

Appendix M: Economic impact modeling

Weldon Cooper Center staff conducted economic impact analysis of the Virginia economic development incentives evaluated in this report. For select incentives, staff first estimated the percentage of activity that could be attributed to the incentive, which is commonly referred to as the “but for” effect.

Weldon Cooper Center staff conducted economic impact analyses of Virginia economic incentives using REMI PI+ (Policy Insight Plus) software. REMI PI+ is a dynamic, multi-sector regional economic simulation model used for economic forecasting and measuring the impact of public policy changes on local economies. The model combines different contemporary regional economic modeling methods such as input-output analysis and econometric forecasting to characterize the mechanics and path of a regional economy. The model has been extensively peer-reviewed and is widely used by state agencies elsewhere in the nation to model economic and tax revenue impacts of economic development incentive programs, including economic development incentives. The model used for this analysis was customized for Virginia and includes 70 industry sectors. Outcome variables examined include total employment, state GDP, and personal income. In addition, a state tax revenue impact analysis was conducted based on a methodology described further below.

Modeling of each incentive program varied depending on the type of economic stimulus the program provided

When the principal information available for the program was the effect of the program on firm costs, program costs savings (state revenue impacts) were modeled as reductions in firm production costs or capital costs for the industries affected. Programs were modeled as decreasing firm *capital costs* if the incentive reduced the costs of purchasing tangible personal property (the three common carrier exemptions, the railroad rolling stock exemption, and aircraft repair parts exemption). Programs were modeled as decreasing firm *production costs* if the costs of labor as well as equipment and supplies could be reduced by the incentive because of no restrictions attached to incentive usage (Barge and Rail Usage Tax Credit and Virginia Port Volume Increase Tax Credit).

When information on program private employment and capital investment impacts are available from program records, firm employment increases and capital investment expenditures were modeled. This was done for two programs: the International Trade Facility Tax Credit and the Port of Virginia grant. However, not all of the job creation or capital investment was attributed to the receipt of the incentive. Instead, the portion that could reasonably be attributed to the incentive based on its share of additional firm operational costs was estimated using a procedure developed by economist Timothy Bartik. This procedure is commonly referred to as estimating the “but for” effect, which estimates the percentage of the activity that would not have occurred but for the incentive.

When information on other metrics was available (i.e., traffic diversion volume, port volume increases, international sales increases), it was also utilized to model economic impacts.

Port of Virginia grant and International Trade Facility Tax Credit

Weldon Cooper Center estimated the “but for” effect of the Port of Virginia Economic and Infrastructure Development Grant (Port of Virginia grant) and the International Trade Facility Tax Credit. The “but for” effect of an incentive is the percentage of firm activity or growth that can be attributed

to the incentive. Trying to determine this effect with precision is difficult. Site selection decisions are based on several factors that affect businesses’ operations and employees. While the importance of individual factors varies based on the requirements of each business and project, factors affecting long-term costs—such as transportation infrastructure and labor availability and costs—are typically most important. Incentives, if considered, often become more important toward the end of the site selection process, after a few sites meeting the fundamental business requirements have been selected. However, some businesses may rule out sites early on if incentives are not available. Site selection decisions are ultimately made by business executives whose motivations are hard to anticipate and impossible to verify after the fact. (See *Review of State Economic Development Incentive Grants*, JLARC 2012).

The estimation relies on recent research by Bartik (2018) on the role of the relative intensity or size of the incentive relative to locating or expanding firm cost of operations in influencing company site decisions. The “but for” effect is determined by a tax-elasticity-based formula. The intuition behind the formula is that smaller incentives relative to the firm’s expanded or newly relocated operations are less likely to “tip the balance” in a firm’s location decision than larger incentives. For instance, Bartik estimates that the recent Wisconsin Foxconn incentive deal (approximately \$230,000 per job) reduces operating costs for the firm on a discounted basis over time by 30 percent. This 30 percent cost reduction would influence firm location and expansion decisions 97 percent of the time, on average. In contrast, an incentive that constitutes just 0.1 percent of the amount would affect only 1 percent of the location/expansion decisions.

The formula (derivation which is explained in Appendix D of Bartik [2018]) is as follows:

$$(E_a - E_b) / E_a = (1 - (1 - s)(-R))$$

- E_a is the employment before the incentive,
- E_b is the employment after the incentive,
- R is the elasticity of long-run business activity for business costs (and assumed to be equivalent to -10 in line with business activity tax elasticities of -0.5 and the finding that business taxes represent about 5 percent of value-added or $R = -.5 / .05 = -10$), and
- s is the relative incentive size (i.e., present value of incentives as a proportion of present value of stream of company value added over the 20-year period).

For grants with job creation information, it was necessary to convert job creation into dollar values. This was done by computing the incentive award value as a percentage of the discounted stream of production costs for a 20-year project lifespan, using a 12 percent real discount rate as outlined by Bartik (2018). Production costs are proxied by value-added, which are payments made to capital and labor. Value-added per employee by industry was obtained from REMI and merged with the grant records using a REMI to NAICS bridge to compute value-added equivalents. The stream of value-added and incentives are discounted over time to determine the present value of costs and cost savings. Bartik recommends using 12 percent as the discount rate because it best represents the time value of money for private companies. Investment grant (International Trade Facility Tax Credit) relative sizes were computed as the time value of an investment grant award as a percentage of total project capital investment spending to determine the same “but for” percentage.

The incentive shares of project costs are estimated to be 0.15 percent for the International Trade Facility Tax Credit and 0.28 percent for the Port of Virginia grant. These figures translate into “but for” estimates of 1.5 percent and 2.7 percent, respectively. The International Trade Facility Tax Credit share of capital investment is estimated to be 1.6 percent, which means that 14.8 percent of total capital investment is estimated to be attributable to the tax credit program.

Since the “but for” effect formula is based on firm reactions to business cost changes due to tax changes, it more typifies the likely firm response to a typical by-right tax cut rather than discretionary incentive. Ordinarily, greater discretion and agency due diligence might be expected to improve the likelihood of an incentive of a given size to move the needle by selecting only those projects most at risk of moving or expanding elsewhere rather than providing the incentive across the board. No adjustments were made for programs that had these elements; thus, they represent conservative “but for” assumptions.

Barge and Rail Usage Tax Credit

A primary purpose of this tax credit is to divert freight traffic from roads to waterways and railroads. Information on tax credit related twenty-foot equivalent unit (TEU) diversions was computed based on Department of Taxation records. The imputed dollar-valued benefits of the cumulative traffic diversion were estimated using information from the Department of Rail and Public Transportation (2017) *State Railway Plan*, which was based on the Rail Enhancement Fund (REF) benefit-cost model for evaluating state rail projects. It was assumed that all the TEUs or equivalents diverted to rail would have entered Virginia roadways and each TEU would equate to one road vehicle. It was also assumed that the traffic was diverted for the full road distance from the Richmond Marine Terminal to the VPA terminals (approximately 86 miles of travel computed using Google Maps). Benefits were computed using baseline REF parameters for accident reduction savings, congestion cost savings, and air pollutant reduction (NOX, CO, MP2.5, VOC, CO2) benefits per vehicle mile travelled (VMT) published in the *Statewide Rail Plan* were computed to total \$0.70 per VMT (consisting of 65 percent accident reduction benefit; 21 percent traffic congestion reduction benefit; and 14 percent air pollution reduction benefit). The computed benefits each year were entered into the REMI model as Non-Pecuniary (Amenity) Aspects policy variable. This treatment of the amenity improvements resulting from traffic diversion is consistent with how it is treated in another REMI product called REMI Transight, which is designed for transportation project economic impact analysis.

TABLE M-1
Amenity value computations for REMI modeling of Barge and Rail Usage Tax Credit

Year	TEUs diverted	Cumulative TEUs diverted	Benefit per VMT	Amenity value
2010	0	0	\$0.70	\$0
2011	0	0	0.70	0
2012	2,514	2,514	0.70	150,668
2013	26,023	28,537	0.70	1,710,273

2014	525	29,062	0.70	1,741,737
2015	2,016	31,078	0.70	1,862,560
2016	8,418	39,496	0.70	2,367,065
2017	5,585	45,081	0.70	2,701,784
2018	8,961	54,042	0.70	3,241,170
2019	12,044	66,086	0.70	3,960,551

SOURCE: Based on Barge and Rail Usage Tax Credit TEU data, Department of Rail and Public Transportation (2017), and Weldon Cooper Center assumptions.

Port Volume Increase Tax Credit

A principal reason for enacting the Port Volume Increase Tax Credit was to increase freight flows through the Port of Virginia and other private terminals. The increase in port volumes (TEUs and equivalents) was computed from Virginia Port Authority (VPA) records. It was assumed that the credit resulted in only 20 percent of this volume being rerouted from ports outside the state based on the amount of Virginia freight weight and value that now uses those ports for international exports from an analysis of Freight Analysis Framework (FAF) data. The other 80 percent are assumed to have utilized Virginia seaports even without the credit. These estimated port volume increases were also assumed to be maintained over the duration of the analysis, and annual TEU increases were cumulative over time. VPA estimates that it receives an estimated \$186 in operating revenue per TEU handled. Roughly 70 percent of the revenues are from direct/basic container unit rate handling charges with the residual 30 percent dependent on additional container movements on terminal (rail vs truck vs barge, dwell time on terminal, and additional charges for handling). Port and Harbor Operations are categorized as NAICS sector 488310. This corresponds to sector 37 in REMI (Scenic and sightseeing transportation; Support activities for transportation). The estimated new annual revenues for the port authority were assigned to that REMI sector using the policy variable Industry Sales (Exogenous Production).

TABLE M-2

Virginia port revenue computations for Virginia Port Volume Increase Tax Credit

Year	TEUs	20% incentivized	Cumulative TEUs	Additional port revenue
2010	0	0	0	\$0
2011	4,560	912	912	169,632
2012	34,905	6,981	7,893	1,468,098
2013	72,256	14,451	22,344	4,156,021
2014	83,211	16,642	38,986	7,251,470
2015	12,968	2,594	41,580	7,733,880
2016	29,275	5,855	47,435	8,822,911
2017	30,438	6,088	53,523	9,955,204

2018	37,807	7,561	61,084	11,361,625
2019	59,637	11,927	73,011	13,580,121

SOURCE: Based on Port Volume Increase Tax Credit TEU data, Virginia Port Authority revenue estimates, and Weldon Cooper Center assumptions.

VALET

The VEDP international trade division collects international sales of firms prior to entry to VALET on program applications. At the conclusion of the program, they also conduct exit interviews for each firm at which they request additional information about firm international sales progress and new markets served. The international sales information is currently used in JLARC annual economic incentive reports as a program performance measure. According to computations using FY10–FY19 data, the median firm experiences a 59.9 percent increase in international sales from program entry to exit and collectively program completers reported a 47.2 percent increase in sales. For the purposes of this report, it is assumed that firms receive a one-time boost in sales performance from program participation and use of the financial assistance, which is up to \$30,000. That is to say, if a 2012 program completer experienced a 50 percent increase in sales, it is assumed that sales increased 50 percent from 2010 (program entry) to 2012 (program exit) but that sales remained flat at that higher level thereafter. Analysis from an earlier VEDP sponsored studies (Transformation Systems Incorporated 2008; Knowledge Advisory Group 2012) indicated that VALET graduates experienced additional international sales growth years after they graduated the program. Thus, the assumptions made for estimating the sales impact can be considered conservative.

Not all of the international sales increase can be attributed to the VALET program. To determine the percentage that can be assigned, results from a 2017 Weldon Cooper Center Survey of firms that received Virginia economic development incentives (Rephann 2018) were used to estimate this “but for” program effect. The survey questionnaire asked firms to evaluate the effect on their project if the incentive had not been available to the firm, including the portion of the project that would have occurred without the financial assistance. For the purposes of VALET, “project” is understood to mean efforts to increase international sales (rather than firm location or expansion). Of the 15 responding firms that had received only VALET assistance over the period, 35.3 percent said they would not have proceeded with the project (increasing international sales) “but for” the incentive. (Five other respondent firms had received other Virginia economic incentives as well, making it more difficult to isolate the effect of VALET; thus they were excluded.) Because of probable survey response bias, Bartik (2019) recommends adjusting responses for technical assistance programs by dividing the “but for” estimate by a factor of three to provide a more accurate estimate. This recommendation is based on his research, which compares econometrically derived estimates of “but for” to survey-based estimates. Using this “rule of thumb”, only 11.78 percent (35.3333%/3) of the estimated sales increases as described above were attributed to the existence of the VALET program and the financial incentive.

Virginia Trade Show Assistance Program

To estimate the international sales impact of this program, information was used from an annual satisfaction and performance survey administered to VEDP international trade program and service users. The questionnaire asks firms to estimate international sales for the year and to also estimate the percentage of the sales that resulted from VEDP’s trade programs and services. Using results from

the latter question for 12 firms that received only trade show assistance, it is estimated that 14.77 percent of the reported sales can be attributed to the program. This percentage was based on midpoint values for question response intervals (g, 0-25%=-12.5%, 25-50=37.5%, etc.). Correcting for response bias using the Bartik recommendation (discussed in the section above) of dividing by three results in a “but for” estimate of 14.7727/3 or 4.92 percent. Thus only this share of reported international sales are assigned to the program. This increase is assumed to remain constant over the window of analysis.

Economic impact modeling

Table M-3 describes the REMI modeling inputs by program using information on REMI modeling blocks and policy variables. For each economic impact analysis, the opportunity cost of state funds was accounted for by raising personal income taxes. Personal income taxes are the largest source of tax revenue for the general fund, and thus seemed appropriate as a source for offsetting the cost of the incentive programs.

REMI PI+ discontinued tax revenue estimation as part of its base package beginning with the 2.0 version and moved improved revenue modeling capabilities into its new REMI Tax PI model. To conduct tax revenue analysis, this study scaled revenues to economic outputs using the procedure described in Regional Economic Models, Inc. (2012). State tax revenues were derived from the Census of Government’s *State and Local Government Finance* and *Annual Survey of State Tax Collections*. Revenue estimates are calculated by multiplying state revenue rates by the corresponding base quantity, which included state-level demand for selected industries (general sales tax, selective sales tax, license taxes), state-level personal income less transfer payments (individual income tax), corporate income tax (gross domestic product), and personal income (other taxes). The tax revenue impact analysis does not include the effect of economic development incentives on other revenues, including non-general revenues. Nor does it estimate the effect on local tax revenues. Lastly, it does not estimate the effect of economic development incentives on government expenditures at the state or local level.

TABLE M-3
REMI policy variables

Incentive	REMI model policy variables	Modeling description	REMI industry (sector number)
Barge and Rail Usage Tax Credit	(1) Compensation and Prices->Production Costs->Production Costs (2) Population and Labor Supply->Migration->Non-Pecuniary (Amenity) Aspects	Model economic impact on firms as reduced production costs. Model impact on community as amenity improvement due to reduced congestion, traffic accidents, and pollution.	Production costs assigned to REMI industries based on NAICS codes of tax credits utilized.

International Trade Facility Tax Credit	(1) Output and Demand>- Investment Spending>- Nonresidential. (2) Labor and Capital Demand>-Employment>-Firm>-Industry	Model completed capital investment as investment spending for nonresidential building. Use 14.8% “but for” estimate. Assign REMI industry based on program corporate tax credit records matched with VEC employment records. Model job creation using 1.5% “but for” estimate.	Employment assigned to REMI industries based on NAICS codes of tax credits utilized.
Virginia Port Volume Increase Tax Credit	(1) Compensation and Prices->Production Costs->Production Costs (2) Output and Demand>-Industry Sales (Exogenous Production)	Model economic impact on firms as reduced production costs. Assign REMI industry based on program corporate tax credit records matched with VEC employment records. Economic impact through port revenue effect modelled as 20% of credit-supported volume (TEUs) multiplied by average VPA revenue per TEU.	Production costs assigned to REMI industries based on NAICS codes of tax credits utilized. Assign estimated increased port revenue to Scenic and sightseeing transportation/Support activities for transportation (REMI sector 37) to reflect increased port revenues.
Port of Virginia Economic and Infrastructure Grant	Labor and Capital Demand>-Employment>-Firm>-Industry	Model economic impact estimate based on 2.7% “but for” assumption. Assign REMI industry based on grant project industry identifiers.	Employment assigned to REMI industries based on NAICS codes of firms for completed grants.
Ships and Vessels Exemption			Water transportation (32)
Railroad Common Carriers Exemption			Rail transportation (31)
Railroad Rolling Stock Exemption	Compensation and Prices->Production Costs->Capital Costs	Model economic impact based on reduced capital cost equal to estimated exemption tax revenue effect. Assign to REMI industry based on program descriptions and other information.	31% Mining (4), 21% Chemical manufacturing (26), 20% Wholesale Trade (28), and remainder to other railroad rolling stock using industries.
Airline Common Carriers Exemption			Air transportation (30)
Aircraft Parts, Engines, and Supplies Exemption			Air transportation (30)

<p>VALET</p>	<p>Output and Demand>-Industry Sales (International Exports)</p>	<p>Model economic impact as increased international sales for industry based on grant project records. "But for" effect is estimated as 11.78% of firm reported sales increase from firm entry and exit surveys based on Weldon Cooper Center firm economic incentive survey.</p>	<p>Change in sales assigned to REMI industries based on NAICS codes of firms for completed grants.</p>
<p>Trade Show Assistance Program</p>	<p>Output and Demand>-Industry Sales (International Exports)</p>	<p>Model economic impact as increased international sales for industry based on grant project records. "But for" effect is estimated as 4.92% of firm reported sales increase based on VEDP annual survey data.</p>	<p>Increased sales assigned to REMI industries based on NAICS codes of firms for completed grants.</p>