The project was supposed to create 250 jobs, with $10,000 per job incentives provided. The project ends up creating more jobs, including non-incented jobs in the assisted firm. Because the incentive is based on number of jobs, the planned incentives do not vary with the wage rate. The entries here are same as in cells A120 through CM208 of “MBDP Case 1 data” worksheet, but I omit rows that chose incented industry.

hourly wage may not reflect all the non-production workers at the plant, so using it to project payroll may understate the project's payroll.

Using this conservative 3.9 percent "but for," we conclude that this particular project has an 80-year ratio of present value of total benefits to incentive costs of 4.213. Over 10 years, the benefit-cost ratio is 3.639. If we only count fiscal benefits over 10 years, the benefit-cost ratio is 0.353. If we further restrict our analysis to only look at revenue benefits over 10 years, which cuts out the needs for increased spending due to increased population, the benefit-cost ratio is 0.716.

We can also ask what "but for" percentages would be required to yield benefit-cost ratios of at least one. These cut-off percentages for the different benefit measures are 80-year benefits (1.5 percent), 10-year benefits (1.4 percent), 10-year fiscal benefits (9.7 percent), 10-year revenue benefits (4.9 percent). All these percentages are derived by setting the "but for" to be arbitrarily determined (set cell B6 to choose 5), and then experimenting with different "but for" percentages in cell F3, and seeing how the benefit-cost ratios change (see cells linked to in cells I2 through L3).

As these patterns suggest, for many incentive programs, only a modest "but for" is needed for the project to provide long-term economic benefits, as job creation often has significant long-term benefits. Providing shorter-term fiscal benefits is more difficult.

Michigan Business Development Program, Case 2: A Failed Project

For Case 2 from the MBDP, we consider a project that failed, and for which all incentive funds were not recovered. This project's data are entered in on the worksheet labeled "MBDP Case 2 data."

The planned project was to create 50 jobs in year 1, followed by another 25 jobs in year 2, for a total of 75 jobs. The payments, at $10,000 per job, would then be $500,000 in year one, followed by another $250,000 in year 2. Presumably the assumption was that these 75 jobs would continue on into the future.

In this hypothetical project, what actually occurred is that in year 3, actual jobs declined to 60, which continued on into year 4. The MBDP program therefore "clawed back" $10,000 per job times 15 jobs in incentives in year 4, or $150,000. The 60 jobs continued for another few years, but then the plant closed. But no further clawbacks occurred, because like most incentive programs, clawbacks are not invoked indefinitely into the future.

The project was in professional and technical services. It is assumed to have a multiplier of 2.0 and pay relatively high initial wages of $54 per hour. The project is also assumed to be non–locally owned, to be export-base, to not pay a wage premium, and to have cash incentives valued by the firm at their cost to the government. All of these data are entered in in cells A120 through CM208 of the "MBDP Case 2 data" sheet. To implement the simulation for this case, this cell range from the "MBDP Case 2 data" sheet is then linked to in the analogous cells of the "Incentive inputs" worksheet. (See Table 4.)

Based on this input data, the calculated "but for" for the planned project—when we assume the firm compares the incentives under the contract with the project's value-added if the planned jobs had continued indefinitely into the future—are 6.8 percent using the ratio of value-added to FTE for the industry, and 5.1 percent using the ratio of value-added to payroll for the industry. The lower "but for" using the payroll information reflects that the reported wages are above average for the industry. If we use the actual jobs data, we are assuming that the firm knew in advance that the project would close down, and therefore that the incentives were a

Table 4 "Failed" MBDP Project

State: Michigan
Starting year: 2013
Multiplier: 2.0
Wage premia of incented jobs: 0.0%
Locally owned firm: 0%
Incentive effectiveness to cost ratio: 1.0
Industry: Professional and Technical Services

		Actual			Planned	
Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)	FTE jobs	Nominal incentives paid under program rules ($)
2013	1	50	500,000	52.00	50	500,000
2014	2	75	250,000	53.63	75	250,000
2015	3	60	-	55.32	75	-
2016	4	60	(150,000)	57.06	75	-
2017	5	60	-	58.85	75	-
2018	6	60	-	60.70	75	-
2019	7	-	-	62.61	75	-
2020	8	-	-	64.57	75	-
2021	9	-	-	66.60	75	-
2022	10	-	-	68.70	75	-
2023	11	-	-	70.86	75	-
2024	12	-	-	73.08	75	-
2025	13	-	-	75.38	75	-
2026	14	-	-	77.75	75	-
2027	15	-	-	80.19	75	-
2028	16	-	-	82.71	75	-
2029	17	-	-	85.31	75	-
2030	18	-	-	87.99	75	-
2031	19	-	-	90.76	75	-
2032	20	-	-	93.61	75	-
2033	21	-	-	96.55	75	-
2034	22	-	-	99.58	75	-
2035	23	-	-	102.71	75	-
2036	24	-	-	105.94	75	-
2037	25	-	-	109.27	75	-
2038	26	-	-	112.70	75	-
2039	27	-	-	116.24	75	-
2040	28	-	-	119.90	75	-
2041	29	-	-	123.66	75	-
2042	30	-	-	127.55	75	-
2043	31	-	-	131.56	75	-
2044	32	-	-	135.69	75	-
2045	33	-	-	139.96	75	-
2046	34	-	-	144.36	75	-
2047	35	-	-	148.89	75	-
2048	36	-	-	153.57	75	-
2049	37	-	-	158.40	75	-
2050	38	-	-	163.37	75	-
2051	39	-	-	168.51	75	-
2052	40	-	-	173.80	75	-
2053	41	-	-	179.26	75	-
2054	42	-	-	184.90	75	-
2055	43	-	-	190.71	75	-

Table 4 (Continued)

		Actual			Planned	
Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)	FTE jobs	Nominal incentives paid under program rules ($)
2056	44	-	-	196.70	75	-
2057	45	-	-	202.88	75	-
2058	46	-	-	209.26	75	-
2059	47	-	-	215.83	75	-
2060	48	-	-	222.61	75	-
2061	49	-	-	229.61	75	-
2062	50	-	-	236.83	75	-
2063	51	-	-	244.27	75	-
2064	52	-	-	251.94	75	-
2065	53	-	-	259.86	75	-
2066	54	-	-	268.03	75	-
2067	55	-	-	276.45	75	-
2068	56	-	-	285.14	75	-
2069	57	-	-	294.10	75	-
2070	58	-	-	303.34	75	-
2071	59	-	-	312.87	75	-
2072	60	-	-	322.70	75	-
2073	61	-	-	332.84	75	-
2074	62	-	-	343.30	75	-
2075	63	-	-	354.09	75	-
2076	64	-	-	365.22	75	-
2077	65	-	-	376.69	75	-
2078	66	-	-	388.53	75	-
2079	67	-	-	400.74	75	-
2080	68	-	-	413.33	75	-
2081	69	-	-	426.32	75	-
2082	70	-	-	439.72	75	-
2083	71	-	-	453.53	75	-
2084	72	-	-	467.79	75	-
2085	73	-	-	482.49	75	-
2086	74	-	-	497.65	75	-
2087	75	-	-	513.28	75	-
2088	76	-	-	529.41	75	-
2089	77	-	-	546.05	75	-
2090	78	-	-	563.21	75	-
2091	79	-	-	580.91	75	-
2092	80	-	-	599.16	75	-

NOTE: These data are for a hypothetical "failed" MBDP project, although based in part on actual cases. The program rules base incentives only on jobs created, so incentives do not vary with wage rates. This table is the same as data entered in cells A120 through CM208 of "MBDP Case 2 data" worksheet, but I omit rows and columns that designate the incented firm's industry.

larger percentage of the present value of the value-added of the project over its expected short lifespan. Using actual jobs data, we get a "but for" of 14.6 percent using the value-added to FTE ratio, and 11.2 percent using the value-added to payroll ratio. All of these "but for" values are reported in cells B3:E3 of the "Incentive inputs" worksheet.

Of these alternatives, it seems more reasonable, as well as more conservative, to use the planned project and the value-added to payroll ratio. It is certainly plausible that the firm expected the project to continue rather than be shut down in a few years. And the payroll ratio reflects what seem to be truly above average wages.

Based on this 5.1 percent "but for", the overall 80-year ratio of the present value of total benefits for all state residents, to the present value of incentive costs, is −0.707. That is, the project had gross costs even without accounting for the incentive costs. The 10-year benefit-cost ratio is quite different at 0.635. This reflects that the project did not shut down until year 7, so the 10-year benefit-cost ratio captures the benefits of the initial job creation without fully capturing the costs of the subsequent job destruction. Also, over 10 years, the ratio of fiscal benefits to costs is 0.107, and the ratio of revenue benefits to costs is 0.509.

We can also calculate the critical "but for" percentages for each of these benefit ratios to exceed one. These "but for" cutoffs are 80-year benefits (45.6 percent), 10-year benefits (6.7 percent), 10-year fiscal benefits (26.9 percent), 10-year revenue benefits (7.8 percent). Again, these are calculated by choosing scenario 5 in cell B6 of the "Incentive inputs" worksheet, and then altering the chosen "but for" for scenario 5 at cell F3 until we get a "but for" that just tips these ratios to exceed one (see cells I3:L3).

Amazon HQ2 in Virginia: A Project with Both Cash Incentives and Services

To illustrate how to analyze a project with both cash incentives and various business services, we consider the Amazon HQ2 project, in Virginia. Virginia provided a cash grant for Amazon jobs created, starting out at $22,000 per year, but with payment delayed for four years after the jobs were created, to make sure jobs were maintained.[36] In addition, the Amazon-Virginia contract called for particular transportation infrastructure projects (both Metro transit and highway improvements), according to an agreed-upon schedule.

These calculations for Amazon HQ2 rely entirely on the original project plan and contract. The calculated benefits and costs assume the project exactly followed that plan and contract. Recently, there have been some delays in the Amazon HQ2 project. These delays are ignored for this report's calculations.

The input sheet "Amazon Virginia w services" shows how to deal with business service incentives, allowing for the possibility that $\$x$ of government costs for such services might have a value for the incented firm that differs from $\$x$. On this sheet, we first enter in data on the cash incentives, based on the contract, along with the jobs created (cells C2 to Q87).[37] To put a combined value on the cash incentives plus the customized transportation infrastructure spending, we then enter in infrastructure spending, by year (cells Z6 to AA23). As one possible valuation, we assume this spending has a value to the company of twice its costs (cells AC8 to AC23). We then figure out the combined value of the cash and non-cash incentives, under two assumptions: services are valued at their cost to the government; services are valued at twice their costs. We determine these costs both yearly and their present value (cells AE4 to AH29). The ratio of the present value of the combined package to the firm to its cost to the government is 1.417 (cell AH30). (See Table 5, which reproduces these calculations.)

How is a user to determine what extra value of services should be assigned? This is really a judgment call. Some studies suggest that infrastructure and other customized services to

[36] In addition, in the out years some of the cash grants per job are smaller. I used the actual Virginia Amazon contract for the cash incentive figures.

[37] We also enter in data on the projected Amazon wages paid, with wages then adjusted each year based on a combination of 2 percent inflation and 1.12 percent secular growth in real wages.

Table 5 Calculations of Value to Firm of Incentive Package vs. Value to Government, when Services Included, Virginia Amazon Project

Calendar year	Cash incentives ($)	Cost to government of services ($)	Value to firm of services (assumed = 2x costs) ($)	Total cost to government of package (cash cost plus services cost) ($)	Total value to firm of package (cash value plus services value at twice costs) ($)	PV if services valued at cost ($)	PV if services valued at twice costs ($)
2019	-	3,120,000	6,240,000	3,120,000	6,240,000	3,120,000	6,240,000
2020	-	9,204,000	18,408,000	9,204,000	18,408,000	8,073,684	16,147,368
2021	-	15,319,200	30,638,400	15,319,200	30,638,400	11,787,627	23,575,254
2022	-	11,224,200	22,448,400	11,224,200	22,448,400	7,576,015	15,152,031
2023	-	20,787,000	41,574,000	20,787,000	41,574,000	12,307,573	24,615,145
2024	8,800,000	18,345,600	36,691,200	27,145,600	45,491,200	14,098,574	23,626,704
2025	26,000,000	12,815,400	25,630,800	38,815,400	51,630,800	17,683,774	23,522,298
2026	43,200,000	17,214,600	34,429,200	60,414,600	77,629,200	24,143,929	31,023,526
2027	31,700,000	23,400,000	46,800,000	55,100,000	78,500,000	19,315,804	27,518,886
2028	58,600,000	23,400,000	46,800,000	82,000,000	105,400,000	25,215,651	32,411,337
2029	51,700,000	17,979,000	35,958,000	69,679,000	87,658,000	18,795,479	23,645,203
2030	36,100,000	28,041,000	56,082,000	64,141,000	92,182,000	15,176,875	21,811,863
2031	48,600,000	16,380,000	32,760,000	64,980,000	81,360,000	13,487,190	16,887,009
2032	66,000,000	30,420,000	60,840,000	96,420,000	126,840,000	17,555,130	23,093,681
2033	66,000,000	24,180,000	48,360,000	90,180,000	114,360,000	14,402,647	18,264,434
2034	50,700,000	23,170,000	46,340,000	73,870,000	97,040,000	10,348,927	13,594,963
2035	74,300,000	-	-	74,300,000	74,300,000	9,130,850	9,130,850
2036	32,700,000	-	-	32,700,000	32,700,000	3,525,050	3,525,050
2037	60,700,000	-	-	60,700,000	60,700,000	5,739,861	5,739,861
2038	48,200,000	-	-	48,200,000	48,200,000	3,998,111	3,998,111
2039	46,700,000	-	-	46,700,000	46,700,000	3,397,972	3,397,972
					sum	258,880,725	366,921,546
				ratio of PV with extra services value firm/PV with services valued at cost			1.417

NOTE: Based on actual Amazon contract with Virginia: Planned cash incentives, planned transport infrastructure. PV calculated based on 12% firm discount rate plus 2% inflation = 14% rate.

business, if well-designed and well-delivered, have an effectiveness to cost ratio of 5-to-1 (Bartik 2020a). On the whole, an assumption of twice the value of cash seems reasonably conservative. However, users might also want to consider setting the value of services at the same as cash, as an ultraconservative alternative.

The 1.417 cost-effectiveness figure is the value to the firm per dollar of the incentive package, which is used in the model (cell H126). Other values in the Virginia calculation include the multiplier calculated in a report analyzing the Virginia Amazon project, which is 1.89.[38] See Table 6, which reproduces the incentives data entered in cells A120 through CM208 of "Amazon Virginia w services" worksheet.

If we enter these data into the "Incentive inputs" worksheet, the calculated "but for" is 8.5 percent based on the value-added to payroll ratio, and 9.2 percent based on the value-added to FTE ratio for Amazon's industry (management of companies). The "but for" is the same for "planned" vs. "actual," as this scenario assumes the planned jobs actually occur. Using the more conservative value-added to payroll ratio, which reflects Amazon's high wages, yields a ratio of the present value of benefits over 80 years to the present value of incentive costs, 1.524. The 10-year ratio is 0.868. The 10-year ratio for fiscal benefits is 0.050, and the ratio for revenue benefits is 0.170.

The cost-effectiveness ratio does make a difference to the calculations. If we instead assume that these services are valued at their costs to the government, we get a total benefit-cost ratio of 0.824. The benefit-cost ratio declines by about 46 percent (0.824/1.524 = 0.54), which, not by coincidence, is similar to the difference in the incentive effectiveness to cost ratio (1.417 vs. 1.000).

[38] This multiplier is from Fuller and Chapman (2018), and comes from their model's assumption of 50,000 direct jobs and 44,321 indirect and induced jobs in Virginia (Table 4). Is this multiplier reasonable? These gross multipliers are based on BEA RIMS input-output multipliers. The multiplier is reduced by Amazon not having extensive local supplier networks, and increased by the assumed high average annual salary of $150,000. If the salaries in fact reach such a high average, the multiplier seems plausible. Of course, the effective multiplier is reduced by cost feedbacks, which are incorporated into the Bartik Incentive Benefit-Cost Model. The input-output multiplier just determines the initial jobs impact before negative feedback effects.

Table 6 Incentive Inputs for Virginia Amazon HQ2 Project

State: Virginia
Starting year: 2019
Multiplier: 1.886
Wage premia of incented jobs: 0.0%
Locally owned firm: 0%
Incentive effectiveness to cost ratio: 1.417
Actual assumed equal to planned
Industry: Management of companies

Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)
2019	1	400	3,120,000	76.53
2020	2	1,580	9,204,000	78.94
2021	3	3,544	15,319,200	81.42
2022	4	4,983	11,224,200	83.97
2023	5	7,648	20,787,000	86.61
2024	6	10,000	27,145,600	89.33
2025	7	11,643	38,815,400	92.14
2026	8	13,850	60,414,600	95.04
2027	9	16,850	55,100,000	98.02
2028	10	19,850	82,000,000	101.10
2029	11	22,155	69,679,000	104.28
2030	12	25,750	64,141,000	107.56
2031	13	27,850	64,980,000	110.94
2032	14	31,750	96,420,000	114.42
2033	15	34,850	90,180,000	118.02
2034	16	37,850	73,870,000	121.73
2035	17	37,850	74,300,000	125.55
2036	18	37,850	32,700,000	129.50
2037	19	37,850	60,700,000	133.57
2038	20	37,850	48,200,000	137.77
2039	21	37,850	46,700,000	142.10
2040	22	37,850	-	146.56
2041	23	37,850	-	151.17
2042	24	37,850	-	155.92
2043	25	37,850	-	160.82
2044	26	37,850	-	165.87
2045	27	37,850	-	171.08
2046	28	37,850	-	176.46
2047	29	37,850	-	182.00
2048	30	37,850	-	187.72
2049	31	37,850	-	193.62
2050	32	37,850	-	199.71
2051	33	37,850	-	205.98
2052	34	37,850	-	212.45
2053	35	37,850	-	219.13
2054	36	37,850	-	226.02
2055	37	37,850	-	233.12
2056	38	37,850	-	240.44
2057	39	37,850	-	248.00
2058	40	37,850	-	255.79
2059	41	37,850	-	263.83
2060	42	37,850	-	272.12
2061	43	37,850	-	280.67

Table 6 (Continued)

Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)
2062	44	37,850	-	289.49
2063	45	37,850	-	298.59
2064	46	37,850	-	307.97
2065	47	37,850	-	317.65
2066	48	37,850	-	327.63
2067	49	37,850	-	337.93
2068	50	37,850	-	348.55
2069	51	37,850	-	359.50
2070	52	37,850	-	370.80
2071	53	37,850	-	382.45
2072	54	37,850	-	394.47
2073	55	37,850	-	406.86
2074	56	37,850	-	419.65
2075	57	37,850	-	432.83
2076	58	37,850	-	446.43
2077	59	37,850	-	460.46
2078	60	37,850	-	474.93
2079	61	37,850	-	489.86
2080	62	37,850	-	505.25
2081	63	37,850	-	521.13
2082	64	37,850	-	537.50
2083	65	37,850	-	554.39
2084	66	37,850	-	571.81
2085	67	37,850	-	589.78
2086	68	37,850	-	608.32
2087	69	37,850	-	627.43
2088	70	37,850	-	647.15
2089	71	37,850	-	667.48
2090	72	37,850	-	688.46
2091	73	37,850	-	710.09
2092	74	37,850	-	732.41
2093	75	37,850	-	755.42
2094	76	37,850	-	779.16
2095	77	37,850	-	803.65
2096	78	37,850	-	828.90
2097	79	37,850	-	854.95
2098	80	37,850	-	881.81

NOTE: Assumed incentive inputs and jobs for Amazon project, including both cash incentives and services. This is all based on signed contract. Actual jobs and incentives are assumed to be equal to those planned under contract.

Let us now go back to assuming that the Amazon incentives have an average value compared to government cost of 1.417. If we want to determine the critical "but for" ratio, for the total 80-year benefit-cost ratio to exceed one, the cut-off "but for" is 6.7 percent. For the other ratios, the critical "but for" is 10-year total benefits (9.4%), 10-year fiscal benefits (105.8%), 10-year revenue benefits (33.8 percent). The 10-year fiscal benefit ratio is impossible—the Amazon incentives would have to somehow be responsible for directly inducing more than 105 percent of the Amazon jobs.

Michigan Economic Growth Authority (MEGA)

This analysis used aggregate data collected for a prior project (Bartik and Erickcek 2014). The aggregate data had incentives data and jobs data for a generous incentives program offered at one time by the Michigan Economic Growth Authority, or MEGA. MEGA provided refundable tax credits for up to 15 years, with the credits set equal to the state income tax liabilities of the workers at the incented projects. The MEGA program is now defunct, offering no new incentive contracts. However, the state of Michigan is still paying hundreds of millions of dollars per year on old MEGA contracts.

For the "actual data," I entered in the nominal incentives data and job creation data from this prior project, for the years 1996 to 2007. (See entries in cells N8 through R20 of the input sheet, "Mega case data.")[39] The analysis here examines what would happen if the program had ended in 2007 but remaining incentives were paid out.

To calculate what would happen if remaining incentives were paid out, I held the number of incented MEGA jobs constant at their 2007 level, and assumed that the number of incented jobs would diminish over time as the 15-year time limit was reached. This ended up projecting the incentives forward to continue until the year 2023, 15 years after the last "new jobs" were created. The projected incentives were equal to the incentives per job paid in the last year, but then adjusted up over time by both the assumed annual inflation rate (2 percent default in the model), and the assumed annual increase in real wages (1.12 percent in the model).

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[39] Note that the nominal incentives data is taken from the published paper, which is in real 2011 dollars, and is restated in nominal dollars of each year.

Based on information from the Bartik and Erickcek paper, I assigned an average nominal wage rate to incented projects in the observed years in the data, 1996 to 2007. Beyond 2007, this nominal wage rate was assumed to increase annually due to both inflation (2 percent) and real wage growth (1.12 percent).

All of this is characterized as the "actual data" to be entered into the model, although some of these data are projected based on the actual data. These data are entered into the "Mega case data" worksheet at cells A127 through E208.

These data, together with other data, allow "but for" to be calculated. I assumed that most MEGA projects were in automotive, which was apparently true, so the industry assigned was NAICS 3361-3363. I assigned the average MEGA multiplier estimated in Bartik and Erickcek , which is quite high, at 3.88. Other incentive inputs were kept at their defaults: no wage premia, incentives dollars are valued dollar per dollar by firms, no locally owned firms, all firms export-based, and firms use a 12 percent discount rate.

From these data, we can calculate "but for" using actual data in two ways: using the industry value-added per FTE ratio to calculate value-added, and using the value-added to payroll ratio to calculate value-added. We end up with a "but for" of 9.6 percent using the payroll data, and 13.7 percent using the jobs data. The former is a more conservative estimate, which reflects that MEGA projects tended to be above average wage projects for the automotive industry, as these projects were mostly in the large auto companies.

An alternative way to calculate "but for" uses the "planned data" columns to provide an alternative calculation, based on statutory rules. This alternative asks the following question: what would be the statutory maximum incentives if 10,000 jobs were created in year 1 and simply maintained? (Why use 10,000 jobs? This is arbitrary. Given the way the model is structured, it makes little difference whether we choose 10,000 jobs or 1,000 jobs or 25,000 jobs. The model is "linear" in the sense that if we blow up both jobs and incentives by the same factor, the same results will obtain.) We calculate the maximum incentives using the state income tax rates and the assumed wage rates and jobs. These "planned incentives" for this "hypothetical" planned project or program, along with these hypothetical jobs, can be used to calculate the "but for" in the same two ways, using either value-added to FTE ratios for autos, or value-added to payroll ratios for autos.[40] The estimated "but fors" for this "planned" scenario end up being 16.9 percent based on the value-added to FTE ratio, or 12.5 percent based on the value-added to payroll ratio.

Table 7 shows the incentives data from the "MEGA case data" worksheet, from A120 through CM208.[41] These show the jobs and incentives by year during the 80 years after the program began, based on either actual data or planned data.

On the whole, it is probably better to use the "actual" numbers using the payroll data. Not all MEGA projects received the full statutory incentives. Projects that received less than full incentives would have a lower "but for" than would be calculated under the planned scenario. However, it is reassuring that the "but fors" from the "planned scenario" do not grossly differ from the "but fors" from the actual scenario. This is reassuring because using the actual aggregate incentive data to calculate "but fors" assumes, among other things, that the "but for" percentages do not change over time, which might not always be the case. In addition, we need to do projections of future incentives for actual jobs, which might sometimes be inaccurate.

[40] The incentives under this planned scenario are also calculated in two different ways. One simply uses actual program data to calculate incentives per FTE. The other uses these data and program wage data to calculate incentives based on program rules. They end up being similar. The former is used when we use FTE to calculate value-added, the latter when we use payroll to calculate value-added.

[41] I omit the multiple columns where industry incented is selected.

Table 7 Selected Portions of Incentive Data Entered for MEGA Program

State: Michigan
Starting year: 1996
Multiplier: 3.88
Wage premia of incented jobs: 0.0%
Locally owned firm: 0%
Incentive effectiveness to cost ratio: 1.0
Industry: Autos

		Actual			Planned		
Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)	FTE jobs	Nominal incentives paid under program rules[a] ($)	Nominal incentives paid under program rules[b] ($)
1996	1	700	-	26.91	10,000	-	-
1997	2	1,800	906,779	27.53	10,000	16,368,304	16,001,165
1998	3	3,000	2,996,812	27.96	10,000	16,623,262	16,368,304
1999	4	5,800	5,869,591	28.58	10,000	16,990,402	16,623,262
2000	5	7,500	9,998,711	29.54	10,000	17,561,508	16,990,402
2001	6	9,800	12,937,641	30.38	10,000	18,061,225	17,561,508
2002	7	11,100	18,817,057	30.86	10,000	18,346,778	18,061,225
2003	8	13,000	21,433,900	31.56	10,000	18,764,910	18,346,778
2004	9	21,000	27,811,985	32.40	10,000	19,264,627	18,764,910
2005	10	31,100	42,912,923	33.50	10,000	19,917,320	19,264,627
2006	11	40,800	63,381,183	34.58	10,000	20,559,814	19,917,320
2007	12	62,100	81,289,238	35.57	10,000	21,145,402	20,559,814
2008	13	62,100	127,615,000	36.68	10,000	21,957,290	21,145,402
2009	14	62,100	131,625,174	37.84	10,000	21,879,171	21,809,875
2010	15	62,100	135,761,363	39.03	10,000	22,238,050	22,495,228
2011	16	62,100	140,027,528	40.25	10,000	22,940,000	23,202,118
2012	17	62,100	144,427,753	41.52	10,000	17,745,650	17,948,416
2013	18	62,100	147,287,082	42.82	10,000	-	-
2014	19	62,100	149,193,820	44.17	10,000	-	-
2015	20	62,100	150,819,756	45.56	10,000	-	-
2016	21	62,100	148,189,141	46.99	10,000	-	-
2017	22	62,100	148,230,598	48.46	10,000	-	-
2018	23	62,100	146,448,234	49.99	10,000	-	-
2019	24	62,100	147,295,629	51.56	10,000	-	-
2020	25	62,100	146,264,324	53.18	10,000	-	-
2021	26	62,100	126,280,407	54.85	10,000	-	-
2022	27	62,100	98,241,068	56.57	10,000	-	-
2023	28	62,100	69,622,276	58.35	10,000	-	-
2024	29	62,100	-	60.18	10,000	-	-
2025	30	62,100	-	62.07	10,000	-	-
2026	31	62,100	-	64.03	10,000	-	-
2027	32	62,100	-	66.04	10,000	-	-
2028	33	62,100	-	68.11	10,000	-	-
2029	34	62,100	-	70.25	10,000	-	-
2030	35	62,100	-	72.46	10,000	-	-
2031	36	62,100	-	74.74	10,000	-	-
2032	37	62,100	-	77.09	10,000	-	-
2033	38	62,100	-	79.51	10,000	-	-
2034	39	62,100	-	82.01	10,000	-	-
2035	40	62,100	-	84.58	10,000	-	-
2036	41	62,100	-	87.24	10,000	-	-
2037	42	62,100	-	89.98	10,000	-	-
2038	43	62,100	-	92.81	10,000	-	-
2039	44	62,100	-	95.73	10,000	-	-

Table 7 (Continued)

		Actual			Planned		
Calendar year	Simulation year	FTE jobs	Nominal incentives ($)	Nominal wage rate per hour ($)	FTE jobs	Nominal incentives paid under program rules[a] ($)	Nominal incentives paid under program rules[b] ($)
2040	45	62,100	-	98.74	10,000	-	-
2041	46	62,100	-	101.84	10,000	-	-
2042	47	62,100	-	105.04	10,000	-	-
2043	48	62,100	-	108.34	10,000	-	-
2044	49	62,100	-	111.74	10,000	-	-
2045	50	62,100	-	115.25	10,000	-	-
2046	51	62,100	-	118.88	10,000	-	-
2047	52	62,100	-	122.61	10,000	-	-
2048	53	62,100	-	126.46	10,000	-	-
2049	54	62,100	-	130.44	10,000	-	-
2050	55	62,100	-	134.54	10,000	-	-
2051	56	62,100	-	138.77	10,000	-	-
2052	57	62,100	-	143.13	10,000	-	-
2053	58	62,100	-	147.62	10,000	-	-
2054	59	62,100	-	152.26	10,000	-	-
2055	60	62,100	-	157.05	10,000	-	-
2056	61	62,100	-	161.98	10,000	-	-
2057	62	62,100	-	167.07	10,000	-	-
2058	63	62,100	-	172.32	10,000	-	-
2059	64	62,100	-	177.74	10,000	-	-
2060	65	62,100	-	183.32	10,000	-	-
2061	66	62,100	-	189.08	10,000	-	-
2062	67	62,100	-	195.03	10,000	-	-
2063	68	62,100	-	201.15	10,000	-	-
2064	69	62,100	-	207.47	10,000	-	-
2065	70	62,100	-	213.99	10,000	-	-
2066	71	62,100	-	220.72	10,000	-	-
2067	72	62,100	-	227.66	10,000	-	-
2068	73	62,100	-	234.81	10,000	-	-
2069	74	62,100	-	242.19	10,000	-	-
2070	75	62,100	-	249.80	10,000	-	-
2071	76	62,100	-	257.65	10,000	-	-
2072	77	62,100	-	265.74	10,000	-	-
2073	78	62,100	-	274.09	10,000	-	-
2074	79	62,100	-	282.71	10,000	-	-
2075	80	62,100	-	291.59	10,000	-	-

NOTE: As explained in text, MEGA is modeled in two ways, each with two variants. First, based on actual data, we use actual program jobs and incentives. These actual program jobs and incentives are always used to measure actual impacts of jobs and incentive costs on Michigan economy. These "actual" numbers include some projections of future incentives and jobs if MEGA had stopped at 62,100 jobs in 2007, and incented no future projects, so it omits post-2007 activity of program except for projected future incentives for actual projects. The two variants of the "actual data" are to project incented firms' value-added based only on FTE jobs or on ratio of value-added to projected payroll based on wage rates. These two variants generate two different ratios of present value of incentives to present value of value-added, which yields two variant "but for" estimates. Second, we use "planned data" to also measure "but for." These "planned data" ask what would be projected incentives under program rules for a project that always had 10,000 jobs. Both incentives and value-added here are estimated using either just FTE data, or using wage data on program. This yields two variants of "but for." This table is identical to what is found on "MEGA case data" sheet from A120 to CM208, except I omit the many rows where the model selects which industry to use in the value-added calculations.

[a] No program or firm specific wage data available.

[b] Some program or firm specific wage data available, beyond industry targets.

On the “Incentive inputs” worksheet, we choose which “but for” to use by choosing a scenario in cell B6. If we choose the lowest “but for,” the actual using payroll data, we get the summary results: overall ratio of present value of benefits to present value of incentive costs is 4.205. This is over an 80-year time horizon. If we restrict ourselves to a 10-year time horizon, the ratio of 10-year benefits to total incentive costs is 0.871. If we further restrict ourselves to only fiscal benefits over 10 years, the ratio of fiscal benefits to costs is 0.060. Finally, if we only look at the present value of increased state and local tax revenue over 10 years, we get a ratio to the present value of total incentive costs of 0.179.

But we can also assign a “but-for.” Another question we can then ask is: what “but for” is needed for each of these benefit measures to just exceed 1? We can calculate this by assigning the” but for” at the incentive input sheet by choosing scenario 5 in cell B6, and then playing around with the” but for” percentage in cell F3, and observing how the various benefit measures change (cells J3 through L3). Doing so, we find that the “cut off” “but fors” for the four benefit measures are 80-year benefits (4.0 percent), 10-year benefits (10.9 percent), 10-year fiscal benefits (136.3 percent), 10-year revenue benefits (46.9 percent).[42] The 10-year fiscal benefit “but for” percentage of 136.3 percent is obviously impossible: the incentives would have to somehow induce one-third more than the jobs incented.

[42] Note that these results are significantly less optimistic than in Bartik and Erickcek (2014), which concluded that the 12-year fiscal benefit breakeven was a “but for” of around 17 percent. This prior paper used a much simpler model which made different assumptions. Among other assumptions, this simpler model ignored the future costs of the MEGA program, beyond the period considered.

IMPACTS IN MORE DETAIL

Model users also can go beyond summary impacts, to get impacts for different income groups, for different types of impacts, or over time. These more detailed impacts should be important to: policymakers; advocacy groups, the media, and other "policy influencers"; the public. Policy judgments should not just be based on total benefits and costs, but also in part on who benefits and loses, and when such benefits and losses occur.

To illustrate the detailed outputs available from the model, we focus on the Virginia Amazon HQ2 case. The particular case we consider is the baseline where the spending parts of the Virginia incentive package are valued as providing benefits that are worth twice as much to Amazon as the costs to Virginia government.

The detailed impacts we consider are on:

- income impacts by income quintile
- job impacts by type of job effect
- job impacts over time
- income impacts by type of income
- income impacts over time.

Income impacts by income quintile. The income impacts by income quintile shows effects on the present value of income, by broad income types, for different "income quintiles." These income quintiles are derived by first ranking all households by the size of household income, adjusted for population size. Using this ranking, households are then divided into five equal population groups, with income group 1 being the lowest income group and income group 5 being the highest. According to the Congressional Budget Office (CBO) data used in the model, the share of total household income that goes to the different income quintiles is quintile 1, 5.08 percent; quintile 2, 9.24 percent; quintile 3, 13.72 percent; quintile 4, 20.00 percent;

quintile 5, 51.96 percent (CBO 2016). As is probably apparent, if household income was equal across all households, each quintile's share of total income would be 20 percent. Therefore, per capita income for the lowest income quintile 1 is roughly one-fourth the "average," the per capita income for the highest income quintile 5 is roughly 2.5 times the average, and the ratio of average income for the top quintile to the bottom quintile is about 10-to-1.

In the "Economic inputs and outputs" worksheet, income quintile effects are given in cells A79:H125. These income quintile effects are based on dividing the different types of income benefits and costs by income quintile, based on empirical studies of how these income types are likely to be divided. The types of income benefits and costs by quintile that are reported in these cells are the present value of each income type by quintile. Other worksheets show effects on each income quintile from each income type over time.

The income types considered include:

- **Net budget costs**. This includes the costs of paying for the incentives, and any net fiscal costs or benefits of the incentives and their effects.[43] Both the direct incentive costs, and any other fiscal costs or benefits, are assumed distributed similarly across quintiles.
- **Labor market benefits**. These "labor market benefits" are the effects on the local labor market of any job creation (or destruction) brought about directly or indirectly due to the incentives. This includes effects on employment rates and real wage rates of job changes. It does NOT include wage effects of cuts in education spending, which is measured separately. To avoid double counting, these labor market benefits are net of state and local tax increases.
- **Property value benefits**. The population growth brought about by the incentive-induced job growth leads to increased property values. This creates a capital gain, which over time is offset in part by increased property taxes.
- **Education cutbacks**. The incentives are financed in part by cutbacks in K–12 education spending. This is assumed to reduce future real wages of residents who stay in the state. The calculated income losses due to these education cutbacks net out reduced state and local taxes.

[43] Row 82 labels these net budget costs as positive numbers, even though the cost adds a negative amount to the benefit-cost calculation. In rows 107 and 118, net local budget costs are accounted for as negative numbers.

- **Local business effects**. Locally owned businesses may suffer losses from increased wages, land prices, and other input prices. If they sell to a local market, it is assumed that these losses are nil, as they pass on these increased costs to local consumers.[44] But if they sell to a national market, these losses must be absorbed, as prices are set based on national market conditions, not this particular local area's costs. In addition, if some or all incentives are provided to locally owned businesses, this is a gain to the incomes of these businesses' local owners. All of these losses are net of any changes in state and local tax liabilities.
- **Real value of non-labor income**. Local residents receive income from some federally funded transfer programs (Social Security, SSI) as well as capital income from ownership of stocks and bonds. The increased local prices erode the real value of this non-labor income. Based on data on the share of local spending that is likely to come from these non-labor income sources, which are almost all from sources outside the local economy, this income effect calculates the losses due to eroding real value of Social Security checks or dividend payments or capital gains. These losses adjust for the declining real value of state and local taxes that are paid on this non-labor income.

The "Economic inputs and outputs" worksheet reports the impacts on these types of income, by quintile, both in present value 2019 national dollars (adjusting future dollar flows both for inflation, and discounting real values over time), and as percentages of the total in each income category for each quintile.[45]

In Table 8, a sample of such output is shown, for the Virginia Amazon HQ2 case.[46] In this case, even though overall there are net benefits of $308.1 million—which is 52.4 percent of

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[44] These increased costs for local consumers are accounted for in the model. For example, labor market benefits consider effects on real earnings and real wages, as do the costs from education cutbacks, and the effects on the real value of non-labor income.

[45] As noted above, these income figures by type of income and by income quintile are after state and local taxes. However, these figures are not after *federal* taxes and transfers. All of these different income types are likely to affect federal tax liability as well as eligibility and receipt of federal transfers. These federal effects are omitted in part to avoid the need to construct an elaborate simulation model of the incidence of federal taxes and transfers by income type and quintile. In addition, the focus of this analysis is on how state incentive policies affect the impact on incomes of different groups, not federal policies.

In general, these federal tax and transfers are not likely to significantly affect the overall benefit-cost analysis. However, it seems plausible that the incidence across income quintiles of difference incentives would become somewhat more progressive. Qualitatively, the results from comparing either different incentive programs in the same state, or a similar incentive program in different states, are likely to show a similar ranking of incentive programs whether or not federal taxes and transfers are included or excluded.

[46] Why not show the *percent* income gain for each quintile, as a percentage of its base income? This could be done: a user could take state personal income, multiply it by the base income shares to determine total quintile

Table 8 Distribution of Incentive Benefits and Costs for Virginia Amazon HQ2 Project Across Income Quintiles, Various Types of Incentive Effects

Panel A: Present value of benefits (or costs), in millions of 2019 national dollars						
		Quintile				
	Total	1	2	3	4	5
Quintile income share (in percent)	100.00	5.08	9.24	13.72	20.00	51.96
Total net	308.1	(15.5)	26.7	106.1	(27.9)	218.7
Net local budget costs	(463.8)	(48.4)	(57.4)	(71.1)	(90.0)	(196.9)
Labor market benefits	1,036.9	123.5	177.6	270.0	138.6	327.4
Property value benefits	563.9	18.0	27.8	37.6	67.7	412.7
Education cutbacks	(361.5)	(86.8)	(79.8)	(69.5)	(63.7)	(61.7)
Local business effects	(79.7)	(1.7)	(1.8)	(2.8)	(5.2)	(68.3)
Real value of non-labor income	(387.6)	(20.1)	(39.6)	(58.1)	(75.3)	(194.5)
Pure incentive costs	(587.9)	(61.3)	(72.8)	(90.1)	(114.1)	(249.6)
Benefit-cost ratio	1.524	0.747	1.367	2.178	0.755	1.876
Panel B: Total benefits or costs as percent of total over all quintiles						
	Total	1	2	3	4	5
Quintile income share	100.00%	5.08%	9.24%	13.72%	20.00%	51.96%
Total net	100.00%	-5.03%	8.68%	34.44%	-9.05%	70.97%
Net local budget costs	100.00%	10.43%	12.39%	15.32%	19.40%	42.45%
Labor market benefits	100.00%	11.91%	17.13%	26.03%	13.36%	31.57%
Property value benefits	100.00%	3.20%	4.94%	6.68%	12.00%	73.19%
Education cutbacks	100.00%	24.01%	22.09%	19.21%	17.62%	17.06%
Local business effects	100.00%	2.12%	2.26%	3.50%	6.46%	85.65%
Real value of non-labor income	100.00%	5.19%	10.22%	15.00%	19.42%	50.17%

NOTE: Quintile income shares are in percents, and are shares of total income of everyone. Each quintile has the same population. As implied by income shares, the quintiles ranked by income go from lowest income at quintile 1 to highest income at quintile 5. In Panel A, the rows, from "Total net" to "Pure Incentive costs," give present value of the dollar benefits and costs over an 80-year period, in millions of dollars, measured in 2019 national dollars. The "total net" benefit row sums the benefits and costs from "labor market benefits" to "real value of non-labor income." "Pure incentive costs" is the direct cost of the incentives to the government. Incentive costs plus fiscal benefits (not in table) equals "net local budget costs." The benefit-cost ratio is the ratio of gross benefits to pure incentive costs. It is therefore equal to "total net benefits" divided by "pure incentive costs," plus one. For each quintile, the benefit cost ratio is gross benefits for that quintile divided by incentive costs for that quintile. Panel A in table is found in cells B114 to H125 of the "Economic inputs and outputs" worksheet of the Excel version of the Incentives Model Workbook. Panel B takes the dollar numbers from Panel A, and calculates each quintile's percent of the total over all quintiles, for each type of income. These percentages are taken from economic research on how these different income types are likely to be divided across quintiles. Panel B is found in cells B94 to H101 of the "Economic inputs and outputs" worksheet. Note that pure incentive costs are omitted from Panel B because their distribution is same as that of net local budget costs.

pure incentive costs, resulting in a benefit-cost ratio of 1.524—the lowest income quintile (quintile 1) and the second-highest income quintile (quintile 4) both have net losses. These quintiles both gain from the labor market benefits of the project and the property value benefits of the project, but these gains are outweighed by various losses: paying for the project's budget

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income, and divide the income gains (or losses) of each quintile by the quintile's total baseline income. But for a typical incentive project, or even a typical incentive program, these percentages are likely to be very small. The analysis shown here instead compares benefits or losses by quintile with both the overall incentive costs, and determines whether a given quintile gains more of less of its baseline share, either in total net effects or in effects on a specific type of income.

costs and fiscal effects; loss of wages due to education cutbacks; loss of real value of non-labor income due to higher local prices.

On the other hand, the project results in gains for the lower middle quintile (quintile 2), and even stronger gains for the middle income quintile (quintile 3) and the highest income quintile (quintile 5). For these quintiles, the gains from labor market benefits and property value benefits outweigh the various losses.

In particular, the net income gains for the middle income quintile and the highest income quintile are a greater share of overall net gains than their baseline income shares. For example, the share of net income gains that go to the middle income quintile is 34.44 percent, which is 2.5 times this quintile's base income share, 13.72 percent. A necessary conclusion is that whatever the percentage gain to overall state personal income, the percent gain to the middle income quintile will be 2.5 times greater.

This *net total* pattern by income quintile is particular to the Virginia Amazon case. This pattern reflects the degree to which the project has labor market benefits and property value benefits, for example, compared to budget costs and education cutback costs. But these types of patterns also reflect common patterns in income distribution of different income types, that occur for most incentive projects or programs for most states.[47]

These common patterns by income types include:

- **Labor market benefits** tend to be distributed progressively. In particular the percent of labor market benefits that go to each of the bottom three quintiles (quintiles 1 through 3) tend to be about twice each of these quintile's baseline income share, meaning the percent impact on each of these quintile's income, relative to the

[47] As the discussion below reflects, the progressivity or regressivity of how different types of income are distributed is related to how the quintile's share of that income type effect is divided by the quintile's baseline share of total income. This comparison dictates the relative percentage effect on income of a quintile of the change in that income type. For example, if x percent of the effect on some income type goes to a given quintile, and that quintile's baseline share of total income is y, and x is twice y, then the observed income effect on that type of income has twice the percentage effect on that quintile compared to the average percentage effect of that income type on all quintiles' income.

quintile's baseline income, is about twice the average impact. In contrast, although the two top income quintiles 4 and 5 do get labor market benefits—in fact the highest income quintile has the highest dollar benefits of all the quintiles—their gains are a lower share of the pie than their baseline income share, meaning that their percentage gain in income from labor market benefits is below average.

- **Property value benefits** are distributed highly regressively: over 70 percent of property value benefits go to the highest income quintile, which is greater than their approximately 50 percent baseline share of total income.
- **Net local budget costs**, from both incentive costs and netting out any fiscal benefits (or costs), tend to be distributed modestly regressively, with the share of costs paid compared to baseline income going up steadily as we go from upper income to lower income quintiles.[48]
- The lost wages due to **education cutbacks** are distributed highly regressively. The dollar losses are similar across income quintiles, based on research suggesting that education has similar dollar benefits for children from different income groups. As a result, the shares of this income loss that hurts lower income groups is higher than these groups' baseline income share of total income, which directly implies that the loss as a percent of baseline income is much higher for lower income groups.
- The decline in **real value of non-labor income** due to higher local prices, which causes costs for all groups, is distributed roughly proportional to income, so although it is potentially an important income loss, it does not much affect the income distribution.
- **Local business effects**. Any effects on local business income, positive or negative, are distributed mostly to the highest income quintile, which disproportionately makes up local business owners. In the present case, these local business effects are net costs, from higher local input prices for some local businesses that sell to a national market, and as a result these costs tend to increase the progressivity of the income distribution effects, by disproportionately costing the top income quintile. But in other cases—for example if incentives were provided to locally owned businesses—local business effects would be on net positive, and this would tend to have a regressive effect on the income distribution by disproportionately benefiting the top income quintile.

Therefore, the pattern of results for the Virginia Amazon HQII case—net costs for the bottom income quintile and second-highest quintile, net benefits for the lower-middle and middle quintiles and the top quintile—reflect this case's distribution of income effect types. The lowest

[48] The distribution of fiscal costs across quintiles does vary by state, depending on its tax system design. However, most states have state/local tax systems that are at least modestly regressive; that is, taxes as a percent of income tend to be greater for lower income quintiles.

income quintile loses because of a combination of several factors: the regressive distribution of the costs from paying for the incentives and the education cutbacks; this income quintile not gaining much in property value effects, and losing more from the role of higher property values in pushing up local prices and eroding the real value of transfer income; these negative factors are not outweighed by labor market benefits. The lower-middle and middle income quintiles (2 and 3) gain because they still have very strong labor market benefits, and their losses from education cutbacks and budget costs are not quite as disproportionate as for the bottom income quintile. The second-highest income quintile loses because its gains from labor market benefits are less, its gains from property value benefits are not particularly large, and these gains both end up being outweighed by the costs of paying for incentives and education cutbacks, as well as the costs of higher local prices for the real value of transfer and capital income from outside the local area. Finally, the top income quintile gains because it has huge property value gains, and some significant labor market benefits, which outweigh the various costs. Furthermore, while education cutbacks also hurt this top income quintile, their losses are a more modest share of the overall education cutback effects than this quintile's baseline income share.

This pattern of results suggests several things. First, for each incentive benefits vs. costs simulation, the relative benefits by quintile will be quite sensitive to the relative magnitude of these different types of income effects. For example, if labor market benefits are much greater because the net cost per induced job are lower, or because multiplier effects are greater, this will tend to skew benefits more toward the bottom three income quintiles. As another example, if property value benefits are higher because the area has very high restrictions on new housing development, which pushes up housing price effects, then benefits will be skewed more to the highest income quintile, which gains the most from such higher property values, while other quintiles lose more from the loss in real value of fixed nominal transfer and outside capital income. As a third example, if education cutback benefits are less, because the incentives are financed by lesser cuts in spending on K–12 education, then net benefits will tend to be more progressive. All of these conclusions reflect that although different incentive programs in different states will have different relative effects on different income types, for a given income type, the distribution of effects on that income type across income quintiles will be similar for most incentive projects or programs and for most states.

Second, the distribution of benefits will also vary within each income quintile, depending on an individual family's receipt of these different types of income. The income quintile numbers provided in the model are the averages for persons in each income quintile; however, income quintiles are not homogeneous, and there will be a lot of variation within any given income quintile in receipts of different income types. For example, if a family within any of these quintiles is retired, their labor market benefits are likely nil, and they may lose more from their retirement income being eroded by higher local prices. If a family within these income quintiles does not own any local property, its property value benefits are nil, but if it happens to own a more valuable home than average for its quintile, its property value benefits will be higher than average for that quintile. Education cutbacks will cause larger costs for families with more children versus families with fewer or no children.

Job impacts by type and over time. As implied by the above discussion, incentives have both a direct job impact—some percent of the incented jobs are actually induced by the incentives; that is, would not have existed "but for" the incentives—and a variety of indirect job impacts. The most commonly discussed indirect job impacts are those due to multiplier effects: the incented jobs that are actually induced will lead to more jobs in local suppliers to those induced jobs, and the extra demand from workers at both the directly induced jobs and the supplier jobs will increase jobs in local retailers. But there are also other indirect effects, which tend to be negative: local job reductions because the directly induced jobs plus multiplier jobs will increase local costs; local job reductions because paying for incentives, via higher state and local taxes, or lower state and local public spending, will have negative demand-side and supply-side effects on local jobs. Finally, of the net jobs created, only a modest portion go to local residents.

As shown in Table 9, the impact of job creation on local residents depends on all these factors: what percent of jobs are induced, the size of the multiplier effect, how much costs go up and therefore how many other jobs are reduced, how incentives are financed and what this does to jobs, and finally, what percent of net jobs created go to local residents. The high net present value of incented job years, 886,050, reflects that the Virginia Amazon project gradually increases over time to 37,850 jobs in a particular year. Only 8.5 percent of these incented jobs would on average be expected to be due to the incentive.[49] For this particular project, with a modest multiplier, the multiplier effect almost doubles the job impact, from 75,417 job years to 140,115 job years. But then higher overall prices, and higher real wages, lowers other jobs in job-year terms by 55,340 job years (equals 4,290 due to higher real wages, plus 51,050 due to overall increases in local prices and nominal wages). In addition, paying for the incentives by increased taxes, including increased business taxes, and reduced public spending, including reduced K–12 spending, will have negative demand-side and supply-side impacts that reduce job

[49] The best interpretation of this is not that Amazon would have cut back its project by 8.5 percent without the incentives, but rather that the project would have an 8.5 percent chance of not happening at all, and a 91.5 percent chance of happening unaltered, if the incentives had not been provided. Or alternatively, if the incentive had not been provided, there is a 91.5 percent chance that the same jobs would have been provided by some other businesses.

Table 9 Present Value of Different Types of Job Impacts

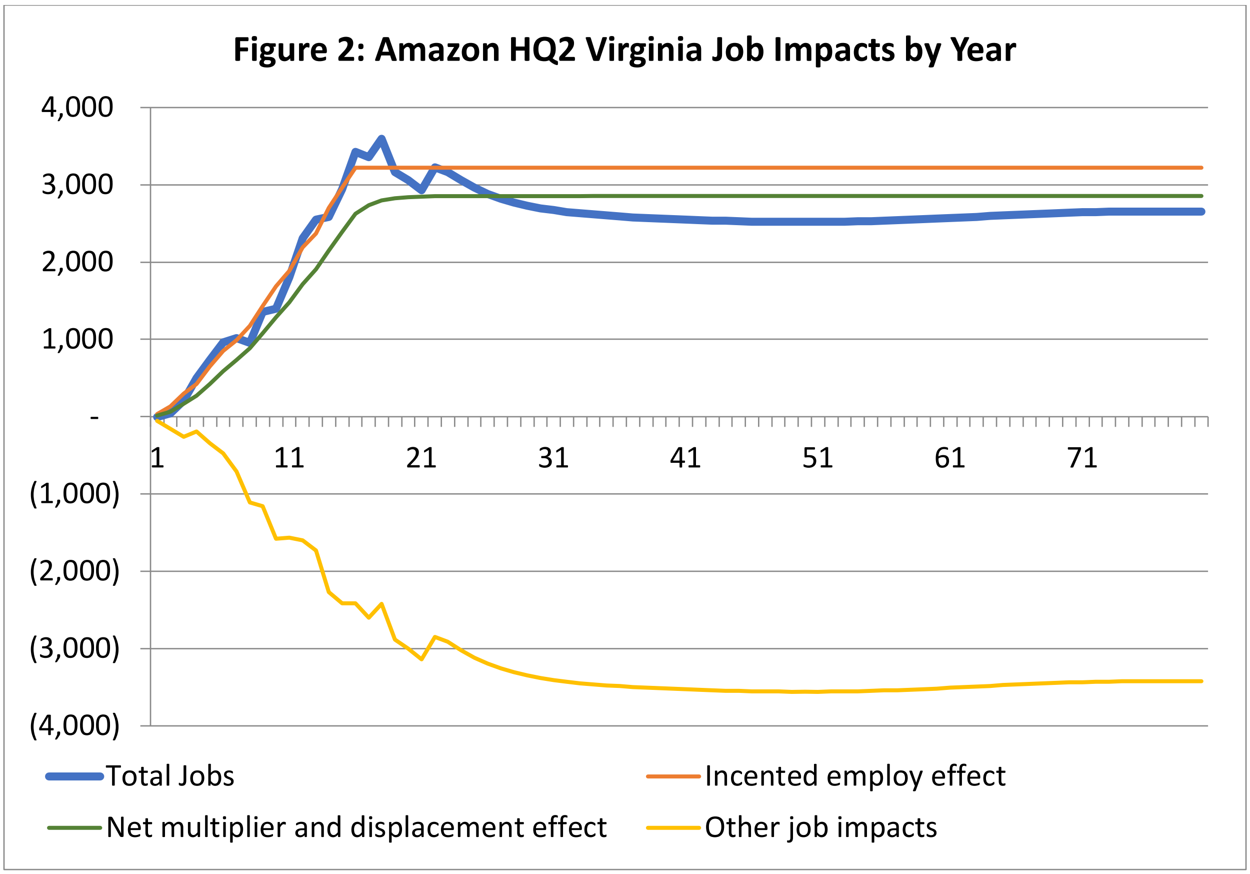
		As percent of incented jobs' present value
Present value of incentive costs	$(587.9)	
Present value of job years of incented jobs	886,050	100.0%
PV of induced jobs ("but for" jobs) in incented firms	75,417	8.5%
PV of induced jobs plus multiplier jobs	140,115	15.8%
PV of lost jobs due to increased real wages	(4,290)	−0.5%
PV of lost jobs due to higher property values & other local costs	(51,050)	−5.8%
PV of jobs lost due to D-side impacts of public spending cuts	(6,095)	−0.7%
PV of jobs lost due to D-side impacts of tax increases	(2,008)	−0.2%
PV of jobs lost due to S-side impacts of business tax increases	(5,045)	−0.6%
PV of jobs lost due to lower earnings because of K–12 ed spending cuts	(4,660)	−0.5%
PV of jobs gained from local incentives	0	0.0%
PV of net jobs (induced plus multiplier minus offsets)	66,967	7.6%
PV of net jobs that go to local residents	**8,950**	1.0%
PV of net increased earnings for local residents (after taxes) due to increased employment to population ratios	$764.1	

NOTE: The job entries in this table are the present value of job years, calculated for the 80 years after the project starts. This present value is calculated by taking job effects in each of the 80 years, and discounting future job years back to the project start year at the social discount rate, whose default value in the model is 3 percent. Each row isolates a given type of job effect. The dollar entries given are present value dollars as of project start, in 2019 national dollars. Numbers are from Table E1 of "Economic inputs and outputs" worksheet.

years by 17,808 (equals sum of 6,095 due to demand-side impacts of public spending cuts, 2,008 due to demand-side impact of higher taxes, 5,045 due to supply-side impacts of higher business taxes, and 4,660 due to reduced future wages because of K–12 spending cuts). Overall, these negative reductions, in this particular case, more than offset all the multiplier effects, resulting in net job creation of 66,967 job years, less than the originally induced jobs of 75,417. Of these 66,967, only 13.4 percent go to local residents, or 8,950 job years.

Not all these jobs are created right away. The time lag occurs in part because the Amazon jobs increase over 16 years. In addition, the other job effects are somewhat lagged from the induced Amazon jobs. Multiplier jobs in suppliers and retailers do not instantly appear. The demand-side impacts of paying for incentives are assumed to occur quickly, but the supply-side effects of higher business taxes take some time to evolve. Even longer-term negative effects occur because of lower K–12 spending, which affects former K–12 students as they enter the workforce, and have lower wages, which reduces jobs.

In the Excel workbook, data on the timing of various categories of job creation—and destruction—are presented in cells A152:K233 of the "Economic inputs and outputs" worksheet. A visual representation of this is in Figure E1 on that sheet, reproduced below as Figure 2. The "net multiplier and displacement effects" reflect the input-output multiplier effects, plus the negative effects on business job-creation that occur through the resulting higher local prices and wages. The "other job impacts" reflect the negative effects of the incentive financing. As one can see, the blue "total jobs" impacts, after considering all these impacts, in the long run end up being somewhat below the direct jobs created, the orange line.



As Figure E1 also shows, most of the positive effects occur in less than 20 years. Then the negative effects emerge further over time, and reach their maximum after about 40 years or so, when most of the former K–12 students have reached their prime earnings years.

Income Impacts by Type and Over Time

The model also allows for a more detailed analysis of types of income effects and how they evolve over time. The quintile analysis had broader income types, but these can be broken out further.

Table 10, taken from the Excel workbook's Table E3, shows the income type effects for more detailed income types. The table entries show effects in millions of present-value 2019 national dollars, and as a percent of the present value of incentive costs.

This type classification in Table 10 does a number of more detailed breakdowns. *Net budget costs* are broken down into incentive costs, state and local revenue gains, increased state and local spending needs, and gains from exporting business taxes. (The latter gain is from the portion of business taxes levied on out-of-state business owners, whose income changes are not counted in this model, which only looks at income effects for state residents.) *Labor market benefits* are broken down into gains due to higher employment rates, higher real wages from demand-side pressures, and possible wage changes if the incented jobs pay a wage premium relative to skills required. (Amazon jobs are not assumed to pay such a wage premium.) *Higher property value* effects are broken down into net capital gains (net of higher property taxes), and losses due to higher property values and their effects on other costs pushing up local prices, which reduces the real value of non-labor income.[50] *Education spending cutbacks* have large

[50] Real labor income is assumed to adjust based on how demand shocks affect real wages, but there is no force that automatically adjusts transfers or capital income from outside the state based on what happens to local prices.

Table 10 Present Value of Different Income Types, Amazon Virginia Project

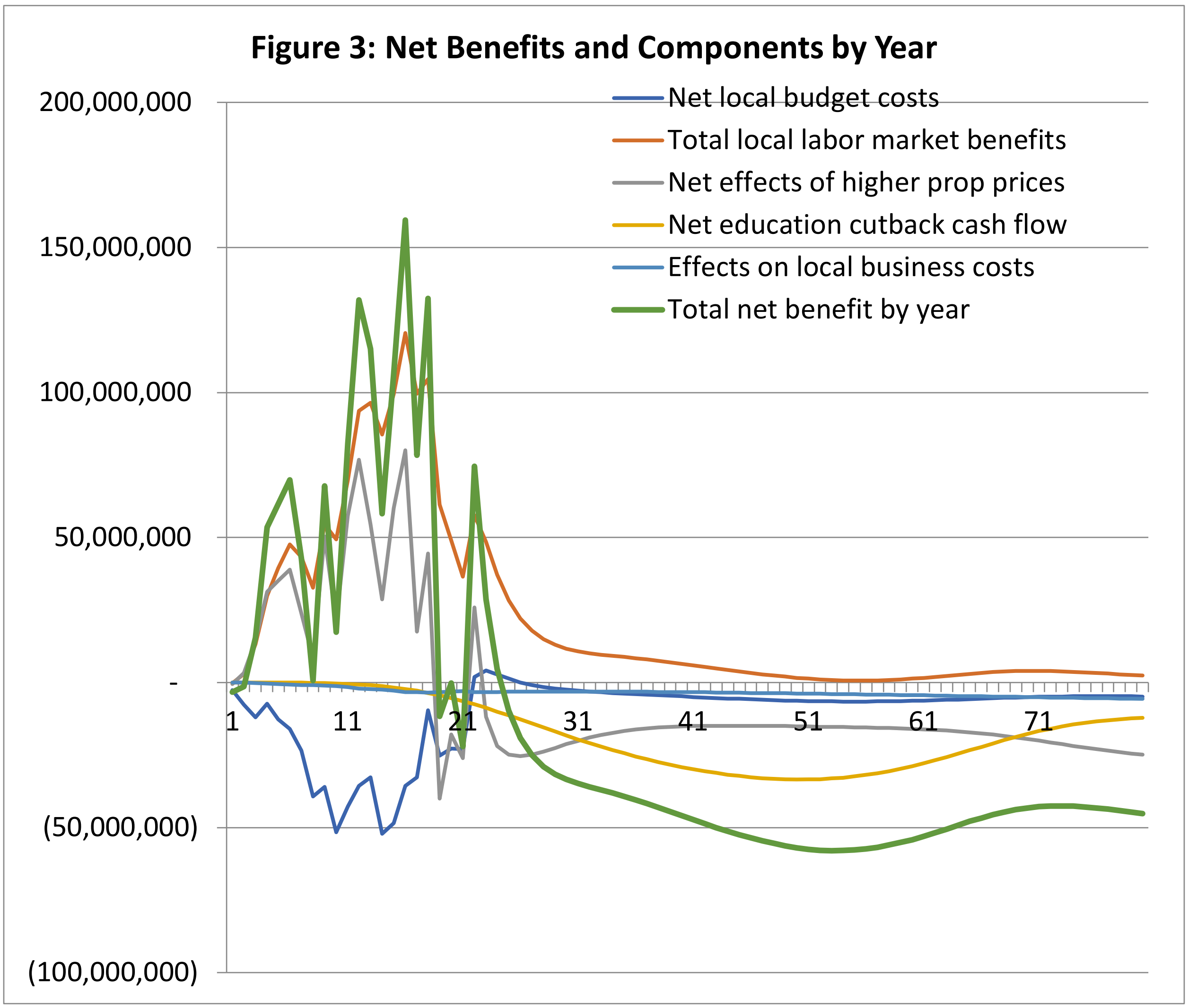
			As a % of cost
Present value of incentive costs	(587.9)		−100.0%
PV of fiscal benefits	39.3		6.7%
PV of st&local revenue gain	2,035.9		
PV of st&local increased spending needs	(1,996.5)		
PV of exported business taxes	84.7		14.4%
Subtotal: Net PV of local residents' incentive costs (incentive costs + fiscal benefits + exported business taxes)		**(463.8)**	**−78.9%**
PV of net earnings (after taxes) due to higher employment to population ratios	764.1		130.0%
PV of net wage increases (after taxes) due to higher employment to population ratios	272.9		46.4%
PV of net wage increases (after taxes) due to wage premia on incented jobs	-		0.0%
Subtotal: PV of labor market benefits from higher net earnings (after taxes) for local residents		**1036.9**	**176.4%**
PV of net capital gains, after increased property taxes, due to increased property values, for local property owners	563.9		**95.9%**
PV of reduced non-labor real income due to higher local prices	(387.6)		**−65.9%**
Subtotal: PV of direct and indirect effects of higher prop prices		**176.2**	**30.0%**
PV of net wage loss (net of lower taxes) due to education spending cutbacks		**(361.5)**	**−61.5%**
PV of lower net after-tax profits for locally owned businesses due to higher wages	(4.6)		−0.8%
PV of lower net after-tax profits for locally owned businesses due to higher prices of local real estate and associated higher costs of other local inputs	(75.1)		−12.8%
PV of higher after-tax profits for local businesses receiving incentives	-		0.0%
Subtotal: PV of total effect on net after-tax profits for locally owned businesses		**(79.7)**	**−13.6%**
Net local income effects summing all effect types		**308.1**	**52.4%**
"Benefit-cost ratio": (Net benefits plus incentive costs)/(incentive costs)		1.524	

NOTE: Figures on left are generally in millions of present value 2019 national dollars, except for benefit-cost ratio. Negative numbers in parentheses. Figures on right are dollar values as percent of present value of incentive costs. This table is from Table E3 of "Economic inputs and outputs" worksheet.

negative effects on future real wages. The model only counts those lower real wages for former K–12 students who stay in the state. *Profit effects on locally owned businesses* are broken down into losses due to higher real wages and higher other costs, as well as possible gains if the incentives are provided to locally owned businesses (which does not occur in the Amazon case).

As this analysis suggests, these "net impacts," which result in net benefits of 52.4 percent of incentive costs, or a benefit-cost ratio of 1.524, reflect a variety of positive and negative effects. The gross distributional flows of benefits and costs to different groups are high relative to incentive costs.

We also can look at how these benefits occur over time. On the "Economic inputs and outputs" worksheet, these annual benefits by income type are shown in Table E4, in cells A260 to A345. Figure 3 (from Figure E3 on the worksheet) breaks down the benefits by type of benefit over time.



For this particular project, labor market benefits by year and total benefits are maximized around year 16. But then various costs occur, due to negative effects of higher costs on other jobs, and the negative effects of education cutbacks. From year 25 on, net benefits are negative.

HOW BENEFIT-COST RATIOS VARY WITH PROJECT INPUT VARIABLES AND ECONOMIC INPUT VARIABLES

To illustrate the power of the model's flexibility—and the importance of project/program characteristics and local economic context—we now see what happens to benefit-cost ratios if we change different input variables. The starting point is the model of Amazon HQ2 in Virginia. As already described above, given baseline assumptions about the project, and Virginia's economic characteristics and various assumed economic elasticities, the overall 80-year benefit-cost ratio for this project is 1.524—the project's net benefits, therefore, are 52.4 percent of the present value of the incentives that Virginia provided to Amazon.

Table 11 shows how the benefit-cost ratio of Amazon HQ2 in Virginia changes if we change different input variables. We consider 16 possible changes, put into three groups: 1) changes in project/program characteristics, 2) changes in assumptions about the local economic context and local hiring, and 3) changes in assumptions about how the project is financed and some of the dynamics of financing. For most of these changes, we change one variable at a time from the baseline for this Virginia Amazon project; other input variables are kept at their baseline values. In a few cases, we show the effect of one change and then add on a further change.

First, we consider what happens to benefit-cost ratios if the Amazon project had somewhat different characteristics but was otherwise the same—same package of incentives, same size of the proposed facility, etc. If the baseline multiplier is increased from 1.89 to 2.50—

Table 11 How Benefit-Cost Ratios Vary with Different Project/Program or Economic Setting Input Variables, Illustrated Using Amazon HQ2 Virginia

Baseline	Amazon in Virginia, baseline assumptions	1.524		
Different Project/Program Assumptions				
	Multiplier increased from baseline of 1.89 to 2.50	2.315	Wage premia of incented firm increased from 0 to 10%	4.122
	% local ownership changed from zero to 100%	2.934	Incentive effectiveness to cost ratio changed from 1.417 to 1	0.824
	% incented firm export-base changed from 100% to 0	−0.929		
Different Local Economy and Hiring Assumptions				
	Prime-age employment rate lowered by 5 percentage points for all 80 years	2.644	Local unemployment rate increased by 5 percentage points for all 80 years	1.474
	Housing price elasticity increased from Virginia's 0.801 to California's 1.285	1.112	Property tax rate increased from Virginia's 0.84% to New Jersey's 2.13%	3.074
	Labor force participation rate elasticity in response to labor demand increases doubled from baseline 0.137 to 0.274	2.792	Employment to labor force elasticity in response to labor demand increases doubled from baseline 0.475 to 0.950	2.099
Different Financing Assumptions				
	Financing changed from 50% tax increases to 100% tax increases	2.415	Financing changed to 100% tax increases, all of which is increased business tax	2.684
	Financing changed from 50% spending cuts to 100% spending cuts	0.471	Financing changed to 100% spending cuts, all of which are cuts in K−12 spending	−10.640
	Financing 100% from K−12 spending cuts, but cut earnings effects of K−12 in half and assume no education spillovers	0.134	Expenditure elasticity in response to population increases changed from 1.0 to 1.1	0.952

NOTE: All changes take Amazon project in Virginia, and only change the input variables described. Before doing next change, all input variables changed back to baseline values.

a value that would be plausible for some manufacturing projects in states with strong manufacturing supplier networks, or for some high-tech projects with strong agglomeration economies—the benefit-cost ratio increases from 1.524 to 2.315. The benefit-cost ratio increases by a somewhat higher percentage than the multiplier increases, as the multiplier increase not only increases the initial jobs impact, but various feedback effects augment the initial multiplier boost to benefits.

Returning the multiplier to 1.89, we now consider whether the Amazon project was assumed to pay a "wage premium" of 10 percent. By wage premium, we mean not whether the wage paid by Amazon is high, but whether it is high relative to the educational credentials and other characteristics (e.g., work experience) of the workers hired. This boost increases the benefit-cost ratio from 1.524 to 4.122. In the model, providing incentives to firms that pay well is all benefits and no costs, increasing all the labor market benefits in the model by quite a bit, as well as boosting fiscal benefits by boosting state personal income more.

Suppose we "incented" a project similar to Amazon HQ2, but that the firm was locally owned. This increases the benefit-cost ratio to 2.934. Benefits go up in part because locally owned firms, under the model's assumptions, have a higher local multiplier. In addition, the incentive's benefits for the firm's owners are now counted as a benefit in the model, as the owners are local residents whose income changes are counted in the model's benefit-cost calculations.

As previously discussed, this report's model of the Virginia incentives to Amazon HQ2 assumed that the transportation infrastructure that was part of the incentives package had a value to Amazon of twice its costs. As a result, the overall incentives package has a firm value to government cost ratio of 1.417. Suppose instead we assumed that the infrastructure spending part of the Virginia Amazon package only had a value of $1 to Amazon per dollar of government costs. In that case, the benefit-cost ratio for the Amazon project is reduced from 1.524 to 0.824.

Amazon is properly assumed to be an export-base firm, whose services are sold to national and international markets. But supposedly the same package of incentives was provided to service firms of similar size, but ones that were selling their services exclusively in Virginia. In that case, the benefit-cost ratio declines to −0.929. Any positive effects of the incentives on the location/expansion decisions of non-export-base firms will displace other firms, and the cost of paying for the incentives has negative effects on the local economy.

We now turn to considering changes that focus on the characteristics of the local labor and housing markets, and how these markets are assumed to respond. Suppose that we reduce the prime-age employment rate by 5 percentage points, for each of the 80 years, from what the model assumes for Virginia over the next 80 years. This might be relevant, for example, in more economically distressed local labor markets than is true for Virginia. Under this assumption, the benefit-cost ratio increases from 1.524 to 2.644.

We can also go back to the baseline prime-age employment rate, but assume that the local unemployment rate, for all 80 years of the simulation, is higher by 5 percentage points. This has little effect, changing the benefit-cost ratio from 1.524 to 1.474. A higher unemployment rate will increase the effects of demand shocks on the employment to labor force ratio but reduce the effects of demand shocks on real wages.

Suppose the housing price elasticity is increased from Virginia's 0.801 to 1.285, which is the estimated effects of population shocks on California's housing prices, presumably due to California's greater restrictions on housing supply. This change lowers the benefit-cost ratio to 1.112. More of the effects of local demand shocks become capitalized into higher property prices, which produces some beneficial capital gains, but also raises local costs and lowers the job growth of other firms.

Suppose the local property tax is higher than Virginia's 0.84 percent and is instead at New Jersey's high rate of 2.13 percent. This increases the benefit-cost ratio to 3.074. More of the capital gains are captured as fiscal benefits and used to reduce other taxes and raise spending, including spending on productive K–12 education.

We can also imagine that policies are adopted to increase local hiring effects of local demand shocks. Suppose that these policies increase the labor force participation rate response to a labor demand shock, at a baseline prime-age employment rate of 81.0 percent, from 0.137 to 0.274, a doubling. Increasing labor force participation rate responses implies that local workforce policies, with both the incented firms and other firms, are highly successful at helping the "hard-core non-employed" to enter the labor force and work. Such a successful "inclusionary" employment policy is estimated to increase the benefit-cost ratio from 1.524 to 2.792.

Suppose instead we assume that policies can increase the employment to labor force elasticity with respect to demand shocks, at the baseline unemployment rate of 6.2 percent, from an elasticity of 0.475 to 0.950, another doubling. This only increases the benefit-cost ratio to 2.099. Such policies only boost the employment of the unemployed who are still looking for work, and who therefore are still engaged in the labor market, which explains the lesser effect of this policy option.

Finally, we consider the effects of different ways of paying for the incentives package. The baseline assumes that incentives are paid for 50 percent by tax increases and 50 percent by spending cuts. The model also assumes that the portion of tax increases that are business tax increases are the state's baseline share of business taxes in total state/local taxes, and that the baseline state/local share of spending cuts that are K–12 spending is at the currently observed percentage in that state. In the model, all tax increases and spending cuts have demand-side effects, and business tax increases and K–12 spending cuts have extra supply-side economic effects.

If we increase the share of incentive spending that is tax financed from 50 percent to 100 percent—that is, there are no spending cuts—then the benefit-cost ratio increases from 1.524 to 2.415. In the model, the demand- and supply-side effects of spending changes exceed those of equivalent dollar-value tax changes.

If we have not only 100 percent tax financing but also 100 percent financing by increased business taxes, then the benefit-cost ratio further increases to 2.684. Although business taxes do have some negative supply-side effects, such business tax increases have the advantage, from the perspective of a state's residents, of exporting much of the financial cost of incentives to out-of-state residents who own businesses that operate in the state. This "tax exporting" benefit exceeds the costs to the state of some reductions in local job growth from higher business taxes.

Suppose that rather than 100 percent tax financing, we assume that incentives are financed 100 percent by cuts in state and local government spending. This lowers the benefit-cost ratio to 0.471. As already mentioned, government spending in this model has higher demand-side and supply-side effects than government taxes.

Suppose we further assume that not only are incentives financed by cuts in government spending, but that rather than 23 percent of those cuts being cuts in K–12 spending (Virginia's baseline share for K–12), 100 percent of those cuts are cuts in K–12 spending. For example, one can imagine incentive programs that are paid for by property tax abatements granted by school districts, with no reimbursement of these abatements by the state government. In this model, spending on K–12 is highly productive, which is supported by research by Jackson, Johnson, and Persico (2016) and Moretti (2004). As a result, if incentives are financed by only cutting K–12 spending, the benefit-cost ratio is reduced from 1.524 to *minus* 10.640. In this model, cutting K–12 spending is highly damaging to state and local economic development.

If users believe that research supports a lower value of education spending, they can alter these effects. Suppose we cut the long-run earnings effects of K–12 spending to half that found by Jackson, Johnson, and Persico (2016). Suppose we further eliminate any Moretti-style "agglomeration economy spillover effects" of higher local human capital on overall local productivity. Then the benefit-cost ratio of financing this incentive project by K–12 spending cuts will increase from *minus* 10.640 to 0.134. In this model, one has to lower education productivity quite a bit from some prior research for K–12 incentive financing not to be a very bad idea.

Finally, we can consider the effects of different assumptions about how state and local government spending "needs"—what is needed to keep public service quality constant—from the baseline assumption, which is an elasticity of 1.00: a 10 percent increase in state population increases needed public spending by 10 percent, to keep public service quality constant. Suppose we assume the elasticity was 1.10—10 percent more population requires an 11 percent boost in public spending to keep public service quality constant. This slightly tweaked assumption lowers the benefit-cost ratio from 1.524 to 0.952. The model is sensitive to what one assumes about economies of scale in state and local public services. One can imagine that in a booming area, with plenty of congestion and existing strain on services, some quite costly infrastructure improvements might be required to keep public service quality constant, and so an elasticity of 1.10 might be plausible. In contrast, in an area that has experienced recent economic decline, and which therefore has excess capacity in public infrastructure and services, an elasticity of less than 1.00 for needed public spending increases, in response to population increases, might be plausible.

As this discussion shows, the benefit-cost ratio for economic development incentives varies greatly, depending on the assumptions about the project details, the local economic context, and the program's financing. But this should not be interpreted as meaning that a model user can get whatever result they want. The variation with details of the project and program reflects a reality about incentives and local economies: local economic impacts of incentives vary a great deal with the details of the incentive program in its local context. This variation is not a license to assume whatever one wants. The model user has a great deal of power to vary program details—but, as the saying goes, with great power comes great responsibility.[51] Model users should be careful to accurately describe the program and its local context, and not just arbitrarily alter assumptions. For example, if a model user wants to assume a greater effect of job shocks on local labor force participation rates, the model user should be prepared to justify that the program actually will have such greater effects.

HOW BENEFITS VARY BY STATE

Because the benefits of an incented project vary with different characteristics of the state—the state's labor market and housing conditions, the state's fiscal structure—a project with the same characteristics, if placed in different states, will have a different benefit-cost ratio.

To illustrate this, consider the Amazon HQ2 project in Virginia and the Michigan MEGA program. We can take the Amazon project, which begins in 2019, and the MEGA program, which began in 1996, and place them in each of the 50 states plus D.C. We keep all project characteristics constant—the same incentive package, the same number of jobs, the same industry mix, the same multiplier, etc. But the state context is different. Some states have more non-employed workers available, which affects what proportion of the jobs go to local residents versus in-migrants. Some states have more "elastic" state and local tax systems, which affects the fiscal benefits from an incented project or program.

Table 12 shows the results. As the table shows, benefit-cost ratios for both programs vary greatly across the states. The ratio of benefits to costs frequently varies by two- or three-times

[51] I think this goes back to Spiderman, but apparently even the U.S. Supreme Court has quoted this.

Table 12 How Benefit-Cost Ratios for Incentives Vary for the Same Projects across States

	Amazon HQ2	MEGA		Amazon HQ2	MEGA
Alabama	3.812	4.788	Missouri	2.428	3.061
Alaska	3.198	3.371	Montana	1.405	1.624
Arizona	2.729	3.631	Nebraska	0.827	0.874
Arkansas	3.667	4.230	Nevada	2.092	2.935
California	2.597	3.366	New Hampshire	1.038	1.382
Colorado	1.056	1.496	New Jersey	2.537	3.999
Connecticut	1.487	2.572	New Mexico	4.744	5.605
Delaware	3.181	3.995	New York	3.365	4.607
District of Columbia	1.911	2.895	North Carolina	3.719	4.218
Florida	2.020	2.378	North Dakota	1.040	0.715
Georgia	3.484	4.149	Ohio	3.156	4.122
Hawaii	1.676	1.795	Oklahoma	3.946	4.499
Idaho	1.777	2.162	Oregon	2.303	2.926
Illinois	2.472	3.319	Pennsylvania	2.419	3.393
Indiana	2.325	3.118	Rhode Island	1.737	2.497
Iowa	1.305	1.320	South Carolina	2.611	3.183
Kansas	1.508	1.951	South Dakota	1.000	0.885
Kentucky	4.248	5.139	Tennessee	2.666	3.467
Louisiana	3.114	3.730	Texas	3.910	4.552
Maine	1.540	1.634	Utah	1.286	1.623
Maryland	1.687	2.193	Vermont	1.315	1.220
Massachusetts	1.426	2.082	Virginia	1.524	1.806
Michigan	2.818	4.205	Washington	2.050	2.616
Minnesota	0.702	1.072	West Virginia	4.433	5.968
Mississippi	3.000	3.772	Wisconsin	1.216	1.508
			Wyoming	1.461	1.419

NOTE: This shows how the ratio of gross benefits for costs varies if we take the 2019 Amazon Virginia HQ2 project and the 1996 begun MEGA program in Michigan and place them in the same year (2019 or 1996) in the various states. The incentives paid and the jobs incented are identical.

costs or more. For example, for Amazon, the benefit-cost ratio varies from a high of 4.744 in New Mexico to a low of 0.702 in Minnesota. For MEGA, the benefit-cost ratio varies from a high of 5.968 in West Virginia to a low of 0.715 in North Dakota.[52]

The pattern of variation across states is similar. The correlation between a state's Amazon benefit-cost ratio and its MEGA benefit-cost ratio is 0.969.

To help explain the results, we ran a regression of the Amazon benefit-cost ratio on various determinants. In this regression, by far the most important determinant was the prime-age employment rate. The coefficient implies that a 5 percent reduction in the prime-age

[52] The mean and standard deviation in the sample are 2.333 (1.032) for Amazon, 2.923 (1.314) for MEGA.

employment rate will on average increase the benefit-cost-ratio by about one.[53] This is roughly consistent with the prior section, but adds the additional result that as a practical matter, variations in prime-age employment rates across states are sufficiently large to make a sizable difference to incentives' benefit-cost ratios.

This result also suggests that benefit-cost ratios for different locations within a state are likely to vary significantly, as local labor markets within states frequently have variations in the prime-age employment rate of 5 percentage points or more (Bartik 2022).

CONCLUSION

This User's Guide has outlined a new and improved version of a simulation model of an incentive project or program's benefits and costs. This model is useful to both policy evaluators and policymakers in two ways.

First, this simulation model provides estimates of benefits and costs that are a) available for a wide variety of benefits and costs for a wide variety of groups, and b) adaptable to different assumptions about how the economy works and different local economic circumstances. Estimates are provided for gains to different types of income (e.g., labor market benefits, property value gains) for different groups (e.g., income quintiles, local business owners) and over any time period up to 80 years. Model users can alter the model to reflect different assumptions about how firms make decisions and how the economy operates (e.g., how much firms respond to incentives, how firms respond to higher real wages), as well as different local

[53] Specifically, if we regress the Amazon benefit-cost ratio for 51 state observations on several possible determinants, including the ln(prime-age employment rate), the resulting coefficient estimate is −21.60 with a standard error of (2.15). The standard deviation of ln(PAER) in this sample of 51 is 0.057, so a 5 percent reduction is a little less than a one standard deviation change. See Appendix E for complete regression results.

economic circumstances (e.g., how tight the local labor market is, how state and local revenues respond to economic shocks). The wide range of both benefits and costs considered, and different assumptions and circumstances accommodated, means that evaluators and policymakers can answer more questions about incentive effects and how and why they vary. Policymakers with different political views may weight these different effects differently—for example, some policymakers may place more emphasis on effects on lower income groups.

Second, this simulation model not only shows the benefits and costs of one particular incentive program or project, but also allows exploration of how incentive reforms can improve their benefit-cost ratios. For example, the model shows that if incentives can achieve a higher "but for" per dollar—for example, by focusing more on high-value customized services—the benefit-cost ratios increase. If incentives can lead to job growth that goes to more nonemployed local residents—for example, by targeting distressed places with low employment rates—then benefit-cost ratios increase. Policy evaluations that show how incentive design and local circumstances affect benefits naturally lead to ideas for policy reforms.[54]

As research proceeds, this model will be updated to include how benefits vs. costs are determined by additional features of incentives or the local economy. The model provides a framework for seeing how new research on regional economic policies can be integrated into our current understandings. With improved understanding, our hope is that economic development policies can be improved. The goals are to help improve the job quality and incomes of all Americans, from all groups, including traditionally disadvantaged groups.

[54] In addition to the policy variations explored in this report, other incentive policy variations are described in the prior report on this model (Bartik 2018, 2019).

Appendix A

Using Aggregate Data as if the Aggregate Represented One Firm

The paper claims that aggregate program data can be used to model the effects of incentives. The claim is that this can be done by treating the aggregate program data as if it were data from one firm. Specifically, we need aggregate program data on jobs incented, and all incentives paid, by year. From treating this as one firm, these data can be used to calculate a "but for" ratio and program benefits versus costs. The claim is that this gives the same result as what would be obtained if instead these aggregate data were disaggregated to individual firm data.

Why is this valid? Suppose we have only two firms in the program. One firm generates J_1t_1 new jobs at time t_1, receives incentives whose present value at that time period is S_1t_1, and has a value-added whose present value is V_1t_1. The other firm generates J_2t_2 new jobs at time t_2, receives incentives whose present value is S_2t_2, and value-added is V_2t_2.

Let's first consider under what circumstances it is valid to simply aggregate across the two firms to calculate "but for." For small incentives, the "induced" jobs—the proportion of the new jobs generated by these firms that were only generated because of the incentive—will be some constant R times the ratio of the present value of incentives to the present value of value-added. So created jobs are $C_1t_1 = J_1t_1 \times R(S_1t_1 / V_1t_1)$, and a similar equation for firm 2.

Now, the ratio S to V will be the same if we instead discount to some other time period, time period 0. So, if we discount both to the same time period, the combined "but for" for both firms is

(1) $(C_1t_1 + C_2t_2) / (J_1t_1 + J_2t_2) = R \times [J_1t_1 \times (S_1t_0 / V_1t_0) + J_2t_2 \times (S_2t_0 / V_2t_0)] / (J_1t_1 + J_2t_2)$

Suppose the firms have similar ratios of value-added to jobs, or $V_1t_0 / J_1t_1 = V_2t_0 / J_2t_2 = K$.

Then we get

(2) $(C_1t_1 + C_2t_2) / (J_1t_1 + J_2t_2) = R \times (S_1t_0 + S_2t_0) / [K \times (J_1t_1 + J_2t_2)]$

But the expression in the denominator is just the combined value-added, so the combined "but for" simply takes the ratio of the sum over the two firms of incentives, and the sum over the two firms of value-added, both in the same time period, and multiplies it by some response rate.

Now, this calculation assumes that it is irrelevant at which time the jobs are generated, which isn't quite true. In other words, it is assuming that if C_1t_1 / J_1t_1 and C_2t_2 / J_2t_2 differ from each other, this is irrelevant. If both firms are generating jobs at the same time, it is irrelevant, but if they are at different times, it is relevant. The time series of when jobs are generated will differ if these percentages are different.

Therefore, if the jobs are generated at different times, in order for this calculation to be valid, the "but for" percentages at the different times have to be similar. But if the program is similarly structured and serves a similar group of firms, this assumption holds. On the other hand, if the program's structure differs—the incentives are paid out over a different schedule or are differently sized or go to different industries—the "but for" would usually be different.

One should note that ideally, the incentive calculations by year should be complete for the jobs that are included. In other words, they should not omit any incentives that are due but not yet paid. Otherwise, the calculations are understating the incentives that will be paid for the jobs in all years. This is likely to mean that latter years will understate "but for" and understate costs. The biases here go in opposite directions but may not exactly cancel out.

What about benefits vs. costs? Suppose that the benefit-cost ratio at time $t1$ for firm 1 is a linear function of the jobs created and the present value of incentive costs, divided by the present value of incentive costs. A similar equation will apply to the benefit-cost ratio at time t_2 for firm 2. Then each of these ratios will be the same if discounted to time period t_0. And we will get the same ratio by aggregating them together as long as the benefit-cost ratio for each of the two firms is the same.

Under what circumstances will the benefit-cost ratio be the same over time? Generally, if the characteristics of the incentive program, and of the economy, do not change much over time. As for the first variable, if we're analyzing the program as one program, it is not unreasonable to think that the program is similar over time in features affecting benefits versus costs, such as how much the program uses cash versus services, how up-front the cash incentives are, and the multiplier of the incented firm. With respect to the economy, the local fiscal structure, which affects state and local revenue responsiveness, also tends to be similar over time. Finally, although local labor market conditions may change over time, the most important local labor market condition is the prime-age employment rate, which for a geographic unit tends not to change drastically over time. The prime-age employment rate would change over time if the state program targeted different local economies with dramatically different employment rates.

In sum, aggregate data on a program can be used as if there was just one firm under the following condition: if we're willing to assume that the program had a similar design and similar industry and geographic targets over time. If the program changed drastically in these features over time, disaggregated data that reflect these different program features should be used.

Appendix B

Outline of Key Changes from 2018 Incentive Simulation

This 2022 Bartik Model is adapted from a prior model described in Bartik (2018), and then extensively used in Bartik (2019). The key differences between the 2018 Model and the 2022 Model are:

- The 2018 Model's goal was to illustrate how plausible incentive benefits and costs varied with different assumptions about how state economies worked and how incentives were designed; the 2022 Model's goal is to provide a practical tool that can be used by evaluators of an individual state's incentive programs.
- Therefore, the 2018 Model looked at the impact of an "average" incentive program in a generic average state and in an average export-base industry. In contrast, the 2022 Model has 51 variants, one for each state plus D.C. The 2022 Model also allows the user flexibility in how the incentive project or program is structured, and flexibility in what industry or industries represent the targets of the incentive project or program.
- In addition, the 2022 Model makes a few methodological improvements over the 2018 Model, reflecting some new research as well as some rethinking of how the simulation model is structured, to make the model more complete and realistic.
- Finally, the 2022 Model is structured to highlight not only 80-year total benefits of the incentive project or program, but also shorter-term 10-year benefits, as well as only fiscal benefits or revenue benefits. These shorter-term and narrower benefits may be of interest to many policymakers. Such benefit measures were produced in the 2018 Model, but were not highlighted for users.

This appendix documents other changes made in the model, compared to the 2018 model. This appendix will make more sense for those who have access to the Excel workbook model, as it refers to various worksheets. It documents both the changes made, and some of the data uses, and has some thoughts on how the model's data could be further updated in the future.

Depreciation. On the "Economic inputs and outputs" sheet, I eliminated depreciation of jobs after 20 years. This depreciation assumed that without further incentives, induced jobs would begin going away after 20 years. In the new model, it is up to the user to decide whether, after the incentive period, the jobs that were incented tend to grow, decline, or stay the same. A "neutral" assumption is to assume that on average, these jobs stay the same. On the other hand, it is arguable that firms in a state will tend over time to receive incentives for MAINTAINING jobs. But this decision to pay incentives for maintaining jobs could be argued to be a separate policy decision, to be analyzed separately.

Incentive inputs and "but for" calculations sheet. As mentioned in the main text, the revised model added an "Incentive input" worksheet that allows users: Nominal incentives by year, FTE jobs by year, and (if available, average wages per FTE in nominal dollars). These are entered as both *actual* (if actual data are available), and *planned* (which can be used even if actual data are available).

Also as already measured in the text, the user needs to input, what is the industry the incentives are in, or what is the weighted average of industries? So, these are a set of industry weights that sum to one. If the inputs are for an aggregate program, these weights represent actual or planned mix of incentive jobs by industry. If the inputs are for an individual project, the weights will be 1 for the industry of the individual project and zero for all other industries.[55]

These data in turn are converted to 2019 real incentives and 2019 real wage payroll by industry using regional price parities data by state from BEA, which goes back to 2008. Also use CPI-U data, which I download back to 1990. The raw data on this are in separate worksheets (labelled "RegPrices state2008-19 BEA" and "CPI-U BLS"), and are downloaded from BEA and BLS. For going back to 1990, I assume regional price parities are same as in first year of data. For years going forward: I assume 2 percent annual inflation, and 1.12 percent growth in real wages.[56] These are input variables for the user to enter. I also assume regional price parities stay

[55] However, the weights are the same for planned inputs versus actual inputs. But if users want to evade this limitation, they can calculate the "but for" using planned inputs and one set of weights, and then use a different set of weights in a second run, but imposing the "but for" from the prior iteration of the model.

[56] Respectively, J27 and G27 on the "Economic inputs and outputs" (EIO) worksheet.

the same. The 1.12 percent comes from 2020 Social Security Trustees' Annual Long-Run Assumptions. https://www.ssa.gov/oact/TR/2020/2020_Long-Range_Economic_Assumptions.pdf. The 2 percent annual inflation assumption is arbitrary but comes from Cleveland Fed long-run inflation expectations. https://www.clevelandfed.org/en/our-research/indicators-and-data/inflation-expectations.aspx.

For updates: a user could download CPI and regional price parities data and sub-out the assumed years going forward, replacing with actual data, or even modifying the forecasts beyond actual data.

The user indicates state (B120 on "Incentive Inputs" (II) worksheet) and starting year (B121 on II) on this "Incentive inputs" data sheet. This in turn pulls up years 1 through 80 of the simulation and uses the regional price parities and CPI data that is appropriate for that state and starting year. The starting year is the first year of the incentive program data, or the first year of the project being considered.

I also have added sheets that download real value-added by industry nationally (Sheet "real VA by ind BEA"), FTE by industry nationally (Sheet "FTE by ind BEA"), and compensation bill by industry nationally ("Comp by ind BEA" sheet). The last is in nominal terms. I cut and paste in the actual data downloaded from BEA on these items to separate worksheets, which are labeled to represent what data they contain. On those separate sheets, I adjust the real value-added by industry to 2019 prices using the GDP price deflator. I adjust the wage bill by industry to 2019 prices using the CPI on these sheets. I then calculate the ratio of real value-added in 2019 prices by industry nationally to FTE, and the ratio of the real value-added in 2019 prices to real compensation in 2019 prices for all years from 1990 to 2110. The backcast years assumes that these backcast years grew at 1.12 percent, as do the forecast years.

The 1.12 percent is entered on the "Incentive inputs" sheet, and then carried over to these other sheets. For updates, a user could download these data and sub-out assumed years with actual data. The real value-added per FTE is entered on the FTE download sheet from BEA (below the downloaded data, on worksheet "FTE by ind BEA"). The real value-added to wage payroll data is calculated on the wage payroll download sheet from BEA (below the downloaded data, on the "Comp by ind BEA" worksheet). The real value to wage payroll data assumes that this ratio stays the same, backcasting and forecasting, as the last observed year, for each industry. These worksheet calculations are then copied and linked to on the "Incentive inputs" worksheet, on the matrix whose diagonal elements are CV11 and JY137.

This particular model assumes that for export-base industries competing in a national market, using national figures are best for determining value-added versus FTE, and that if one has project-specific wage data, doing ratio of value-added to payroll is alternative to just using ratio of value-added to FTE.

More details on MEGA calculations sheet. As discussed in the main text, in order to illustrate how to use historical program data, I use data from Bartik and Erickcek (2014) on Michigan's MEGA program. This provides some data on the MEGA program.

The data reported in the paper was in 2011 real dollars, and ran from 1996 to 2007. To make this comparable to the type of data that users will commonly have, I reconverted this to nominal incentive dollars per year.

To use these data in the simulation model, we need to decide what happens to the jobs that received incentives and the incented jobs after the observed period. First, I decide to just consider these created jobs and their future, not jobs newly aided after 2007. I assume the 62,100 jobs that had received some aid by 2007 would continue indefinitely.

As for incentive amounts: the Bartik-Erickcek paper also says that MEGA incentives typically began with a one-year lag, and then continued for a total of 15.75 years. So, I assume that the incentive dollars reflect last year's jobs, and that the ratio of the two represents average incentive costs per job. I assume that the change in the number of jobs represents new jobs added that year, and that new jobs are incented in the following year, and 15 years after that. Finally, I assume that incentive costs per job in nominal terms, after the first period, increase by the sum of the assumed inflation rate (2 percent) and the assumed growth in real wages (1.12 percent) per year. These assumptions allow me to project forward incentive amounts associated with these 62,100 jobs.

For the MEGA calculations to work, we have to calculate a value-added per job by year for the MEGA program. We do not now have these data. (The data used in the Bartik and Erickcek project was used just for that project, and was then destroyed as confidential data, per an agreement with MEDC.) But we do know that 49 percent of the credits were in motor vehicles, and so it's not a bad assumption to simply act as if all the jobs were in that industry. Most of the other credits were in other similar manufacturing industries.

From "Incentive inputs" sheet to "Incented employ effect" sheet and "Incentive costs" sheet, and other changes. Compared to the old model, instead of the incentive inputs and job inputs and "but for" inputs coming from the master "Economic inputs and outputs" page, they come from this "Incentive inputs" sheet. Cell B12 on the "Incentive inputs" sheet allows the user to put weights on actual versus planned incentive costs and jobs to be entered into the model to determine impacts.[57] Cell B6 on the "Incentive inputs" sheet assigns whether the "but for" is

[57] This is not mentioned in the main text discussion of the "Incentive inputs" worksheet, as I strongly recommend users keep the default of using actual incentives and actual jobs to predict impacts. Predicting the "but for" is another matter. When predicting "but for," there often might be strong reasons for using planned or hypothetical data, not what actually occurred.

calculated using either actual or planned data, or using wage data or not, or simply assigning a but for. An arbitrarily chosen "But for" can be entered at cell F3. These options are the four mentioned above, plus an arbitrarily chosen but for. (This allows the user to check to see how results vary if the "but for" is arbitrarily varied from 5 percent to 10 percent to 15 percent to 20 percent to 25 percent, etc. In particular, the user can see what "but for" is required for the project or program to have a benefit-cost ratio of 1.0 or higher.)

The jobs inputs go to the "Incented employ effect" worksheet page, in column E. We also add the actual year info to column C. The "but for" used goes from the incentive input page to the "Incented employ effect" worksheet, cell B7.

The incentive costs in the new incentives input page goes to the "Incentive costs" worksheet, column AD, the baseline regime. All the other regimes are not used, and are not part of this version of the model. We also add an actual year column.

For the "Incentive inputs" worksheet, we use the average VA per FTE, and VA per Payroll in the weighted industry to calculate average wages per FTE in the targeted industry. This is then used in the "wage premia" sheet. Also, we redo the "Incentive inputs" sheet so that it has a wage premia input, which is used to drive the "Economic inputs and outputs" worksheet. This seems more logical—the wage premia is an economic parameter of the incented jobs. I also put the multiplier there as well, as part of the "package," not the economy. I put the incentive effectiveness to cost ratio here as well. On the other hand, the firm sensitivity parameter is part of the economic assumptions on the "Economic inputs and outputs" page.

I redid the "Economic inputs and outputs" worksheet to add two rows at the top that designate the "State" and "Starting year." This is linked to from the "Incentive inputs" page, and then links to other pages what year and state this is, which then selects which data are used on various pages.

I redid the “Net of taxes benefits” worksheet so that for benefits for local owners, the various Harberger triangles are calculated using the variable number of jobs incented and the change in jobs. These are in cells around CA86 and below on that webpage.

On the “Incentive costs” sheet, I linked the material starting around AK11 with AD11 and below, as it turns out numerous other worksheets link to AK11, and this avoided any need to re-create all these links.

At the “Incentive inputs” worksheet, and the various “project case” or “program” worksheets, the incentives data and jobs data are entered consistently from cell A120 to cell CM208. This then allows these case pages to be just copied from these project or program worksheets into the analogous range of cells on the “Incentive inputs” worksheet.

The data entered in at this range, bounded by cells A120 and CM208, includes:

1) multiplier;
2) industry vector;
3) state and starting year;
4) incentive effectiveness to cost ratio;
5) whether firm is locally owned;
6) extent to which firm is export based;
7) vector of actual jobs, and actual incentives paid, and actual nominal wage rate paid (if available);
8) vector of planned job, planned incentives if no data on specific wage of project or program is known (other than industry), planned incentives with program or project-specific wage data. Also, program-specific wage data planned, if available;
9) vector of nominal wages paid, if available.

These data will be calculated above in a case sheet for the incentive, and then this will be cut and linked into the “Incentive inputs” worksheet. Also, the state and starting year will go to the “Economic inputs and outputs”. Other outputs such as “but for” also go to the “Economic inputs and outputs” worksheet.

The purpose of this is to allow easy updating of stuff: just create a new incentive page, and then update the main link. To do so, each input page for a specific program, after doing calculations, needs to create an input matrix defined by Cells A120 through CM208. Then simply copy this and paste it as a link on the “Incentive inputs” worksheet.

The worksheet “Template for incentive inputs” provides a template. Simply enter in the data in the appropriate cells, and then copy and link into the analogous cell range from A120 through CM208 in the “Incentive inputs” sheet.

One note on industry mix: one option in choosing industries is to choose “export base,” which is manufacturing plus the 12 other export base industries from Bartik (2017a). All ratios are calculated from the raw BEA data for this database. The numbers are added up for each year from 1998 to 2019 to get ratios to FTE. This implicitly allows the precise industry mix within this 31-industry aggregate to vary over this time period. As with other nominal variables, the variation before 1998, from 1990 to 1998, is assumed to vary with CPI ratios and with a 1.12 percent secular real growth rate. After 2019, these ratios grow at sum of 1.12 percent plus assumed annual inflation of 2 percent.

Labor market condition variables.[58] For unemployment and prime-age workers: I obtained figures for prime-age employment rate by state from 2007 through 2019 from Pew: https://www.pewtrusts.org/en/research-and-analysis/articles/2020/08/20/state-employment-recovered-unevenly-from-last-recession. Their figures in turn were derived from CPS Monthly files, compiled over 12 months.

[58] This section discusses a number of regressions done to generate the numbers. Users are not expected to duplicate these. The Upjohn Institute will periodically update the model to reflect new information.

To go back to 1990, I took data from BLS on employment rates and unemployment rates by state from 1976 through 2020 https://www.bls.gov/lau/rdscnp16.htm. I then estimated two regressions, each with state fixed effects, for the sample period of 2007 through 2019 for all 50 states. The first one estimated the effects of ln(*ER*) (overall employment to population ratio) on ln(prime-age employment rate) for each state—this is essentially tracking how prime-age employment rate varies with employment rate. The coefficient is 0.7863 with a standard error of 0.0221; that is, the t-stat is over 30. The R-squared is about 0.66. So, I use this to project prime-age employment rate to other years. I do so by taking the last observed values of prime-age employment rate (2007 and 2019), and projecting forward and backwards based on the observed changes in the overall employment rate

As for DC, which is not reported in Pew, from my prior research, DC has a 0.1 percent higher employment rate than Maryland, so I assume that this holds throughout the period.

For filling in other years, from 2021 forward, I use the model's assumptions about how unemployment adjusts, as well as some estimates for how the prime-age employment rate adjusts to unemployment. The model in its original form assumes the unemployment rate adjusts at 10 percent per year to an unemployment rate of 4.5 percent. This is controlled on the "Economic inputs and outputs" worksheet. I keep this control, and carry this over to an input page for the unemployment rate and the prime-age employment rate (the worksheet named "UnRate&PAEmpRate"). I also change this to assume an adjustment to an unemployment rate of 3.0 percent, which I assume is closer to true full employment. I also increased the adjustment rate to 20 percent per year, which I think is more realistic than 10 percent per year.

The Upjohn Institute will periodically update these numbers for state prime-age employment rates and unemployment rates as new figures are released. Users may also enter in updated data on the sheet "unRate&PAEmpRate" in column AC, or in columns Q and R.

As for the prime-age employment rate: Using the 50-state sample from 2007 to 2019, and regressing ln(prime-age employment rate) on ln(1 − unemployment rate) yields a coefficient of 0.9799 with a standard error of 0.0273; that is, the t-stat is well over 30 and the R-squared is 0.665. This reflects that prime-age employment rate may change less than the overall employment rate in response to unemployment, in part due to prime-age workers being less unemployed and this variable being less responsive than overall. This input is controlled on the "UnRate&PAEmpRate" sheet, with column AB using this formula to predict prime-age employment rates beyond what is observed.

This is all to address that I am now going to have the prime-age employment rate drive the labor force participation rate baseline adjustment, which occurs on the worksheet labeled "LFP." Given the adjustments defined here, a place that is below average in its prime-age employment rate due to a temporary recession will adjust more to a normal level, but places with more persistently low prime-age employment rates will not fully adjust back to the national average.

In usage: users ideally should supply prime-age employment rate and unemployment rate numbers by local labor market, depending on where the project is located.[59] This can be done for all areas using the five-year averages of the ACS for the prime-age employment rate and the unemployment rate for each county in the United States, and then aggregating the counties into

[59] Alternatively, with aggregate program data, if the jobs incented and incentive dollars paid are reported by county, then the analysis can treat the data for each county as a separate program and use county-specific labor market conditions.

local labor markets. This will allow current numbers to be used going forward, and then the user can use the adjustment factors to see how this will adjust over time. For larger areas, the one-year averages can be used to get individual year numbers from 2008 forward. The ACS from 2007 needs adjustments to be more comparable to the CPS: See https://www.census.gov/content/dam/ Census/library/working-papers/2012/demo/Gottschalck_2012FCSM_VII-B.pdf.

Calculating the prime-age employment rate requires some mechanics using the ACS, as this is not directly reported. See endnote 11 in Bartik (2020b).

The initial labor force participation elasticity at different prime-age employment rates is calculated by taking the raw elasticities from Bartik (2023) of my long-term demand paper. These elasticities are after 16 years, and are adjusted to initial elasticities by dividing by the assume proportion of the initial elasticity still present at year 16 based on the population's average out-migration and mortality. (See text and Appendices C and D for a discussion of these depreciation rates.) I adjust the prime-age employment rate by adding to its log the logarithmic difference of 3.4 percent higher employment rate at the mean. I then do a regression with an R-squared of 0.999 (not surprising) that predicts the elasticity given the prime-age employment rate (PAER). I then create a specification where the user gets to choose the baseline elasticity at a typical PAER, and also gets to specify a sensitivity with respect to the PAER. These inputs can be altered on the "Economic inputs and outputs" worksheet. The baseline elasticity the user gets to choose also modifies the sensitivity so that the overall elasticity at all values of the PAER gets blown up or shrinks by the same percentage.

Compensation per FTE. The model uses the average real compensation in 2019 dollars per FTE over the 80-year period in some of the worksheets to calculate how much changes in employment rates and percentage changes in wages affect real earnings per capita. To get this, I downloaded data on wage and salary employment for all states from BEA from 1990 to 2019. I also downloaded data on total compensation for all states as well for the same years. I calculated the ratio of the two. I then projected this forward to the years 2020 through 2110. The projection from 2019 to 2020 uses the actual CPI change (about 1.2337 percent) and 1.12 percent real growth. The projection from 2021 to 2110 uses 2 percent annual inflation and 1.12 percent real growth. I then use the "Incentive inputs" sheet to choose the state and starting year and pull off the relevant 80 years for that state. These 80 years are then adjusted to real national dollars using the BEA relative price index for the state previously entered, and the national CPI. They are then adjusted to compensation per FTE using the national ratio of FTE to employment for those years, with this ratio carried forward and backwards from the observed years. These calculations are on the worksheet labeled "BEA Comp by state&year."

Property values. From Saiz (2010), I took his elasticities of housing supply for metro areas. I took the multiplicative inverse of these to get the elasticity of housing prices with respect to shocks to population. I then calculated a population weighted (using entire MSA) average for each state of these multiplicative inverse averages. New Hampshire, Alaska, and Hawaii were missing. I set Alaska and Hawaii to U.S. weighted average. I set New Hampshire to the average (unweighted) of Maine and Vermont. These calculations are done and then resorted on two worksheets labelled with Saiz.

In actual evaluations, users should ideally use the elasticity of housing prices from the particular metro area of the specific project.[60] Alternatively, if the data come from a program, the program's incented jobs and incentive costs should be disaggregated by local housing market.

[60] Saiz's elasticities by metro area are available at the sheet "Saiz elasticities w state."

Each local housing market should be treated as its own program and use the appropriate housing price elasticity for that local housing market.

The property value section was then redone. From BEA, I downloaded household property values, corporate real estate values, and non-corporate real estate values, the last in both total, and the portion specifically for residential (e.g., landlords). I took an average of the end of quarter numbers that were appropriate and got values for 1990 to 2020. I converted to 2019 national real values using CPI-U. I then divided by population to get per capita numbers. I assumed from 2020 to 2110, the values grew at 1.12 percent, the overall national growth rate of the real economy. I then downloaded regional *rental* price parities for each state from 1998 to 2019. I divided each state's numbers by the national number. I then assumed that this same relative regional rental price could be projected to years before 1998 and years after 2019. I then adjusted this up or down to reflect different property values.

On the "real estate values" worksheet, real property values per capita were used, rather than real property values per FTE. To generate property value increases due to incentives, what drives these property value increases is the population increase predicted from the "Demographic calcs" worksheet.

The calculation of cost changes was modified. I now enter in direct rental costs as a cost (column AC in worksheet "Property&cost&price changes"). I count this for all local businesses, as I am counting all business costs and not just costs for export-base businesses. Then I infer wage increases. The required wage increase is equal to the estimated increase in prices due to rents times the labor share of after-tax total spending, based on CBO. (See column AE on "Property&cost&price changes.") The total increase in business costs from higher property values is the sum of these two variables (see column AG on same worksheet).

The direct increase in housing prices is the sum of direct effects on homeowner equivalent rent and apartment rental prices. These increases in "rental prices" are based on the increase in property values, multiplied by an assumed ratio of annual rents to property values.

For the "Emp feedback from wages and prop" worksheet, I modified this to reflect GSP per FTE for all activity, including government. Government employment may also respond to increased costs and should be included.

For this same employment feedback worksheet, I want real value-added per FTE for each state. But how to do real? The state real numbers the BEA uses gather nominal compensation by industry and use this in part to get nominal value-added. Then the Census uses industry-specific price indices at the national level to get real GDP. But I don't think this is right. The real labor input will not be given by this calculation, given that there will be state-specific wages given state-specific prices. In addition, I am measuring costs given national price trends and state adjustments to prices. So, I think I should be consistent in how real GDP is measured at the state level, compared to how it is measured elsewhere in the model.

To use a consistent procedure for real GDP, since I go back to 1990, I use nominal GSP at the state level from the SIC from 1990 to 1996. I use the ratio of NAICS GSP to SIC GSP for each state in 1997 to adjust upward the SIC numbers by state. I then convert the nominal state GSP numbers to real numbers by using regional price parities and the CPI-U. I then calculate real GSP per FTE using state employment numbers and national ratios of employment to FTE. All of these calculations are done on the worksheet "BEA VA by State&Year."

Addition to 2018 model. In thinking about the 2018 model, one asymmetry in the 2018 model is that property value increases only really have one side. I allow this to affect firm costs, but that is only one dimension. Now, for earnings, the assumption is that real wage adjustments are such that we don't have to worry about earnings. But what about non-labor income?

From looking at the CBO income distribution data from 2013,[61] it appears that most capital income should be exogenous to the local economy, with the exception of business income. And it looks like all except Medicare and Medicaid should not adjust to local prices—I assume these adjust. So, if one includes the capital and transfer income that does not adjust to local prices, it appears that about 26 percent of local income (equals all income minus federal taxes) does *not* adjust to local prices. So, one needs to multiply the dollar increase in local prices (derived above in calculating local nominal wage increases) by this amount to get a loss in *non-labor* income, both capital and transfers.[62] This is then allocated across income quintiles roughly proportionately to income, as capital income is distributed regressively and transferred progressively, and the sum ends up being distributed roughly proportional to baseline income.

Overall, the negative effects of higher local prices on the real value of fixed income from non-local sources ends up offsetting most but not all of the increases in local income from higher local property values. Not all property is owned locally, so that reduces the gain from higher local property values. The gain from higher local property values also is reduced by higher local property taxes. Local prices only erode the real value of a portion of local income, that which comes from external sources, such as national transfer and capital income, which is not indexed to local prices. But the feedback effects of higher local wages end up multiplying the local property effect on overall local prices. The net result is that the losses from higher local property values for local residents almost offset the gains for local residents. Furthermore, as property

[61] I use this older data only in part because I used it in the prior model. The old model sorts by income after transfers. The newer CBO reports sort by income before transfers. The former seems preferable.

[62] This calculation is done in columns AJ of "Property&cost&price" worksheet, based on the local price increase in column AH.

ownership is concentrated in the highest income quintile, and non-local income sources are roughly proportional to baseline income across quintiles, the highest income quintile tends to have a net gain from the overall influence of higher property values, whereas the other quintiles tend to have a net loss.

I also added in some demand feedback from this lowering of real value of non-labor income. This is added on the quintile sheet for non-labor income ("Dis price effect nonLY by quint" sheet), as it uses CBO data that show percent of income that goes to the bottom 90 percent at about 62 percent or so. I lag this one year to prevent complications: your real income is eroded by higher prices, and you adjust to that next year.

Demand feedback. I adjusted the Zidar (2019) and Suárez Serrato and Wingender (2016) numbers in the 2018 model from 2015 national numbers to 2019 national numbers. See worksheets labeled "Zidar calcs" and "Serrato calcs."

The Serrato numbers are simply entered into the "Economic inputs and outputs" worksheet, at cell G5. The Zidar calculations in 2019 national dollars are $45,178. However, I assume that his calculations apply in 2019 for a state that has the average for taxes on the bottom 90 percent of income through non-income taxes. His estimates are for the effects of federal tax changes by state. Such federal tax changes will *not* be taxed under state personal income taxes. However, implicitly taxes such as sales taxes and property taxes at the state level will be imposed on these federal tax changes. As his estimates pool states, they reflect the average state's tax rate in these non-personal taxes on the bottom 90 percent. This average non-personal tax rate on the bottom 90 percent is calculated at cell J202 of the sheet "ITEP calculations." Cell J204 on the same sheet calculates this for 2019 for the state we're considering. We then multiply the Zidar 2019 national cost per job created by tax changes on the bottom 90 percent by the ratio

(1 − J202) / (1 − J204). That is, we assume that the cost per job created or destroyed by state tax changes will be slightly lower if the state tends to have lower non-personal taxes than the national average, and slightly higher if the state has higher non-personal taxes than the national average. For example, if the state raises its income taxes slightly to pay for incentives, the impact of this on local jobs will be smaller if the state tends to have higher sales taxes and other taxes on state residents' incomes. This ratio on the "ITEP calculations" sheet at J205 is linked to cell J35 on the "Zidar calcs" sheet. This is then used to adjust the national figure of $45,178 at cell E33 on the "Zidar calcs" sheet to a state-specific figure at cell E37 on the same sheet. Cell E37 then dictates the content of G8 on the "Economic inputs and outputs" sheet.

Whatever the 2019 numbers are for costs per job created from spending and tax changes, these are adjusted by 1.12 percent per year to other years in the model.

ITEP. I entered in all the ITEP (2018) income and tax rate figures, and used these to figure relative tax rates by quintile that are state specific. The 2018 model had used average state figures for the nation. However, the ITEP numbers that are used are the same for all years, as there is no good source showing how state tax incidence varies over time.

Compensation. Rather than using BEA wages by state and year, I used BEA compensation (of wage and salary employees) by state and year. Why do this? First, this helps us give a different and better way of calculating personal income (see below), which is adding things up: wage and salary FTE employment is multiplied by total real compensation per FTE to get total increase in wage and salary compensation. We then need to add in proprietors' income, and capital income and transfer income to get personal income. Second, this is theoretically a better measure of total income benefits of these programs than only focusing on wages, which excludes benefits.

Note that for calculating incentive effects, which requires calculating value-added, I still use wages, as I assume that program evaluators are more likely to have nominal wage data by incented firm and year than total compensation data.

Wage premia. The wage premia calculation is simplified in the new model. The wage premia is to be stated as a percent of the wage actually paid per FTE by the firm, which is probably the way it would be estimated. (This assumes that normally we will have data only on wages, not on total compensation.) And we are going to allow wage premia only on incented jobs—I don't think anyone will really calculate a wage premia on multiplier jobs, as this would be almost impossible to calculate. I assume the "multiplier" that one might assume would apply to incented jobs might allow for this. This "multiplier" is part of the model. Its default is set at 0.93, but one could set it at some much higher value if incented jobs' wage premia is assumed to "spill over."

Personal income. In the 2018 model, personal income was calculated by blowing up employment change by the average national ratio of personal income to FTE employment. This could be extended to the state level, but this seems wrong, as there are personal income effects greater than employment due to wages being pushed up, for example, and in addition it is not obvious that all personal income scales with FTE.

In the new model, personal income is more fully modeled (see sheet "S Pers Y change calcs"), as the sum of different components:

- Compensation changes due to changes in employment are directly measured.
- Compensation changes per FTE are added in due to employment shocks or wage premia changes.
- Changes in income of local businesses are modeled due to changes in local prices and wages and incentives received.
- Changes in the real value of transfer income and capital income due to higher local prices are entered in.

- Other changes in income are assumed to increase with population. These other types of income include: proprietors' income, transfers, dividends, and interest. Scaling these other types of income with population is a somewhat arbitrary choice. Ideally an improved model would more fully derive these income sources.

Property tax revenues. For the fiscal benefits calculation, we directly model the increase in property tax revenues by summing up several effects (see "Prop tax calcs for revenue" sheet). The change in property tax revenue is the property tax rate times the change in property values. The property tax rate is taken from the 2019 average state rate from the Tax Foundation (2021). Users may choose to use the local property tax rate, if available.[63] To determine how much property values went up, we added up three components: 1) the change in property values with respect to income; 2) the change in property values with respect to population, simply due to more people buying housing even if prices did not change; and 3) the change in property values with respect to the price changes brought about by this demand shock.

The first component can be shown to equal the income elasticity of housing demand times the ratio of overall property values to income times the change in income. I used the figure of 0.702 for the income elasticity of housing demand from Albouy, Ehrlich, and Liu (2016), which accords with other research literature that housing demand is somewhat income inelastic. The ratio of overall property values with respect to income is derived for each state by using the overall property values per capita found by the Federal Reserve and then adjusted to other years by the shelter CPI and by each state's relative housing price index from BEA. Going forward this ratio is constant.

The second component can be shown to equal the assumed elasticity of property values with respect to population times the ratio of property values to population times the change in

[63] This local property tax rate would override the default state property tax rate by being entered at cell F3.

population. I assume that the elasticity here is 1.00: if the population goes up by 10 percent, all else constant (including housing prices), property values go up by 10 percent. The ratio of real property values historically is adjusted based on BEA relative rental prices by state and the CPI for shelter. Going forward, we assume that real values go up by 1.12 percent per year, which is how much everything else in the model goes up by in real terms over time.

The third component can be shown to equal (one plus the price elasticity of housing demand) times the change in the price times the quantity of property. The latter term is the measured price shock in the model. For the price elasticity, I use −0.700, from Albouy, Ehrlich, and Liu (2016), which fits in with other research literature that housing is somewhat price-responsive but is not elastically so. So, essentially property values only go up by 30 percent of the price shock to property values due to people buying less property.

Fiscal benefits. For property tax revenues, see above. For other revenues I used the state-specific elasticities from Bruce et al. (2006) for how sales and income taxes respond to shocks to state personal income per capita. For some states for which they did not report, I used national averages. The elasticities used were their long-term elasticities. I also used the sales tax elasticity for all other revenue (other than sales and gross receipts, personal income tax, and general sales). Intergovernmental revenue was assumed to scale up with population.

I interpreted their elasticities as applying to shocks to state personal income that are shocks to per capita personal income. For shocks to personal income that are due to shocks to population, an elasticity of 1.00 seems appropriate. That is, if one blows up the economy due to population growth by *x* percent, but there are no changes in per capita income of anyone, it seems reasonable that state and local income tax revenue and sales tax revenue and other tax revenue should simply be blown up by that same *x* percent.

This is reflected in the calculations made in the "Fiscal benefits" worksheet at cells AD10:AD89 (sales tax revenues), AG10:AG89 (income tax revenue), and AJ10:AJ89 (other tax revenue). The calculation reflects the following reasoning:

If $d(\ln Rev) = e \times d[\ln(Y/POP)] + 1 \times d[\ln(POP)]$

Where *d* represents some small differential change, lnRev is the natural log of some type of state/local tax revenue, *e* is the elasticity estimated by Bruce et al. (2006), and we assume that this elasticity *e* only applies to the small change in the natural log of per capita state personal income (Y/POP), and 1 is the elasticity for shocks to the natural log of state population, *POP*.

Then:

$d[\ln(Y/POP)] = d\ln(Y) - d\ln(POP)$ by definition of logarithms.

Substituting in

$d\ln(Rev) = e \times d[\ln(Y)] + (1 - e) \times d[\ln(POP)]$

Now by definitions of how differentials work, $d\ln(X)$ for any variable $X = dX / X$. So we have

$dRev/Rev = e \times (dY) / Y + (1 - e) \times (dPop) / Pop$

Multiplying both sides by Rev we get

$dRev = [e \times (Rev/Y) \times dY] + [(1 - e) \times (Rev/Pop) \times dPop]$.

So if we want to know the change in some type of revenue that occurs due to a shock that changes both state personal income *Y* and state population POP by some amount (and therefore implicitly might change *Y*/Pop), we can:

Multiply d*Y* by the elasticity of that type of tax (*e*) and multiply that by the share that type of tax's revenue is of state personal income. But then we also have to add in (1 minus the tax elasticity of that type of tax) times the per capita revenue of that type of tax times the change in dPOP).

So essentially this only applies the e term to the change in per capita income, and it applies 1 to the population induced change in income, and you end up subtracting a factor based on population to adjust down for initially applying *e* to all income.

For expenditure, I used the general revenue figure for each state as the figure of general expenditure, based on the assumption that long-run general expenditure equals long-term general revenue. This assumed general expenditure was then assumed to scale with population.

I extrapolated 2019 values for all revenue figures to all other years. I could have downloaded years back to 1993, but I chose not to do so because: 1) the elasticities I am using are from one particular year; 2) the property tax calculations I am doing are from one particular year; and 3) I think the major variation in state fiscal structure is across states, not years. Ideally one would have data for all years, but I think this is a second-order problem.

To make intergovernmental revenue and overall general revenue figures scale properly, they were assumed to be same percentage of personal income going back in time and going forward. Then they were converted to real 2019 prices per person using the overall CPI and relative state prices. Going forward past 2020, they were assumed to grow in real terms by 1.12 percent.

Tax calculations on individual income. The previous model used average revenue figures for share of different revenue categories in personal income for the average state. This could have been updated to just do a state-specific average. However, this seems somewhat inconsistent with using marginal elasticities to calculate fiscal benefits. If a state has a highly "elastic" tax system—the sum of income tax revenues and sales tax and other non-property tax revenue responds elastically to boosts to personal income—this should not only increase fiscal benefits but also have some effect of reducing net of tax income of people who benefit from the incentives, such as those who get jobs or higher wages. In addition, the new property tax calculations (see above) specifically calculate changes in property taxes due to higher personal income, which implies a marginal elasticity, and this should be used directly in the analysis.

Therefore, we assumed that the same marginal elasticities that applied in the fiscal benefit calculations for boosts to per capita income also applied to the calculations of aggregate tax liabilities on added income for workers or local business owners. In the real world, the marginal elasticities for these groups might differ from overall marginal elasticities, but this at least incorporates some features of state and local tax system in determining how marginal personal tax liabilities might change.

Specifically, for marginal property tax liability on increased income, I use numbers on worksheet for "Prop tax calcs for revenue" to estimate the marginal extra property tax paid on income boosts, incorporating a plausible income elasticity of housing demand (column X on the worksheet.) This was linked to on the "Fiscal effects" page, column AS. In addition, in columns AO through AQ I calculated marginal revenue gain for sales tax revenue, income tax revenue, and other revenue for a given boost to personal income per capita (see calculations in cells AO10:AQ89 on "Fiscal effects" worksheet). Then column AT on the "Fiscal effects" page sums up these marginal tax rates. This is then linked to on the "Net of taxes benefits" page at column C, C4:C83. For comparison purposes, the "Incentive inputs" page compares "average revenue" to "marginal revenue" calculations for overall tax rates, at cells F112 and F113.

Education spending share. Before, I used the national average for this share. I now switch to using each state's average share of direct state and local general expenditures that go to education. Unlike before, I include capital spending in both numerator and denominator.

This variable is calculated at cell X23 on the sheet "exerpted&processed stloc fin." This cell then links to cell G27 on the "Economic inputs and outputs" sheet.

Business share of overall state/local taxes. Before, I used the national average for this state share from Ernst and Young. The revised version uses a state-specific share from Ernst and Young (2020), for fiscal year 2019. This calculation is at cell K5 on the sheet "Ernst&young bus tax share." This then links to cell G23 on the "Economic inputs and outputs" sheet.

Appendix C

Revision of pp. 5–32 of Bartik (2018) to be Consistent with Updated Model

Outline of Incentive Model

The model simulates, over a period of 80 years, the effects of some incentive policy that is initiated by a state or local government in some starting year. The policy starting year can be any year from 1990 to 2030, and for any of the 50 states or DC. In addition, with some effort, users can adjust the model for different local labor markets and housing markets in their state. The same incentive package may have different impacts in a highly distressed local labor market versus a booming local labor market.

This policy is to offer some firm, or some group of firms, in some starting year, a set of incentives paid out over time. This series of promised incentive payments is tied to specific location or expansion decisions promised to occur from that starting year forward by that firm or firms. The user can then aggregate what happens in that starting year with program activity in other starting years, to get an overall program assessment. Alternatively, the model can be applied with some effort to aggregate data on an incentive program, under assumptions specified in the model.

For example, some firm might be locating a new plant. To entice the plant, the state will offer a series of annual payments, paid over as many as 20 years. Alternatively, a firm may be considering an expansion. To encourage that expansion, the state may also offer some time series of payments. In both cases, the purpose of such policy is to encourage job creation due to the new plant or the expanded facility, with a consequent array of diverse effects on the local economy.

The model assumes that incentive package has some probability of creating the jobs promised by the firm or firms. This assumed probability by default is derived in the model as depending on the size of the incentive payments, relative to the scale of the proposed new facility or facility expansion. However, the user can also simply assign the probability of creating the promised jobs, either based on other information or as a way of determining how sensitive the model effects are to these assumed probabilities or what probability is required for the incentive policy to pass a benefit-cost test. In determining the effects of this incentive policy on various benefits and costs, the model acts as if the actual jobs created are the promised jobs times the probability that the incentives induced the jobs. This is best interpreted as the "expected jobs" to be created by the incentive policy, as in the real world it is more likely that either the incentives tipped the location/expansion decision or it did not.

The model estimates the effects of that incentive policy as it unfolds over the following 80 years on local incomes of different types: labor income, capital gains from increased property values, profits of locally owned businesses, fiscal benefits of local taxpayers; real incomes from outside-derived capital income or transfer income as local prices. "Local" in this context is best thought of as meaning incomes in a particular state, although it could also be a metropolitan area or other local labor market area. Nonlocal income effects are ignored, so the model ignores losses to residents of other states that might otherwise have obtained the new facility's location, and it ignores gains or losses to out-of-state owners of businesses, for example those due to changes in this state's incentives or business taxes.

After the overall local income gains or losses of various types are estimated, the model then allocates these income gains or losses across the local income distribution—more specifically, gains or losses are allocated across the local area's five "income quintiles," which rank households by whether they are low income, low to middle income, middle income, upper-middle income, or upper income.[64] The model estimates what incentive policy does to the present value of the net income gains of various types of income for the five income quintiles, considering all the relevant multiplier effects, and considering opportunity costs stemming from how incentives are designed and financed.

The logic model of how incentives affect incomes of different types for different groups in a state goes as follows: We start with some incentive package, which has estimated effects on the probability of tipping that location decision—either a new plant-location decision or a facility-expansion decision. The estimated effects on the tipping probability will be based in part on how the incentive is designed and delivered. The probability estimates are derived from the research literature consensus on how taxes affect firms' location decisions.

If the incented firm is an export-base firm, which sells its goods and services to customers outside the state, any tipped location decision of that incented firm will induce the creation of other jobs at local suppliers and retailers. The new dollars brought into the state by the out-of-state sales will in part be respent by the incented firm and its workers on local suppliers and retailers. These induced effects on other jobs are commonly referred to as "local multiplier" effects.

If the incented firm is instead a "non-export-base firm"—that is, its goods and services are sold locally—net local effects are quite different. For incentives to a non-export-base firm, even if the incentive tips the location decision, the new jobs in the incented firm will displace sales and thereby jobs from other local firms. This displacement of other local firms' sales and jobs has the potential to totally offset the job creation of the incented non-export-base firm. However, if the incented firm is locally owned, the incented firm may tend to spend more on

[64] Income quintiles are derived by ordering households by income and then dividing this ordering into five groups of equal population size. The model uses income quintiles from CBO (2016).

local suppliers than is true for competing non–locally owned firms. In addition, the incentives and the resulting expansion of local firms would increase profits of locally owned firms, and local owners would spend some of their extra income on local goods and services. Therefore, for non-export-base firms that are locally owned, incentives may still result in some net job creation effects.

To sum up these direct effects on induced jobs and multiplier jobs: These direct effects of the incentive policy would be expected to increase local job growth, but only by a small fraction of the originally incented jobs, because most incentives only tip location and expansion decisions for a small percentage of incented firms. Most incented firms would have located or expanded at this location even if the incentive had not been provided.

But the incentive must be financed by either raising taxes or cutting public spending. Both financing mechanisms have negative demand effects on local jobs because either will reduce local incomes, leading to less local purchasing power and thereby less local retail sales and fewer jobs. Financing of incentive costs also has some negative supply-side effects by raising business costs and reducing worker skills. Raising business taxes is likely to reduce the growth of other local businesses. Cutting education spending is likely to depress local workers' future wages, but this effect is much delayed.

Because of the incentives and their financing, there is some net effect on local jobs due to the combination of the incented jobs, the multiplier jobs, and the negative effects of the incentive financing. This net local job growth in turn affects local employment rates (the ratio of local employment to local population), wage rates, housing costs, and the local population. Some of the new jobs go to local residents who otherwise would not be employed, increasing local employment to population ratios, while other jobs go to in-migrants.[65] Higher employment and population puts upward pressure on housing prices and other local real estate prices. The higher local labor demand relative to labor supply also puts some upward pressure on real wage rates. Wages also may be affected if induced jobs pay wage premia relative to similar jobs for workers with given characteristics. These increases in wage rates and housing costs raise local business costs, which will tend to reduce job growth in some local businesses, so net job effects end up also reflecting these feedback effects.

After all these feedback effects are incorporated, the resulting increase in employment and the accompanying increase in local incomes will increase state and local tax revenues, and the resulting increase in population will increase the need for state and local public spending. Fiscal benefits tend to be positive because of three factors: 1) tax revenues go up with employment and incomes, 2) spending needs increase with population, and 3) increases in local labor demand increase employment to population ratios. The resulting net fiscal benefit reduces the need to finance incentive costs. These feedback effects are also incorporated into the model.

In the end, all these effects alter six types of income:

1) Fiscal benefits or costs, which accrue either to taxpayers or local residents in the form of higher taxes or lower public spending.

2) Net labor income effects of increased labor demand on employment to population ratios and wage rates, adjusted to be net of tax increases.

[65] What about new local jobs that go to the local employed? As explained further below, this creates a local job vacancy, which will be filled by the local employed, the local nonemployed, or in-migrants. (The local nonemployed consists of two groups: the local unemployed; local residents who are not in the labor force.) This job vacancy chain ultimately terminates in new jobs for either the local nonemployed or in-migrants. To put it another way, a shock to local employment must result in some combination of an increase in the local employment to population ratio and local population. See below and Persky, Felsenstein, and Carlson (2004).

3) Net property value gains for local property owners, adjusted to be net of property tax increases.

4) Effects of higher local housing prices, and the resulting higher local overall prices, on the real after-tax incomes of local residents whose income comes from outside the state; for example, from federal transfer payments, or interest and dividends from out-of-state banks and businesses.

5) Net effects of higher costs and higher business taxes on after-tax business profits of businesses owned by local residents. These net effects may possibly be offset by receiving some incentives.

6) Reduced future wages due to cutbacks in education spending. These reduced future wages are adjusted to be net of the lower tax liabilities due to lower wages.[66]

Finally, these net effects on local incomes of different types are divided among quintiles in the local income distribution. This division among quintiles is based on how labor demand shocks, labor incomes, property ownership, out-of-state income, business ownership, and tax shares and spending shares are distributed by income quintile.

Because the model is simulated over 80 years, it necessarily incorporates some parameters governing model dynamics—that is, how model effects change over time. Model dynamic parameters are derived where possible from the empirical literature.

One question that might be asked is: why consider incentive policy effects over such a lengthy period of 80 years? As will be seen, the answer is: because many of the most important effects of incentives only occur in the long-term. In particular, the wage losses due to cutbacks in

[66] The effects of both increased labor demand and education cutbacks are effects on labor market income, so they both are effects on the same "type" of income. However, I choose to describe these two effects separately, largely because the effects of education cutbacks are much delayed compared to the effects of increased labor demand, and also because they are distributed across income quintiles quite differently.

education spending only fully occur after 20 years or more, when former K–12 students enter the local labor market and then begin their peak earnings years. A shorter time horizon overlooks these important effects.

MODEL ASSUMPTIONS

This section summarizes the key assumptions of the model. More details are in the original report's Appendix C, which is modified here as Appendix D to be consistent with the revised model. Alternatives to the baseline scenario assumptions are considered later in the text of Bartik (2018), as well as in the current report's text. In both cases, these reports explore how incentive effects vary under different assumptions about factors such as incentive multipliers, incentive design and financing, and local labor markets.

Unless otherwise stated, all figures in the model and the report are in 2019 national dollars, and all "jobs" are measured as FTE jobs.

In the model, various real values per FTE worker are based on BEA figures for states for the period from 1990 to the present. Beyond the present, these real values per FTE are assumed to grow each year from the present to the year 2110 by 1.12 percent. This real economic growth assumption is based on the long-run projections of the Social Security Board of Trustees. This procedure is adopted to adjust all real values per FTE, including the following: real compensation, real value-added, real property values, real personal income, real general state and local revenues, real state and local general expenditures, real costs of creating or destroying jobs through demand or supply shocks to local taxes and spending, and real costs of creating or destroying jobs through cost shocks to local wages and other local costs.

In evaluating model benefits and costs from a social perspective, the model consistently uses a 3 percent real discount rate. A 3 percent real discount rate is commonly used in benefit-cost analyses.[67] This commonly used discount rate for benefits and costs, from society's perspective, implicitly assumes that although future benefits or costs from Year 20 on should be discounted somewhat, such future benefits or costs, if persistent enough, may often be large enough to significantly affect a policy's net benefits.

Incentive Effectiveness Rate

The incentive effectiveness rate is derived from assumptions about how firms respond when the costs of a new plant location or facility expansion are lowered by incentives. "Costs" here are operationalized as the "value-added" associated with the new plant, or with the facility expansion.

In economics jargon, "value-added" is the difference between sales and the firm's purchase of goods and services other than capital and labor. For example, "value-added" for a steel company is the value of steel sold, subtracting out the cost of inputs such as iron and coal and electricity. It is the "value-added" to these inputs by the firm's capital and labor. The big advantage of "value-added" is that it is a measure of the costs of production that is unaffected by rearrangement of corporate ownership—for example, if a firm buys its suppliers. Total sales go down when a steel company buys the company that supplies its iron, but total value-added in the economy will not change.

The baseline model assumes that an incentive whose present value, from the firm's perspective, is 1 percent of value-added will increase location and expansion decisions by 10

[67] See the discussion of discount rates in Bartik (2011). The Moore et al. (2004) article, under the 1.2 percent real wage growth assumptions used here, implies a long-run discount rate of 2.2 percent. The EPA uses discount rates of both 3 percent and 7 percent.

percent. In other words, an incentive package of 1 percent of the value-added associated with the new plant or the facility expansion will tip 10 percent of location and expansion decisions. Ten percent of the incented firms would not have located or expanded in this local economy "but for" the incentive package, whereas the other 90 percent of the incented firms would have made the same location or expansion decision without the incentive package.

This cost sensitivity of location decisions to incentives is based on the consensus in the research literature about the sensitivity of state and local business-location decisions to business taxes. The location cost sensitivity that is used is the response of location decisions to state and local business taxes, holding public services constant.[68] The public-service-constant response to business taxes and costs is the appropriate response to use because the model later explicitly allows for changes in public spending and services to have both demand-side and supply-side effects.

This cost-sensitivity may appear small to some readers. In particular, state and local policymakers concerned with economic development often implicitly or explicitly assume that 100 percent of incented business activity, or close to 100 percent, would not have been attracted to this local area "but for" the incentives. But this common assumption is not justified by

[68] Without holding public services constant, the research consensus is that the long-run elasticity of state and local business activity to total state and local business taxes is −0.2 (Bartik 1991; Wasylenko 1997). However, Phillips and Goss (1995), in a meta-analysis of the literature, show that holding public services constant makes the business tax elasticity more negative by −0.3, which implies an overall elasticity, holding public services constant, of −0.5. In addition, Bartik (1992) concludes that for studies that use both area fixed effects and control for public services, the average elasticity is −0.50, with a 95 percent confidence interval from −0.15 to −0.85. Business taxes average 5 percent of value-added (Bartik 2017a; Phillips, Sallee, and Peak 2016). Therefore, if cost changes induced by tax changes or incentive changes have similar effects, the business tax elasticity implies that cost changes as a percentage of value-added of 1 percent have a −10 percent effect (−10 = −0.5/5 percent). The long-run elasticity consensus from the research literature is derived from a literature review by Bartik (1991) that treats effects on new facility location or expansion decisions as long-run effects. The literature reviews by both Wasylenko (1997) and Phillips and Goss (1995) do not find much evidence that the long-run elasticities from such micro studies differ greatly from the implied long-run elasticities of aggregate business activity.

business location research. Nor does this common assumption make sense given that many other cost factors vary across local areas far more than is provided by typical incentives.

Consider that an incentive of 1 percent of value-added will be roughly 2 percent of wages. This incentive probability means that lowering costs by 2 percent of wages alters location decisions enough to boost employment by 10 percent. This is not a trivial size for an effect. This effect seems reasonable given that wages, labor productivity, and other costs vary across locations in the United States by far more than 2 percent of wages. Given the large variation in costs across location due to many other location factors, it should not be surprising that only a minority of firms are on the margin where a modest cost change, of 2 percent of wages, ends up altering the location decision.

In addition, this sensitivity implies that for observed levels of state incentives, estimated effects on the probability of tipping location or expansion decisions can in some cases be sizable. For example, as of 2015, the state with the largest incentives was New Mexico, which had incentives of around three times the national average. With the assumed sensitivity, location incentives of New Mexico–size would be expected to tip 31 percent of location decisions. As a more extreme example, consider the incentive package agreed to a few years ago by Wisconsin with Foxconn. This incentive package is at least 10 times the current national average incentive package. With the assumed sensitivity, the estimated probability of a Foxconn-size incentive package tipping a location or expansion decision is 76 percent.

The present value of incentives that is relevant to a firm's location decisions depends on how the firm discounts future dollar flows. The real discount rate used by firms in making location and expansion decisions is assumed to be a 12 percent real rate. This 12 percent firm discount rate is based on research by Poterba and Summers (1995) and is derived from surveys of corporate CEOs asking what discount rates they use in evaluating investment projects.

The Time Pattern of Assumed Incentive Offers

The model allows users to assume any time pattern of incentive offers after the starting year for the next 80 years.

Incentive Program Size, Incentive Payments, and Incentive Effects on Incented Firms

The model allows users to assume the incented project has any pattern of jobs after the starting year for the next 80 years. The recommendation in this report is to assume that after the incentive payments are completed, the promised jobs will remain intact through year 80. But the user can choose to assume that jobs will depreciate over time, or have some probability of expanding over time.

The value-added of the incented jobs can be derived in either of two ways. First, based on the industry, the ratio of value-added to FTE in that industry is applied to the incented jobs, with value-added allowed to grow over time based on past history or future assumed real growth per FTE. Alternatively, if the user has data on wages per FTE for the project, the data are used to construct a wage bill for the project, multiplying incented jobs times wages per FTE. Then the industry's ratio of real value-added to the real wage bill are used to estimate the real value-added for the incented jobs.

The firms' location decisions are assumed to be driven by the present value of all incentive payments, as a percentage of the present value of value-added, over an 80-year time period. Therefore, the future incentive payments not only add budget costs, but also add some benefits by affecting location decision.

As mentioned above, firm location decisions are assumed to be based on evaluating their costs and profits using a 12 percent real discount rate. Based on the assumed cost sensitivity of firms' location decisions to lower costs, incentives that lower costs by 1 percent will affect location decisions by about 10 times as much, or a 10-percentage point effect on the probability of the job location or expansion decision occurring. Because the model assumes a log-linear response of jobs to costs, the actual change in the probability of a location decision is slightly less than 10 times the incentive percentage of 1 percent, at 9.6 percent.

How should this "tipping probability" be interpreted? For any particular firm, the actual "tipping probability" from the perspective of the firm is either zero percent or 100 percent. In other words, either the firm would have made the same location and expansion decision without the incentive, or it would not have made this location or expansion decision "but for" the incentive. But the state and local policymaker does not know the true tipping probability, unless it has on its staff mind-reading telepaths who can tell policymakers what the firm is thinking about its decision. In the absence of such magical inside information, the "tipping probability" used in this report represents this probability from the perspective of state and local policymakers, based on their best estimate. This best estimate of the tipping probability is based on the empirical research literature on how firms respond to costs such as changes in taxes, and the assumption that firms will respond similarly to incentives, such as "negative taxes," as they do to taxes.

Given the nature of the research literature on how taxes affect location decisions, the tipping probability represents total activity with the incentive compared to activity at that same location without the incentive. Therefore, the tipping probability of 9.6 percent is saying that without the incentive, 90.4 percent of the time the firm would have made the same location or expansion decision, or some similar firm would have chosen the same site. Therefore, a tipping probability of 9.6 percent might be compatible with a particular firm being tipped by a somewhat greater probability than 9.6 percent on average.

In other words, even if in a given case an incentive was decisive in causing this firm to choose this site, this does not mean that without the incentive the site would have experienced zero business activity. Some other firm might have chosen that same site, and some jobs might have been created anyway.

Thus, the tipping probability is meant to state what percentage of incented jobs would not have been created at this site "but for" the incentive. The counterfactual without the incentive includes possible jobs created by this firm anyway, by making the same location or expansion decision, or by other firms. From a benefit-cost perspective, the tipping probability represents the *expected* direct job effects of the incentives, which will drive a large part of the subsequent benefit-cost analysis.

Multiplier Effects

The new jobs induced in incented firms, due to activity that would not have occurred "but for" the incentives, will have local multiplier effects, at least if they are export-base firms. Incented firms that are export-base firms will bring new dollars into the local economy from sales to customers outside the state. These new dollars will in part be respent on local suppliers. Expanded sales by local suppliers will cause these suppliers to add jobs. The added jobs at induced incented firms, and at these expanding local suppliers, will lead to more workers with higher incomes. These workers will spend some of their increased local income at local retailers. This will cause these local retailers to add jobs.

In the baseline model, multiplier effects on local suppliers and retailers can be assumed by model users to be any value. Such values could be based on some input-output model of the local economy, for example models provided by BEA or by IMPLAN. Based on prior studies, a reasonable input-output multiplier for an "average" export-base firm at the state level probably would be around 2.4; at the local level, around 1.8 (Bartik and Sotherland 2019). That is, for each new job in incented firms that would not have existed "but for" the incentive, there will be 0.8 additional jobs created in local suppliers and retailers, and a total of 1.4 additional jobs at the state level.

The multiplier effect is assumed to take a little time to reach its full size. This lagged adjustment seems reasonable, as it takes some time for local suppliers and retailers to respond to increased demand. The adjustment rate to the full multiplier is assumed to be 50 percent per year. This adjustment rate is consistent with the time pattern of multiplier effects found in Bartik (1991) and Blanchard and Katz (1992).

Export-Base, NonLocally Owned

Most incented firms are 100 percent export-base firms, with all their sales of goods and services competing in a national market. But if instead the incented firm is not an export-base firm, then any increased activity of incented firms could displace a similar level of activity in competing local firms. Because non-export-base firms sell to a local market, any increased sales of incented firms will reduce sales of other local firms. For example, if we give incentives to a McDonald's franchise, the incentives might induce the McDonald's restaurant to expand. But local fast food restaurant sales as a whole are unlikely to increase much. Therefore, the increased sales of the incented McDonald's restaurant will come at the expense of reduced sales and reduced jobs at local Burger King restaurants. Users can choose what percent of the incented firms' activity is export-base, which affects these local displacement possibilities.

Most incented firms are not locally owned. But users can allow for incented firms to be locally owned. Local ownership changes the effects of incentives because locally owned firms may use more local suppliers, which will tend to increase multipliers. In addition, the incentive dollars given to lower owners will increase their income, which will both directly raise local incomes and lead to some increases in local spending and local jobs.

Job Growth Effects on Labor Market Outcomes

Incentives will have a variety of effects on net local job growth. These net local job growth effects stem from effects on incented firms and multiplier effects, which have already been discussed, as well as offsetting effects that will be discussed later. The final net job effects would be expected to alter local real wages, unemployment, and labor force participation.

The baseline real wage elasticity in response to local job growth is assumed to be 0.2—a 1.0 percent boost to local jobs will initially boost the local real wage by 0.2 percent, at a baseline unemployment rate of 6.2 percent. This real wage elasticity is based on the literature summary in Bartik (2015). This initial real wage elasticity is assumed to depreciate by 13 percent per year, based on estimates reported in Table 1 of Bartik (2015).

The baseline elasticity of employment to labor-force ratios with respect to local job growth is assumed to have an initial value of 0.476. That is, a 1 percent increase in jobs will increase the employment to labor force ratio (1 minus the unemployment rate) by 0.476 percent, at the assumed baseline unemployment rate of 6.2 percent. An alternative interpretation: for each 1,000 jobs created, initially 476 of those jobs will go to local residents who otherwise would be unemployed. This initial effect on the employment to labor force ratio depreciates by 27 percent per year. The initial effect and its depreciation are based on the median result from the estimates underlying Bartik (2015). These estimates and their depreciation are consistent with the overall research literature (Bartik 2015).

The baseline elasticity of labor force participation rates is assumed to be 0.137. That is, a 1 percent shock to local job growth increases the local labor force participation rate by 0.137 percent, at a baseline prime-age employment rate of 81 percent. In other words, out of every 1,000 additional jobs, 137 initially would go to local residents who otherwise would not be in the labor force. These labor force participation effects are based on estimates reported in Bartik (2023).

How persistent are labor force participation effects over time? Bartik (1991, 1993, 2015) estimates that labor force participation effects of labor demand shocks are quite persistent, with modest if any depreciation over periods of a decade or so. In contrast, Blanchard and Katz (1992), in a widely cited paper, find moderately rapid depreciation of labor force participation effects of local job growth. However, Bartik (1993, 2015) suggests that the Blanchard and Katz result is overturned in more robust and general models, which better capture what labor demand shocks do in the long run.

Why might labor force participation be affected persistently? As explored fully in Bartik (1991), perhaps because local job growth increases labor market experience and job skills. Due to local job growth, some individuals who were out of the labor force gain valuable labor market experience, as well as greater self-confidence and a better reputation with employers. With better skills and a better perception of their skills, these local residents can continue to be more productive and hence more likely to be employed.

Although the labor force participation effects of labor demand might be very persistent, would these effects be truly permanent? If these effects are due to the long-run employability benefits of short-run labor market experience, we would not expect these effects to remain completely unaltered over time. We would expect that as individuals retire, move out of the local economy, or die, the initial effects on labor force participation rates will eventually show some depreciation and, in the very long run, will completely depreciate.[69]

To reflect this short-run persistence and long-run depreciation of labor force participation effects, I estimate how labor force participation rates will eventually depreciate because of three forces:1) out-migration, 2) mortality, and 3) changing labor force participation due to aging. This model ends up with quite persistent labor force participation effects: such effects are 82.0 percent of their initial level after 10 years. This is an effective annual depreciation rate of 2.2 percent, far less of a depreciation rate than is the case for unemployment effects or wage effects. But these effects eventually dramatically depreciate: labor force participation effects are 0.7 percent of their original level after 60 years. The average depreciation rate over this entire period, from the starting year to year 60 after the starting year, is 8.2 percent per year. By 60 years after the shock, most of the original labor force has either retired, moved to another state, or died. Appendix D (was Appendix C of the original report) provides more details on how these labor force participation depreciation rates are calculated.

The net effects on jobs, together with the resulting effects on the unemployment rate and the labor force participation rate, result in effects on how many local residents get jobs out of the total new jobs available. The remaining new jobs will go to in-migrants. These migration effects

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[69] This could be argued to be a conservative assumption. For example, research by Greg Duncan and his colleagues suggests sizable causal effects of parental income on children's future academic achievement and income (Duncan, Morris, and Rodrigues 2011; Duncan, Ziol-Guest, and Kalil 2010).

are used to estimate the effect of incentives on local population. Local population will affect fiscal benefits by affecting needs for public spending.

These effects on labor market outcomes will vary with the initial local unemployment rate or initial prime-age employment rate. In the model of Bartik (2015), the effects of demand shocks to local jobs on wages and the unemployment rate vary with the baseline overall local unemployment rate. Higher overall local unemployment rates yield lower effects of demand shocks to local jobs on raising real wages, and higher effects on reducing unemployment and increasing labor force participation. Furthermore, in Bartik (2023), lower prime-age employment rates yield higher effects of demand shocks to local jobs on the labor force participation rate.

In the model, historical unemployment rates and prime-age employment rates are based on CPS data on state rates. Users may also substitute their own local data for these state data. After historical data, the unemployment rate is assumed to converge at 20 percent per year to a long-run unemployment rate of 3.0 percent. The prime-age employment rate is assumed to respond to this unemployment rate, using a 50-state sample from 2007 to 2019. The resulting coefficient is 0.9799 (standard error of 0.0273); that is, the prime-age employment rate changes in log percentage terms about one for one with the log percentage change in the employment to labor force ratio.

Job Growth Effects on Real Estate Markets

The model assumes property value elasticities for each state based on results from Saiz (2010). The capital gains from higher local real estate prices are counted as local income gains if the property is owned by local residents. Higher local property values also lead to higher property tax revenues, which affects fiscal benefits.

Effects on Overall Employment of the Increased Wages and Real Estate Costs

Higher wage and real estate costs feed back into the local economy to reduce future employment, dampening the net job increase. I use the same cost-increase sensitivity for other local employment that is used with incented firms, with three exceptions:

1) Changes in wages are assumed to have 30 percent of the effect on local employment that would be expected based on how wages affect costs. This assumption is based on empirical evidence, which finds that for a cost increase due to wages, the business location response is less than it would be from a similar-size cost increase due to increased state and local business taxes (Bartik 1991).[70] A plausible explanation is that real wage increases have some offsetting benefits for productivity. The model's effective long-run elasticity of local jobs with respect to real wages is −1.5, which is within the range of estimates in the literature (Hamermesh 1993).[71]

2) Unlike the case of incented firms, the effects of these wage and real-estate cost increases on other employment do not have multiplier effects. Estimates of the cost sensitivity of overall employment to wages or business taxes already implicitly incorporate such multiplier effects.[72]

3) To reflect lagged adjustment, other overall employment only gradually adjusts to the new higher cost structure. The adjustment rate is 9 percent per year toward the new equilibrium,

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[70] In Bartik (1991), the average elasticity of state and local business activity with respect to wages is −0.70; the average elasticity of state and local business activity with respect to state and local business taxes is −0.25. State and local business taxes are 5 percent of overall value-added, versus about 50 percent for wages. With an elasticity of state and local business activity with respect to state and local business taxes of −0.25, we would expect the corresponding wage elasticity to be 10 times as great, at −2.5. The actual estimate of −0.70 is 28 percent of the expected elasticity.

[71] Hamermesh (1993) suggests a range for the labor demand elasticity with respect to wages, not holding output constant, from −1.0 to −1.5. Kline and Moretti (2013) assume an elasticity of −1.5 in the regional context. Beaudry, Green, and Sand (2014) have estimates that imply a long-run metro area elasticity of about −1.5. My assumptions yield an effective elasticity of −1.5. This is consistent with these prior researchers. My assumed real wage elasticity is more negative than the −0.70 found in Bartik (1991) to summarize the relevant regional literature. However, it can be argued that the research literature's average wage elasticity is biased toward zero by the endogeneity of wages.

[72] In other words, the overall employment elasticity estimated with respect to wages or other costs incorporates both the export-base and non-export-base sectors, including whatever multipliers occur for each sector.

based on estimates by Helms (1985) and Bartik (2017a). This lagged adjustment contrasts with the response of incented firms, which is assumed to be immediate. For incented firms, the baseline model assumes we are targeting new location or expansion decisions. The adjustment of marginal investment decisions to the lower costs due to incentives is assumed to be immediate.

Offsets from the Opportunity Cost of Financing Incentives: Demand-Side Effects

The incentive's dollar costs must be paid for by state and local governments.[73] Either state and local taxes must go up, or public spending must be lowered, or both. The financing of incentives will reduce employment because of demand-side and supply-side effects of higher taxes and lower public spending. Demand-side effects are the reduction in demand for local goods and services because of higher taxes and lower public spending. Supply-side effects are the reduction in the supply of business capital or skilled labor due to at least some types of higher taxes and lower public spending. In this subsection, demand-side effects are considered.

The costs of paying for incentives may be relieved to some extent by the fiscal benefits of the incentives, to be discussed further below. These fiscal benefits are assumed to be distributed in the same way as the incentive costs between spending and taxes, with similar effects.

For the baseline model, it is arbitrarily assumed that incentives are financed 50 percent by public spending cuts and 50 percent by tax increases. The demand-side impacts of public spending cuts are based on a recent paper by Suárez Serrato and Wingender (2016). This paper estimates the local "fiscal multiplier" effects of state and local public spending induced by changes in federal grants due to updated census population estimates. Based on their paper, I

[73] Any fiscal benefits, because of the incentive's effects on state and local taxes and public spending needs, may reduce the incentive's net fiscal costs. These fiscal benefits are allowed for in the model and are discussed later.

assume that spending cuts, by reducing both public jobs and local demand for private jobs, will have a ratio of spending cuts to job reductions of $38,303 per FTE job, in 2019 dollars.[74]

Tax increases are divided between business taxes and household taxes. Based on estimates from Ernst and Young (2020), the business share of state and local taxes is assigned based on state-specific figures.

The local demand-side effects of higher taxes are derived from Zidar (2019). Zidar estimates the local economic effects of much higher or lower taxes for different income groups in the state due to changes in federal taxes. Based on Zidar's results, the local demand-side impact of higher taxes depends on the division of those taxes between the bottom 90 percent of the income distribution and the top 10 percent. Zidar estimates that tax increases on the bottom 90 percent will reduce local jobs, with a ratio of tax increases to job reductions of $45,178 in 2019 national dollars per FTE job.[75] In contrast, tax increases on the top 10 percent are found to have no local demand-side effects. These results from Zidar make sense. For the bottom 90 percent, spending on local goods and services is constrained by disposable income after taxes. In contrast, the wealthiest taxpayers do not adjust their consumption of local goods and services by much in response to tax-induced changes in net income. However, note that when tax increases on the top 10 percent come in the form of higher business taxes, they may reduce business investment in the state. This will be discussed in a little bit.

To determine how much of an increase in household taxes goes to different income groups, I use tables from the Institute on Taxation and Economic Policy (ITEP 2018).These

[74] This is adjusted by 1.12 percent per year for years other than 2019. Bartik (2017b) explains the derivation of this number from Suárez Serrato and Wingender.

[75] This is adjusted by 1.12 percent per year for years other than 2019. Bartik (2017b) explains the derivation of this number from Zidar (2019). In addition, the initial number for the nation of $45,178 is adjusted slightly for different states based on taxes on the bottom 90 percent. See Appendix B.

ITEP figures are state-specific, but in the absence of better data, are not allowed to vary over time.

For business taxes, I use U.S. Department of Treasury incidence assumptions for the corporate income tax, which assume that the top 10 percent of the income distribution bears 66.8 percent of the burden of this business tax (Cronin et al. 2013).[76] This reflects assumptions about how much in business taxes are borne by supernormal profits and economic rents as opposed to being passed on to workers. Demand-side effects of business taxes are further reduced because the model assumes that only 26.0 percent of state and local business taxes are paid by businesses owned by local residents.[77] Therefore, the only demand-side impact of business taxes stems from the 26.0 percent borne by locally owned businesses. Only 33.2 percent of such local business income is received by the bottom 90 percent of the income distribution and thereby affects local demand. Business taxes that are "exported" to out-of-state business owners have zero local demand effects, and business taxes paid by local owners in the top 10 percent of the income distribution also have zero effects on local demand.

Financing of Incentives: Supply-Side Effects of Higher Business Taxes

However, although business taxes do not have much demand-side impact on local economies, higher business taxes will have adverse impacts on local jobs by increasing business costs. This is a supply-side impact because these higher business costs reduce the supply of business capital investment to the state economy.

[76] The Cronin et al. (2013) figures in their "New methodology" column of Table 5 are slightly adjusted so that they sum to 100 percent.

[77] This is derived from assuming that 10 percent of nonfinancial corporate businesses are owned locally and 50 percent of nonfinancial, noncorporate businesses are owned locally. I then combine these assumptions with information from the U.S. Federal Reserve Board (2017), Tables B103 and B104, on the allocation of total business capital by these two categories as of 2016. Capital included is real estate, machinery and equipment, and intellectual property.

In the model, I assume a business cost response that is the same as that assumed in estimating effects of incentives. In the long run, a business tax increase of 1 percent of business value-added will reduce other private business employment by 10 percent.

However, this long-run equilibrium elasticity of business response is only reached gradually, as general business-tax increases target all businesses, both existing ones as well as businesses considering expanding. The adjustment to the long-run equilibrium is assumed to be 9 percent per year, based on Helms (1985) and Bartik (2017a).[78]

Financing of Incentives: Negative Effects of Lower Public Spending on Education

Many reductions in state and local spending might have negative effects on the supply of labor or capital or other inputs to business production. Cuts to any type of education or job training spending might hurt local labor skills and hence local productivity. Cuts in higher education spending might harm local business research, which might reduce high-tech business investment and business productivity. Cuts in road spending and other infrastructure might raise local business costs and thereby reduce business investment in the state. Cuts in health spending might reduce local workforce productivity. Cuts in child care spending might reduce the ability of parents to work, thereby reducing local labor supply quantity in the short run, and in the long run reducing labor supply quality by reducing parents' work experience.

In the baseline model, I assume that the only negative supply-side effects of lower public spending stem from lower spending on K–12 education. If a model user wanted to allow for

[78] In addition, no multiplier effects are allowed for, as the estimated elasticities already reflect that business tax changes affect both export-base and non-export-base businesses. The overall elasticity implicitly incorporates multi- plier effects for the export-base businesses and no effects for the non-export-base businesses.

impacts of other local public spending, this can be done in an ad hoc way by assuming that a larger share of public spending cuts have the same negative effect as cutting K–12 spending.[79]

In the model, it is assumed that of public spending cuts, the percent that comes from K–12 spending is the average percentage of state and local spending in that state that goes to K–12 education. This percentage tends to be a little bit above 20 percent. Figures for each state's share of spending that goes to K–12 comes from the Census of Governments.

What negative effects might lower K–12 spending have on the quality of a state's labor force? The model uses estimates from Jackson, Johnson, and Persico (2016) of the effects of K–12 spending on future wages. Their estimates are derived by examining how future wages vary with court-ordered increases in K–12 spending. This is a plausibly "exogenous" change in K–12 spending that helps get at the true causal effects of K–12 spending on future earnings. The model relies on the estimate of Jackson, Johnson, and Persico that a 10 percent change in overall per-pupil K–12 spending, over 13 years, will change the adult wage rate by 7.7 percent, an elasticity of 0.77. The model analyzes the effects of reducing K–12 spending on a yearly basis. Therefore, the model assumes that changing K–12 spending for one year only will have one-thirteenth of the overall impact of 7.7 percent, or about a one-half of 1 percent impact, for a 10 percent one-year change in funding.

The model assumes that most of this impact takes place through wages, and takes place in equal percentage terms over all ages in a career. Thus, these impacts are quite delayed compared to some other policy impacts.

In addition, the model is focused on estimating impacts on local residents. Therefore, the effects of K–12 spending are reduced by allowing not only for mortality between the K–12 years

[79] Alternatively, if the supply-side effects of cutting some type of spending were felt to be more immediate, one could lower the cost per job created and destroyed from that estimated by Suárez Serrato and Wingender (2016).

and later ages, but also for out-of-state migration. Only wage effects for workers who stay in their original state are counted. The survival probabilities are based on Life Tables from the U.S. Department of Health and Human Services and are ratios of the number of persons surviving to a later age to the number of persons who are at a particular age that corresponds to the K–12 grade when the change in school spending takes place. The staying probabilities are estimated by looking at the ratio from the U.S. Census Bureau of persons living in their birth state as of some later age to persons living in their birth state as of some earlier K–12 age when the change in K–12 spending takes place. These staying probabilities average 65 to 75 percent for most of the typical worker's career in a typical state.

Based on estimates by Moretti (2003, 2004, 2012) and Diamond (2013), changes in some local residents' skills should have spillover effects on the productivity and wages of other state residents. Estimates suggest that an individual worker's wages depend not only on his or her own education, but also on the average education of fellow local residents. These spillover effects may be due to teamwork effects within a firm or agglomeration effects across firms, in which firms steal ideas and workers from one another. Based on Moretti's results, the model assumes an education spillover of 86 percent.[80] That is, each $1 reduction in local wages that is directly brought about for persons impacted by K–12 education spending cuts will result in a total of $1.86 in total wage reductions in the local economy.

[80] This ratio, based on Moretti, was previously calculated in Bartik, Hershbein, and Lachowska (2016). Moretti's (2004) estimates cluster around finding that a 1 percentage point increase in college graduates has an effect on others' local earnings of around a 1.2 percent increase. Bartik, Hershbein, and Lachowska estimate that getting a college degree, compared to a high school degree, increases an individual's earnings by 140.3 percent. Therefore, the individual effect of 1 percent more of the population getting a college degree is about 1.4 percent (1 percentage point times 140.3 percent), and the external effect is 1.2 percent. The total effect on local earnings of a 1 percentage point boost to local college graduates is therefore 2.6 percent. The ratio of this total effect to the individual effect is 2.6/1.4 = 1.86. I assume this "agglomeration economy multiplier" effect of education due to increased college graduates can be applied to local skill changes due to changing education spending.

The wage rate changes due to lower K–12 spending are assumed to be matched by changes in labor productivity, and therefore they have no impact, positive or negative, on whether businesses locate in the state.

In addition to these pure supply-side impacts of lower K–12 spending, the resulting lower wages are assumed to have some distributional demand-side effects on local job creation. The proportion of the reduced wages that go to the bottom 90 percent of the income distribution are calculated (see below for more on how this is done), and the fiscal multiplier derived from Zidar (2019) is used to calculate the resulting impact in destroying jobs.

Wage Premia Effects

The recommended version of the model assumes that the incented jobs pay no wage premium relative to the average job. That is, although the jobs may pay above-average wages or below-average wages, these wage differentials are exactly what can be expected based on the education and other credentials of the hired workers. The multiplier jobs and other jobs in the model are not assumed to have any wage premia on average.

However, the "Incentive inputs" worksheet does permit users to assume that incented jobs pay a wage premium. This wage premium for incented jobs, when it exists, proves to have significant effects on the benefits of incented jobs.

"High wage premium" jobs are not necessarily the same as high-wage jobs. What is key is the wage paid relative to the credentials of workers. For example, some high-tech jobs may pay high wages, but if these jobs expect workers to have a PhD, then these jobs might not pay a positive wage premium. More modestly paid factory jobs may pay a high wage premium if these jobs only require workers to have a high school diploma.

Firms or industries may pay a wage premium for a variety of reasons. Institutional factors such as unionization may play a role. Some firms or industries may find it in their interest to pay higher "efficiency wages" (Akerlof and Yellen 1986; Dickens and Katz 1987). By paying higher wages than normal, an employer can readily recruit good workers, reduce worker quits, and motivate workers. Empirically, many manufacturing jobs traditionally have paid wage premia (Katz and Summers 1989), although this may be less true today, because many manufacturing industries have faced serious economic challenges. In addition to wage premia varying across industries, wage premia may vary with an individual firm's wage strategy (Barth et al. 2016; Groshen 1991).

This wage premium is an extra benefit of the creation of the incented jobs. Based on estimates from Beaudry, Green, and Sand (2012), the dollar increase in overall local wages is assumed to be 7 percent less than expected based solely on what happens to the incented firms—an elasticity of 0.93.

Fiscal Effects

The incentive-induced increase in employment will usually be greater than the increase in population. Since a lot of revenue tends to go up with employment, and spending needs go up with population, there is some tendency for state and local tax revenues to go up faster than spending needs. However, the fiscal benefit also depends on how each tax base varies with employment, as well as on how different types of personal income are affected.

State personal income increases are calculated based on various income sources, and a large share of total personal income typically tracks employment. More specifically, the state personal income calculations look at effects on the following types of personal income:

- compensation increases due to higher employment;

- real wage increases due to higher employment putting upward pressure on wages per hour;
- wage increases if incented jobs pay higher wage premia;
- losses in wages due to negative effects on education spending;
- negative effects on locally owned businesses due to higher costs, in cases where they sell to a national market and can't pass these costs on to consumers;
- benefits for locally owned businesses if this incentive is being provided to such businesses;
- positive effects on local real incomes from outside income sources, such as national dividend income, or Social Security income, associated with population in-migration;
- negative effects on local real incomes due to higher local prices eroding the real value of income from outside sources.

Of these various personal income effects, the largest dollar value tends to be the compensation increases due to more people having jobs, so if revenue stays a constant share of personal income, and employment grows faster than population, then state and local revenue will tend to grow faster than state and local spending needs.

The model then tracks what happens with the main components of state and local general revenue. The main general revenue sources are assumed to vary in the following ways:

- Federal government revenue goes up proportionately with population.
- Property revenue effects are calculated based on how property values vary with the local shocks brought about by incentives. Property value increases will tend to increase revenues. Personal income increases will also tend to increase property taxes, as these income increases will increase housing consumption. But the increase in housing prices will tend to reduce housing consumption, which has a countervailing effect. The net property tax revenue effects combine these three calculations.
- The effects on income tax revenue, sales tax revenue, and other revenue combines two calculations. First, to the extent to which state personal income goes up with population, these revenue sources are assumed to increase proportionately with population. Second, state personal income also goes up due to increases in state per capita personal income. For income tax revenue, sales tax revenue, and other revenue, I use the elasticities of Bruce, Fox, and Tuttle (2006) for each state to ascertain the resulting revenue gain. Their elasticities for sales taxes are extended to other tax revenues. The elasticities for personal income tax revenues tend to be greater than

> those for sales/other tax revenues. And elasticities for personal income tax revenues are greater if a state has more progressive income taxes, and for sales taxes if a state has more coverage of services.

For public spending, all types of direct general expenditures are assumed to experience increased "need" that scales proportionally with population.

These elasticities are combined with Census data on average dollar values in each state for state and local general revenue in different categories, and state and local general expenditure.

The resulting calculations yield annual fiscal benefits or costs. These fiscal benefits or costs are fed back into the model and divided among spending and tax categories in the same way as incentive costs, with supply-side and demand-side effects on the state economy.

Effects on Profits of Business Owners

Business owners' profits are affected by increases in local costs that cannot be recovered by higher prices, and by the profit effect of any incentives received. In the model, only effects on the income of local residents are counted. Therefore, effects on business owners are only counted if these business owners are local residents.

The model assumes that 26.0 percent of businesses in the local economy are owned by local residents.[81] These are the only businesses whose profit effects due to higher costs are counted in the model. For cost increases that are directly or indirectly due to higher real estate costs, I assume that for local-resident-owned businesses that sell to a local market, any cost

[81] This percentage is based on assuming that 10 percent of nonfinancial corporations are locally owned and 50 percent of nonfinancial businesses that are unincorporated are locally owned. I combine this with data on the total real estate, machinery and equipment, and intellectual property owned by these two types of businesses, as of the end of 2016, from Tables B103 and B104 of the Federal Reserve System's *Flow of Funds Report* from the second quarter of 2017. Relative profits of the two sectors are assumed to be allocated with relative holdings of all types of capital. This calculation suggests 26.0 percent of business profits go to local owners.

increases are completely reflected in higher prices of local goods and services, with no profit effect. Therefore, the only real estate cost increases that reduce the profits of businesses owned by local residents are for such businesses that sell to an "export-base" market—that is, that sell outside the local economy. I assume that the export-base share among locally owned businesses is half the overall average. Based on the full set of 45 export-base industries defined in Bartik (2017a), and on 2015 industry data from BEA, 43.5 percent of value-added in the United States is in export-base industries, so the assumed percentage of export-base businesses among locally owned businesses is 21.8 percent.[82] Therefore, the cost increases due to higher real estate prices have a much-diminished net effect on the profits of locally owned businesses compared to the total increase in real estate rental prices. The assumed effect on annual real estate rents is multiplied by 26.0 percent times 21.8 percent, or 5.6 percent.

The model generates some temporary effects of labor demand shocks on increasing real wages (see discussion above). As with real estate prices, I assume that the only businesses affected by real wage increases are export-base businesses that are locally owned, which from above is equal to 5.6 percent of all businesses. However, as noted above, there is some possible effect of higher real wages on increasing productivity, as inferred by the empirical finding that higher real wages do not have as great an effect on business location decisions as is true for other cost increases. The assumed downweighting of real wage effects on location decisions is to multiply these real wage increases by 0.3. This is consistent with a model in which real wage increases of *x* percent increase productivity by 0.7 times *x* percent, with a net increase on costs of 0.3 times *x* percent. Therefore, in determining the profit loss for locally owned export businesses

[82] These calculations are based on the full set of 45 export-base industries initially identified in Bartik (2017a), not the later, more restricted set of 31 export-base industries.

from real wage increases, I multiply such real wage increases by 0.3 to reflect these productivity effects of real wage increases.

As a result, the initial increase in real wages ends up being translated into a much smaller loss for businesses, being multiplied by 5.6 percent times 0.3, or 1.7 percent.

Most incentives will go to businesses that are not locally owned. In that case, incentives have no direct effects on the profits of local residents who happen to be local business owners, although of course there are indirect effects. But users can do model simulations that allow for incentives to go to local owners. In those cases, the model calculates how much such incentives will increase profits, with this calculation based on incentive costs, the assumed effectiveness of incentives in reducing business costs per dollar spent, and the assumed adjustment costs of local owners in changing employment and output in response to incentives. More details are discussed when those alternative scenarios are presented in Bartik (2018).

Summary of Net Per Capita Income Effects

The model then gathers together the various effects, and it estimates overall effects on different types of local residents' income. These estimated overall effects on per capita incomes include the following:

- Effects on costs for state/local taxpayers, due to both direct incentive costs and the various fiscal benefits or costs that stem from incentive policy
- Effects on labor market incomes due to the increased employment to population ratios, higher wage rates from a tighter labor market, and higher wage rates from the incented jobs' wage premium
- Effects on local income from capital gains on local real estate, as a result of increased local employment increasing real estate demand relative to supply
- Effects on losses of future wages of local residents due to lower education spending
- Effects on lower profits of local businesses from higher costs, but counterbalanced in some model scenarios if locally owned businesses receive incentives
- Effects on the real income of local residents who receive either capital income (e.g.,

dividends and interest) or transfer income (e.g., SSI) from out-of-state sources, but who must pay higher prices due to effects of the incentive package and its jobs on local prices.

To avoid double counting tax revenue benefits, the last five categories are calculated as net changes in income after state and local taxes. This is done by multiplying the gross income changes by an assumed marginal state and local tax rate on higher per capita incomes, and then subtracting out this approximate tax revenue figure from the gross income figure. This procedure avoids counting taxes as a benefit in the fiscal benefit calculations without accounting for taxes' costs.

Dividing Costs and Benefits by Income Quintile

After calculating overall local benefits and costs, these different types of benefits and costs are then divided by income quintile, as follows:

- The nonbusiness portion of any increased taxes is divided among income quintiles in the same way as is implied by that particular state's average state and local personal tax rates (including income taxes, sales taxes, and property taxes) calculated in ITEP (2018). This leads to a somewhat regressive distribution of these taxes across income quintiles, as state and local personal income tax rates are relatively flat, and sales taxes are regressive.[83]
- The business portion of increased business taxes is divided among income quintiles based on the assumed incidence of business taxation by quintile from IRS research (Cronin et al. 2013). Because this research suggests that most of business taxation falls on supernormal profits, and thus is allocated with capital income, most business taxation is assumed to be borne by the top income quintiles. For example, this model suggests 76.8 percent of business taxes are paid by the top income quintile.[84]
- The costs of spending cuts are divided among income quintiles based on Tax Foundation data (Prante 2013) on how the benefits of state and local public spending are divided by quintile. Because these data suggest that state and local public spending is

[83] As mentioned above, ITEP uses mainstream assumptions about tax incidence. Most public finance economists would agree that state and local nonbusiness taxes are regressive in their incidence.

[84] The Cronin et al. (2013) figures are adjusted so that incidence breakdowns by quintile and other income group sum to 100 percent.

progressively distributed by quintile, public spending cuts have regressive effects on the income distribution.[85]

- Employment rate effects on earnings, and wage effects due to demand shocks to employment, are divided across income quintiles based on how the earnings effects of labor demand shocks vary by quintile in Table 2 of Bartik (1994). Increased earnings due to positive labor demand shocks have moderately progressive effects on the income distribution, with the dollar benefit by income quintile making up a greater percentage of income for lower income quintiles. This is particularly true for the bottom three income quintiles. There is a significant break in the benefits from labor demand shocks as we go from the middle income quintile to the next-to-highest income quintile. The highest income quintile and the next-highest income quintile gain less than their baseline income shares from shocks that increase local labor demand. However, the absolute dollar benefit of increased earnings due to positive labor demand shocks tends to go up with household income.[86]
- Effects of wage premia paid for incented jobs are derived by dividing effects by CBO figures on the share of each income quintile in total labor earnings (CBO 2016, Table 6, in Supplemental Data Appendix). These wage premia effects are distributed roughly proportionally to total income, reflecting CBO's findings that quintile shares in labor income and total income are quite similar.
- For property values, homeownership capital gains are divided by quintile using Federal Reserve data on homeownership rates and mean home value by quintile. Real estate capital gains for locally owned businesses are divided according to capital income by quintile. These property value capital gains are distributed regressively: initial income shares go disproportionately to upper income quintiles.
- The effects of education cutbacks are divided across income quintiles based on estimates from CBO (2016) of the total number of households with children in each income quintile. This relatively even distribution of these wage costs across quintiles results in a highly regressive impact of education cuts on the income distribution, as such cuts lead to larger wage cuts as a percentage of initial income for lower income quintiles.
- The effects of cost-induced changes in business income for locally owned businesses are divided among quintiles by how capital income varies by income quintile, based on CBO (2016).
- The effects of lower real values of outside-derived transfer and capital income, due to higher local prices, is divided among quintiles based on CBO (2016). This

[85] I use the Tax Foundation estimates based on the benefit principle, which assumes that public goods are more highly valued by higher-income households. I include education spending cuts in these calculations. I do not regard this as double counting, even though later the model estimates the costs of education spending cuts in terms of lower future wages for children. I view the estimated cost of education spending cuts in the Tax Foundation–based calculations as reflecting the dollar value that parents might place on education spending independent of effects on their child's future income—for example, because of its value as child care, or because of the nonpecuniary benefits of education for children.

[86] As a result, demand shocks to labor market earnings are not distributed as progressively as are wage increases due to greater education spending. See the below discussion of education spending's distributional effects.

> distribution ends up being close to proportional to each quintile's baseline income, as transfer income is distributed progressively, but capital income is distributed regressively, and the two tendencies roughly offset.

Of these assumptions, the most important is the assumption that the dollar benefits of changes in educational quality are close to evenly distributed by income quintile. This assumption is supported empirically by Chetty et al.'s (2011) research that shows that changes in education quality—in their example, kindergarten class quality—seem to show similar dollar effects on earnings at different points in the percentile distribution of test scores. Improvements in kindergarten class quality cause similar dollar increases in future income for children who otherwise would be at quite different test-score levels. This assumption is also supported by results from Bartik, Gormley, and Adelstein (2012); these results show that providing high-quality preschool is likely to cause similar dollar changes in future income for children from low-income families as for children from middle-income families.

Some support for this assumption is also provided by the estimates in Jackson, Johnson, and Persico (2016) that break down the effects of public school spending on future wage rates for children from different income backgrounds. In particular, their point estimates of effects of K–12 school spending on future wages are higher for children from low-income households than for children from non-low-income households.

Furthermore, the estimated effects of school spending on future wages for children from non-low-income households are not statistically significantly different from zero. Based on this result from Jackson, Johnson, and Persico (2016), it could be argued that the estimated income distribution effects assumed here are conservative: the model assumes the same dollar benefits per child by quintile, whereas the results from Jackson, Johnson, and Persico suggest that cutbacks in education spending for upper income quintiles might have no effects.[87]

Why might education spending cutbacks have similar or even larger dollar effects per child for children from lower income quintiles? One could argue that children from low-income households may be more dependent on school inputs for learning because neighborhood problems, family problems, and low family income may reduce nonschool learning. In addition, the public schools that lower-income children attend may have lower spending relative to their educational challenges than is true of more middle-class schools.

[87] The information in Jackson, Johnson, and Persico does not allow a full calculation of the relative dollar effects of school spending on the future earnings of persons from low-income backgrounds versus non-low-income backgrounds. They only report effects on the logarithm of wages for the two groups, and on average wages at age 30, but do not report either annual work hours for the two groups or effects of school spending on annual work hours. If annual work hours were the same in the two groups, and were unaffected by school spending, then the reported coefficients imply higher dollar effects of school spending on the earnings of persons from a low-income background. Under those assumptions, the relative dollar effect on earnings of the two groups would be proportional to the elasticity of ln wages with respect to ln school spending for the two groups, times the relative wage rates of the two groups. The elasticity of wages is 0.9598 for the low-income group and 0.5525 for the non-low-income group (Jackson, Johnson, and Persico 2016, Table IV), and the wages at age 30 are $10.60 for the low-income group and $13.60 for the non-low-income group (p. 165). If work hours are unaffected by school spending, and work hours are the same in the two groups, the ratio of dollar earnings effects of school spending in the low-income group to the non-low-income group will be $1.354 = (0.9598) \times (10.60) / [(0.5525) \times (13.60)]$. I would assume that work hours are higher in the non-low-income group, but members of the low-income group might be more likely to have their work hours affected by school spending. These two effects go in opposite directions.

Appendix D

Revision of Appendix C from Bartik (2018)

More Details on the Simulation Model

INTRODUCTION

The purpose of this appendix is to provide some additional details on the procedures used to implement the simulation model. Most of the explication of the model is in Bartik (2018), which is updated in the current report's text and Appendices B and C; this Appendix D, which updates Appendix C from Bartik (2018), seeks to preserve sufficient additional details that the model could be fully understood and reconstructed by an interested reader.

The simulation model assumes a "small" program, relative to the size of the state economy. The baseline characteristics of the state or local economy may alter incentive impacts, and incentives are estimated in the model to have economic effects. But we ignore the feedback effect due to incentives altering state or local economic characteristics, as we also ignore these alterations in turn changing incentive impacts.

The model has various factors that either multiply or shrink the impact of incentives on the local area's overall income. These impacts on different types of income are then divided among different income quintiles.

Among the features of the program that multiply or shrink the overall impact are the following, as fully explained in the main report:

- The incentive program has some cost, and it has some initial impact on the incented industries.
- The initial impact on the incented industries yields some multiplier effects on overall employment.

- The overall change in employment has some effects on housing prices and wages.
- The effects on housing prices and wages in turn have effects on reducing other employment, with some lag. These housing price and wage increases also have some effects on reducing the business income of locally owned businesses.
- The financing of the program through tax increases and spending cuts has some demand-side and supply-side effects on employment and wages.
- Some of the incentive cost may be paid to local owners of capital, enhancing their income. This also has some demand-side effects on the economy.
- The overall impact of the program on employment yields some effects on overall employment to population ratios, and this, in addition to wage changes and price changes yields effects on per capita income, and implied effects on population. These population changes in turn also yield some effect in receipt of income from outside the state.
- The directly incented jobs or the spinoff jobs may pay some wage premium, and that wage premium may have some spillover effects on wage standards for state residents.
- Effects on per capita income and population yield effects on various other spending and revenue categories, resulting in fiscal surpluses and deficits.
- These effects on fiscal surpluses and deficits, with some lag, force tax increases and spending cuts, which have some demand-side and supply-side effects on employment and wages, just as do direct incentive costs.
- The overall effects on per capita income, and the effects on various tax and spending liabilities, are divided among different income quintiles of the population.

Because the incentive impact is assumed to be small relative to the overall economy, the various elasticities can be converted into linear multipliers that translate a linear change in one variable into a linear change in another variable.[88] So, for example,

- the net job effect of the model is modeled by a "multiplier" term that gives the dollar change in wages in one part of the model;
- the job effect is multiplied by another term that gives the employment rate effect and the population effect;
- employment rate effects and population effects are multiplied by terms that generate effects on real personal income;

[88] The one exception is the effect of incentives on firm location decisions, which instead is based on a constant elasticity model because, as explained below, incentives cannot be assumed to be small relative to the costs of the incented firm.

- the dollar effect on personal income and the effect on population are multiplied by other terms that give dollar effects on personal income tax revenues, and other tax revenues; and
- the effect on population is multiplied by a term that gives the dollar effect on required public spending.

Examples will be given below.

This linearization enormously simplifies the model. A previous version of the model was written solely in terms of elasticities. Calculation of effects on different variables then requires creating a baseline time series for all predicted variables so that, using the elasticities, the logarithmic effects can be translated into actual effects on different variables. In contrast, the linearization uses the elasticities, but can simply use some baseline ratios of the levels of key variables at one point in time to calculate linear multipliers relating one predicted variable to another predicted variable. Relying on the observed levels of variables at one point in time to yield simulation results is much simpler than relying on questionable assumptions about the future trend growth rate in such variables. The model must make a few assumptions about growth rates, but if the model was kept in the elasticity form, virtually all variables would have to have predictions of future growth rates, which would be altered by interactions with incentives.

Incentive Cost and Effects on Incented Firms

This part of the analysis is straightforward, and in large part is adequately detailed in the main report, except for three additional details.

The first additional detail is that throughout the model, in figuring out dollar values, the model assumes that from 2020 on for the next 80 years, the overall productivity of the economy grows by 1.12 percent annually. This is based on estimates from the Social Security Trustees that this is the long-run-trend growth rate of real wages in the economy (SSA Trustees 2020). Thus, in determining the real wage rate associated with a certain number of jobs of some type in year *t*, it is assumed that real wages grew at 1.12 percent per year between 2020 and year *t*. Real value-added per job is also assumed to grow at 1.12 percent per year, in any calculations that require real value-added.

The second additional detail is that in modeling the effects of incentives on the location decisions of incented firms, I cannot approximate these effects with a linearization, as it is inappropriate to assume these effects are small relative to the costs of incented firms. Instead, I assume that the average effect of a change in log costs of firms translates into a change in the expected logarithmic level of expected employment for the firm. In other words, I must assume some explicit functional form for the effects of incentives on incented firms, because these effects cannot be assumed to be small, and I choose to assume a constant elasticity functional form. If this were not done—for example, if we had a very large incentive, say 20 percent of costs, and we assumed a cost responsiveness of 6, and linear functional form—we would get the absurd result that the incentive increases the probability of the firm choosing the location by 120 percent.[89] See Appendix D of Bartik (2018) for more details on the implications of this functional form assumption for the effects of incentives on incented firms.

Multiplier Effects

The multiplier analysis is also straightforward, and, by and large, is adequately detailed in Bartik (2018) and in the main portion of the current report and its Appendices B and C.

The one extra detail is about the extra local multiplier due to local ownership. This extra local multiplier is reduced to the extent to which the induced employment in one locally based

[89] In addition, because the logarithmic formulation of how costs affects location probabilities blows up if costs become zero or negative with incentives, the assumed effect on the probability of location of incented firms is maximized at close to 100 percent by not permitting the "effective" cost reduction to exceed 99.99 percent.

firm displaces other locally owned employment. Therefore, some assumptions must be made about the extent of local ownership among displaced local firms. The default assumption that is made is that 25 percent of the displaced local firms are locally owned. Therefore, the net extra multiplier from local ownership is equal to (gross local advantage multiplier) × (1 − export-base percentage) × (1 − share of local businesses among displaced businesses). For export-base firms, this is simply equal to 0.25 of the gross local advantage multiplier. For non-export-base firms, this local ownership advantage is equal to 0.25 × 0.75 = 0.1875.

Effects on Overall Wages and Housing Prices of Shocks to Employment

As explained in this report and in Bartik (2018), whatever shocks to employment occur due to initial incentive effects, multiplier effects, and other causes, they will have some effect on local wages and housing prices. These effects on wages and housing prices in turn will have some feedback effects on employment. The report explains the main assumptions made. Here, we go over some details.

Based on a wide variety of estimates in a research literature reviewed in Bartik (2015), effects on real wages of labor demand shocks are significant. These effects are estimated to be somewhat persistent over time, but they do deteriorate over time, at about 13 percent per year. The magnitude of these effects does depend significantly on the unemployment rate that would otherwise prevail.

Because the research literature estimates are of elasticities, they estimate $\text{dln}W/\text{dln}E$. But the model developed here states effects as a linear dollar effect on wages in relation to jobs created. We can write $dW/DE = (\text{dln}W/\text{dln}E) \times (\text{d}w/\text{dln}W) \times (\text{dln}E/\text{d}E)$, which in turn equals $(\text{dln}W/\text{dln}E) \times (W/E)$.

For the model, we apply this wage elasticity to total compensation, so the change in dollar compensation is derived from a similar equation.

Because this elasticity of wages or compensation depends on the prevailing unemployment rate, we need to have a time series for the underlying unemployment rate. The time series is derived from state data for the period up to 2020. Beyond 2020, the state unemployment rate is assumed to adjust toward a “full employment” unemployment rate of 3 percent, at 20 percent (one-fifth) of the differential from 3 percent per year.

Employment shocks from the incentive program may also affect the prevailing unemployment rate. However, these effects are ignored, as they will be a second order of small for incentive programs that are small relative to the overall economy.

In addition, the model assumes that the absolute change in wages each year depends on the prevailing wage rate per worker. Therefore, we need a time series for that. We use state-specific time series from BEA for compensation per FTE worker for years prior to 2021. These time series figures are adjusted using state price indices, and the national CPI, to year 2019 national values. For years beyond 2020, we assume real compensation per FTE worker goes up annually by 1.12 percent.

The elasticities of wages are taken from the literature reviewed in Bartik (2015). The variation in elasticities at different unemployment rates is derived from the new estimates in Bartik (2015). We take the first-year elasticity estimated at three different unemployment rates and use those to develop a simple equation that relates the elasticities to all unemployment rates. The baseline model adjusts these elasticities down so that they are consistent with an initial real wage elasticity of about 0.200 at the median unemployment rate in the Bartik study of 6.2 percent; 0.200 is about the average short-run real wage elasticity estimated in the research literature (Bartik 2015, Appendix). In addition, we assume that these elasticities deteriorate by a factor of 12.9 percent per year, based on the estimates in Bartik (2015, Table 1).

As will be detailed later, the shocks to employment yield effects on employment rates and hence population. The population effects in turn affect property values. We base the average elasticity of property values with respect to population on the effects estimated by Saiz (2010). The figures in Saiz are housing supply elasticities for metro areas. To get state housing price elasticities, we first derive the housing price elasticities for each metro area as one over the housing supply elasticity. For each state, we then take the population-weighted housing price elasticity. New Hampshire, Alaska, and Hawaii are missing. New Hampshire is assigned the average of Vermont and Maine. Alaska and Hawaii are assigned the U.S. average. Note that users may find the metro price elasticities useful in adapting the model to incentives targeted at particular metro areas.

We use a similar equation as was used above to figure out property-value effects per induced job—that is, to linearize the above elasticities. This requires calculation of average ratios of property values to jobs. From BEA, I downloaded household property values, corporate real estate values, and non-corporate real estate values, the last in both total, and the portion specifically for residential (e.g., landlords). I took an average of the end of quarter numbers that were appropriate and got values for 1990 to 2020. I converted to 2019 national real values using CPI-U. I then divided by population to get per capita numbers. I assumed from 2020 to 2110, the values grew at 1.12 percent, the overall national growth rate of the real economy. I then downloaded regional *rental* price parities for each state from 1998 to 2019. I divided each state's numbers by the national number. I then assumed that this same relative regional rental price could be projected to years before 1998, and years after 2019. I then adjusted this up or down to reflect different property values.

The property-value effects are used in part to determine capital gains for local property owners. For these calculations, we need to determine the change in property values from the prior year. In addition, for each class of property, we need to use some estimates of the percentage of property that is locally owned. The assumption made in the baseline is that local ownership is 100 percent of owner-occupied housing property, 10 percent of real estate owned by nonfinancial corporate businesses, and 50 percent of real estate owned by nonfinancial noncorporate businesses.

In addition, for both wages and housing prices, we need to determine their effects on costs, which will be used to determine feedback effects of these increased costs in reducing other private employment. For real wages, this is straightforward: we simply use the annual increase in real wages as the estimate of the increase in costs.

For real estate prices, we need to translate the increase in property values into ultimate effects on local prices, due to both direct effects on local housing annual costs, and indirect effects due to effects on local prices and hence on local nominal prices. First, we need to translate the increase in property values into some increase in annual rental costs. To do so, we need ratios of rental prices to owner prices for real estate. Although historically this has hovered around 5 percent, in recent years it has been lower (Davis, Lehnert, and Martin 2008). For capital gains brought about by a once-and-for-all shift in employment growth, it seems appropriate to use the long-run average of 4.90 percent that is reported by Davis et al., using Case-Shiller data, as there would be no reason that this boost to property values necessarily would result in a revision of long-run expectations of capital gains, which is what is probably driving down the rental-price-to-owner ratio in recent years.[90]

In addition, we would expect the increase in homeowner prices and private rental prices to increase overall local costs by more than the initial shock because of feedback effects on nominal wages, which will further increase costs. The required wage increase is equal to estimated increase in prices due to rents times the labor share of after-tax total spending, based on CBO.

The local price increase is the direct increase in housing prices multiplied by some factor that reflects a reduced form estimate of feedback effects on overall local prices. The direct increase in housing prices is sum of direct effect on homeowner equivalent rent and apartment rental prices. These increases in "rental prices" are based on the increase in property values, multiplied by an assumed ratio of annual rents to property values. The multiplication factor occurs because when local housing prices go up, in addition to directly raising overall local prices, local prices will go up by more due to effects on local business rentals, and increases in local wages. Rather than doing a structural model of the magnitude of these feedback effects, I rely on research from Aten (2006). This research shows that although direct housing price effects are only 29 percent of the overall market basket that makes up overall local prices, a regression of local overall prices on local housing prices yields a coefficient of 0.50, which is 1.74 times what one would expect based on housing's share of overall consumption.

All of this is entered on columns AB through AH on the "Propertyvalue&cost&pricechange" worksheet. Column AG is the overall local cost increase for businesses, and column AE = AH is the overall local price increase.

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[90] The relevant Davis, Lehnert, and Martin (2008) data can be downloaded at the Land and Property Values section of the website of the Lincoln Institute on Land Policy.

For demand-side effects of changes in local wealth due to changes in local property values, we rely on evidence from Howard (2020), backed up by Berger et al. (2015), that the elasticity of consumption with respect to house prices might be 0.2. Some manipulation shows the following for the expected change in local employment:

$$(dE/dV_h) = (dE/dC_l) \times (dC_l/dC) \times (dC/d\ln C) \times (d\ln C/d\ln P_h) \times (d\ln P_h/dP_h) \times (dP_h/d(P_h \times H)) ,$$

where C_l is local consumption, C is overall consumption, E is employment, P_h is the price of housing, H is the quantity of housing, and V_h is the value of housing (= $P_h \times H$).

In the above equation, (dE/dC_l) is how much employment goes up with an increase in local consumption. We assume this is 1 over average private value-added per FTE worker. dC_l/dC is how much local consumption goes up for a \$1 increase in overall consumption: we assume this is 0.5; $(d\ln C/d\ln P_h)$ is the elasticity mentioned above, which is assumed to be equal to 0.2.

This ends up being (1/*VA* per private-sector worker) × 0.5 × (C/V).

So, we need to know the ratio of consumption to local real estate wealth, or C/V. From our real estate calculations based on the Federal Reserve Board’s (2016, 2017) data, we get that in 2015 local real estate wealth in the United States averaged \$27.4 trillion. Personal consumption expenditures in the United States in 2015 were \$12.3 trillion. The ratio is 0.448.

Value-added per private sector worker is calculated in real terms for each state, and adjusted to 2019 national dollars, based on data from BEA. See below for more details.

Employment Feedback Effects of Increased Wages and Rental Costs

These increased costs from higher real wages, and from higher rental costs of real estate (including feedback effects through higher local prices and higher local nominal wages), will tend to reduce overall employment. This report and Bartik (2018) explain how these adjustments are done.

One detail is that in implementing the model, we assume that the long-run adjustment is toward the long-run equilibrium implied by last year's boost to costs. This introduces a further one-year lag into the model and assumes that business decision makers observe cost changes and then react in their next year's decisions to last year's costs. One reason for making this assumption is that it reduces the simultaneity in the model. Employment in the model immediately affects wages and housing prices, and if those price changes in turn immediately affect employment, the model becomes more complicated to solve. However, it seems plausible to introduce some lags in response, and a one-year lag in overall business activity response does not seem unreasonable. Once employment is reduced because of increased costs, this in turn dampens the increased costs through a feedback effect.

As we have done previously, we linearize the model to get simple multipliers. The effect of a dollar change in costs on the number of jobs can be written as $dE/dC = (d\ln E/d\ln C) \times (E/C)$. We merely weight the elasticity by the ratio of employment to costs, where costs are considered to be value-added.[91]

We consider the relevant ratio to be the ratio of FTE to GSP for all activity, including government. Government employment may also respond to increased costs, and should be included.

To derive this, we want real value-added per FTE for each state. But how to do real? The state real numbers the BEA uses gather nominal compensation by industry and use this in part to get nominal value-added. Then the Census uses industry-specific price indices at national level to

[91] One detail is that we consider last year's increment to wage costs and effective rental costs, and therefore we weight by last year's ratio of employment to costs.

get real GDP. But I don't think this is right. The real labor input will not be given by this calculation, given that there will be state-specific wages given state-specific prices. In addition, I am measuring costs given state adjustments to prices and national price trends. So, I think I should be consistent in how real GDP is measured at the state level to how it is measured elsewhere in the model.

To use a consistent procedure for real GDP, since I go back to 1990, I use nominal GSP at the state level based on the SIC system from 1990 to 1996. I use the ratio of NAICS to SIC for each state in 1997 to adjust the SIC numbers by state. I then convert the nominal state GSP numbers to real numbers by using regional price parities and the CPI-U. I then calculate real GSP per FTE using state employment numbers and national ratios of employment to FTE.

Demand Effects Due to Opportunity Cost of Funds

The funds used to finance the incentives must come from either increased state and local taxes or decreased state and local spending, given balanced budget multiplier effects. In addition, later in the model, any fiscal benefits or costs from the economic development created by the incentive must also be financed in some way.

The demand-side effects of spending cuts and tax increases are described in the main text and are straightforward. The methodology in moving from the estimates of Suárez Serrato and Wingender (2016) and Zidar (2019) to the actual estimates here, which are costs of creating or destroying one job in 2019 dollars, is described fully in Bartik (2017b). The initial 2019 national costs are then adjusted to other years by assuming that these costs change in real terms by 1.12 percent per year.

If the tax incentive is financed by increases in household taxes, the calculated demand-side feedback effects on jobs combines the estimates from Zidar (2019), adjusted as shown in Bartik (2017b), along with data from CBO, Ernst and Young, and ITEP.

First, data from Ernst and Young is used to determine the business-tax share in a particular state of any tax increase (Ernst and Young 2020).

Then, we determine what share of business taxes and nonbusiness taxes at the state and local level are paid by the bottom 90 percent of the state income distribution, and what share by the top 10 percent. This focus on the bottom 90 percent versus the top 10 percent is based on Zidar's finding that tax changes for the top 10 percent have no demand-side effects on state economies and jobs, whereas tax changes for the bottom 90 percent have sizable effects.

For business taxes, we use CBO income distribution data to determine that the top 10 percent of the income distribution gets 80.7 percent of all capital income. This is based on Table 6 in CBO's supplemental data to CBO's June 2016 report (CBO 2016). The broad capital income calculation here includes CBO's narrow capital income category, plus capital gains, plus business income, plus the portion of the corporate income tax that CBO assumes is borne by capital.

For nonbusiness taxes, we look to the income distribution tables done by ITEP (2020). We exclude the nonhousehold categories. We use estimates from Ernst and Young (2020) for business-paid portion of individual income taxes, and divide by Census of Governments figures on individual income tax collections to get state-specific shares of income taxes that are on pass-through business income, and so we only use the remaining percentage (typically above 80 percent) that is on households. We use ITEP's figures for the distribution of nonbusiness taxes for each state by income group. ITEP breaks the income distribution at the eightieth percentile and the ninety-fifth percentile. We assume the ninetieth percentile share is halfway in between the eightieth percentile and the ninety-fifth percentile (not two-thirds, because of the skewed income distribution).

The resulting calculations then allow us to calculate nonbusiness taxes on the bottom 90 percent and top 10 percent, and business taxes on the bottom 90 percent and top 10 percent. Zidar finds that tax changes on the top 10 percent have zero demand-side effects on state economies, and we adopt that assumption by assuming essentially an infinite cost per job created and destroyed for tax changes on this group. For the bottom 90 percent, he finds relatively low costs per job created and destroyed. We take his number and translate the figures into 2019 estimates per FTE job, as described more fully in Bartik (2017b). This initial 2019 figure is then allowed to years other than 2019 by assuming an annual adjustment in real terms of 1.12 percent.

In addition, Zidar's national average number for 2019 of $45,178 per job is adjusted to be a state-specific 2019 number. This is because his estimates are based on federal tax changes by state, and the demand effect of such taxes will vary slightly based on state and local taxes that are not income taxes, but rather might apply to consumption, such as sales and property taxes. The basic idea is that we slightly inflate the $45,178 cost per job if the state has above average non-income taxes on the bottom 90 percent, and slightly deflate this cost if the state has below average non-income taxes on the bottom 90 percent. Appendix B gives more details.

These demand-side effects may include some supply-side effects if changes in personal taxes or changes in spending on various programs (e.g., child care programs) lead to immediate supply-side effects on the quantity of labor supply or on labor productivity. However, these fiscal offsets clearly do not include other supply-side effects of financing that are longer term, such as the effects of higher business taxes on long-run business activity, or the effects of lower education spending on long-run labor productivity and wages. These long-run supply-side effects are allowed for separately below.

Supply-Side Effects Due to Higher Business Taxes

If the incentive program is financed from higher business taxes, these higher business taxes will have some long-run effects on job creation decisions. We assume that the change in business taxes, as a percentage of average value-added per job in the private business sector, leads to a long-run change in employment equal to some multiple, where that multiple is the same as what is used to ascertain the direct effects of incentives on incented businesses. The difference here is that the value-added per FTE job in the private business sector will tend to be lower than for export-base businesses. Also, we assume that higher business taxes do not have multiplier effects, as the estimated elasticities already take such multipliers into account. The model also allows for value-added per FTE job in the private business sector to grow over time, at a rate of 1.12 percent annually.

Supply-Side Effects Due to Lower Public School Spending

If the incentive costs, and any other fiscal effects, are financed by spending cuts, these cuts may include cuts to public school spending. We allow for those public school spending cuts to have supply-side effects by affecting worker productivity and wages of workers who grew up attending public schools, are still alive, and remain in the state economy.

The default percentage of spending cuts that go to public schools is assumed to be the average percentage of total state and local public direct general expenditures that go to K–12 education in that state, as measured by the U.S. Census Bureau.

I use the estimates derived by Jackson, Johnson, and Persico (2016) as the default effects of education on earnings. Specifically, their preferred estimates suggest that the elasticity of the natural log of the wage-rate ages 20–45 with respect to a log change in per-pupil expenditure is 0.7743. This is for all income levels. The effect for the nonpoor is 0.5525, and this would be a possible value if one thought that this group would dominate in the aggregate numbers. Also, one could support lower numbers, as Jackson, Johnson, and Persico's numbers are derived in part from court orders to help low-income schools (as well as from other court orders dealing with the adequacy of K–12 spending), and it is certainly plausible that the returns to spending increases in general might be lower than the returns to spending increases for low-income schools. Therefore, the model also includes a variable enabling this sensitivity to school spending to be adjusted downward.

Jackson, Johnson, and Persico's numbers are for effects of a given increase in expenditure for 13 years of schooling. We assume that the effects of merely changing one year of schooling are one-thirteenth as great.

In calculating our estimates, we first consider the effects of just changing spending in one year. That change affects 13 different cohorts—those in kindergarten, first grade, and so on up through twelfth grade. Each of them, because of the change in per-pupil spending by *x* percent, will experience a percentage earnings effect that is one-thirteenth as great as the 0.7743 effect. I assume that this effect occurs evenly throughout the person's lifetime, at all ages, even though there is some evidence (see Jackson, Johnson, and Persico) that the effects might grow over time. In addition, the fact that effects are growing over time may imply that using Jackson, Johnson, and Persico's numbers to predict lifetime effects may understate effects, as we are missing some of the prime earning years after age 45.

The Jackson, Johnson, and Persico estimates already implicitly adjust for some individuals not attending public school, so we do not need to further control for that variable.

However, in looking at effects on state earnings, we need to allow for mortality and outmigration. Hence, for each of the 13 cohorts, we will allow for the probability of surviving to a given age, and the probability of living elsewhere than the state one lived in at a particular age. The survival probabilities will be calculated by averaging the male and female survival probability to age *a*, compared to the initial age of this intervention. The probability of living elsewhere is based on the percentage of persons living in their birth state at age *a* compared to the initial age of this intervention.[92] These two probabilities will be multiplied by the number showing the effect of public school spending on all persons unconditional on whether the person survives or on what state they end up in.

We want to get a set of dollar numbers showing the change in dollar earnings by year for a change in public school spending by year, or

dE_{ca}/dP_t .

Without changing anything, this can be rewritten as the effect on an individual's earnings, so we can redefine E_{ca} as earnings per person at age *a* for cohort *c*, and P_t as public school spending per person.

We can then rewrite this as $dE_{ca}/dP_t = (d\ln E_{ca}/d\ln P_t) \times E_{ca}/P_t$. $d\ln E_{ca}/d\ln P_t$ is the elasticity parameter estimated by Jackson, Johnson, and Persico, divided by 13. E_{ca} is the average earnings at a particular age of a typical person. P_t is public school spending per pupil.

We get E_{ca} by first obtaining a cross-sectional set of observations on earnings by single year of age from the American Community Survey (ACS) for 2015. We then adjust this to make it expected future earnings by assuming for each cohort from 2015 that their earnings at a given

[92] For both the survival probabilities and the staying probabilities, I use the same values for all states. Future refinements of the model could add variation by state.

age will grow in real terms by 1.2 percent annually from their current age to the age at which they would receive those cross-sectional earnings.

We get P_t as public school spending per pupil as of 2015.

We calculate this separately for each of 13 cohorts for their entire working career. We then multiply the actual numbers for each cohort by their survival and staying probabilities for each age. We then have a series of numbers, when we sum across the 13 cohorts, for the dollar change in earnings in each future year that can be expected because of a dollar change in public school spending in the initial year, 2015.

What do we do with these numbers for other years? Earnings will grow over time, at some historical rate in each state from 1990 to 2020, and at an assumed 1.12 percent per year after 2020. But on the other hand, one might assume that per-pupil spending in the long term may vary similarly to real earnings. The net result is that I decided to use the same set of multipliers for all years. Although the ratio is calculated for 2015, it can be assumed to not vary dramatically over time, as it takes the ratio of an earnings effect at one time to a spending cause at an earlier time.

Finally, the numbers for each year may be subject to an educational spillover multiplier. We assign such a spillover based on Moretti's numbers on such spillovers. This is used to multiply all the numbers.

The practical complexity of this model is that for each year we must construct a separate set of earnings multipliers for each of 13 cohorts, as the growth in earnings, mortality, and moving behavior for each of the 13 cohorts will differ. We then sum over 13 cohorts to get effects per dollar on earnings for each of 80 subsequent years of history. This is then multiplied by the dollar change in education funding to get actual effects on earnings. Then for each year of the simulation, we need to apply the dollar change in education spending to the vector giving the dollar change in earnings per dollar of education spending for each year to get subsequent changes in earnings.

For the staying probabilities, we use data from the 2000 Census PUMS on the percentage of people living in their birth state at different ages, and take ratios of the percentage living in their birth state at age *a* to the percentage living in their birth state at the assumed earlier age. Comparison of this with data from the Panel Survey of Income Dynamics data on staying shows that this matches reasonably well at younger ages, but tends to slightly overestimate staying at later ages. However, given that U.S. internal mobility has fallen in recent years, this overstatement of staying relative to 2000 may lead to more accurate staying predictions.

The net result of all this is a vector of changes in earnings in the state economy due to changes in education funding. In the model, this is treated as directly occurring solely because of changes in wages, so jobs do not directly change. However, there will be indirect changes in jobs due to demand-side effects of the change in wages.

To implement these demand-side changes, we assume that the estimates by Zidar (2019) of the demand-side effects of taxes can be used to determine the demand-side effect of changes in wages. Zidar's estimates imply that only changes in the net income of the bottom 90 percent of the income distribution matter in affecting local jobs. The initial multiplier effect from Zidar implies that initially, in 2019 dollars, each $45,178 reduction in wages for the bottom 90 percent due to education cutbacks (or increase in wages due to education spending expansions) will destroy (or create) one job. This Zidar multiplier is adjusted by a 1.12 percent annual growth rate to other years of the model.[93] To determine what share of the wage changes due to education

[93] As described above, it is also slightly adjusted by state to reflect differences in state taxes that apply to household consumption.

cutbacks (or education expansions) go to the bottom 90 percent, we use data from the CBO that show that 91.54 percent of households with children are in the bottom 90 percent of the income distribution. This allocation of education's wage effects by the count of households with children is consistent with how the effects of education on wages are divided by income quintile, as will be discussed later in this appendix.

Effects of Incentives to Local Business Owners on Local Demand

Most incentives are assumed to be provided to businesses owned outside the local area. These incentive dollars, and whatever effect they have on business profits, may affect business location decisions but are assumed to be respent outside the local economy. Therefore, these incentive dollars do not have direct demand effects on the local economy.

But in some cases, incentives are provided to local business owners. These incentives will have some effect on business profits. If local business owners did not respond at all to incentives, the increase in their profits will simply be equal to the dollar cost of the incentives times the assumed ratio of incentive effectiveness to dollar costs. But in general, we expect incented businesses to respond by expanding employment and output. If there is an upward sloping business supply curve of output and/or a downward sloping labor demand curve, this expansion raises costs of the firm. To calculate the increase in profits, we treat the incentive as if it lowers the effective cost of labor. The firm's labor demand then expands in response to the lower cost. The gain in profits is the area to the left of the labor demand curve, between the old and new labor cost lines. This differs from the incentive cost times its effectiveness by an area that would be a "Harberger triangle." That is, if one makes the simplifying assumption that the labor demand curve is linear, the adjustment cost reduces the profit gain by one-half the change in costs times the change in jobs. We make this simplifying assumption.[94]

In practice, I calculate this Harberger triangle area by multiplying the (incentive cost times service effectiveness) per FTE worker times (the change in the number of workers due to the incentive) times one-half. This adjustment is small if the incentive is assumed to only induce a small percentage of the incented jobs. In general, the adjustment as a percentage of incentive costs times the incentive effectiveness ratio will be one-half the percentage of incented jobs that are actually induced.

What effect does this change in profits have on local demand? Based on Zidar's research, I assume that such income increases only have demand effects to the extent to which this change in profits is received by business owners in the bottom 90 percent of the income distribution. The model assumes that the incentive payments to local business owners are distributed across the income distribution in the same way that capital income is distributed across the income distribution, based on CBO (2016). According to CBO, 78.9 percent of capital income goes to the top 10 percent of the income distribution, and 21.1 percent of capital income goes to the bottom 90 percent of the income distribution.

The local demand effect is assumed to be given by Zidar's results. Specifically, I assume that in Year One, each \$*x* increase in profits of local business owners in the bottom 90 percent of the income distribution due to incentive payments increases local demand sufficiently to increase FTE local jobs by \$*x* divided by \$45,178 in 2019 national dollars, and is adjusted by 1.12 percent per year to other years.

[94] One could instead assume the labor demand curve is log-linear, but this would require numerically integrating the appropriate area, which seems an unnecessary complication for modest gains in computational accuracy. And since we are not sure of the true functional form of labor demand, any assumed functional form may be in error.

Effects on Labor Force Participants, Unemployment, Full-Time Employment, and Employment of Local Residents, Population of Employed New Residents, and Overall Population

We next see what effect the overall demand shock to employment, resulting from all these changes, has on the number of local residents who are labor force participants, the number of unemployed, the number of local residents who are full-time employed or employed at all, the number of new residents who are employed, and the overall population.

Because effects are stated as FTE employment, what we are trying to determine are $dLFP/dF$, dU/dF, dF_l/dF, dE_l/dF, dP_w/dF, and dP/dF, where F is total FTE in the state, LFP is the number of labor force participants among local residents, U is the number of unemployed local residents, F_l is the FTE level of local residents holding jobs, E_l is the number of local residents holding jobs, P_w is the population of new residents holding jobs, and P is the total population including new residents. In addition, we define the labor force participation rate among local residents as $LFPR = LFP/POP$, and the unemployment rate among local residents as $UR = U/LFP$. We also note that total employment, not just full-time-employment, can be written as $E = LFPR \times (1 - UR) \times POP$.

To begin with, we calculate the change in local residents who are labor force participants and who would then be expected to be employed at the prevailing unemployment rate. This is $d[LFPR(1\text{-}UR)POP]/dF = (d\ln LFPR/d\ln E) \times (1\text{-}UR) \times POP \times (d\ln E/d\ln F) \times (LFPR/F)$.

We assume $(d\ln E/d\ln F)$ equals one (total employment and total FTE employment expand by the same percentage). This expression then simplifies to the labor force participation elasticity (the first term, or $d\ln LFPR/d\ln E$) times the ratio (E/F).

The labor force elasticity term will depend on the prime-age employment rate, as shown in Bartik (2023). The elasticity at a prime-age employment rate of 81.0 percent will be 0.137, meaning that the labor force participation rate increases enough that at that prime-age employment rate, initially 137 out of every 1,000 new jobs will go to local residents who otherwise would not be in the labor force. The elasticity at a lower prime-age employment rate of 75.0 percent will be 0.311, meaning that at that baseline prime-age employment rate, initially 311 out of every 1,000 new jobs will go to local residents who otherwise would not be in the labor force.

This elasticity varies over time—first, with the prime-age employment rate. Therefore, the effect of a shock at time *t*0, as of some later time *t*1, is assumed initially to be the number of jobs created at time *t*0 times the appropriate elasticity, given the prime-age employment rate, at time *t*1.

The empirical research literature does not find huge depreciation of labor force participation rate effects over time, say for 5 or 10 years (Bartik 1991, 2015). However, it seems absurd to think that labor force participation rate effects of an initial shock to some population continue forever, even as that original population leaves the state, drops out of the labor force as it ages, or dies.

Therefore, we allow these labor force participation rate effects to depreciate over time. This depreciation is based on reasonable assumptions about labor force participation patterns, migration, and survival. To derive the appropriate depreciation percentages, I use data from the American Community Survey for labor force participation rates for the nation, for each year of age from ages 16 to 80 for 2015, along with the same staying and survival data used above for calculating the long-run effects of education spending. The idea here is that the long-run effects on labor force participation of a one-time job shock are due to permanent human capital effects on the persons in the state as of the year the shock takes place. The size of this shock's implications for overall labor force participation rates depends on how many of the original residents stay in the state, how many survive, and their likely labor force participation rate based on their age distribution.

For each individual year of age cohort *c* of local residents, the change in employment due to labor force participation rate effects of some shock to FTE employment as of some later date will be as follows:

$\mathrm{d}LFPR_c(1\text{-}UR)(POP_c)/\mathrm{d}F$, where $\mathrm{d}LFPR_c$ is the change in labor force participation rates for that cohort as of some later date, and POP_c is the population of that cohort that remains in the state as of that later year, accounting for out-migration and deaths.[95] We can rewrite this cohort-specific effect on employment of local residents as

$$\mathrm{d}LFPR_c\,(1 - UR)(POP_c)\,/\,\mathrm{d}F = [(1 - UR)\,/\,F] \times (\mathrm{dln}LFPR_c\,/\,\mathrm{dln}E) \times POP_c \times (\mathrm{dln}E/\mathrm{dln}F) \times LFPR_c\,.$$

As before, we assume that $(\mathrm{dln}E/\mathrm{dln}F)$ equals one, so that term goes away.

If we assume the labor force participation rate elasticity is constant across cohorts, then we can write the following expression for the sum of this term across cohorts, where the summations are across all age cohorts *c* from initial age 16 to age 79:

$$\sum \mathrm{d}LFPR_c\,(1 - UR)(POP_c)\,/\,\mathrm{d}f = [(1 - UR)\,/\,F] \times (\mathrm{dln}LFPR\,/\,\mathrm{dln}E) \times \sum[POP_c \times LFPR_c].$$

In the initial time period, the population is the original population of the area for each age cohort, and the labor force participation rate is whatever labor force participation rate each age cohort has. In the next year, the age cohort ages by one year. There is some probability that each age cohort remains in that same state. We ascertain that probability by using the Census PUMS from 2000 to calculate the ratio of the proportion living in their birth state at age $a0 + 1$ to the proportion living in their birth state at age $a0$. (As mentioned above in discussing the education

[95] I implicitly assume that the unemployment rate is the same for all cohorts.

calculations, this ratio is close to the net proportion staying in their childhood state for the same persons followed from one year to the next that is estimated in the Panel Survey of Income Dynamics.) There is some probability of death from one year to the next for the persons in each age cohort. We ascertain that probability by using the U.S. Life Tables to calculate the ratio of the proportion surviving to age $a0+1$ compared to the proportion surviving to age $a0$. We multiply these two ratios or two probabilities by the original population of each age cohort to get the estimated surviving population in that state one year later. The baseline labor force participation rate for that age cohort c in the next year is ascertained by using the ACS 2015 to estimate the labor force participation rate at that one-year-later age. Finally, we sum the product of these estimated surviving and staying populations and labor force participation rates of each age cohort to get $\sum[POP_c \times LFPR_c]$ one year later. We then take the ratio of this summation to the similar summation for the first year to get a ratio. We do the same calculation for each subsequent year. We then, for each subsequent year, get a cumulative probability by multiplying these ratios together. Appendix Table D1 shows the underlying data.

The population data shows that initially the younger cohorts dominate, although obviously as the population ages, the younger cohorts go away and the older cohorts dominate. The survival data shows some slight death rates at earlier ages, accelerating at later ages, so this variable tends to lead to slight depreciation of the labor force participation rates at first, but accelerates much more as the cohorts age. The "birth-state" staying variable shows some initially greater out-migration in the more populous younger cohorts, so this variable tends to contribute to greater depreciation of the labor force participation rate effects at first, and somewhat lower depreciation later. However, the birth-state staying variable never shows very great depreciation from year to year or even over a cumulative number of years. Finally, the labor force

Table D1 Inputs into Calculating Persistence of Shocks to Labor Force Participation

Age	Population of cohort in millions, based on 2015 ACS	Survival rate (as % of those born)	Staying in birth state rate (%)	Labor force participation rate (%)
16	4.203	99.1%	78.7%	17.4%
17	4.159	99.1%	79.0%	30.2%
18	4.531	99.0%	75.4%	45.8%
19	4.175	99.0%	72.3%	58.5%
20	4.644	98.9%	72.1%	66.3%
21	4.618	98.8%	71.0%	70.4%
22	4.524	98.8%	70.1%	75.6%
23	4.443	98.7%	69.3%	79.5%
24	4.412	98.6%	68.5%	81.1%
25	4.804	98.5%	66.8%	82.1%
26	4.498	98.4%	66.2%	82.5%
27	4.383	98.3%	65.7%	83.1%
28	4.317	98.2%	65.0%	82.9%
29	4.238	98.1%	64.4%	83.2%
30	4.608	98.0%	63.7%	83.0%
31	4.200	97.9%	63.5%	82.7%
32	4.303	97.8%	63.6%	82.9%
33	4.248	97.7%	63.6%	82.7%
34	4.226	97.6%	63.6%	82.4%
35	4.498	97.4%	63.0%	82.0%
36	4.121	97.3%	62.5%	82.2%
37	4.013	97.2%	62.3%	82.2%
38	4.035	97.0%	62.6%	83.2%
39	3.891	96.9%	62.4%	82.4%
40	4.221	96.7%	62.3%	82.3%
41	3.812	96.6%	62.0%	83.0%
42	4.031	96.4%	62.0%	82.6%
43	4.069	96.2%	61.7%	82.5%
44	4.308	96.0%	61.6%	82.8%
45	4.459	95.7%	60.9%	82.7%
46	4.103	95.5%	60.7%	82.3%
47	4.009	95.2%	60.4%	82.0%
48	4.056	94.9%	60.2%	81.5%
49	4.195	94.5%	59.8%	81.1%
50	4.620	94.2%	59.6%	79.9%
51	4.349	93.8%	59.4%	79.8%
52	4.485	93.3%	58.5%	78.8%
53	4.428	92.8%	58.1%	77.5%
54	4.440	92.3%	57.0%	77.3%
55	4.552	91.8%	56.0%	75.5%
56	4.335	91.2%	56.4%	73.9%
57	4.312	90.6%	56.8%	72.4%
58	4.271	89.9%	57.5%	71.0%
59	4.102	89.2%	56.8%	69.1%
60	4.254	88.4%	57.4%	65.2%
61	3.907	87.6%	57.2%	61.8%
62	3.842	86.7%	57.7%	55.8%
63	3.719	85.8%	57.2%	50.2%
64	3.554	84.8%	57.5%	46.2%
65	3.496	83.8%	57.3%	39.2%

Table D1 (Continued)

Age	Population of cohort in millions, based on 2015 ACS	Survival rate (as % of those born)	Staying in birth state rate (%)	Labor force participation rate (%)
66	3.320	82.7%	57.6%	34.1%
67	3.335	81.6%	57.6%	30.0%
68	3.347	80.3%	57.8%	27.4%
69	2.602	79.0%	57.9%	24.6%
70	2.549	77.6%	57.8%	21.6%
71	2.398	76.0%	57.7%	19.0%
72	2.431	74.4%	57.9%	17.6%
73	2.173	72.6%	57.5%	15.8%
74	1.948	70.7%	57.7%	14.8%
75	1.833	68.7%	57.7%	12.7%
76	1.717	66.6%	57.4%	11.3%
77	1.651	64.3%	57.5%	9.4%
78	1.536	61.8%	57.2%	8.5%
79	1.409	59.2%	57.4%	7.9%

NOTE: Population numbers are sum of person weights from 2015 American Community Survey. Survival rates are proportion of population surviving to various ages, from U.S. Life Tables. Proportion living in birth state are figures from 2000 U.S. Census. Labor force participation rates are weighted averages calculated from unallocated data in 2015 American Community Survey.

participation rate variable at first contributes to some mix of appreciation and depreciation, as at first some of the younger and more populous cohorts tend to have increasing labor force participation rates. However, later, as the entire age distribution of the original local residents age, the labor force participation rate variable leads to much more severe depreciation, as older cohort labor force depreciation rates head dramatically downward.

Appendix Table D2 shows the resulting assumptions about the year-to-year and cumulative depreciation rates of the labor force participation rates, based on the combined effects of populations aging and as a result of sometimes leaving the state, dying, or dropping out of the labor force.

The year-to-year depreciation rates are only 1 percent from Year 1 to Year 2, gradually increase to 3 percent in Year 10, 4 percent in Year 20, 5 percent in Year 30, 8.5 percent in Year 40, and then more dramatically to 15 percent in Year 50 and 26 percent in Year 60. The cumulative depreciation rate is only 1 percent from Year 1 to 2, but goes up to 18 percent at Year 10, 42 percent at Year 20, 63 percent at Year 30, 82 percent at Year 40, 95 percent at Year 50,

Table D2 Year-to-Year Changes in Labor Force Participation of Surviving and Staying Population, and Cumulative Change in Labor Force Participation

	Year-to-year ratio of human capital of surviving and staying population at Year *t* compared to Year *t*−1	Cumulative total human capital of surviving and staying population at Year *t*, ratio to Year 1
Year	Year-to-year	Cumulative
1	1.0000	1.0000
2	0.9909	0.9909
3	0.9867	0.9777
4	0.9823	0.9604
5	0.9790	0.9402
6	0.9762	0.9178
7	0.9747	0.8947
8	0.9727	0.8702
9	0.9711	0.8451
10	0.9700	0.8197
11	0.9693	0.7945
12	0.9688	0.7697
13	0.9677	0.7448
14	0.9673	0.7205
15	0.9667	0.6964
16	0.9659	0.6727
17	0.9653	0.6493
18	0.9641	0.6260
19	0.9633	0.6030
20	0.9623	0.5803
21	0.9613	0.5578
22	0.9604	0.5357
23	0.9593	0.5139
24	0.9573	0.4920
25	0.9563	0.4705
26	0.9543	0.4490
27	0.9527	0.4277
28	0.9508	0.4067
29	0.9489	0.3859
30	0.9466	0.3653
31	0.9440	0.3448
32	0.9421	0.3249
33	0.9393	0.3052
34	0.9366	0.2858
35	0.9334	0.2668
36	0.9298	0.2480
37	0.9262	0.2297
38	0.9228	0.2120
39	0.9192	0.1949
40	0.9150	0.1783
41	0.9104	0.1623
42	0.9048	0.1469
43	0.8977	0.1319
44	0.8893	0.1173
45	0.8820	0.1034
46	0.8733	0.0903
47	0.8671	0.0783
48	0.8620	0.0675

Table D2 (Continued)

Year	Year-to-year ratio of human capital of surviving and staying population at Year t compared to Year $t-1$	Cumulative total human capital of surviving and staying population at Year t, ratio to Year 1
	Year-to-year	Cumulative
49	0.8594	0.0580
50	0.8516	0.0494
51	0.8512	0.0421
52	0.8511	0.0358
53	0.8477	0.0303
54	0.8390	0.0255
55	0.8302	0.0211
56	0.8195	0.0173
57	0.8167	0.0141
58	0.7977	0.0113
59	0.7794	0.0088
60	0.7422	0.0065
61	0.7116	0.0046
62	0.6744	0.0031
63	0.5968	0.0019
64	0.4735	0.0009
65 and after	0	0

NOTE: The year-to-year probability measures the total labor force participation of the surviving and staying population in year t versus year $t-1$, based on the assumed age-specific staying and surviving and labor force participation probabilities, and the estimated age distribution of the original population for each year of the simulation. The cumulative probability measures the total labor force participation of the initial population at Year 1 that survives and stays to Year t, compared to Year 1, as measured by total expected labor force participation of the survivors and stayers at Year t as a ratio to total expected labor force participation at Year 1.

and 99 percent at Year 60. The model ends up with a result that can be reconciled both with the empirical literature and with common sense. Consistent with the empirical literature, labor force participation rate effects of labor demand shocks do not depreciate much for the first 10 years or so, but then depreciate almost completely as the original population either leaves the state, drops out of the labor force, or dies, with this depreciation accelerating over time.

The unemployment-rate changes from a demand shock are derived more simply. The effect of a labor demand shock is assumed to decay log linearly from the initial shock.

We derive that

$$dU/dF = (d\ln(LFP-U)/LFP)/d\ln E) \times (d\ln E/d\ln F) \times (d\ln F/dF) \times (dU/d\ln((LFP-U)/LFP).$$

The second term is assumed equal to 1. (FTE and all employment grow at the same percentage rate.)

We can then reduce this equation to

dU/dF = (first elasticity term) × ($-E/F$).

The first elasticity term will vary with both the prevailing unemployment rate and the length of the time since the growth shock.

We use the estimates underlying Bartik (2015) to estimate effects on unemployment. These models imply that the initial effect of a shock to employment at 6.2 percent unemployment is an elasticity of about 0.476. This elasticity means that for every 1,000 new jobs created, 476 go to local residents who otherwise would be unemployed. This elasticity goes up to 0.586 at 10 percent unemployment. This initial elasticity, because of a shock, decays at 27 percent per year—that is, each year the elasticity with respect to the shock is about 0.729 of the year before. We assume that the elasticity varies with both the current unemployment rate and the years since the shock, so that the actual elasticity in any given year for a given growth shock is equal to the appropriate elasticity for the current unemployment rate, times 0.729 taken to the number of years since the shock.

From the shock to full-time employment, we can infer the shock to employment, assuming both are the same percentage. By subtracting the change in local non–labor force participants taking jobs, and the change in the local unemployed taking jobs, we get the change in the number of in-migrant workers taking jobs. By subtracting this from the change in employment, we get the change in local workers taking jobs. Then we can adjust back to the change in FTE local workers. Finally, from the ratio of U.S. population to workers, we can infer the change in overall population that corresponds to the change in the number of in-migrant workers. (This implicitly assumes that both adjust locally by the same percentage.)

Wage Premia Effects

The wage premia calculations are described adequately in Bartik (2018, pp. 9–32), which is edited to be Appendix C of the current report.

Fiscal Benefits or Costs

Fiscal benefits or costs are based on observing what happens to per capita income and population, and how this affects various tax bases and spending needs.

To generate this, we first must measure the increase in personal income, which is modeled as the sum of different components:

- Compensation changes due to increased employment is directly measured.
- Compensation changes per worker are added in due to employment shocks or wage premia changes.
- Changes in income of local businesses are modeled due to changes in local prices and wages and incentives received.
- Changes in the real value of transfer income and capital income due to higher local prices are entered in.
- Other changes in proprietors' income and transfers and dividends and interest with population, so these types of income go up with population changes. This is a somewhat arbitrary choice. Ideally the determinants of these types of income would be estimated using a more detailed model.

The general revenue categories we consider separately are federal intergovernmental revenue, property taxes, sales taxes, personal income taxes, and then all other revenue. "All other revenue" consists of other taxes (corporate income taxes) as well as fees that support general functions. All dollar figures for revenue and expenditure categories are the averages for the state being used in the model over all state and local governments from the Census of Governments.

Federal intergovernmental revenue is assumed to go up proportionately with population. Therefore, we assume $\mathrm{d}Fig/\mathrm{d}Pop = (Fig/Pop)$, where *Fig* is federal intergovernmental revenue.

Property tax revenues. For the fiscal benefits calculation, we directly model the increase in property tax revenues by summing up several effects. The change in property tax revenue is the property tax rate times the change in property values. The property tax rate is taken from the 2019 average state rate from the Tax Foundation (2021). Users may choose to use the local property tax rate, if available. To determine how much property values increased, we added up three components: 1) the change in property values with respect to income; 2) the change in property values with respect to population; and 3) the change in property values with respect to the price changes brought about by this demand shock.

The first component can be shown to equal the income elasticity of housing demand times the ratio of overall property values to income times the change in income. I used the figure of 0.702 for the income elasticity of housing demand from Albouy, Ehrlich, and Liu (2016) which accords with other research literature that housing demand is somewhat income inelastic. The ratio of overall property values with respect to income is derived for each state by using the overall property values per capita found by the Federal Reserve, and then adjusted to other years by the shelter CPI, and by each state's relative housing price index from BEA. Going forward this ratio is constant.

The second component can be shown to equal the assumed elasticity of property values with respect to population times the ratio of property values to population times the change in population. I assume that the elasticity here is 1: if the population goes up by 10 percent, all else constant, property values go up by 10 percent. The ratio of real property values historically is adjusted based on BEA relative rental prices by state and the CPI for shelter. Going forward, we assume that real values go up by 1.12 percent per year, which is what everything else in the model goes up in real terms over time.

The third component can be shown to equal (one plus the price elasticity of housing demand) times the change in the price times the quantity of property. The latter term is the measured price shock in the model. For the price elasticity, I use −0.700, from Albouy, Ehrlich, and Liu (2016), which fits in with other research literature that housing is somewhat price-responsive but is not elastically so. Essentially, property values only go up by 30 percent of the price shock to property values due to people buying less property.

Fiscal benefits. For property tax revenues, see above. For other revenues, I used the state-specific elasticities from Bruce et al. (2006) for how sales and income taxes respond to shocks to state personal income per capita. For some states that did not report, I used national averages. The elasticities used were their long-term elasticities. I also used the sales tax elasticity for all other revenue (other than sales and gross receipts, personal income tax, and general sales). Intergovernmental revenue was assumed to scale up with population.

I interpreted their elasticities as applying to shocks to state personal income that are shocks to per capita personal income. For shocks to personal income that are due to shocks to population, an elasticity of 1 seems appropriate. That is, if one blows up the economy due to population growth by x percent, but there are no changes in per capita income of anyone, it seems reasonable that state and local income tax revenue and sales tax revenue and other tax revenue should simply be blown up by that same x percent.

This is reflected in the calculations made in the "Fiscal benefits" worksheet at cells AD10:AD89 (sales tax revenues), AG10:AG89 (income tax revenue), and AJ10:AJ89 (other tax revenue). The calculation reflects the following reasoning:

If d(lnRev) = e times d[ln(Y/POP)] + 1 times d[ln(POP)]

Where *d* represents some small differential change, lnRev is the natural log of some type of state/local tax revenue, *e* is the elasticity estimated by Bruce et al. (2006), and we assume that this elasticity *e* only applies to the small change in the natural log of per capita state personal income (Y/POP), and 1 is the elasticity for shocks to the natural log of state population, POP.

Then:

$d[\ln(Y / POP)] = d\ln(Y) - d\ln(POP)$ by definition of logarithms.

Substituting in

$d\ln(Rev) = e \times d[\ln(Y)] + (1 - e) \times d[\ln(POP)]$

Now by definitions of how differentials work, $d\ln(X)$ for any variable $X = dX / X$.

So we have

$dRev / Rev = e \times (dY) / Y + (1 - e) \times (dPop) / Pop$

Multiplying both sides by *Rev* we get

$dRev = [e \times (Rev / Y) \times dY] + [(1 - e) \times (Rev / Pop) \times dPop]$.

So, if we want to know the change in some type of revenue that occurs due to a shock that changes both state personal income *Y* and state population *POP* by some amount (and therefore implicitly might change Y / Pop), we can:

Multiply dY that results by the elasticity of that type of tax (*e*) and multiply that by the share that type of tax's revenue is of state personal income. But then we also have to add in (1 − the tax elasticity of that type of tax) × the per capita revenue of that type of tax × the change in $dPOP$).

So essentially this only applies the term *e* to the change in per capita income, and it applies 1 to the population induced change in income, and you end up subtracting a factor based on population to adjust down for initially applying *e* to all income.

For expenditure, I used the general revenue figure for each state as the figure of general expenditure, based on the assumption that long-run general expenditure equals long-term general revenue. This assumed general expenditure was then assumed to scale with population.

I extrapolated 2019 values for all revenue figures to all other years. I could have downloaded years back to 1993, but I chose not to do so because 1) the elasticities I am using are from one particular year; 2) the property tax calculations I am doing are from one particular year; and 3) I think the major variation in state fiscal structure is across states, not years. Ideally one would have data for all years, but I think this is a second-order problem.

To make intergovernmental revenue and overall general revenue figures scale properly, they were assumed to be the same percentage of personal income going back in time and going forward, based on state figures from the Census for FY 2019. Then they were converted to real 2019 prices per person using the overall CPI and relative state prices.

For all direct general expenditure categories, we assume an elasticity with respect to population of 1. We therefore get ($dDGE/dPOP$) = (DGE/POP), where *DGE* is direct general expenditure and *POP* is population. We use BEA figures for each state for the period 1990 to 2020, and then assume that it grows by 1.12 percent in real terms after that to reflect economic growth. To force the budget to be balanced, we actually use state and local general revenue to measure general expenditure; in most states, general expenditure and general revenue are not the same, but they are close.

I considered incorporating some downward adjustment in welfare expenditures. However, cash welfare is so small and so politically determined that this seemed problematic. The same is true of medical expenditures. So, we assume that the population dictates welfare expenditures even as employment to population ratios and income increase.

Once the effects on revenue and expenditure are calculated, this value is fed back into the model as either a fiscal benefit or a cost. If a fiscal benefit, it results in either fewer net costs of incentives or potentially a fiscal benefit for the government that the government can allocate in some way. If a fiscal cost, then either net costs of incentives go up, or, after the incentive period is over, there is an additional governmental cost. This governmental benefit or cost is assumed to be allocated identically to the financing of the incentives. But the effect of fiscal benefits or costs is assumed to be lagged one year. That is, the assumption is that at the end of each fiscal year, state and local governments take the resulting surplus or deficit and apply it to next year's budget. This avoids simultaneity problems and may be more realistic.

Avoiding Fiscal Double Counting

The fiscal benefits and costs from the above calculations include tax revenue gained from the increased earnings and property values for local residents from this incentive package and its consequences. To avoid double counting, these tax revenue gains must be subtracted from these gains.

The local income gains and losses are these:

- gains for locals from increased employment rates
- gains for locals from wage premia and their multipliers
- gains for local workers from wage increases due to tighter local labor market
- losses for local businesses from wage increases
- gains for local property owners from property value increases
- losses for local business owners from cost consequences of local property value increases
- losses for local residents from education cutbacks
- gains for local business owners who are awarded incentives
- losses for local residents because of declining real value of outside capital income and transfers due to higher local prices.

All the income gains are calculated, and then a tax rate is applied that reflects the marginal tax rates on income calculated in the prior fiscal benefit section. . For property value gains, the property tax increase is calculated using an effective property tax rate estimated by the Tax Foundation for 2019.[96]

Property taxes also go up due to increased income. The property tax section calculates the resulting implied marginal property tax rate because increased income will lead to buying more expensive houses. Finally, the elasticities for state and local personal income taxes, and state and local sales and other taxes, are used to derive marginal tax rates on increased per capita income.

In addition, although the model default is to assume that all local tax and spending costs have an overall value equal to their dollar value, we also considered subtracting out some value from education to reflect that education's benefits are already counted once, in the form of increases in future earnings of students. But the baseline assumes that K–12 education would be valued by parents at cost solely for its effects in terms of free day care and its effects in developing civic values and reducing youth crime.

Adding Everything Up

Based on this calculation, we have the incentive costs. We have fiscal benefits of those costs. And we have net income gains after taxes for various groups. Finally, we have a portion of those incentive costs that are exported to non-local businesses.

Together, we can calculate the present value of net benefits for each group and compare those net benefits with incentive costs. We can also calculate this for each year of the 80-year simulation.

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[96] A future refinement to the model would provide estimated property tax rates for all years for all states, rather than using the 2019 rate for all years.

Dividing Costs and Benefits by Income Quintile

The model first produces aggregate benefit and cost estimates, both over the 80-year period of the simulation and in present-value terms. The model then proceeds in a top-down manner to allocate all these benefits and costs by income quintile. The allocators force the quintile numbers to add up to the all-group totals.

Incentive costs. Incentive costs are divided in the model among taxes and spending. Taxes in turn are divided between business taxes and nonbusiness taxes. Spending is divided between education spending and noneducation spending.

The direct immediate costs of increased nonbusiness taxes are assumed to be divided across income quintiles in the same way as is implied by the state-specific personal tax rates for 2019 by quintile that are reported by ITEP—that is, the ITEP rates are applied to the CBO before-tax-but-after-transfer income quintiles, and the numbers are then adjusted so that the quintile revenue figures add to the total. The direct costs of increased business taxes are first assigned only to local business taxes. They are then allocated across income quintiles based on the division of capital income by quintile in the CBO data.

For spending, we use the benefit results from the Tax Foundation to divide state and local spending by quintile (Prante 2013). We apply the quintile benefit rates from the Tax Foundation to the before-tax and after-transfer income figures in CBO.

Fiscal benefits. Fiscal benefits are allocated the same as incentive costs.

Employment rate effects. Employment rate effects are divided by CBO income quintiles by multiplying each quintile's share of before-tax-but-after-transfer income by the relative contribution of labor demand shocks on earnings that are reported in Table 2 of Bartik (1994).

Taxes on these employment rate effects are derived by first dividing earnings in this way and then multiplying by the state-specific relative personal tax rates reported in ITEP (e.g., the rate for each quintile divided by the overall rate). This is then used to divide the tax total for employment-rate effects by quintile.

Wage premia effects. Wage premia effects are divided by quintile based on each quintile's share of labor income in the CBO income quintile data. Wage premia tax effects are derived by taking these shares, multiplying by the relative personal tax rate in the ITEP data, and then adjusting the quintile numbers proportionately to force them to add up to the total.

Property value effects. Homeowner capital gains are divided up by quintile using data from the Federal Reserve, based on the Survey of Consumer Finances, of homeownership rates and median home values by income quintile. The product of the two is used as an allocator.

The other business real estate that is owned locally is divided among quintiles based on the division of capital income across quintiles in CBO.

Property taxes are divided up identically to this division, based on the assumption of uniform property tax rates across income classes and, for that matter, classes of property.

The negative effects on local profits due to increases in the rental price of real estate are divided among different income quintiles based on each quintile's share of capital income.

Wage increase effects. Wage increases' benefits by income quintile are based on each quintile's share of labor income in the CBO data. Wage increases' costs for local business owners are divided across income quintiles based on each quintile's share of capital income.

Taxes for each of these categories for wage earners are derived by taking these income categories, multiplying by the relative personal tax rate on that quintile in ITEP, and using the product to allocate total state and local taxes on that category of income. For capital owners, we allocate the taxes by each quintile's share of capital income.

Education spending's effects on children's earnings. These effects are assumed to be divided by income quintile by CBO's estimates of the number of households with children in each income quintile. This implicitly assumes the same number of children per household in each income quintile, which probably is not correct. This method of allocation gives shares that are close to even, but tipped a bit toward the lower income quintiles.

The increased taxes on these education effects are divided among income quintiles by using this division, and then the ITEP relative quintile personal tax rates, to allocate the entire tax amount.

Incentive effects on local business owners. These local business-owner effects are divided across income quintiles based on each quintile's share of capital income in the CBO's income distribution tables. The taxes on these changes in local business owners' income combines this information with ITEP relative tax rates by income quintile, in order to allocate the overall tax collections from this type of income.

Appendix E

A Simple Model of the Amazon Benefit-Cost Ratio across States

This model seeks to estimate the determinants of differences in the simulated benefit-cost ratio for a project with the same incentives and job creation as the Amazon HQ2 project in northern Virginia.

The number of observations in this regression is 51: the 50 states plus DC. The dependent variables are the benefit-cost ratios in Table 12 of the text.

The independent variables are:

- Ln(prime-age employment rate)
- Ln(1 − unemployment rate)
- Ln(elasticity of housing prices with respect to population times real value of housing values per capita)
- Ln(property tax rate times elasticity of housing prices times real value of housing values per capita)
- Ln(other tax elasticity with respect to state personal income × percent that state and local tax revenue that depends on that elasticity is of state personal income)
- Ln(income tax elasticity with respect to state personal income × income tax share of state personal income plus other sales tax elasticity with respect to personal income × percent that revenue that depends on that elasticity is of state personal income) − the prior sales tax only variable.

These independent variables are determinants that do enter linearly into the model, and hence potentially could have a linear effect on the benefit-cost ratio. The "other tax elasticity" is the estimated elasticity for the sales tax with respect to personal income per capita, which is applied to both the sales tax and other tax revenue (other than the personal income tax and the property tax).

Why might these variables matter? For the labor market condition variables, a lower prime-age employment rate, or a higher unemployment rate, will tend to increase the proportion of jobs that go to the local non-employed, and reduce the proportion of jobs that go to in-migrants. The housing price variable affects how much costs go up with a labor demand shock, which potentially creates some negative employment side effects on other employers of the initial Amazon demand shock, while at the same time increasing capital gains for some local residents. The three tax variables all potentially increase fiscal benefits, while at the same time increasing marginal tax rates on local residents.

As these remarks suggest, only the first two variables have an unambiguous predicted sign in affecting the benefit-cost ratio. The housing price effects and the three tax variables have uncertain net effects on the benefit-cost ratio. Table E1 shows the results.

As the table shows, the only statistically significant effects are for the prime-age employment rate variable, and the housing price variable. Furthermore, the prime-age employment rate variable has by far the highest standardized effects, where "standardized effect" here means the coefficient times a one standard deviation change in the right-hand-side variable.

The implication is that the prime-age employment rate is one of the most important drivers of variations across place in the benefits of economic development programs. This is an important lesson not only for when states debate their overall aggressiveness in providing incentives, but when states decide whether and how to target incentive programs within the state.

Table E1 How Benefit-Cost Ratios for Amazon Projects in Different States Vary with State Characteristics

	ln(Prime-age emp rate)	ln(1 − unem rate)	ln(housing price effect term)	ln(property tax effect term)	ln(other revenue effect term)	ln(income plus other revenue effect terms) − ln(other revenue effect term)
Coefficient	−21.599	9.705	−0.751	0.341	0.422	0.592
Standard error	2.154	5.937	0.231	0.187	0.359	0.354
T-statistic	−10.03	1.63	−3.25	1.83	1.17	1.67
Standardized effect	−1.231	0.007	−0.152	0.008	0.074	0.157

NOTE: See text for detailed definition of these right-hand-side variables. Dependent variable is simulated Amazon benefit-cost ratio in 51 states (including D.C.). Standardized effect is an effect on the benefit-cost ratio of one standard deviation increase in the above right-hand-side variable. Standard deviation of benefit-cost ratio is 1.03.

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