

## Appendix L: Economic impact modeling

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Weldon Cooper Center staff conducted economic and tax revenue 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. The model used for this analysis was customized for the state of 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. In order 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 fund 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.

### Modeling varies by incentive program

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.

The REMI modeling of each program was conducted differently depending on the type of economic stimulus provided by the program. Table L-1 describes the REMI modeling inputs by program using information on REMI modeling blocks and policy variables. Several approaches were used.

When the principal information available for the program was the effect of the program on firm costs, program cost savings (state revenue impacts) were modeled as reductions in firm capital costs for the industries that were affected. Capital cost reductions were assigned to REMI Sector 30 (Air Transportation) for the space launch incentives. For the Research and Development Exemption, industry assignment information was drawn from the National Science Foundation Business Research and Innovation: 2013 on corporate R&D expenditures by industry (Table 30).

Additional information about the modeling for the remaining programs is described further below.

**TABLE L-1**  
**REMI policy variables**

<b>Name of incentive</b>	<b>REMI model policy variables</b>	<b>Modeling description</b>	<b>REMI industry (sector number)</b>
Major Research and Development Tax Credit	Output and Demand>-Investment Demand>-Private investment in research and development	Model R&D tax credit investment impact as 1.25X tax credit utilization.	Investment is assigned to private investment in research and development based on REMI industry of tax credit utilization.
Research and Development Expenses Tax Credit	Output and Demand>-Investment Demand>-Private investment in research and development	Model R&D tax credit investment impact as 1.75X tax credit utilization.	Investment is assigned to private investment in research and development based on REMI industry of tax credit utilization.
Research & Development Sales and Use Tax Exemption	Compensation and Prices->Production Costs->Capital Costs	Model economic impact based on reduced capital cost equal to estimated exemption tax revenue amount.	Capital costs assigned to REMI industries based on National Science Foundation survey data.
Qualified Equity and Subordinated Debt Investments Tax Credit (angel investment tax credit)	Compensation and Prices->Production Costs->Capital Costs	Model economic impact based on reduced capital cost equal to estimated tax credit tax revenue effect.	Capital costs assigned to REMI industry based on tax credit industry of utilization.
Qualified Business Long-Term Capital Gain Subtraction	Compensation and Prices->Production Costs->Capital Costs	Model economic impact based on reduced capital cost equal to estimated tax subtraction tax revenue effect.	Capital costs assigned to REMI industry based on tax credit industry of angel investment tax credit utilization.

Name of incentive	REMI model policy variables	Modeling description	REMI industry (sector number)
GAP Fund	Labor and Capital Demand>-Employment>-Industry (Exogenous Production) >-Industry	Model economic impact estimate based on 11% "but for" assumption using employment data.	Employment assigned to REMI industries based on NAICS codes of firms for completed awards.
Commonwealth Research Commercialization Fund (CRCF)	Labor and Capital Demand>-Employment>-Industry (Exogenous Production) >-Industry	Model economic impact estimate based on 17% "but for" assumption using employment data.	Employment assigned to REMI industries based on NAICS codes of firms for completed awards.
Virginia Spaceport Users Sales and Use Tax Exemption	Compensation and Prices->Production Costs->Capital Costs	Model economic impact based on reduced capital cost equal to estimated exemption tax revenue amount.	Capital costs assigned to Air transportation (REMI industry 30).
Zero G Zero Tax Act Income Tax Subtractions (resupply subtraction)	Compensation and Prices->Production Costs->Capital Costs	Model economic impact on firms as reduced capital costs equal to estimated tax subtraction revenue amount.	Capital costs assigned to Air transportation (REMI industry 30).

NOTE: Economic impacts of the Venture Capital Account Subtraction and Zero G human flight subtraction were not modeled because they have not been used.

**Major R&D tax credit and R&D expenses tax credit**

The REMI modeling for these tax credits relies on peer-reviewed empirical research using contemporary causal econometric methods discussed in the report, which indicate that the tax elasticity of research and development expenditures is well in excess of one. Recent state evaluation studies of R&D tax credits have used multiplicative factors in the range of 1–2 to represent the effect of state tax credits on firm qualified R&D expenditures. For example, an Iowa study (Giraldi 2016) assumed that each dollar of forgone tax revenue results in an additional \$1.68 in state qualified research expenditures. A Pennsylvania study (Commonwealth of Pennsylvania Fiscal Office 2020) assumes that its tax

credit has a 1.75 multiplicative effect on qualified research expenditures for small firms and 1.25 multiplicative effect for large firms and is based on U.S. and international research that indicates that more credit-constrained firms experience greater expenditure effects than less constrained firms. This evaluation uses the same assumptions. For the major R&D tax credit, which is used by firms with larger budgets, the 1.25 factor is multiplied by the amount of tax credits utilized by REMI industry. For the R&D expenses tax credit, which is currently oriented toward firms with smaller research budgets, the 1.75 factor is multiplied by the amount of tax credits utilized by REMI industry. These amounts are assigned to the ‘private investment in research and development’ policy variable.

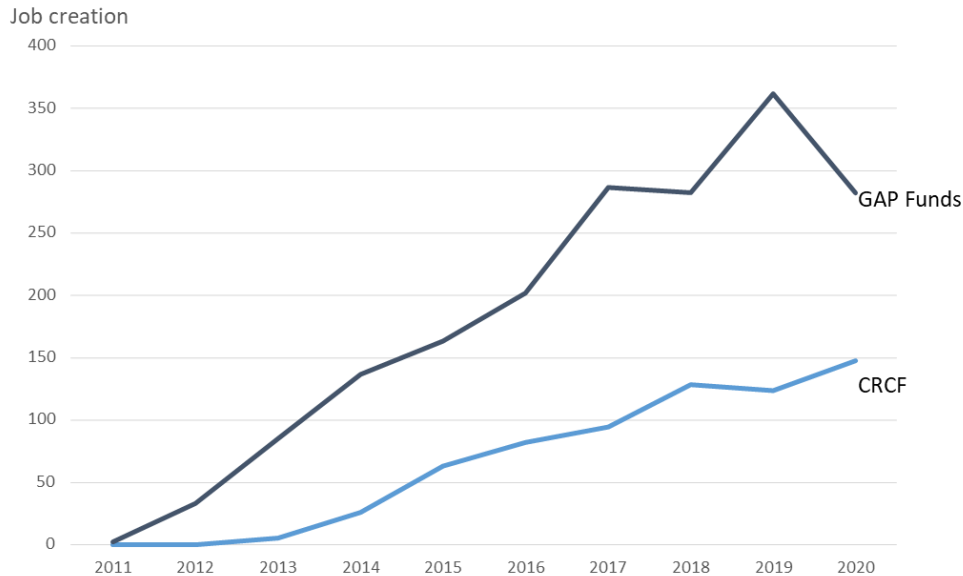
### ***GAP Funds and CRCF program***

GAP Funds and CRCF program economic and tax revenue impacts were computed using a three-step process. First, employment change for firm completers was estimated by NAICS codes, which were mapped to REMI industry sectors. Second, a “but for” adjustment factor for the job creation was estimated. This is applied to the employment change to estimate the amount of employment increase that could be attributed to the financial assistance provided by the programs. These adjusted employment figures were then entered into the REMI model. Lastly, in computing fiscal impacts based on REMI outputs, the net state appropriation used in the completed projects was computed. For the CRCF grant program, this was simply the computed total grant spending for the tracked and completed projects. For GAP Funds, an adjustment factor was made that accounts for the fact that proceeds from equity sales and penalties/clawbacks imposed on firms that did not adhere to the terms of their agreements help fund future program investments similar to a revolving loan fund.

To calculate the employment change, GAP Funds and CRCF project data were combined with VEC QCEW firm employment data to independently track job creation over the FY11–FY20 period. Unduplicated totals were obtained by selecting firms for the first year they received investments and were listed as having fulfilled their requirements (i.e., they were completed projects). The firm employment was obtained as described above.

Based on matched projects that received approximately \$4.3 million in completed awards (out of \$7.2 million in completed awards and \$21.6 million in total awards over the FY11–FY20 period), completed GAP funded projects generated 282 jobs by 2020. This works out to approximately \$15,149 per job. However, GAP Funds operates as an evergreen fund. Over the FY11–FY20 period, it is estimated that GAP Funds investments recouped 62 percent of initial state appropriation of \$33.3 million and \$20 million in recouped investments over the period. Thus, the actual cost per job taking into account these recouped investments is \$5,757. Based on CRCF matched projects that received approximately \$6.9 million in completed awards (out of \$10.8 million in total completed awards and \$13.5 million in total awards), 147 jobs were created by 2020. Thus, the estimated cost per job is significantly higher at approximately \$46,800.

**FIGURE L-1:**  
**CIT program matched completers over the FY11–FY20 period created 430 jobs by 2020**



SOURCE: Weldon Cooper Center analysis of GAP Funds and CRCF completion and VEC employment data.

NOTE: CRCF matched firms represent only \$6.9 million of awards and GAP Funds represents \$4.3 million in awards.

Not all of the employment creation from GAP Funds and CRCF can be attributed to the programs so what would not have happened “but for” the incentives was assessed. To determine the percentage of impact (“but for”) that can be assigned, results from a 2017 Weldon Cooper Center survey of firms that received Virginia economic development incentives were used (Rephann 2018). 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 analyzing the GAP Funds and CRCF programs, the project metric is interpreted here to mean employment. Using results from this question, the average self-reported percentage of firms that had received only GAP Funds or CRCF assistance over the FY10–FY16 period that would not have proceeded without the assistance was 51 percent for CRCF and 33 percent for GAP Funds. The estimated “but for” based on these responses is substantially higher for CRCF than the average economic development incentive of 30 percent. This large effect is likely related to the financial constraints facing startups, firm “halo effects” resulting from the rigorous expert review process for each program, and value-added services provided by the Virginia Innovation Partnership (VIPIC). 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 17 percent of the estimated CRCF grant recipient employment increase, and 11 percent of GAP Funds equity investment recipient as described above, were attributed to the existence of the programs.

GAP Funds generated a return on its capital investment for each of the last 10 fiscal years (FY11–FY20). Gross realized returns derive from mergers and acquisitions, to include escrows, dividends,

and milestone payments, along with secondary sale of assets (GAP Funds' equity positions) and convertible note repayments. Using this data, the nearly \$20 million in gross returns for the period represents 62 percent of the \$32.3 million in state appropriations during the period. Thus, it is assumed that only 38 percent of total completed project award amount relied on new state appropriations over the period.

**TABLE L-2**  
**GAP portfolio returns, FY11–FY20**

<b>Fiscal Year</b>	<b>State Appropriation</b>	<b>Total gross returns</b>
2011	\$500,000	\$28,937
2012	5,000,000	47,449
2013	4,200,000	104,929
2014	4,200,000	822,861
2015	3,100,000	527,981
2016	3,100,000	789,051
2017	2,875,596	1,452,704
2018	3,100,000	1,719,267
2019	3,100,000	1,961,632
2020	3,100,000	12,529,261
<b>Total</b>	<b>\$32,275,596</b>	<b>\$19,984,072</b>

SOURCE: Virginia Innovation Partnership Corporation.

### ***Angel investment tax credit and capital gains subtraction***

Both the angel investment tax credit and capital gains subtraction were modeled as decreasing the cost of capital for the firms utilizing the credits. This decision is based on research that suggests that a similar federal small business capital gains tax deduction had the principal effect of increasing the stock values of shares issued by the companies, effectively decreasing their costs of obtaining capital. The most recent research on angel investment tax credits suggests that state angel tax credits have little effect. However, many of the state tax credit programs that they studied are less restrictive than Virginia's angel investment tax credit in terms of allowing some insider investment. The Virginia tax credit does not exclude some categories of insider investors such as "friends" and also does not require investors to have experience or to be accredited investors as some state programs do. Thus, this program is modeled as having a similar stock cost price effect and is modeled as reducing the cost of capital. REMI industry assignments for the angel investment tax credit are based on Virginia Tax's tax credit utilization records. Similar information on the industry characteristics of users was not available for the capital gains subtraction; however, the programs target similar categories of small high-technology sector firms. Therefore, the tax revenue impact of the tax subtraction program was assigned to reduced capital cost for REMI industries in the same proportion as the tax credit program.