Appendix K: Regression analysis of grant awards

Analysis of custom award issuance

Several factors are predictors of whether an incentivized project received a custom grant or another economic development grant (Table K-1). Grant award per job, pledged job creation, and pledged capital investment were found to have a statistically significant association with custom grant selection in a regression analysis of how custom grant issuance differs along observable award dimensions, including project scale (i.e., capital investment awarded, job creation awarded), wage levels (average wage awarded), and relative award size (award per job). A probit regression was estimated for whether an award was issued as a custom grant or other economic development grant (1=Custom grant; 0=Other economic development incentive grant) using the above factors as independent variables. Grant awards included in the analysis included 1,615 awards between FY12 and FY22. A second probit regression was estimated using a longer list of variables, including employment multiplier, industry export share of sales, etc. These variables were not statistically significant, indicating that these potential return on investment (ROI) determinants were not important for distinguishing between custom grants and other economic development incentive grant programs.

TABLE K-1
Probit regression of custom grant issuance

	Coefficient	Std. Err	z	P>|z|
Average_wage_awarded	4.4E-06	3.8E-06	1.16	0.246
Capex_awarded	1.1E-09	4.7E-10	2.36	0.018
Jobs_created_awarded	0.00095	0.0002	4.84	0.000
Award_per_job	3.1E-05	3.1E-05	5.70	0.000
Constant	-3.49002	0.34897	-10.00	0.000
Number of observations	1615			
LR chi2(4)	110.55			
Log likelihood	-39.0489			
Pseudo R2	0.586			

SOURCE: Weldon Cooper Center analysis of economic development incentive grants.

Comparison of the probability scores for receiving a custom award for the 1,615 grant awards in the probit regression indicate that while custom grant projects tended to have higher probability scores (their scores ranked among the top 88 of 1,615 grant awards, there is some overlap in the characteristics (award per job, job creation, and capital investment) of custom and non-custom grant projects. The probability scores for custom grant projects ranges from a low of 0.0107 for Morgan Olson to a high of 1 for Amazon HQ2 and SRI International (Table K-2). An examination of probability scores

for non-custom projects identified 71 non-custom grant awards that have characteristics more like a custom grant award than Morgan Olson.

TABLE K-2
Project scale, wage levels, and relative award size predict custom grant issuance to various degrees

Custom grant project	Computed probability
Morgan Olson	0.0107617
CMA CGM	0.01661518
Volvo	0.07669708
Amazon Web Services	0.08689911
Siemens Gamesa	0.13333577
Microsoft	0.13587634
Huntington Ingalls–Training	0.16182448
Rocket Lab	0.18283228
CoStar	0.31281354
Rolls-Royce	0.32375786
Merck	0.39385716
Huntington Ingalls–Production	0.47918929
Blue Star	0.49528698
LEGO Group	0.82574691
Micron	0.99935067
Amazon HQ2	1
SRI International	1

SOURCE: Weldon Cooper Center analysis.

Fourteen non-custom grant projects have probability scores greater than 0.1, meaning that they were more like a custom grant on these characteristics than Morgan Olson, CMA CGM, Volvo, and Amazon Web Services (Table K-3). They include two Major Eligible Employer (MEE) grants and one Virginia Economic Development Incentive Grant (VEDIG). These programs offer awards comparable in size to some custom grants but offer less flexibility in eligibility requirements (e.g., VEDIG requires that projects pay at least 150 percent of local prevailing wage) or reimbursement period (MEE has relatively long performance reimbursement lags). The list also includes four Tobacco Region Opportunity Fund (TROF) grant awards, including two large prospective projects that were canceled (Project Red and Project K2). Lastly, the list contains three Virginia Investment Performance (VIP) grants, two Virginia Jobs Investment Program (VJIP) projects, and one COF award (a canceled Tranlin Paper Company project, which was awarded a custom grant, but the MOU was never signed).

TABLE K-3
Other grant programs funded projects that look like custom grants awardees

Firm	Program	FY	Award amount	Average wage	Capital investment	Jobs created awarded	Computed probability
Northrop Grumman	VEDIG	2011	$10,000,000	$200,000	$24,000,000	300	0.10353519
ADP	VJIP	2016	2,200,000	41,600	42,150,000	2,200	0.12678701
Microsoft	TROF	2013	2,000,000	45,318	348,000,000	30	0.21021103
Celanese Acetate LLC	VIP	2013	1,500,000	100,000	145,000,000	22	0.22691853
Virginia Poultry Growers Cooperative	VIP	2016	500,000	23,920	61,888,793	6	0.23582923
Philip Morris (HQ)	MEE	2006	25,000,000	133,333	300,000,000	450	0.3380185
Project K2	TROF	2021	10,000,000	75,000	0	3,000	0.41706862
Amazon	VJIP	2014	2,355,541	23,920	135,000,000	3,290	0.46342625
Project Red	TROF	2020	4,000,000	48,360	1,120,608,000	2,281	0.57014859
Canon Virginia, Inc.	VIP	2013	3,000,000	38,000	27,000,000	27	0.57431667
South Boston Energy, LLC	TROF	2012	2,723,349	61,105	140,211,360	26	0.58510798
Booz Allen Hamilton	MEE	2005	8,000,000	79,591	133,000,000	3,700	0.72078925
Renmatix, Inc.	TROF	2012	5,000,000	30,000	100,000,000	40	0.75071813
Shandong Tranlin Paper Company	COF	2014	5,000,000	45,663	2,000,000,000	2,000	0.81339685

SOURCE: Weldon Cooper Center analysis.

Analysis of custom award amounts per employee

Another regression analysis examined variables that are associated with the relative custom grant award (award per job). This analysis was limited to the 14 custom grant awards between FY13 and FY22, and results were compared to "baseline" results from the state's "deal closing" fund, the Commonwealth's Development Opportunity Fund (COF) grant. Because of the limited sample size, three sets of variables were tested independently: project characteristics that would influence the return on investment (ROI), local characteristics, and state industry competitiveness factors (Table K-4). The first group (project characteristics) are connected directly to the expected economic impacts of a given project. For example, holding all else constant, more capital spending, a higher employment multiplier, a greater percentage of exported sales, and higher wages will increase the economic impact and associated tax revenue impact. The second group of independent variables (local characteristics) may figure into determinations of relative awards if bonuses are provided to firms located in economically disadvantaged (high unemployment rate, high poverty rate) or more rural (low population density) regions. The third set of characteristics are indicators of industry state competitiveness. The state may

be willing to offer higher incentives to offset areas in which it is less competitive such as relative industry tax rates, lower levels of agglomeration, or higher relative wages.

TABLE K-4
Variables used in regression analysis

Variable	Description	Source
Project characteristics		
AWARD	Amount of grant awarded	VEDP incentive records
EMP	Jobs awarded	VEDP incentive records
CAPEX	Capital investment awarded	VEDP incentive records
MULTIPLIER	Employment multiplier	IMPLAN, 2013–2022
PEXPORT	Percentage of output exported out-of-state	IMPLAN, 2013–2022
AVEWAGE	Average wage awarded	VEDP incentive records
Local characteristics		
UNRATE	Unemployment rate	Bureau of Labor Statistics, Local Area Unemployment Rate (LAUS)
POVRATE	Poverty rate	U.S. Census Bureau, Small Area Income and Poverty Estimates (SAIPE)
POPDEN	Population density	Weldon Cooper Center for Public Service Population Estimates
State competitiveness		
TRATE	Relative tax rate for industry	Bartik (2017) Panel Database on Incentives, 2007–2015
LQ	Industry location quotient (3-digit NAICS)	LightcastTM
WAGERATIO	Ratio of industry state average wage to national average wage	Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2013-2022

SOURCE: Weldon Cooper Center.

For the custom grant regression, none of the project-level ROI determination variables are statistically significant (Table K-5). Two additional regressions were run for custom grants using just local characteristics and state competitiveness factors, but there were no statistically significant results. These results suggest that there are no systematic patterns in why custom grant relative amounts vary. Custom grant awards are required to generate net positive state tax revenue streams at some point in the project, but otherwise there are no formal guidelines that help determine the relative size of the grant. Though custom grants may need to pass a tax revenue ROI test, award determination is not made based on expected ROI. Nor do other factors representing local characteristics and state competitiveness factors appear to play a role.

TABLE K-5
Regression analysis of award per employee

	CUSTOM			COF I			COF II		
	β	SE	t	β	SE	t	B	SE	t
CAPEX	0.0000146	0.0000192	0.76	6.09E-06	4.65E-06	1.31	5.72E-06	4.59E-06	1.25
MULTIPLIER	1408.496	8399.655	-0.17	1523.512	488.5821	3.12***	1722.534	510.9905	3.37***
PEXPORT	-318.5347	670.8189	-0.47	135.7928	7.452651	0.00	-12.99625	10.77032	-1.21
AVEWAGE	-0.204537	0.622219	-0.33	5.854044	0.00849	2.33**	0.0227484	0.0135355	1.68*
UNRATE							244.9974	598.373	0.41
POVRATE							-0.375366	101.6578	0.00
POPDEN							0.0611014	0.1860445	0.33
TRATE							-7990.569	5104.32	-1.57
LQ							2046.944	1538.481	1.33
WAGERATIO							1062.924	1335.016	0.8
Constant	60358.37	99873.38	0.6	-595.4914	1213.575	0.624	668.2788	3290.184	0.2
Observations	14			315			305		
R2	0.1083			0.1166			0.1575		
F	0.39			4.57***			2.17***		

***α < .01; **α < .05; *α < .10.

In contrast, regression results indicate that COF relative award sizes are associated with larger capital investment levels, higher annual average wages, and larger employment multipliers (COF I). Both average wage and employment multipliers are statistically significant and have the expected positive signs. CAPEX has the expected positive sign but is not statistically significant. According to VEDP staff and program documentation, COF award amounts are informed by an ROI formula that includes economic multipliers and accounts for capital expenditures and wages paid among other considerations. A second COF regression (COF II) that includes local characteristics and state competitive characteristics as well as year specific effects (not shown in the results) to account for inflation adjustments over time in award determination does not materially change these findings. However, these latter categories of variables are never statistically significant and, in some instances, have unexpected signs.

Tabulated results of VEDP internal ROI analyses for projects reviewed by the MEI Project Approval Commission to date (TABLE 1-6) also indicate a high variation in ROI calculations for three periods (five-year cumulative ROI, 10-year cumulative ROI, and 20-year cumulative ROI). These results suggest that the relative program award sizes are not determined by the usual economic criteria but individual project characteristics, which are poorly represented by the economic variables examined.

The average computed five-year ROI is 1.89, 10-year is 2.95, and 20-year is 8.47. However, the range of five-year ROIs are 0.08 to 7.07, 10-year ROIs are 0.57 to 8.43, and 20-year ROIs are 8.47 to 23.42.

Some projects such as Rocket Lab do not exhibit surplus revenues until after the 10th year, which is unusual for economic development incentive grants.