COVID-19 ECONOMIC AND TAX REVENUE IMPACTS: ESTIMATES FOR THE COMMONWEALTH OF VIRGINIA AND LOCALITIES

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April 10, 2020

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Introduction

This report provides an initial look at the potential economic and fiscal impacts of the COVID-19 pandemic on the Commonwealth of Virginia and its localities (i.e., 133 counties and independent cities). Much is still unknown at this point about how different regions of the country and sectors of the economy will be affected, the length and recurrence of jurisdictional stay-at-home orders, the effectiveness and timetable for medical therapies and vaccines, the size and rate of deployment of federal public health and economic relief spending, and other factors such as state and local policy. Moreover national macroeconomic forecasts of COVID-19 effects vary widely. The assumptions that underpin them are also often not disclosed to the general public, being either hidden behind subscriber paywalls or considered proprietary methodologies that cannot be disclosed without compromising intellectual property. This report provides an initial look at potential COVID-19 economic effects using a standard commercial regional economic model. The model characteristics, data and modelling assumptions are spelled out more fully in a methodological appendix. The report provides estimates for two different recessionary scenarios ("moderate" and "severe" scenarios), allowing readers to interpolate or extrapolate as additional national macroeconomic information becomes available. Updates to the assumptions, modelling methods and results will be provided as more information becomes available and time permits.

Estimating the economic and fiscal impacts of COVID-19

The study uses REMI PI+ (Regional Economic Models, Inc. Policy Insight Plus) to estimate the economic effects of COVID-19. REMI PI+ is a respected, peer-reviewed model that has been used by federal, state, and local government agencies and private consultants in thousands of national and regional economic studies, including at least one previous study of a national pandemic (Loose et al. 2010). It is a dynamic, multi-sector regional economic simulation model used for economic forecasting and measuring the impact of public policy changes on economic activity, area demographics, and government fiscal conditions. The model used in this analysis is calibrated to use in modelling economic impacts for events in Virginia.

The Virginia modelling of COVID-19 undertaken here depends on national-level data inputs. The Virginia model effectively piggybacks on the national macroeconomic forecasts with the REMI PI+ model apportioning national impacts to the Virginia economy using its model data, parameters and architecture. Two fundamental pieces of data are key. First, national macroeconomic forecasts of COVID-19 are needed. Second, since industry-level demand sensitivity to social distancing varies, some allowance must be made for these differential effects at the industry level.

This analysis develops national macroeconomic GDP forecast scenarios that are based on several recent national macroeconomic forecasts that provide a range of plausible 2020-2025 national GDP growth estimates. Forecasts vary by forecasting organization and time period of forecast. Generally speaking, economic forecasts have deteriorated over time as the pandemic progressed. **Table 1** shows three major forecasts released over the period 3/19/20-4/8/20 that publicly released their results and some modelling assumptions. RSQE provides baseline macroeconomic forecasts for the REMI PI+ model, but the 3/19/20 "Prolonged Scenario" forecast is an update to that forecast that captures moderate pandemic effects and a fiscal stimulus package with elements similar to the Coronavirus Aid, Relief, and Economic Act (known as the CARES Act) (Burton et al. 2020). The other two (Wells Fargo and IHS Markit) forecasts were released well after the CARES Act was signed, and presumably capture its full effects.

TABLE 1: Economic Forecasts and Virginia REMI Simulation Assumptions

	Forecast Date	2019-20	2020-21	2021-22	Beyond 2022
RSQE	3/19/20	-1.8%	3.2%	2.1%	NA
Wells Fargo	4/8/20	-3.0%	1.7%	NA	NA
IHS Markit	3/30/20	-5.4%	3.4%	5.2%	NA
Average		-3.4%	2.8%	3.6%	
Simulation Assumptions					
-6 Percent Scenario		-6.0%	3.0%	3.0%	2.0%
-2 Percent Scenario		-2.0%	3.0%	3.0%	2.0%

For this modelling exercise, moderate and severe recessionary scenarios are used (more methodological details are provided in **Appendix A**). For the moderate scenario, it is assumed that GDP growth declines at an annual rate of 2% in 2020 and the national economy "snaps back" slightly in 2021 and 2022 before resuming baseline (pre-COVID-19) growth of 2% for 2023-2025. In the severe scenario, 2020 decline is assumed to be -6%, which would make it the most serious economic downturn since WWII, eclipsing the financial crisis induced Great Recession of 2007-09. For out-years, the growth assumptions are the same as the moderate scenario. It should be noted that an earlier CBO study (CBO 2005) that modelled a severe epidemic estimated a -4.1% annual effect on GDP growth. Subsequent studies such as McKibbon and Sidorenko (2006) provided estimates of similar magnitude. Thus, the range of the two scenarios modelled here include the best guestimates of growth impacts for similar pandemics prior to the arrival of COVID-19.

The other key piece of data used were industry exposure factors. In estimating these factors, the analysis relies on earlier CBO study (2005) assumptions about which industries are affected most by pandemics, based loosely on Asian Avian flu experience. The study estimates that those industries most affected by social-distancing include transportation (air and transit services), arts and entertainment, accommodation, and food services industries. These assumptions are likely to be revised as more U.S. data becomes available. Current estimates of industry impacts rely on industry data from previous epidemics, imputations of industry exposure based on surveys such as the Occupational Information Network (O*NET) (Dingel and Neiman 2020), and expert assessments. One CBO industry exposure assumption, that medical services would see increasing demand because of pandemic health needs, is already being called into question because of the closure of ambulatory care facilities by regional medical systems around the country due to consumer avoidance and a reduction in accidents and other health problems.

Results

Table 2 presents the result of the moderate and severe recession scenarios. In the severe scenario of -6% growth in 2020, the state is projected to lose more than 500,000 jobs and $40.7 billion in GDP in 2020 relative to baseline growth assumptions. The impact lessens to -168,000 jobs and- $8.7 billion in state GDP by 2025. Under the moderate (-2% growth scenario), the state loses almost 300,000 jobs relative to baseline and nearly $18 billion in GDP. This turns positive by 2024, meaning that the state recovers and grows above baseline levels. **Appendix B**. provides an industry-level breakout of employment impacts by scenario and **Appendix C**. provides a locality-level breakdown.

TABLE 2: COVID-19 Economic impact on Virginia, employment and GDP relative to baseline, 2020-2025

	2020	2021	2022	2023	2024	2025
-6 Percent						
Total Employment	-503,918	-332,586	-249,143	-222,762	-195,348	-168,049
GDP ($ Billions)	-$40.764	-$33.109	-$22.180	-$17.757	-$13.275	-$8.746
-2 Percent						
Total Employment	-298,779	-126,205	-45,115	-21,977	3,314	29,335
GDP ($ Billions)	-$17.898	-$9.864	$1.543	$6.280	$11.203	$16.307

Table 3 shows state tax revenue estimates under the two scenarios (details on the revenue impact methodology are provide in Appendix A). Under the severe scenario, the state is projected to lose over $1 billion in revenues relative to baseline growth, growing to $1.8 billion in FY2021 before declining and stabilizing at levels above $1 billion. For the moderate scenario, FY2020 revenue losses relative to baseline are nearly $600 million in FY2020, growing to $900 million in 2025 and gradually declining to less than $200 million by FY2025.

TABLE 3: COVID-19 Tax Revenue Impact for Virginia, 2 Scenarios, FY2020-FY2025

	-6 Percent	-2 Percent
FY2020	-$1,036,901,657	-$591,218,702
FY2021	-$1,818,365,897	-$899,821,742
FY2022	-$1,365,883,582	-$448,893,329
FY2023	-$1,164,965,831	-$261,751,830
FY2024	-$1,152,885,925	-$223,999,362
FY2025	-$1,129,194,295	-$182,427,065

Table 4 shows that both state and local governments experience significant tax revenue declines relative to baseline over the FY2020-FY2021 period. However, the state is projected to experience a disproportionately higher revenue impact (70-75% of the total) because of its reliance on more business activity sensitive revenue sources such as income and sales taxes. Localities rely on property taxes for substantially more than half of their revenues. However, individual state localities such municipalities with more income sensitive revenues and localities with greater exposure to tourism and other COVID-19 sensitive industries are also projected to experience large revenue declines. **Appendix C**. provides revenue impact results for individual localities.

TABLE 4: COVID-19 Fiscal Impact on State and Localities (FY2020-FY2021)

	-6 Percent	-2 Percent
State	-$2,855,267,554	-$1,491,040,444
Localities	-$974,744,806	-$621,373,474
Total	-$3,830,012,360	-$2,112,413,918
% State	74.5%	70.6%

APPENDIX A.
Data and Methodology

REMI PI+ Model Estimation of COVID-19 State and Local Economic Effects

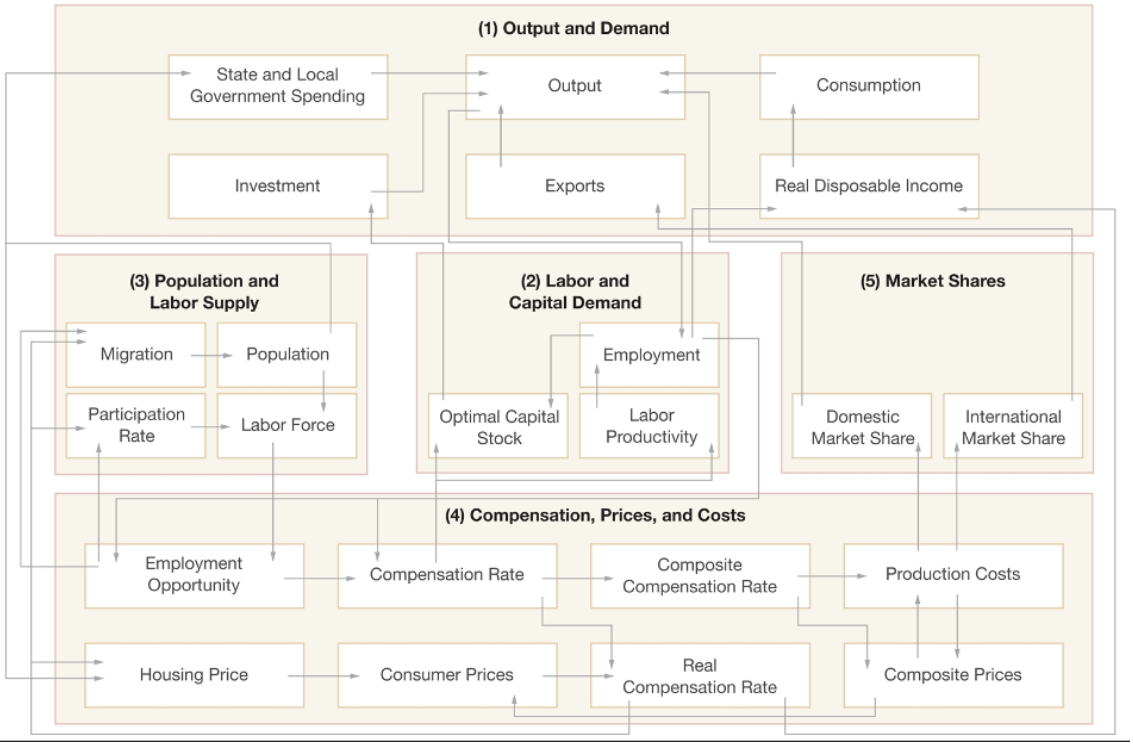
REMI PI+ (Policy Insight Plus) is a dynamic, multi-sector regional economic simulation model used for economic forecasting and measuring the impact of public policy changes on economic and population variables. REMI PI+ has been described as an eclectic economic model (Partridge and Rickman 2010). It utilizes different economic modeling methods such as input-output analysis, econometric forecasting, and computable general equilibrium in combination to characterize the mechanics and path of a regional economy (Treyz, Rickman, and Shao 1991). The model used for this analysis was customized for the state of Virginia. REMI PI+ and earlier versions of the software have been used in thousands of national and regional economic studies, including at least one economic impact study of a national flu pandemic (Loose et al. 2010).

The model contains five major modules or blocks (see **Figure A.1**), which interact simultaneously. The Output block determines expenditures for final demand, including consumption, investment, government, imports, and as well as demand for intermediate inputs. Final demand responds to changes in other model blocks. This module contains a key engine in the model, an input-output model based on the BEA benchmark transactions table that shows flows of goods and services among industries. The Labor and Capital Demand block determines employment, capital, and fuel demand as well as labor productivity. The Population and Labor force block determines the population characteristics of the region, including age, race, and sex composition. Labor force participation changes in response to wages and employment opportunities. A key driver of state population changes is migration, which is influenced by relative wage levels as well as amenities. The Wage, Price, and Costs block is where the prices of factor and housing and product price levels are determined. The Market Shares block helps to measure exports to and imports to the region. Changes in market share are driven by production costs, demand characteristics, distance to markets, and output. Full model documentation, including model equations, data sources, and other pertinent information for the Version 2.3 model and software used in this study is available at the company website (www.remi.com).

The basic procedure used to obtain COVID-19 economic impacts is illustrated in **Figure A.2** and briefly summarized here. A new national control forecast was created using information from published recent national macroeconomic forecasts of annual aggregate GDP growth forecasts for 2020 and beyond. The new national control forecast replaced the default RSQE national forecast produced prior to COVID-19, which assumed approximately 2% GDP growth over the horizon of the simulation period (2020-2025). Two scenarios were modelled that reflect the wide range of annual forecasts available on March 31, 2020: (a) a moderate recessionary scenario of -2 percent growth in 2020 GDP with 3% growth each in 2021 and 2022 and reversion to REMI/RSQE approximately 2% thereafter and (b) a severe recessionary scenario of -6 percent growth in 2020 GDP with 3% growth each in 2021 and 2022 and reversion to REMI/RSQE approximately 2% growth thereafter.

Rather than assume that GDP growth/decline would be the same for all GDP components, the scenarios were modelled by calibrating individual consumer expenditure adjustment factors in the Final Demand Macroeconomic Update for 85 Major GDP Components (75 Personal Consumption Expenditure categories, 4 private fixed investment categories, 3 government purchase categories, imports of goods and services, exports of goods and services, and change in private inventories). Adjustment to the default growth assumptions were introduced using information from a much earlier CBO study (2005) of a global pandemic similar to

FIGURE A.1: Simplified Economic Structure of the Key Interactions in Regional Economies Based on the REMI PI+ Model



Source: Regional Economic Models, Inc.

COVID-19. The study estimated industry (2 and 3 digit NAICS) industry exposure factors based on a review of other Asian studies of the effect of pandemic social distancing and public avoidance on industry activity (see **Table A.1**). Since the CBO study expresses exposure by industry, an industry to commodity to PCE category crosswalk was developed using information from 2012 BEA Input-Output Accounts (PCE Bridge connecting PCE categories to commodities and the Supply table connecting commodities to industries). These exposure factors were assumed to abate after 2020, which seemed the most realistic assumption based on the resiliency of Asian economies after SARS and Avian flu experiences. However, other scenarios were run in which the exposure factors were more permanent; these scenarios (not reported here) created significantly longer negative employment impacts.

TABLE A.1 : Industry Exposure Factors (Decline as Percentage of Final Industry Demand)

Industry	%
Agriculture	10
Mining	10
Utilities	0
Construction	10
Manufacturing	10
Wholesale trade	10
Retail Trade	10
Transportation and warehousing	
Air	67
Rail	67
Transit	67
Information	0
Finance	0
Professional and business services	0
Education/health care	0
Education	0
Health care	-15
Arts/entertainment/accommodation/food	
Arts and recreation	80
Accommodation	80
Food service	80
Other services	5
Government	
Federal	0
State and local	0

Source: CBO (2005)

Following the creation of new national controls, a new regional control forecast for the Virginia economy was generated. This "alternative forecast" for Virginia is then measured against the previous Virginia "control forecast" based on baseline data for the nation and Virginia to examine how COVID-19 affects the Virginia economy. Estimates of county employment impacts were made using information from the Virginia industry employment impact estimates. State industry employment percentage impact results were reweighted to reflect locality industrial compositions using locality employment imputations for six-digit to two-digit NAICS industries from imputed U.S. Census Bureau County Business Pattern employment data for 2016 made by Eckert (2020) that were cross-walked with 70 REMI industries. This locality estimation technique does not take into account other local economic variables that affect local growth and decline that are used in more complete local economic forecasting models.

Sources of data for state and local economic and revenue impact estimates are described in **Table A.2**.

FIGURE A.2: REMI PI+ Model Simulation Flow

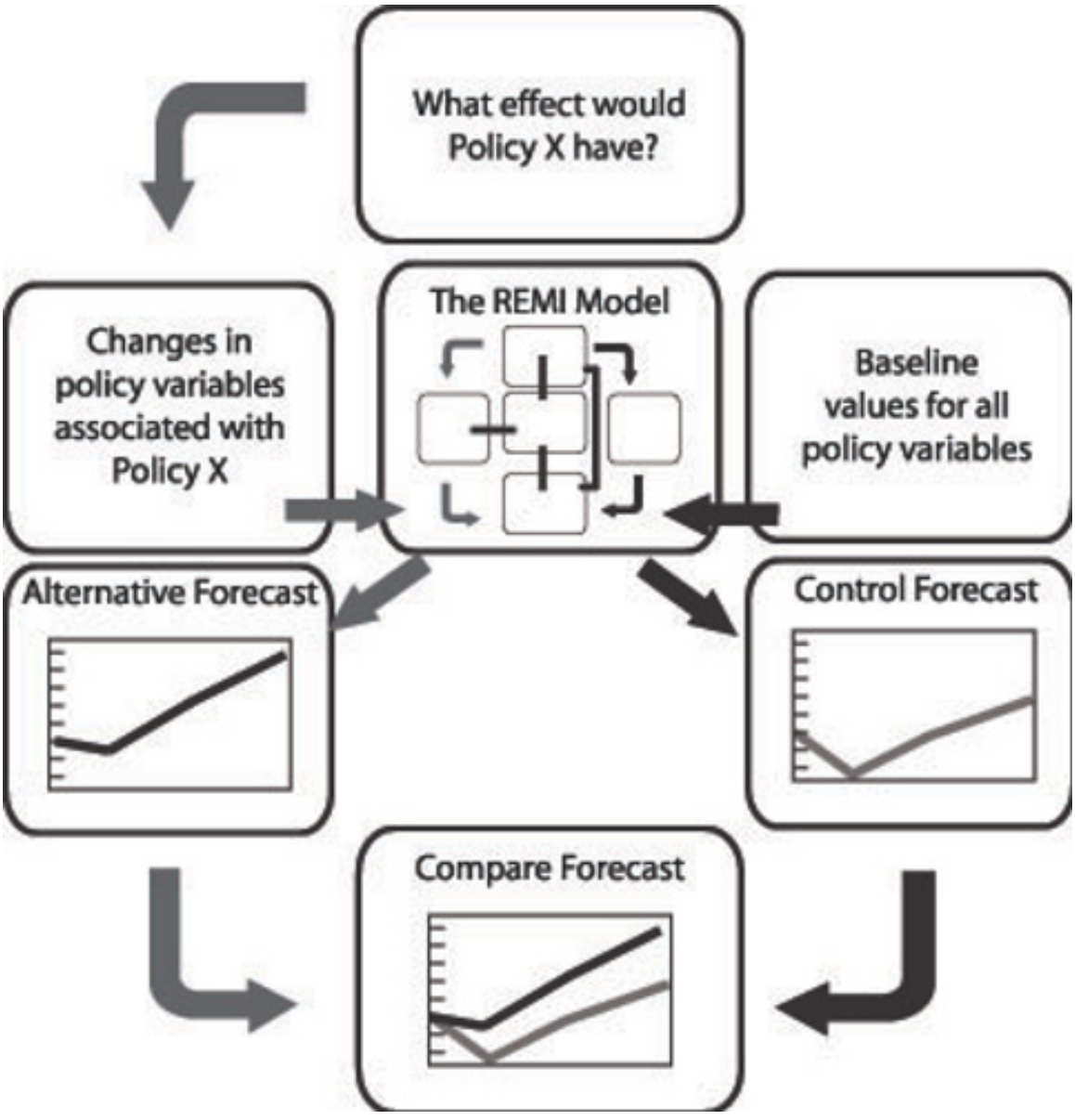


TABLE A.2: Data Sources

Data source	Description of data	Analysis
Congressional Budget Office (2005)	Assumed declines in demand, by industry, in the event of an avian flu pandemic, severe scenario	Estimate industry exposure factors
REMI PI+	State demand by industry, state personal income, state transfer receipts, state employment and percentage employment impact by industry	State and local tax revenue impact analyses.
U.S. Bureau of Economic Analysis Input-Output Accounts	PCEBridge (commodity composition of PCE for 2012--405 commodities), Supply Table (2012)	Crosswalk of GDP personal consumer expenditure components to 3-digit NAICS and REMI industries
U.S. Census Bureau; Census of Government, Annual Survey of State Government Finances	State tax revenue by tax category	State tax revenue impact analysis
U.S. Census Bureau, County Business Patterns and Eckert (2020)	6-digit industry imputed non-farm private employment for localities.	Adjust statewide economic impact estimates to localities based on locality industry composition weights
Virginia Auditor of Public Accounts, Comparative Report of Local Government Revenues and Expenditures	Local revenues by tax category, Exhibits B and B2	Local tax revenue impact analysis
Weldon Cooper Center for Public Service, Virginia Local Tax Rates	Assessed value of real property by category and by locality	Estimate impact to commercial real property tax revenues

State and Local Revenue Estimation

In order to conduct state tax revenue analysis, this study scaled revenues to economic outputs using the procedure described in Regional Economic Models, Inc. (2012). State tax revenues were obtained from the Census of Government's State 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).

For estimating local tax revenues, estimates of total state and industry employment impact were applied to individual local tax revenue categories. The following revenue categories were multiplied by total employment impact factors: consumer utility tax, business license tax, franchise license tax, motor vehicle tax, bank stock tax, recordation and will tax, tobacco tax, and other local taxes. Individual industry employment impact factors were used when detailed industry impact factors seemed more appropriate, including: real property (Rental and leasing services; REMI Sector 48), sales and use tax (Retail trade; REMI 29), admission tax (Amusement, gambling, and recreation; REMI 60), hotel and motel tax (Accommodation; REMI 61), restaurant and food tax (Food services and drinking places; REMI 62), and coal and oil tax (Mining; REMI 4). For real property, only the commercial component was estimated, using Weldon Cooper Center data on the percentage of total property assessments that were commercial/industrial properties. These properties are often assessed using the income approach which estimates property value on the basis of rental income potential. Residential and farm properties and personal property assessments are assumed to be less responsive to economic downturns in the short run and are not modelled. These assumptions can be revisited and revised as more information becomes available.

APPENDIX B.
State Employment Impacts by Scenario and Industry

TABLE B.1: Employment Impact by Industry, -6% Growth Scenario

Industries	2020	2021	2022	2023	2024	2025
All Industries	-503,918	-332,586	-249,143	-222,762	-195,348	-168,049
Forestry, fishing, and hunting	-1,984	-737	-479	-392	-335	-255
Forestry and Logging; Fishing, hunting and trapping	-1,066	-320	-187	-135	-103	-51
Support activities for agriculture and forestry	-918	-418	-292	-257	-232	-204
Mining	-1,150	-713	-468	-359	-267	-166
Oil and gas extraction	-594	-291	-145	-72	-8	60
Mining (except oil and gas)	-484	-360	-277	-247	-221	-187
Support activities for mining	-73	-61	-46	-40	-38	-39
Utilities	9	-526	-221	-67	84	227
Construction	-16,932	-14,672	-9,840	-7,248	-3,496	732
Manufacturing	-26,270	-15,670	-11,699	-10,395	-9,731	-8,911
Wood product manufacturing	-1,399	-963	-779	-725	-662	-547
Nonmetallic mineral product manufacturing	-872	-590	-469	-428	-382	-316
Primary metal manufacturing	-381	-210	-133	-95	-78	-57
Fabricated metal product manufacturing	-1,808	-1,137	-836	-716	-649	-563
Machinery manufacturing	-1,275	-919	-675	-560	-535	-523
Computer and electronic product manufacturing	-1,459	-1,151	-1,032	-1,010	-1,046	-1,066
Electrical equipment, appliance, and component manufacturing	-941	-610	-503	-469	-463	-440
Motor vehicles, bodies and trailers, and parts manufacturing	-1,094	-623	-385	-267	-225	-202
Other transportation equipment manufacturing	-2,283	-1,664	-1,106	-890	-734	-590
Furniture and related product manufacturing	-1,465	-1,105	-1,085	-1,172	-1,301	-1,420
Miscellaneous manufacturing	-1,026	-690	-511	-454	-444	-429
Food manufacturing	-3,863	-1,780	-1,224	-1,084	-987	-920
Beverage and tobacco product manufacturing	-1,079	-370	-108	23	135	244
Textile mills; Textile product mills	-1,336	-495	-328	-272	-242	-178
Apparel manufacturing; Leather and allied product manufacturing	-699	-132	-16	40	79	136
Paper manufacturing	-837	-464	-344	-308	-282	-251
Printing and related support activities	-1,073	-717	-565	-527	-498	-467
Petroleum and coal products manufacturing	-52	-29	-19	-15	-11	-8
Chemical manufacturing	-1,591	-1,015	-826	-790	-770	-735
Plastics and rubber products manufacturing	-1,735	-1,006	-755	-677	-636	-580
Wholesale trade	-12,310	-8,373	-6,964	-6,857	-6,814	-6,764
Retail trade	-59,952	-37,664	-33,180	-34,148	-34,952	-35,852

TABLE B.1: Employment Impact by Industry, -6% Growth Scenario (continued)

Industries	2020	2021	2022	2023	2024	2025
Transportation and warehousing	-23,201	-12,583	-10,120	-9,671	-9,265	-8,852
Air transportation	-2,803	-797	-497	-367	-244	-123
Rail transportation	-411	-269	-216	-207	-204	-198
Water transportation	-143	-84	-68	-65	-63	-60
Truck transportation	-4,309	-2,835	-2,310	-2,235	-2,191	-2,146
Couriers and messengers	-2,090	-1,536	-1,320	-1,327	-1,339	-1,351
Transit and ground passenger transportation	-7,583	-3,346	-2,558	-2,313	-2,046	-1,774
Pipeline transportation	-26	-22	-14	-10	-7	-4
Scenic and sightseeing transportation; Support activities for transportation	-2,488	-1,449	-1,195	-1,169	-1,152	-1,135
Warehousing and storage	-3,348	-2,244	-1,943	-1,977	-2,020	-2,061
Information	-8,329	-6,755	-6,005	-6,048	-6,169	-6,297
Publishing industries, except Internet	-1,901	-1,713	-1,597	-1,636	-1,721	-1,817
Motion picture and sound recording industries	-1,062	-903	-904	-967	-1,041	-1,110
Data processing, hosting, and related services; Other information services	-2,018	-1,434	-1,164	-1,110	-1,073	-1,042
Broadcasting, except Internet	-973	-721	-606	-579	-569	-563
Telecommunications	-2,375	-1,983	-1,734	-1,756	-1,765	-1,766
Finance and insurance	-5,983	-11,522	-7,620	-6,392	-5,343	-4,567
Monetary authorities - central bank; Credit intermediation and related activities	-3,798	-4,557	-3,390	-3,137	-2,937	-2,815
Securities, commodity contracts, other investments; Funds, trusts, other financial vehicles	-2,893	-4,115	-3,010	-2,801	-2,652	-2,611
Insurance carriers and related activities	707	-2,851	-1,220	-455	247	859
Real estate and rental and leasing	687	-11,550	-6,864	-4,811	-2,584	-407
Real estate	2,155	-10,531	-6,038	-4,013	-1,813	341
Rental and leasing services; Lessors of nonfinancial intangible assets	-1,468	-1,019	-826	-797	-771	-748
Professional, scientific, and technical services	-54,563	-40,687	-30,901	-27,262	-24,817	-22,967
Management of companies and enterprises	-9,223	-5,635	-4,562	-4,350	-4,263	-4,170
Administrative, support, waste management, and remediation services	-22,853	-19,819	-14,623	-12,958	-11,362	-9,842
Administrative and support services	-22,382	-19,304	-14,291	-12,702	-11,187	-9,748
Waste management and remediation services	-471	-515	-332	-255	-175	-94
Educational services; private	-5,653	-7,927	-6,525	-6,199	-5,656	-4,932
Health care and social assistance	-25,045	-37,472	-33,002	-34,274	-35,299	-36,425
Ambulatory health care services	-9,356	-14,971	-12,868	-13,422	-14,093	-15,064
Hospitals; private	-3,794	-6,859	-5,701	-5,815	-6,000	-6,320
Nursing and residential care facilities	-4,097	-5,986	-5,223	-5,378	-5,490	-5,609
Social assistance	-7,799	-9,657	-9,210	-9,658	-9,715	-9,432

TABLE B.1: Employment Impact by Industry, -6% Growth Scenario (continued)

Industries	2020	2021	2022	2023	2024	2025
Arts, entertainment, and recreation	-20,232	-7,275	-5,685	-5,295	-4,914	-4,569
Performing arts, spectator sports, and related industries	-7,511	-3,601	-2,938	-2,816	-2,719	-2,636
Museums, historical sites, and similar institutions	-888	-736	-798	-901	-972	-1,008
Amusement, gambling, and recreation industries	-11,832	-2,937	-1,950	-1,578	-1,223	-924
Accommodation and food services	-98,571	-25,804	-19,197	-16,691	-13,793	-10,719
Accommodation	-12,316	-3,686	-2,875	-2,649	-2,395	-2,137
Food services and drinking places	-86,255	-22,117	-16,322	-14,042	-11,398	-8,582
Other services (except public administration)	-37,222	-25,620	-23,190	-23,662	-23,433	-22,674
Repair and maintenance	-9,006	-2,992	-1,895	-1,493	-1,145	-880
Personal and laundry services	-11,976	-7,306	-5,759	-5,395	-4,933	-4,466
Religious, grantmaking, civic, professional, and similar organizations	-12,915	-13,252	-13,893	-15,252	-16,001	-16,163
Private households	-3,324	-2,070	-1,643	-1,521	-1,354	-1,165
State and Local Government	-34,667	-23,710	-11,516	-4,916	2,376	9,741
State Government	-10,559	-7,209	-3,472	-1,433	816	3,087
Local Government	-24,108	-16,502	-8,045	-3,483	1,560	6,654
Federal Civilian	-23,706	-8,243	-2,469	450	3,223	5,615
Federal Military	-10,980	-6,812	-1,951	690	3,288	5,751
Farm	-5,789	-2,817	-2,064	-1,908	-1,825	-1,746

TABLE B.2: Employment Impact by Industry, -2% Growth Scenario

Industries	2020	2021	2022	2023	2024	2025
All Industries	-298,779	-126,205	-45,115	-21,977	3,314	29,335
Forestry, fishing, and hunting	-1,457	-161	107	199	263	351
Forestry and Logging; Fishing, hunting and trapping	-827	-52	84	138	173	227
Support activities for agriculture and forestry	-630	-108	23	61	90	123
Mining	-622	-171	79	191	287	393
Oil and gas extraction	-346	-27	129	210	282	358
Mining (except oil and gas)	-246	-125	-45	-20	3	35
Support activities for mining	-30	-20	-5	0	2	1
Utilities	549	-30	266	409	551	686
Construction	-6,188	-5,036	-1,235	439	3,567	7,477
Manufacturing	-16,735	-5,918	-2,008	-819	-235	519
Wood product manufacturing	-813	-379	-207	-167	-112	-3
Nonmetallic mineral product manufacturing	-508	-224	-108	-74	-33	29
Primary metal manufacturing	-237	-64	11	45	60	78
Fabricated metal product manufacturing	-1,084	-402	-105	7	68	151
Machinery manufacturing	-696	-340	-104	0	17	20
Computer and electronic product manufacturing	-1,002	-694	-586	-576	-623	-653
Electrical equipment, appliance, and component manufacturing	-629	-290	-185	-155	-153	-133
Motor vehicles, bodies and trailers, and parts manufacturing	-667	-186	52	165	205	226
Other transportation equipment manufacturing	-1,155	-531	28	237	388	528
Furniture and related product manufacturing	-1,036	-666	-650	-741	-874	-996
Miscellaneous manufacturing	-589	-247	-70	-16	-9	3
Food manufacturing	-2,613	-462	102	244	346	420
Beverage and tobacco product manufacturing	-693	31	290	416	523	628
Textile mills; Textile product mills	-1,056	-184	-13	45	78	146
Apparel manufacturing; Leather and allied product manufacturing	-595	-6	115	175	219	280
Paper manufacturing	-540	-161	-44	-15	6	33
Printing and related support activities	-654	-297	-152	-124	-105	-81
Petroleum and coal products manufacturing	-31	-7	2	6	9	13
Chemical manufacturing	-1,021	-434	-250	-223	-211	-184
Plastics and rubber products manufacturing	-1,117	-376	-133	-66	-34	14
Wholesale trade	-7,552	-3,569	-2,212	-2,179	-2,189	-2,180
Retail trade	-40,935	-18,492	-14,520	-16,057	-17,324	-18,603

TABLE B.2: Employment Impact by Industry, -2% Growth Scenario (continued)

Industries	2020	2021	2022	2023	2024	2025
Transportation and warehousing	-16,010	-5,037	-2,547	-2,109	-1,687	-1,244
Air transportation	-2,292	-210	97	230	358	483
Rail transportation	-247	-101	-48	-40	-37	-31
Water transportation	-94	-33	-16	-13	-11	-7
Truck transportation	-2,662	-1,163	-651	-598	-568	-533
Couriers and messengers	-1,235	-663	-444	-453	-464	-474
Transit and ground passenger transportation	-5,651	-1,267	-467	-221	57	346
Pipeline transportation	-8	-5	4	7	10	12
Scenic and sightseeing transportation; Support activities for transportation	-1,672	-592	-329	-298	-274	-250
Warehousing and storage	-2,149	-1,003	-693	-723	-757	-789
Information	-5,111	-3,533	-2,813	-2,903	-3,060	-3,221
Publishing industries, except Internet	-1,194	-1,012	-905	-956	-1,052	-1,156
Motion picture and sound recording industries	-747	-583	-585	-652	-727	-798
Data processing, hosting, and related services; Other information services	-1,237	-625	-341	-279	-232	-190
Broadcasting, except Internet	-615	-361	-252	-233	-228	-229
Telecommunications	-1,318	-951	-730	-783	-820	-848
Finance and insurance	3,478	-2,423	1,555	2,813	3,925	4,773
Monetary authorities - central bank; Credit intermediation and related activities	-529	-1,360	-173	83	295	430
Securities, commodity contracts, other investments; Funds, trusts, other financial vehicles	239	-1,073	59	284	460	533
Insurance carriers and related activities	3,768	10	1,669	2,447	3,171	3,809
Real estate and rental and leasing	10,610	-2,561	1,902	3,692	5,711	7,734
Real estate	11,467	-2,154	2,123	3,892	5,890	7,892
Rental and leasing services; Lessors of nonfinancial intangible assets	-857	-406	-220	-200	-179	-158
Professional, scientific, and technical services	-31,387	-17,003	-6,935	-3,159	-492	1,617
Management of companies and enterprises	-6,067	-2,329	-1,213	-983	-871	-753
Administrative, support, waste management, and remediation services	-10,074	-7,070	-1,807	-141	1,506	3,108
Administrative and support services	-9,997	-6,940	-1,860	-269	1,297	2,817
Waste management and remediation services	-77	-129	54	129	209	291
Educational services; private	-1,066	-3,465	-2,032	-1,701	-1,138	-384
Health care and social assistance	-4,053	-17,310	-12,905	-14,338	-15,450	-16,619
Ambulatory health care services	-254	-6,214	-4,085	-4,647	-5,294	-6,223
Hospitals; private	487	-2,828	-1,732	-1,932	-2,187	-2,569
Nursing and residential care facilities	-748	-2,753	-1,991	-2,167	-2,289	-2,414
Social assistance	-3,538	-5,516	-5,097	-5,593	-5,680	-5,413

TABLE B.2: Employment Impact by Industry, -2% Growth Scenario (continued)

Industries	2020	2021	2022	2023	2024	2025
Arts, entertainment, and recreation	-16,366	-2,956	-1,368	-995	-613	-257
Performing arts, spectator sports, and related industries	-5,617	-1,563	-886	-761	-653	-556
Museums, historical sites, and similar institutions	-659	-492	-547	-646	-711	-741
Amusement, gambling, and recreation industries	-10,089	-901	65	411	750	1,041
Accommodation and food services	-86,266	-11,050	-4,769	-2,681	-142	2,628
Accommodation	-10,528	-1,607	-825	-638	-414	-180
Food services and drinking places	-75,738	-9,443	-3,944	-2,043	271	2,808
Other services (except public administration)	-25,057	-13,123	-10,690	-11,192	-10,937	-10,118
Repair and maintenance	-6,913	-716	374	764	1,112	1,383
Personal and laundry services	-7,602	-2,839	-1,295	-938	-459	39
Religious, grantmaking, civic, professional, and similar organizations	-8,420	-8,731	-9,365	-10,736	-11,482	-11,633
Private households	-2,122	-836	-405	-282	-107	93
State and Local Government	-13,290	-3,127	8,282	13,995	20,530	27,269
State Government	-4,056	-957	2,524	4,271	6,264	8,318
Local Government	-9,234	-2,170	5,758	9,724	14,266	18,951
Federal Civilian	-16,126	-118	5,754	8,712	11,539	13,985
Federal Military	-5,151	-907	4,032	6,705	9,350	11,859
Farm	-3,903	-816	-39	126	222	313

APPENDIX C.
Locality Employment and Tax Revenue Impacts by Scenario

TABLE C.1: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -6% Growth Scenario

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Accomack County	-11.19%	-6.35%	-0.99%	-1.56%
Albemarle County	-9.94%	-6.63%	-1.79%	-2.76%
Alleghany County	-10.15%	-6.74%	-0.72%	-1.09%
Amelia County	-9.02%	-6.58%	-0.59%	-1.00%
Amherst County	-10.44%	-6.78%	-1.23%	-1.91%
Appomattox County	-10.41%	-6.81%	-0.73%	-1.20%
Arlington County	-11.09%	-6.90%	-2.20%	-3.42%
Augusta County	-9.47%	-6.47%	-1.38%	-2.13%
Bath County	-15.84%	-6.59%	-2.17%	-2.95%
Bedford County	-10.20%	-6.78%	-1.04%	-1.60%
Bland County	-10.02%	-6.97%	-0.51%	-0.79%
Botetourt County	-9.90%	-6.34%	-1.35%	-2.05%
Brunswick County	-9.78%	-6.21%	-0.41%	-0.68%
Buchanan County	-9.14%	-6.44%	-2.50%	-4.31%
Buckingham County	-9.28%	-6.54%	-0.42%	-0.71%
Campbell County	-10.52%	-6.47%	-1.18%	-1.93%
Caroline County	-10.94%	-6.60%	-0.95%	-1.41%
Carroll County	-12.15%	-6.97%	-0.90%	-1.37%
Charles City County	-9.28%	-6.49%	-0.41%	-0.68%
Charlotte County	-10.10%	-6.60%	-0.53%	-0.87%
Chesterfield County	-10.64%	-6.58%	-1.44%	-2.33%
Clarke County	-8.95%	-6.80%	-0.58%	-0.99%
Craig County	-8.83%	-6.47%	-0.57%	-0.85%
Culpeper County	-10.56%	-6.75%	-0.85%	-1.40%
Cumberland County	-9.71%	-6.59%	-0.41%	-0.67%
Dickenson County	-9.64%	-6.49%	-2.51%	-4.32%
Dinwiddie County	-10.23%	-6.56%	-1.20%	-1.88%
Essex County	-11.41%	-6.71%	-1.00%	-1.65%
Fairfax County	-9.62%	-6.69%	-1.18%	-1.97%
Fauquier County	-10.64%	-6.57%	-0.83%	-1.37%
Floyd County	-10.99%	-6.61%	-0.58%	-0.93%
Fluvanna County	-9.90%	-6.49%	-0.45%	-0.73%
Franklin County	-10.02%	-6.59%	-1.06%	-1.66%

TABLE C.1: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -6% Growth Scenario (continued)

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Frederick County	-10.64%	-6.53%	-1.76%	-2.72%
Giles County	-10.69%	-6.75%	-0.74%	-1.20%
Gloucester County	-11.10%	-6.75%	-1.54%	-2.32%
Goochland County	-9.17%	-6.27%	-1.16%	-1.95%
Grayson County	-11.08%	-7.34%	-0.37%	-0.61%
Greene County	-11.37%	-6.59%	-1.39%	-2.11%
Greensville County	-12.91%	-6.18%	-1.24%	-1.86%
Halifax County	-10.68%	-6.61%	-1.09%	-1.74%
Hanover County	-10.80%	-6.51%	-1.36%	-2.22%
Henrico County	-9.41%	-6.45%	-2.40%	-3.70%
Henry County	-11.16%	-6.69%	-1.97%	-3.01%
Highland County	-8.97%	-6.37%	-0.35%	-0.57%
Isle of Wight County	-11.37%	-6.19%	-0.86%	-1.37%
James City County	-12.13%	-6.42%	-1.75%	-2.58%
King and Queen County	-11.07%	-6.41%	-0.30%	-0.48%
King George County	-9.97%	-6.59%	-1.03%	-1.55%
King William County	-11.20%	-6.19%	-1.00%	-1.55%
Lancaster County	-9.51%	-6.72%	-0.77%	-1.28%
Lee County	-10.33%	-6.66%	-1.12%	-1.85%
Loudoun County	-10.82%	-6.58%	-1.17%	-1.91%
Louisa County	-9.35%	-6.44%	-0.68%	-1.03%
Lunenburg County	-10.44%	-6.43%	-0.46%	-0.74%
Madison County	-9.73%	-6.71%	-0.86%	-1.29%
Mathews County	-11.19%	-6.91%	-0.66%	-1.00%
Mecklenburg County	-10.91%	-6.71%	-0.73%	-1.20%
Middlesex County	-11.56%	-6.85%	-0.83%	-1.26%
Montgomery County	-11.24%	-6.88%	-1.02%	-1.69%
Nelson County	-13.67%	-6.54%	-1.33%	-1.90%
New Kent County	-9.99%	-6.40%	-0.85%	-1.28%
Northampton County	-11.28%	-6.64%	-1.05%	-1.59%
Northumberland County	-10.40%	-6.40%	-0.42%	-0.68%
Nottoway County	-9.15%	-6.67%	-0.83%	-1.37%
Orange County	-11.15%	-6.71%	-0.91%	-1.43%
Page County	-10.69%	-6.94%	-1.00%	-1.50%
Patrick County	-10.21%	-6.41%	-0.82%	-1.27%
Pittsylvania County	-9.90%	-6.80%	-0.95%	-1.52%

TABLE C.1: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -6% Growth Scenario (continued)

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Powhatan County	-10.96%	-6.46%	-0.85%	-1.39%
Prince Edward County	-10.49%	-6.78%	-1.25%	-2.07%
Prince George County	-9.90%	-6.41%	-1.54%	-2.39%
Prince William County	-11.04%	-6.59%	-1.08%	-1.76%
Pulaski County	-10.99%	-6.46%	-1.25%	-1.89%
Rappahannock County	-12.94%	-6.43%	-0.68%	-1.01%
Richmond County	-9.56%	-7.07%	-0.93%	-1.54%
Roanoke County	-9.80%	-6.67%	-1.51%	-2.35%
Rockbridge County	-13.10%	-6.72%	-1.67%	-2.39%
Rockingham County	-10.31%	-6.36%	-0.90%	-1.43%
Russell County	-9.49%	-6.55%	-0.92%	-1.54%
Scott County	-11.02%	-7.04%	-0.88%	-1.45%
Shenandoah County	-10.90%	-6.64%	-0.85%	-1.40%
Smyth County	-9.84%	-6.40%	-0.74%	-1.22%
Southampton County	-11.60%	-6.60%	-0.56%	-0.86%
Spotsylvania County	-11.28%	-6.73%	-1.69%	-2.59%
Stafford County	-9.48%	-6.32%	-1.46%	-2.25%
Surry County	-3.26%	-4.99%	-0.13%	-0.24%
Sussex County	-10.57%	-6.72%	-0.40%	-0.65%
Tazewell County	-10.20%	-6.64%	-1.36%	-2.26%
Warren County	-10.85%	-6.78%	-1.17%	-1.85%
Washington County	-10.16%	-6.69%	-1.13%	-1.86%
Westmoreland County	-10.94%	-6.71%	-0.47%	-0.77%
Wise County	-10.21%	-6.66%	-1.20%	-2.02%
Wythe County	-11.77%	-6.49%	-1.26%	-1.96%
York County	-12.06%	-6.63%	-2.01%	-3.02%
Alexandria city	-10.23%	-6.96%	-1.95%	-3.04%
Bristol city	-12.19%	-6.76%	-3.28%	-4.67%
Buena Vista city	-10.48%	-6.57%	-1.05%	-1.56%
Charlottesville city	-10.34%	-6.86%	-2.58%	-3.82%
Chesapeake city	-10.54%	-6.55%	-2.18%	-3.31%
Colonial Heights city	-13.01%	-6.82%	-4.21%	-6.11%
Covington city	-11.28%	-6.53%	-2.10%	-3.10%
Danville city	-10.68%	-6.79%	-3.25%	-4.77%
Emporia city	-10.87%	-6.66%	-4.77%	-6.72%
Fairfax city	-10.90%	-6.80%	-2.69%	-4.19%

TABLE C.1: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -6% Growth Scenario (continued)

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Falls Church city	-10.13%	-6.77%	-1.87%	-2.89%
Franklin city	-10.04%	-6.90%	-2.45%	-3.67%
Fredericksburg city	-11.75%	-6.76%	-3.75%	-5.45%
Galax city	-10.19%	-6.79%	-3.42%	-4.98%
Hampton city	-10.53%	-6.80%	-2.18%	-3.21%
Harrisonburg city	-11.99%	-6.69%	-3.89%	-5.61%
Hopewell city	-10.14%	-6.73%	0.00%	0.00%
Lexington city	-9.61%	-6.99%	-2.56%	-3.69%
Lynchburg city	-9.23%	-6.68%	-2.72%	-4.05%
Manassas city	-10.33%	-7.02%	-1.96%	-3.09%
Manassas Park city	-8.39%	-5.91%	-1.14%	-1.84%
Martinsville city	-9.67%	-6.70%	-2.36%	-3.58%
Newport News city	-9.55%	-6.46%	-2.49%	-3.81%
Norfolk city	-9.94%	-6.62%	-2.67%	-3.95%
Norton city	-9.63%	-6.61%	-4.47%	-6.55%
Petersburg city	-8.46%	-6.67%	0.00%	0.00%
Poquoson city	-11.95%	-6.78%	-0.76%	-1.09%
Portsmouth city	-9.37%	-6.63%	-1.72%	-2.67%
Radford city	-13.26%	-6.88%	-1.64%	-2.38%
Richmond city	-9.32%	-6.61%	-2.21%	-3.33%
Roanoke city	-9.79%	-6.63%	-3.02%	-4.54%
Salem city	-9.98%	-6.65%	-2.83%	-4.26%
Staunton city	-10.60%	-6.82%	-2.42%	-3.54%
Suffolk city	-10.51%	-6.66%	-1.91%	-2.88%
Virginia Beach city	-10.68%	-6.51%	-2.32%	-3.39%
Waynesboro city	-12.38%	-6.85%	-2.68%	-3.91%
Williamsburg city	-16.01%	-7.51%	-5.65%	-7.79%
Winchester city	-9.68%	-6.74%	-3.52%	-5.28%
Estimated average percentage revenue impact			-1.68%	-2.60%
Estimated total local revenue impact			-$374,454,721	-$600,290,086

TABLE C.2: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -2% Growth Scenario

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Accomack County	-7.46%	-2.51%	-0.67%	-0.93%
Albemarle County	-6.17%	-2.82%	-1.25%	-1.68%
Alleghany County	-6.40%	-2.95%	-0.53%	-0.69%
Amelia County	-5.24%	-2.85%	-0.37%	-0.56%
Amherst County	-6.70%	-3.00%	-0.87%	-1.18%
Appomattox County	-6.69%	-3.06%	-0.48%	-0.69%
Arlington County	-7.36%	-3.07%	-1.54%	-2.05%
Augusta County	-5.68%	-2.66%	-0.96%	-1.29%
Bath County	-12.33%	-2.81%	-1.77%	-2.12%
Bedford County	-6.46%	-3.00%	-0.75%	-1.00%
Bland County	-6.25%	-3.14%	-0.37%	-0.50%
Botetourt County	-6.15%	-2.55%	-0.96%	-1.26%
Brunswick County	-6.02%	-2.39%	-0.27%	-0.39%
Buchanan County	-5.33%	-2.60%	-1.38%	-2.06%
Buckingham County	-5.50%	-2.76%	-0.27%	-0.40%
Campbell County	-6.79%	-2.67%	-0.78%	-1.10%
Caroline County	-7.23%	-2.82%	-0.71%	-0.92%
Carroll County	-8.49%	-3.19%	-0.65%	-0.86%
Charles City County	-5.51%	-2.77%	-0.26%	-0.38%
Charlotte County	-6.34%	-2.80%	-0.34%	-0.49%
Chesterfield County	-6.91%	-2.79%	-0.94%	-1.33%
Clarke County	-5.15%	-3.04%	-0.36%	-0.54%
Craig County	-5.03%	-2.69%	-0.42%	-0.55%
Culpeper County	-6.82%	-2.96%	-0.55%	-0.80%
Cumberland County	-5.96%	-2.85%	-0.26%	-0.39%
Dickenson County	-5.87%	-2.70%	-1.39%	-2.07%
Dinwiddie County	-6.48%	-2.75%	-0.83%	-1.12%
Essex County	-7.71%	-2.91%	-0.65%	-0.94%
Fairfax County	-5.83%	-2.86%	-0.74%	-1.07%
Fauquier County	-6.93%	-2.81%	-0.53%	-0.77%
Floyd County	-7.28%	-2.82%	-0.40%	-0.56%
Fluvanna County	-6.16%	-2.77%	-0.29%	-0.42%
Franklin County	-6.27%	-2.80%	-0.73%	-1.00%

TABLE C.2: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -2% Growth Scenario (continued)

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Frederick County	-6.90%	-2.71%	-1.24%	-1.66%
Giles County	-6.96%	-2.94%	-0.49%	-0.70%
Gloucester County	-7.40%	-2.99%	-1.12%	-1.47%
Goochland County	-5.35%	-2.39%	-0.71%	-1.04%
Grayson County	-7.36%	-3.54%	-0.25%	-0.37%
Greene County	-7.68%	-2.85%	-1.00%	-1.32%
Greensville County	-9.26%	-2.33%	-0.91%	-1.18%
Halifax County	-6.94%	-2.80%	-0.74%	-1.02%
Hanover County	-7.08%	-2.73%	-0.89%	-1.27%
Henrico County	-5.62%	-2.63%	-1.70%	-2.26%
Henry County	-7.43%	-2.86%	-1.41%	-1.87%
Highland County	-5.17%	-2.57%	-0.22%	-0.32%
Isle of Wight County	-7.65%	-2.35%	-0.57%	-0.78%
James City County	-8.46%	-2.62%	-1.31%	-1.67%
King and Queen County	-7.36%	-2.62%	-0.20%	-0.28%
King George County	-6.21%	-2.77%	-0.76%	-0.99%
King William County	-7.50%	-2.40%	-0.69%	-0.93%
Lancaster County	-5.73%	-2.93%	-0.49%	-0.73%
Lee County	-6.60%	-2.91%	-0.73%	-1.06%
Loudoun County	-7.09%	-2.78%	-0.75%	-1.07%
Louisa County	-5.57%	-2.65%	-0.49%	-0.65%
Lunenburg County	-6.70%	-2.63%	-0.30%	-0.43%
Madison County	-5.98%	-2.95%	-0.63%	-0.83%
Mathews County	-7.49%	-3.15%	-0.48%	-0.64%
Mecklenburg County	-7.18%	-2.90%	-0.47%	-0.68%
Middlesex County	-7.88%	-3.09%	-0.61%	-0.81%
Montgomery County	-7.53%	-3.09%	-0.66%	-0.95%
Nelson County	-10.06%	-2.74%	-1.02%	-1.28%
New Kent County	-6.26%	-2.68%	-0.63%	-0.82%
Northampton County	-7.57%	-2.84%	-0.76%	-1.00%
Northumberland County	-6.68%	-2.63%	-0.27%	-0.39%
Nottoway County	-5.36%	-2.88%	-0.53%	-0.78%
Orange County	-7.45%	-2.94%	-0.64%	-0.87%
Page County	-6.96%	-3.17%	-0.74%	-0.97%
Patrick County	-6.44%	-2.56%	-0.58%	-0.78%
Pittsylvania County	-6.15%	-3.04%	-0.64%	-0.90%

TABLE C.2: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -2% Growth Scenario (continued)

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Powhatan County	-7.28%	-2.77%	-0.56%	-0.80%
Prince Edward County	-6.76%	-3.00%	-0.81%	-1.19%
Prince George County	-6.12%	-2.57%	-1.07%	-1.43%
Prince William County	-7.34%	-2.85%	-0.70%	-1.00%
Pulaski County	-7.26%	-2.61%	-0.90%	-1.18%
Rappahannock County	-9.32%	-2.66%	-0.50%	-0.64%
Richmond County	-5.78%	-3.29%	-0.60%	-0.89%
Roanoke County	-6.02%	-2.85%	-1.05%	-1.41%
Rockbridge County	-9.47%	-2.93%	-1.29%	-1.62%
Rockingham County	-6.56%	-2.54%	-0.61%	-0.84%
Russell County	-5.71%	-2.76%	-0.57%	-0.83%
Scott County	-7.29%	-3.24%	-0.57%	-0.83%
Shenandoah County	-7.17%	-2.82%	-0.55%	-0.79%
Smyth County	-6.07%	-2.57%	-0.48%	-0.69%
Southampton County	-7.90%	-2.76%	-0.40%	-0.53%
Spotsylvania County	-7.59%	-2.96%	-1.21%	-1.60%
Stafford County	-5.69%	-2.51%	-1.01%	-1.35%
Surry County	0.77%	-1.16%	-0.07%	-0.11%
Sussex County	-6.83%	-2.91%	-0.28%	-0.39%
Tazewell County	-6.45%	-2.85%	-0.86%	-1.25%
Warren County	-7.12%	-3.00%	-0.80%	-1.10%
Washington County	-6.40%	-2.86%	-0.73%	-1.06%
Westmoreland County	-7.22%	-2.91%	-0.32%	-0.45%
Wise County	-6.46%	-2.87%	-0.74%	-1.08%
Wythe County	-8.08%	-2.68%	-0.89%	-1.20%
York County	-8.40%	-2.86%	-1.47%	-1.91%
Alexandria city	-6.46%	-3.14%	-1.35%	-1.82%
Bristol city	-8.52%	-2.94%	-2.55%	-3.16%
Buena Vista city	-6.72%	-2.72%	-0.78%	-1.01%
Charlottesville city	-6.59%	-3.07%	-1.92%	-2.46%
Chesapeake city	-6.81%	-2.77%	-1.57%	-2.06%
Colonial Heights city	-9.39%	-3.06%	-3.22%	-4.06%
Covington city	-7.57%	-2.71%	-1.57%	-2.01%
Danville city	-6.94%	-2.98%	-2.45%	-3.12%
Emporia city	-7.15%	-2.88%	-3.75%	-4.61%
Fairfax city	-7.18%	-3.00%	-1.88%	-2.53%

TABLE C.2: Locality Private Non-farm Employment and Tax Revenue Impacts, 2020 and 2021, -2% Growth Scenario (continued)

	Private Non-farm Employment (percentage of baseline)		Tax Revenues (percentage of baseline)	
Locality	2020	2021	FY2020	FY2021
Falls Church city	-6.38%	-2.99%	-1.31%	-1.75%
Franklin city	-6.29%	-3.12%	-1.80%	-2.35%
Fredericksburg city	-8.07%	-2.97%	-2.85%	-3.59%
Galax city	-6.43%	-2.99%	-2.60%	-3.30%
Hampton city	-6.79%	-3.00%	-1.63%	-2.08%
Harrisonburg city	-8.31%	-2.89%	-2.98%	-3.74%
Hopewell city	-6.37%	-2.91%	0.00%	0.00%
Lexington city	-5.82%	-3.18%	-1.98%	-2.47%
Lynchburg city	-5.42%	-2.86%	-2.01%	-2.58%
Manassas city	-6.59%	-3.24%	-1.33%	-1.82%
Manassas Park city	-4.62%	-2.24%	-0.74%	-1.03%
Martinsville city	-5.88%	-2.88%	-1.69%	-2.23%
Newport News city	-5.75%	-2.60%	-1.76%	-2.31%
Norfolk city	-6.17%	-2.80%	-1.97%	-2.52%
Norton city	-5.85%	-2.80%	-3.37%	-4.29%
Petersburg city	-4.64%	-2.86%	0.00%	0.00%
Poquoson city	-8.29%	-3.04%	-0.59%	-0.74%
Portsmouth city	-5.58%	-2.83%	-1.20%	-1.60%
Radford city	-9.62%	-3.07%	-1.25%	-1.58%
Richmond city	-5.52%	-2.79%	-1.58%	-2.06%
Roanoke city	-6.01%	-2.82%	-2.18%	-2.85%
Salem city	-6.21%	-2.83%	-2.06%	-2.68%
Staunton city	-6.86%	-3.02%	-1.83%	-2.33%
Suffolk city	-6.78%	-2.87%	-1.38%	-1.80%
Virginia Beach city	-6.95%	-2.72%	-1.75%	-2.20%
Waynesboro city	-8.72%	-3.05%	-2.03%	-2.58%
Williamsburg city	-12.50%	-3.75%	-4.58%	-5.54%
Winchester city	-5.90%	-2.92%	-2.58%	-3.35%
Estimated average percentage revenue impact			-1.17%	-1.57%
Estimated total local revenue impact			-$260,413,996	-$360,959,478

REFERENCES

Congressional Budget Office. 2005. A Potential influenza pandemic: Possible macroeconomic effects and policy issues. Washington, DC.

Congressional Budget Office. 2006. A potential influenza pandemic: An update on possible macroeconomic effects and policy issues. Washington, DC.

Dingel, Jonathan and Brent Neiman. 2020. How many jobs can be done at home? Chicago: Becker Friedman Institute, University of Chicago.

Eckert, Fabian Teresa C. Fort, Peter K. Schott, and Natalie J. Yang. 2020. Imputing missing values in the U.S. Census Bureau's County Business Patterns. NBER Working Paper #26632.

Burton, Jacob T., Gabriel M. Ehrlich, Donald Grimes, Danil Manaenkov, Michael R. McWilliams, Wenting Song, and Aditi Thapar. 2020. The U.S. and Michigan economic outlook for 2020-2022: An interim update. https://lsa.umich.edu/content/dam/econ-assets/Econdocs/RSQE%20PDFs/RSQE_Forecast_Update_(2020.03).pdf

Loose, Verne W., Vanessa N. Vargas, Drake E. Warren, Shirley J. Starks, and Theresa J. Brown, Braeton J. Smith. 2010. *Economic and policy implications of pandemic influenza*. Sandia Report. SAND2010-1910.

McKibbin, Warwick J. and Alexandra A. Sidorenko. 2006. Global macroeconomic consequences of pandemic influenza. Sydney, New South Wales, Australia: Lowy Institute for International Policy, Australian National University.

Partridge, Mark D. and Dan S. Rickman. 2010. Computable general equilibrium (CGE) modeling for regional economic development analysis. *Regional Studies* 44, 10: 1311-1328.

Regional Economic Models, Inc. 2012. *Predicted revenue & expenditure effects*.

Treyz, George I. 1993. *Regional economic modeling: A systematic approach to economic forecasting and policy analysis.* Nowell, MA: Kluwer Academic Publishers.

Treyz, George I. Dan S. Rickman, Gang Shao. 1991. The REMI Economic-Demographic Forecasting and Simulation Model. *International Regional Science Review*. 14, 3: 221-253.

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