

Documenting the Financial Impact of a New Cancer Clinical Trials Network and the Out-migration of WV Cancer Patients

January 2013

A report prepared for the Claude Worthington Benedum Foundation by:

Bureau of Business and Economic Research
College of Business and Economics
West Virginia University

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West Virginia University**

150 Clay St.
PO Box 6527
Morgantown, WV 26501
(304) 293-7831
bebureau@mail.wvu.edu

Tami Gurley-Calvez, Ph.D. Department of Health Policy and Management
University of Kansas Medical Center
tgurley-calvez@kumc.edu

Srimoyee Bose Department of Economics
West Virginia University
srimoyee.bose@mail.wvu.edu

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Executive Summary

Each year more than 10,000 West Virginians are newly diagnosed with cancer (Hudson, 2011). There is an interest among policymakers, care providers, industry officials, and others to reduce the impact of cancer in the state. Several key objectives aimed at prevention, early detection, and quality of life are outlined in the West Virginia Cancer Plan, including the objective to increase enrollment in cancer trials (Mountains of Hope, 2007). In addition, there is a significant opportunity to impact the lives of cancer patients and their families, as well as the West Virginia economy, by altering cancer care options in the state.

About one in five newly diagnosed West Virginia cancer patients elect to receive their cancer care in another state.¹ Enhancing the existing cancer care system in West Virginia might induce more patients to receive their care in-state, reducing the travel burden on families. Implementing and operating a West Virginia cancer clinical trials network would create new opportunities for patients and generate a significant economic impact in West Virginia. We estimate that about \$360 million is spent in other states for the cancer care of West Virginia residents. This spending results in just under 3,000 outside jobs. Accounting for the indirect effects of medical spending on retail sales and the broader economy, we estimate that about \$622 million in economic activity spills into neighboring states for the care of West Virginia cancer patients.

¹ Based on tabulations from the West Virginia Cancer Registry of patients diagnosed in 2008 that received some type of cancer care in another state. In our analysis, each patient is categorized as either in-state or out-of-state for the purposes of our calculations and we use 20% receiving out-of-state treatment as the basis for the out-of-state group. Note, that if some of these patients receive a portion of their care in West Virginia, we might overstate the amount of spillover. Likewise, if some of the in-state patients opt for out-of-state treatment at some point in the future, or if those going out-of-state for some cancer care receive additional medical services not related to cancer care, we have understated spillovers. Estimates of the economic impact of the cancer clinical trials network are based on the conservative assumption that the trial network only retains 20-50% (depending on year of operation) of the patients going out-of-state for cancer trials and we assume a 5.8% participation rate for trials. This assumption is less impacted, since the availability of clinical trials presents options for patients to be treated in West Virginia regardless if they are on trial. Thus, the impacts of the cancer clinical trials network are based on retaining 0.2 to 0.6% of newly diagnosed patients.

Nationally, only about 5 percent of newly diagnosed cancer patients participate in cancer clinical trials, but retaining just a fraction of these patients in West Virginia would generate millions in economic activity and hundreds of new jobs. The trial network is estimated to generate \$11 million in new economic activity and 90 jobs in its first year, and impacts are expected grow to over \$36 million and 300 jobs by its sixth year.

The economic effects of a new trial network are divided into two main areas. First, funds to operate the network and research grants would come from federal and industry sources, representing new spending in the state. Second, the trial network would provide an incentive for West Virginians to remain in the state to participate in a trial and to receive other cancer care. The sizable gains to the West Virginia economy and West Virginia families are mainly attributable to the second source.

Operating expenses and grant revenues account for about 14 percent of the total economic impact. In the first year, operating expenses of \$762,000 and grants of \$76,000 result in \$1.486 million in direct and indirect economic activity, generate 12 jobs, and add state tax revenues of about \$30,000. In the sixth year, as the network becomes more established, operating expenses and grant revenues increase to about \$3 million and total economic impacts increase to \$5.3 million, 44 jobs are created, and state tax revenues would increase by about \$100,000.

Although operation of the trial network results in significant economic activity, the largest gains are possible by retaining West Virginia cancer patients in the state for care, particularly in the first year of treatment. Retaining 20 percent of cancer trial participants in-state for care would increase economic activity in the state by almost \$10 million. Retaining 50 percent of trial participants by the sixth year of the trial network would increase economic activity by more than \$31 million. In total, the cancer trial network is estimated to create 92 jobs

in the first year and 303 jobs by the sixth year at an average wage of just under \$47,000. Tax revenues increase by \$200,000 in the first year and by more than \$670,000 in the sixth year.

These numbers do not include harder-to-quantify effects on quality of life as West Virginians would have the opportunity to remain in-state for trials and develop stronger relationships with local care professionals. The research also highlights the vast opportunity to increase economic activity by providing more in-state cancer care for residents. The above estimates assume that a cancer trial network retains 20 to 50 percent of cancer trial participants in-state for their cancer care. These patients account for only a small portion of cancer patients who leave the state for care, and efforts to retain more patients in-state for quality cancer care would lead to substantial activity in the West Virginia economy.

Introduction

In 2008, about 20 percent of West Virginians newly diagnosed with cancer received their cancer care at an out-of-state facility. Some of this out migration might be due to the lack of a cancer trial network in the state of West Virginia. The presence of a trial network might not only induce patients to remain in the state for cancer trial participation, but to also receive their cancer care in West Virginia. This report is divided into several sections aimed at providing a general sense for the economic activity associated with implementing a new cancer trial network and potential economic gains if more West Virginia cancer patients opted to receive their cancer care in-state because they could participate in a trial. We estimate the direct economic effects from operating expenses, research grants, and medical and travel expenses. In addition to direct expenditures, we estimate the indirect effects on the economy in terms of business volume (e.g. increased retail sales), total jobs, and state tax revenue.

Initially, we include only the expected cancer trial network operating expenditures and additional research grant funding that is possible with researcher access to a trial network.² We estimate direct expenditures to be \$838,000 in the first year, including about \$762,000 in operating expenditures and \$76,000 in external grant funding. These expenditures result in about \$648,000 in indirect economic activity for a total first-year impact of \$1.486 million. By year six, direct expenses and grant revenues are expected to increase to \$3.003 million generating a total economic impact of \$5.327 million. We estimate that the cancer trial network would generate 12 total jobs in the first year and that this number increases to 44 jobs by the sixth year. Based on these figures, the state would see about \$30,000 in increased tax revenue in the first year and \$100,000 in the sixth year.

² Note that the grant revenue may accrue to the cancer trial network directly or to other entities within the state including universities and hospitals.

These economic impacts increase by more than a factor of ten if the presence of an in-state trial network induces a portion of trial participants to remain in West Virginia for their cancer care. In 2008, about 20 percent of newly diagnosed cancer patients received care outside of the state.³ Of these patients, we would expect about 5.8 percent to participate in a cancer trial.⁴ We assume that one in five trial participants will remain in state for care in the first year of trial network operation and that this number will steadily increase to one half of trial participants by year five and remain at 50 percent going forward. We also allow for the possibility that a small number of out-of-state cancer patients will be drawn to West Virginia for cancer care because of the presence of the new cancer trial network.

Adding in the economic gains from retaining more patients in-state for care, we estimate that a new cancer trial network will result in \$11.2 million in economic activity in the first year. By the sixth year of operation, we estimate that the impact will grow to \$36.8 million. The new trial network is expected to generate about 90 jobs in the first year and 300 jobs by the sixth year.

In the sections below, we outline our main assumptions and present the economic impact estimates. In the following section, we estimate the total amount of economic activity that occurs in other states due to the out-migration of West Virginia residents for cancer care. Next, we estimate the economic impacts of implementing and operating a new cancer clinical trials network in West Virginia. We begin by estimating the impact running the trial network (operating expenditures and grant revenues), which represents new economic activity to the state as funding will come from federal and industry sources. We then estimate the economic impact of retaining a portion of West Virginia cancer clinical trial participants in-state for their cancer

³ Based on tabulations from the West Virginia Cancer Registry.

⁴ This estimate is based on a survey of West Virginians with new cancer diagnoses in 2009 and allowing for higher trial participation rates among patients with female breast cancer (12 percent) (Health Statistics Center, 2010). This estimate is likely to be a lower bound as the possibility of trial networks in other states likely lead a higher percentage of trial participants to seek care outside of the state than those not participating in a trial.

care. In the final section we present conclusions. Detailed information on data sources and calculations can be found in the appendices.

Economic Impact of Out-of-State Care for Patients who were Newly Diagnosed in 2008

Estimates in this section are meant to provide a reference point for the estimated annual economic activity that spills over into other states when West Virginia cancer patients receive care at out-of-state facilities. These estimates represent the amount of spillover in one year (2008) for lifetime expected cancer-related care and the difference in in-state and out-of-state travel expenses. Given the recent trends in medical and travel costs, we would expect the dollar amount of these impacts to increase over time.

In 2008, just under 2,100 patients or about 20 percent of West Virginians newly diagnosed with cancer received their cancer care in another state.⁵ We estimate the amount of economic activity associated with their out-of-state care and travel expenses. The two main components of these estimates are direct expenses (medical and travel), and indirect effects (e.g. retail sales, employment in other sectors). We calculate lifetime expected medical expenses as the sum of first year, continuing year, and final year treatment. Costs are calculated for seven different cancer sites (colorectal, female breast, leukemia, lung and bronchus, non-Hodgkin lymphoma, prostate, and liver) as well as an “other” category. We then assign 20.2 percent of total medical expenses to an out-of-state category based on the percentage of patients diagnosed in 2008 that received care in another state resulting in an estimate of \$309 million.⁶ Accounting for indirect effects, we estimate that the total cost to West Virginia from patients going out-of-state in 2008 is \$539 million.

We approach travel slightly differently. If medical care received out-of-state were provided in West Virginia, this would represent new economic activity to the state. In the case

⁵ Based on tabulations from the West Virginia Cancer Registry.

⁶ See Appendix A for detailed information on our data sources and calculations.

of travel, patients will make some travel expenditures for care whether it is in West Virginia or outside of the state. In this case, we take the difference in mean in-state and mean out-of-state travel costs and multiply by the number of patients receiving care outside of the state (2,071). By staying in-state for treatment, the difference in travel costs is now available for household consumption and will result in added economic activity.⁷ We estimate additional travel expenses to be about \$7.9 million for patients receiving care out of the state.⁸

Next, we run these estimates through the IMPLAN[®] model (allocated to the medical and travel industries as appropriate) to estimate the amount of indirect economic activity associated with out-of-state care spending. We estimate that medical care and travel costs amount to almost \$360 million for patients newly diagnosed in 2008 (Table 1). Medical expenditures account for almost 98 percent of this total or about \$349 million. Travel expenditures contribute about \$8 million in direct expenditures. As shown in Table 1, we estimate that these direct expenditures generate over 2,900 jobs. This spending has an indirect effect on the economy, as employees live and shop in the local economy. We estimate that the total economic impact, direct and indirect, is about \$622 million and generates a total of 5,100 jobs. It is perhaps unrealistic to think that all of this activity could be retained in West Virginia, but keeping just a portion of these patients in West Virginia for cancer care produces significant economic impacts as outlined in the following section.

⁷ Note that with this approach we implicitly assume that some travel expenditures (e.g. gasoline) are made in West Virginia even if the patient is receiving out-of-state care.

⁸ Travel estimates are based on an assumption that 25 trips will be made in the first year of care. We do not include travel expenses for future years, assuming that continuing care can be scheduled to coincide with other routine medical service visits.

**Table 1: Total Economic Impact of Cancer Care Out-Migration from
West Virginia (Millions of 2008 Dollars)**

	Direct	Indirect & Induced	Total
Total Cancer-related Economic Activity (\$millions)	\$357	\$264	\$622
Employee Compensation (\$millions)	\$175	\$63	\$238
Employment (jobs)	2,935	2,167	5,101

Potential Cancer Trial Network Economic Impacts (2011-2016)⁹

A portion of newly diagnosed cancer patients and those living with cancer beyond the year of diagnosis are eligible to participate in cancer trials. The absence of a cancer trial network in the state of West Virginia means that many of these patients will seek treatment outside of the state or forgo trial participation. In this section, we estimate the additional economic activity that the state would accrue with the implementation of a cancer trial network.

Key Assumptions

There are two key components to our estimations: economic impacts due to operating the cancer trial network and economic impacts from retaining more West Virginia residents in-state for trial participation and cancer care. The first component includes cancer trial network operating expenses and grant revenues accumulating for medical research to trial network providers and other researchers in the state. Operating expenses are funds that are new to the state (from federal or corporate sources) and generate new economic activity and tax revenue when expended on items such as salaries and equipment.¹⁰ Grant revenue represents an estimate of the additional funds that West Virginia researchers are able to procure due to the presence of an active trial network. The second component includes medical and travel expenses associated with cancer care. Medical expenses represent funds that are newly spent in West Virginia as patients choose to receive care in West Virginia because of the presence of the cancer trial network. Travel expenses represent the difference in mean in-state and out-of-state travel expenses that are newly available for household consumption when a patient receives care in West Virginia because of the presence of the cancer trial network.

⁹ Please see Appendix A for a list of data elements and sources as well as underlying calculations.

¹⁰ We distinguish between funding from external sources and state funding, which would represent a transfer from some other state activity.

A few key assumptions are worth noting as they are important for determining what expenses are counted in our estimates. First, implementation of a new trial network might induce patients to participate in trials that they would not have considered if faced with traveling out-of-state. We do not include these patients in our economic impact numbers because it is unlikely that they were leaving the state for treatment prior to implementation of the cancer trial network.

Second, after talking with experts in the field, there is not a preponderance of evidence to suggest that trial participation clearly affects expected longevity or non-trial medical expenses. To the extent that those who participate in trials have better health outcomes or receive some of their routine cancer care through the trial, our estimates will understate the actual economic impact of a new cancer trial network.

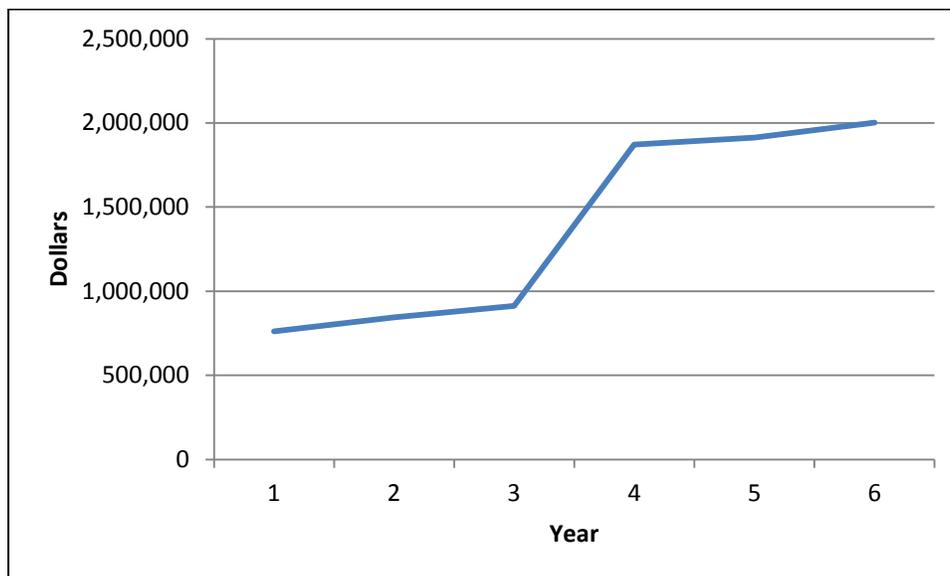
Finally, we calculate the expected trial participation rate using the 5 percent rate reported in Health Statistics Center (2010) for West Virginia and adjusting this number for higher rates of participation among those with a breast cancer diagnosis (12 percent). We arrive at a weighted mean participation rate of 5.8 percent, which is used in the medical and travel calculations that will follow.

Operating Expenses

Budget planning for the potential cancer trial network calls for funding from federal and industry sources. These funds would represent new spending in the state and would generate additional economic activity, jobs, and tax revenue. We take a conservative approach to including budget numbers in our economic estimates; we include only expected expenditures, not total revenue or margin distributions (when applicable). Only direct expenditures are included because these are the most likely to be funneled into the West Virginia economy.

Retained revenue or distributions might not have an immediate impact on the economy or might be invested/spent outside of the state. Estimated operating expenses are about \$762,000 in 2011 and steadily increase to just over \$2 million in 2016, as illustrated in Figure 1 (West Virginia Clinical Trial Network Draft Operating Statement, 2012).

Figure 1: Estimated Cancer Trial Network Operating Expenditures

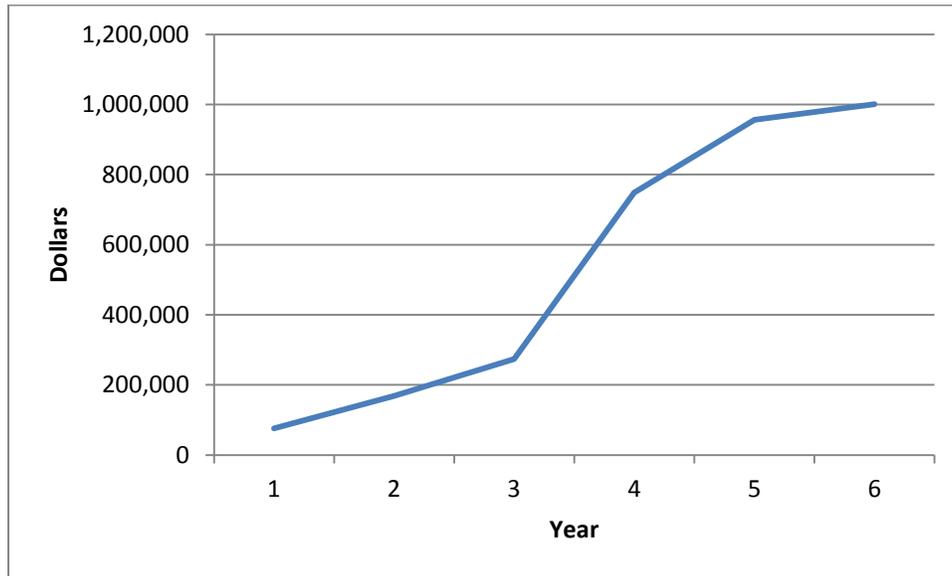


Grant Revenue

The presence of an in-state cancer trial network will improve the chances that West Virginia cancer researchers are successful in securing external research funding.¹¹ We assume that researchers will generate revenues equal to about 10 percent of the cancer center operating budget in the first year. In the second year, we assume that researchers will generate revenues equal to about 20 percent of the cancer center operating budget, which will increase to 50 percent of the budget by year 5 (whether the researchers are serving as PI or have other roles on grant applications). Based on these assumptions, expected grant revenues range from \$76,000 in the first year to \$1 million in year 6 (Figure 2).

¹¹ Presence of an in-state trial network will also likely improve the chances of recruiting to researchers to the state.

Figure 2: Estimated Trial Network-related Grant Revenue



Medical Expenses

Medical expenses are estimated for two main groups, those newly diagnosed in 2011 (10,770) and those currently living with cancer post-diagnosis (86,161) (2011 Claritas Population and SEER incidence rates). For new diagnoses, we include first-year continuing care costs in our estimates and for those living with cancer post-diagnoses we include only expected costs for the ‘continuing’ years, those between the first year of diagnosis and the year of death. Due to the nature of cancer treatment, the majority of treatment costs are borne in the first year so that retaining a newly diagnosed patient in the state for care has a larger economic impact than recruiting a patient beyond the first year of treatment. However, a limitation of our analysis is that we do not estimate the harder-to-quantify aspects of cancer treatment that affect quality-of-life, which could be significantly enhanced for an existing patient who can remain in-state for “continuing” treatments.

In equation form we estimate:

$$First\ Year\ Cost_{ij} + \sum_{t=2}^{T-1} Continuing\ Cost_{ij} + (Cancer\ Death_{ij} - Other\ Cause)$$

Where T is the number of years from diagnosis to death and *i* represents an individual, and *j* represents cancer site. We calculate costs for seven different cancer sites (colorectal, female breast, leukemia, lung and bronchus, non-Hodgkin lymphoma, prostate, and liver) as well as an “other” category. Cost of care estimates are taken from the National Cancer Institute, Average Annual Costs of Care (2011).¹² The number of years of continuing care is calculated by cancer site as the difference between average age of death and average age of diagnosis.¹³ Our estimates range from an average lifetime cost (in 2011 dollars) for treating female breast cancer of \$118,904 to an average cost of \$228,891 for leukemia. We multiply the average cost of care for each cancer site times the number of newly diagnosed cases that received treatment out-of-state. Our total estimate (in 2011) dollars of the lifetime cost of cancer care for new diagnoses in 2011 that receive treatment out-of-state is \$374 million. Continuing care costs for the more than 80,000 patients living with cancer post–diagnosis are estimated to be another \$359 million.

Among patients leaving the state for care, we expect about 5.8 percent (assuming a 12 percent participation rate for breast cancer patients and 5 percent for all other cancer sites) to be participating in cancer trials. To calculate medical expenses for trial participants newly diagnosed with cancer we calculate medical expenses as total expected out-of-state medical expenditures for 2011 times the cancer trial participation rate to get \$22 million. For those living with cancer post-diagnosis, we take the expected medical costs of trial participants for continuing years (the portion of total expected lifetime medical costs that is attributable to the years between

¹² Estimates are provided in 2010 dollars, which we adjust back to 2008 dollars to match our cancer data.

¹³ We calculated a weighted average age of diagnosis and death (the sum of the percent in each age category times the median age in each category; e.g. about 2 percent of colorectal cancer diagnoses occur at between the ages of 45 and 49 and we assign 2 percent of colorectal diagnoses to age 47, etc.).

diagnosis and death) of those diagnosed in 2011 and multiply by the ratio of eligible existing cases to new cases (0.96). The ratio is calculated as the number of existing cases (86,161) times the percent eligible for treatment (30 percent) times the percent eligible for trial participation (40 percent), resulting in 10,339 cases (Oncology Solutions, 2012) divided by 10,770 newly diagnosed cases.¹⁴ Our estimate of medical expenses for continuing cases is \$4 million.

The presence of a cancer trial network in West Virginia might also induce new economic activity as patients in neighboring states choose to receive care in West Virginia because of the presence of the cancer trial network. To account for this possibility, we estimate the dollar amount of potential medical expenditures from out-of-state residents. We first calculate the relative size of the population living in West Virginia's bordering counties¹⁵. Based on Census data, border county population totals 2.154 million. This is 1.161 times greater than West Virginia's population of 1.855 million. We take the estimated number of cancer cases in the border counties and estimate the number of cases that might seek cancer trial participation and treatment out-of-state based on West Virginia's out-of-state treatment rate and trial participation rates. Finally, we assign our estimated average cost of care to these potential patients. In sum, we estimate that potential out-of-state participants could generate economic activity that represents about 7 percent of that generated by in-state patients (about \$2 million for newly diagnosed and continuing patients).

For the first year of the trial network, we assume that an in-state cancer trial network would induce 20 percent of patients in cancer trials to stay in-state for trial participation and medical treatment. This results in about \$5.571 million in additional medical spending in the state. This breaks down into \$4.330 million for newly diagnosed patients, \$874 thousand for

¹⁴ Note that we assume that only 5.8 percent of these cases will actually participate in a trial.

¹⁵ See Appendix B for a list of bordering counties and their populations.

continuing patients,¹⁶ and \$367 thousand for new and previously diagnosed out-of-state patients. We expect the portion of trial patients remaining in-state to increase as the trial network becomes established. In year 2, we assume that 20 percent of trial participants will stay in-state for their trial and treatment. We increase the portion remaining in-state by ten percentage points a year to a maximum of 50 percent in years 5 and 6. This assumption recognizes that an in-state trial network might not be able to serve all trial participants, particularly those diagnosed with rare cancers.

Travel Expenses

Travel expenses are estimated as the difference in mean in-state travel costs and mean out-of-state travel costs for trial participants. Thus, in-state trial participation and cancer care does not eliminate travel costs, but reduces them, freeing up the difference for household consumption. We calculate travel savings only for West Virginia residents newly diagnosed with cancer, implicitly assuming that any costs or savings that accrue to out-of-state patients will likely benefit their local economies.¹⁷

To calculate travel costs, we assume that the patient will make 25 trips for cancer treatment in the first year of treatment. The number of trips is calculated as the average number of trips indicated in treatment protocols for breast cancer, colorectal cancer, lung cancer and leukemia. We also assume that a working-age adult will accompany the patient. Out-of-state travel expenditures are calculated based on county of residence. For each county, we collect the distance from the county seat to the nearest major out-of-state cancer treatment center. The

¹⁶ Note the lower total for continuing cases, largely due to the difference in first-year and continuing year treatment costs.

¹⁷ We do not include travel expenses for trial participants beyond the first year of treatment as these trips are harder to quantify. As such, the travel estimates should be viewed as conservative, but this does not have significant implications for our general conclusions as travel is a relatively small component of medical and travel expenses (Figure 3).

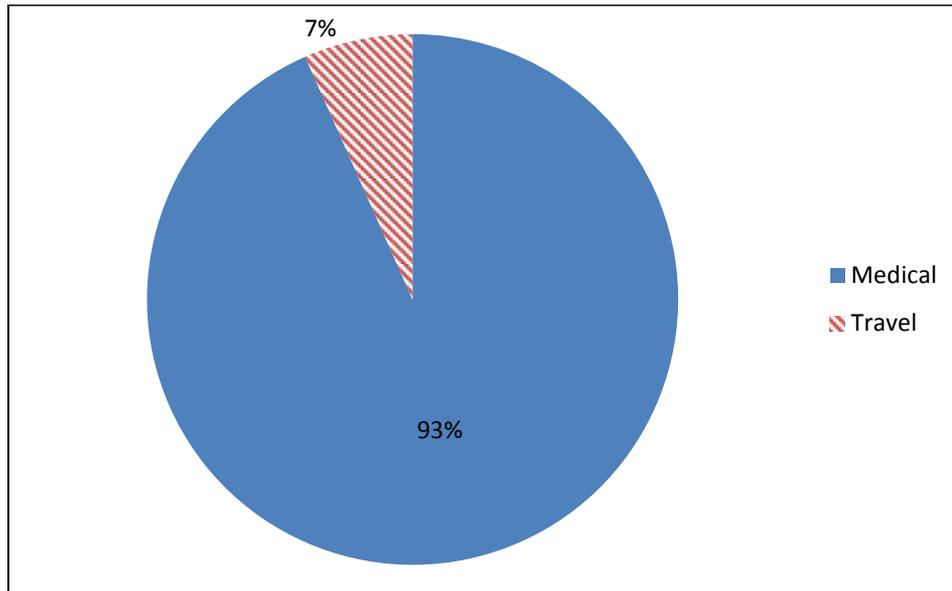
average round trip for out-of-state treatment is 136 miles. The cost of each trip is calculated as the roundtrip mileage times the medical travel reimbursement rate (\$0.23)¹⁸ plus one night of lodging at the General Services Administration (GSA) reimbursement rate for the treatment location. The mean lodge rate is \$112 across all out-of-state locations. We also assume that the patient and the accompanying adult forego two days of work at the mean daily wage rate for the county (mean daily wage is \$91 across all counties). For those receiving treatment in West Virginia, we assume that the average in-state round trip is 50 miles, the patient and accompanying adult forego one day of wages at the mean daily wage rate for the county, and there is no expenditure for lodging.¹⁹

In our first year scenario where 20 percent of cancer trial patients are retained in-state, we estimate the travel savings for patients remaining in-state for trials and care to be about \$396,000. By year six, travel savings are expected to be about \$1.285 million as more patients elect to stay in West Virginia for trials and cancer care. Although it is clear that travel savings result in economic gains, they are much smaller in magnitude than the potential gains from retaining patients for in-state cancer treatment as illustrated in Figure 3.

¹⁸ This is the average medical reimbursement rate for 2008. Note that the medical reimbursement rate is lower than the average business travel reimbursement rate of \$0.545 in 2008. We utilize the more conservative medical rate in our calculations.

¹⁹ We calculated the distance from each county seat to the nearest in-state hospital. The mean distance for all counties is 35 miles each way for a round trip of 70 miles. Because population is greater in more urban areas with hospitals, we chose a more conservative estimate of 50 miles round trip for our analysis.

Figure 3: Relative size of Medical and Travel Expenses in First Year Estimates



Total Economic Impacts 2011-2016

In this section we estimate the total economic impacts of implementing a cancer trial network in West Virginia. In addition to the direct operating, grant, medical and travel effects discussed above, we estimate the indirect economic effects using the West Virginia IMPLAN[®] model. We input operating expenditures, grants, and medical spending into the medical sector, and travel spending into the travel sector (excluding recreation and entertainment). Indirect effects include economic activity such as retail sales and tax revenues that are associated with the households and jobs created by the increased spending in each sector.

First, we consider just the economic activity associated with operating the cancer trial network and grant research. These estimates represent the economic impact of the new trial network in the absence of any changes in patient care behavior. That is, these are the economic effects assuming that none of the current out-of-state trial participants are induced to receive their cancer care in West Virginia. As shown in Table 2, operating expenditures grow from about \$762,000 in year 1 to just over \$2 million in year 6 as the network becomes more

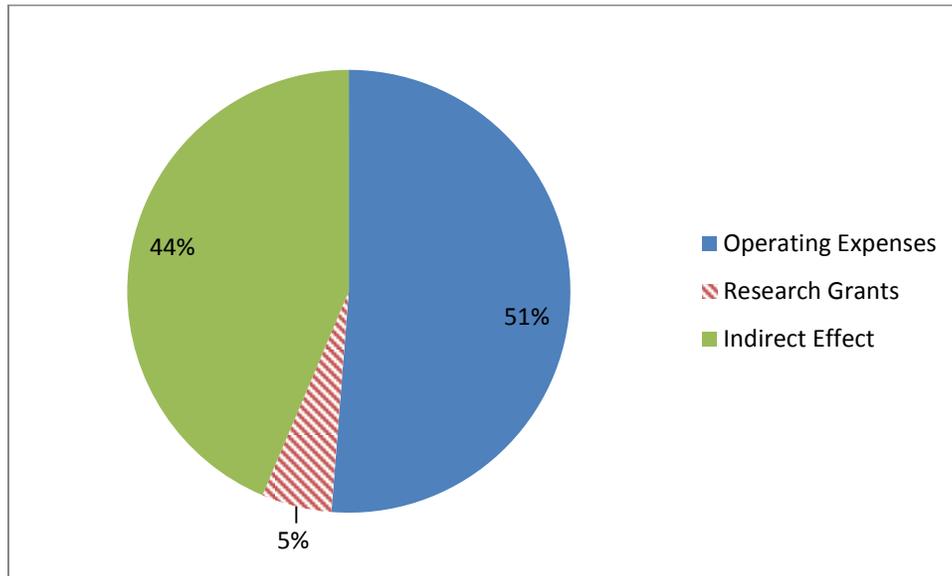
established and robust. Expected grant revenues also increase from \$76,000 to just over \$1 million as the network becomes more established and researchers are able to capitalize on the opportunities. Our estimates for total economic activity include direct and indirect effects. We expect the trial network operation to increase economic activity in West Virginia by about \$1.5 million and create 12 jobs in year 1. By year six, we expect the network to increase economic activity by over \$5 million, create 44 jobs, and increase state tax revenue by about \$100,000.

Table 2: Economic Impacts of Trial Network Operating Expenses and Research Grants

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Operating Expenses (\$)	761,615	844,158	912,550	1,870,873	1,913,211	2,002,013
Research Grants (\$)	76,162	168,832	273,765	748,349	956,606	1,001,007
Total Economic Activity (\$)	1,486,108	1,796,914	2,104,371	4,646,164	5,090,686	5,326,971
Jobs	12	15	17	38	42	44
Tax Revenue (\$)	27,889	33,722	39,492	87,192	95,534	99,968

Figure 4 illustrates the relative importance of each of the components in generating the total economic impact estimate. Just over half of the impact is from direct operating expenditures (e.g. salary payments and supplies). It is apparent from Figure 4 that accounting for the substantial indirect effects is important for getting a complete picture of the economic effects.

Figure 4: Relative size of Operating, Grant and Indirect Effects in the First Year



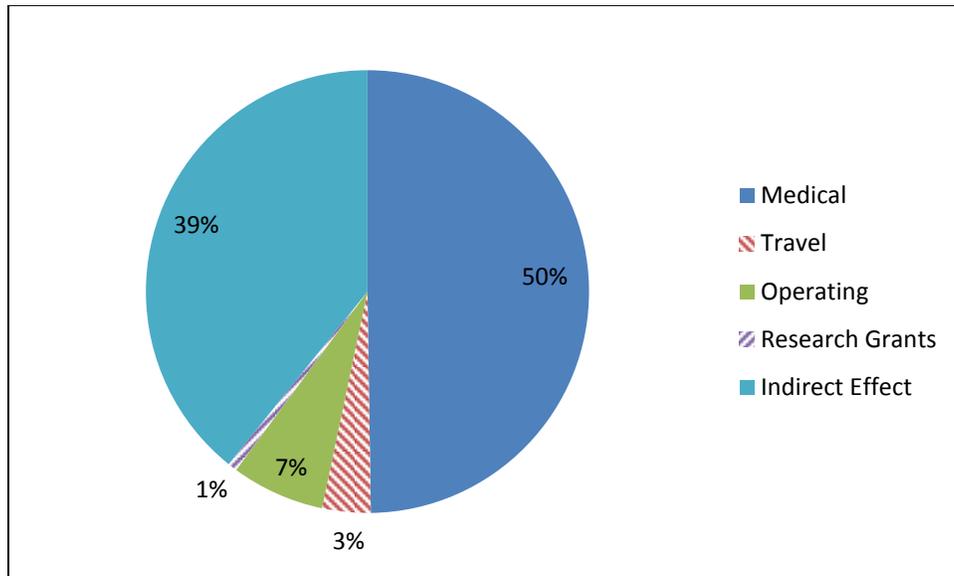
The economic impacts of a cancer trial network are more than seven times larger if the network retains more West Virginians in the state for trial participation and cancer care, particularly cancer care in the first year following diagnosis. Table 3 presents economic impacts for retaining 20 to 50 percent of trial participants in-state for cancer care over the first six years of the clinical trial network. Medical expenses are estimated to grow at 2 percent annually. This conservative growth projection is chosen given the uncertainty over future health care spending with the implementation of the Affordable Care Act. Travel costs are also assumed to grow by 2 percent annually. Research grants are 10 percent of operating expenditures in the first year, 20 percent in the second year, 30 percent in the third year, 40 percent in the fourth year, and 50 percent thereafter. Expected operating expenditures are taken from Oncology Solutions (2012). Total economic activity is expected to increase by more than \$11 million and 92 jobs in year 1. The economic impact is expected to grow to almost \$37 million and 303 jobs in year 6. State tax revenues are expected to increase by about \$200,000 in year 1 and by more than \$670,000 in year 6.

Table 3: Total Economic Impacts of a West Virginia Cancer Trial Network

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Medical (\$)	5,570,512	5,681,922	8,693,341	13,909,346	17,734,416	18,089,104
Travel (\$)	395,655	403,568	617,459	1,234,918	1,259,617	1,284,809
Operating (\$)	761,615	844,158	912,550	1,870,873	1,913,211	2,002,013
Research Grants (\$)	76,162	168,832	273,765	748,349	956,606	1,001,007
Total Economic Activity (\$)	11,195,084	11,679,709	17,271,761	29,227,715	35,974,377	36,818,595
Jobs	92	96	142	240	296	303
Tax Revenue (\$)	204,087	212,922	314,865	532,823	655,815	671,205

Figure 5 illustrates the relative importance of each of the factors in the overall economic impact. Half of the total arises from increased spending for medical care in West Virginia. Thus, recruiting and retaining West Virginians in-state for cancer trials and cancer care will largely determine the ultimate economic impact of a cancer trial network in West Virginia. Indirect effects make up the next largest category (39 percent), illustrating the importance of accounting for indirect effects when estimating the economic impact. Operating expenditures represent 7 percent of the total and travel savings account for 3 percent. Although travel savings are not a major component of the overall impact, these savings could have an important impact on the well-being of West Virginia families. Grant revenues account for 1 percent of the total economic impact, but this category is likely to be of great importance in recruiting and retaining the top cancer doctors and care providers.

Figure 5: Relative Size of Operating, Grant, Medical, Travel and Indirect Effects in the First Year



Conclusions

An in-state cancer trial network would have a clear economic impact on the West Virginia economy. However, the ultimate size of the effect depends crucially on how many trial patients who would have received their care in another state opt to receive cancer care in West Virginia because of the trial network. We estimate that the trial network would increase economic activity in the state by more than \$11 million in the first year and by nearly \$38 million in the sixth year. About half of this impact is from increased medical spending on cancer care and more West Virginia patients remain in the state for care, particularly in the year following their diagnosis.

Of course, there are a number of factors associated with a new trial network that do not lend themselves to quantification. Included in this category are the psychological and quality-of-life effects of trial participation for the patient and his or her family. Some of these factors might have economic consequences (e.g. stress causes health problems that require medical care or missed days from work) and others might not have a clear impact on economic activity, but could seriously affect the lives of patients, their families, and caregivers. In fact, the West Virginia Cancer Plan identifies increasing cancer trial participation as a key objective for improving quality of life (Mountains of Hope, 2007). Because we are not able to quantify all of these effects, we view the economic impacts presented above as a lower bound estimate of the true impact of improving cancer care opportunities in West Virginia.

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Appendix A: Data and Calculations

Data Elements

NAME OF THE VARIABLE	DESCRIPTION	SOURCE OF DATA	LIST OF MAIN AREAS WHERE THE DATA IS USED
Shortest travel distance in miles	Distance from the county seat to the nearest out of state hospital	Google maps shortest distance calculator	Used to calculate mileage cost for out of state travel expense
Mileage rate	Standard mileage rate at IRS for medical and moving	http://www.irs.gov/taxpros/article/0,,id=156624,00.html	Used to calculate mileage cost for instate and out of state travel expense
Lodging rate	Maximum rate for one night stay at the General Service Administration	http://www.gsa.gov/portal/category/21287	Used to calculate lodging cost for both out of state and instate travel expense
Out of state treatment cases by county	The number of out of state cancer cases by county in WV in 2008	Tabulations provided by the West Virginia Cancer Registry and researchers at the Mary Babb Randolph Cancer Center	Used to calculate the number of instate cancer cases, mileage lodging and forgone wage cost for out of state travel expense
Total cases of cancer	The total number of cancer cases by county in 2008 in WV	West Virginia Cancer Registry 2011 Annual Report http://www.dhhr.wv.gov/oeps/cancer/Documents/Cancer_Incidence_in_WV_2011.pdf	Used to calculate the instate cancer cases, weighted average wage per week and per year and total forgone wage due to cancer.
Average weekly wage data (all industries)	Mean weekly wage rate in 2008	http://workforcewv.org/lmi/EW2008/default.htm	Used to calculate the instate and out of state forgone wage for the travel expense and total forgone wage.
Annual average CPI	The Consumer Price Index compiled by Bureau of Labor Statistics and it is based on 1982 base of 100	http://inflationdata.com/inflation/Consumer_Price_Index/HistoricalCPI.aspx	Used to calculate the medical expense of year 2008 from 2010
Population of WV in 2008	The population of WV in July 2008 from the Bureau of Labor Statistics	http://www.census.gov/popest/data/state/asrh/2008/SC-EST2008-03.html	To calculate the weighted death age for each cancer type by age groups

NAME OF THE VARIABLE	DESCRIPTION	SOURCE OF DATA	LIST OF MAIN AREAS WHERE THE DATA IS USED
Age adjusted US mortality rates	US mortality age adjusted rates by age groups by cancer types for all races for 2008 from Surveillance Epidemiology and End results	http://seer.cancer.gov/faststats/selections.php?series=age	To calculate the weighted death age for each cancer type by age groups
Annualized Mean Net Costs of Care by Age, Gender and Phase of Care (Per Patient). Costs in 2010 US Dollars	Average Annual Costs of Cancer Care in US 2010 Dollars by cancer types by phases of care: Initial year after diagnosis, Last year of life, and the period between (Continuing). Months of survival are first applied to last year of life, any remaining to initial phase, then to continuing.	http://costprojections.cancer.gov/annual.costs.html	Used to calculate the total medical expense for each cancer types for the year 2010 and then convert it into expenses for year 2008
Cancer cases of WV in 2008	The total number of cases of cancer by types in WV for the year 2008	http://www.cancer.org/Research/CancerFactsFigures/cancer-facts-figures-2008	Used to calculate the total medical expense and total forgone wage for all cancer types in 2008. Also used to calculate the weighted age of diagnosis for each cancer type by age groups
Diagnosed rate	The diagnosis rate for each cancer type by age group	West Virginia Cancer Registry 2011 Annual Report http://www.dhhr.wv.gov/oeps/cancer/Documents/Cancer_Incidence_in_WV_2011.pdf	Used to calculate the weighted age of diagnosis for each cancer.
Rate of diagnosis by stage	The percentage of diagnosis in each stage of colon cancer	West Virginia Cancer Registry 2011 Annual Report Cancer Incidence in West Virginia, 1993-2008	Used to calculate the medical expenses by stages for colon cancer in 2008.
Population in counties bordering West Virginia	U.S. Census Bureau	Population Projections for 2011 (or latest available year).	Used to estimate the population the relative size of the population in bordering counties.

Underlying Calculations

- Travel costs

1. Out-of-state travel cost for each county is the sum of round-trip mileage costs, lodging cost, and foregone wage costs.
 - a. Mileage cost = number of out of state patients times shortest distance in miles to the nearest out-of-state hospital \times the medical and moving reimbursement rate for mileage at the IRS (2008). It has been assumed that a patient will have 9 trips. So this mileage cost is further multiplied by 9 trips to the hospital to get the total mileage cost.
 - b. Lodging cost = number of out of state patients \times one night at the GSA reimbursement rate (2008) \times 9 trips.
 - c. Foregone wage is represented as the number of out of state patients' \times two days for two individuals (patient and companion) at the mean county wage rate for one day (2008) \times 9 trips. The mean county wage rate for one day was calculated from the average weekly wage data.
2. In-state travel cost for each county is the $\sum \text{roundtrip mileage costs} + \text{foregone wage costs}$.
 - a. Mileage cost = the number of instate patients' \times fifty miles times the medical and moving reimbursement rate for mileage at the IRS (2008) \times 9 trips.
 - b. There is no lodging cost for the instate patients.
 - c. Foregone wage = number of in state patients' \times one day for two individuals (patient and companion) at the mean county wage rate for one day (2008) \times 9 trips.
3. Cost of out-of-state treatment is the difference between mean in-state and out-of-state travel expenses times the number of out-of-state cases: $\text{Travel expense}(TTE) = (Moos - Mins) \times \text{number of out of state cancer cases}$
 - a. $Moos = \text{Mean of out of state travel expense for one patient across counties}$
 $= \sum_{i=0}^n \text{Out of state travel expense for one patient} / n$, where $n=55$ (counties)
 - b. $Mins = \text{Mean of instate travel expense for one patient}$
 $= \sum_{i=0}^n \text{Instate travel expense for one patient} / n$, where $n=55$ (counties)
 - c. $\text{Travel expense adjusted to 2011}(TTE1) = TTE \times ((1 + 0.062)^3)$, where 0.062 is the mean energy Consumer Price Index growth for 2008-2011.

- Medical costs

1. Total medical cost is calculated as [Initial average cost + (Continuing age -1)*Continuing average cost + (Cancer death average cost- Other death average cost)]

a) The continuing age is calculated as the difference between the weighted age of death and weighted age of diagnosis for each cancer types.

1. The weighted age of diagnosis is represented in few steps based on eighteen age groups and corresponding diagnosed rates for cancer type X.

a. $A =$

$$\left(\text{Diagnosed } \frac{\text{rate}}{\text{Total}} \text{ of diagnosed rate} \right) * \text{Total no of cases for cancer X}$$

b. $B = \frac{A}{\text{Total}}$ no of cases for cancer X

c. C= the middle age for each age group

d. D= weighted age of diagnosis for each age group= $B \times C$

e. $E = \sum D$ to get the weighted age of diagnosis for cancer type X

2. The weighted age of death is based on five age groups and corresponding mortality rate for cancer site X.

a. $A = \text{death rate} * \left(\text{population of WV for } \frac{2008}{100000} \right)$

b. $B = \text{Total no of death cases for cancer X} = \sum A$

c. $C = \frac{A}{B}$

d. D= the middle age for each age group

e. E= weighted age of death for each age group= $C \times D$

f. $F = \sum E$ to get the weighted age of death for cancer type X

2. The initial average, continuing average, cancer death average cost and other death average cost are calculated by taking the average of female and male cost for 2010 dollars.

3. The 2010 medical expense for each cancer type X is then converted to medical expense 2008 dollars = $(\text{Medical expense of 2010} \times (\frac{2008 \text{ CPI}}{2010 \text{ CPI}}))$

4. Medical Expense for Out-of-state patients

a) $\text{Medical expense ME} =$

$$\text{Total medical expense of 2008} \times \text{percentage of out of state cases (poos)}$$

b) $\text{poos} = \frac{\text{Sum of out of state cases in 2008}}{\text{Total number of cancer cases in West Virginia in 2008}}$

c) $\text{Medical expense adjusted to 2011 (ME1)} = \text{ME} \times ((1 + 0.0733)^3)$, where 0.0733 is the mean medical expense growth rates.

• Calculations for Continuing Cases (patients beyond the initial year of treatment)

1. Continuing travel cost (CTC): $CTC = \frac{TTE1 \times \text{percent of oos} \times \left(\text{Rate of } \frac{\text{continuing}}{\text{new}} \right)}{4.5}$

2. Continuing medical expense (CME):

b) $CME = \text{Continuing medical cost (CMC)} \times \left(\frac{\text{continuing}}{\text{new}} \right) \times \text{percent of oos}$

$$\begin{aligned}
 \text{c) } &= \frac{CMC \times ME \times poos \times \text{existing number of cancer cases of 2008}}{\text{new cases of cancer of 2008}} \\
 \text{d) } CMC &= \frac{\text{Sum of continuing cost of 2010 for all cancers}}{\text{Sum of total medical expense of 2010}} \\
 &= \frac{\sum_{i=0}^n ((\text{continuing age} - 1) \times \text{continuing medical cost for 2010})}{\text{sum of total medical expense of 2010}}, n=8 \\
 &= \frac{\sum_{i=0}^n (((\text{Age of death} - \text{Age of diagnosis}) - 1) \times \text{continuing medical cost for 2010})}{\text{sum of total medical expense of 2010}}
 \end{aligned}$$

- Medical Impacts from Out of State Patients Drawn to West Virginia by the Trial Network

1. Medical impacts for out-of-state residents are estimated as the number of patients expected from border counties times the mean medical expense per patient.

- TPOS (Trial Patients from Other States)*CPP (Cost per Patient)
- CPP = ME/Number of Patients
- TPOS = BCP (Border Cancer Patients) * 5.8 (trial participation rate)
- BCP = Border Population * Cancer Rate * Out-of-state Treatment Rate

*Note West Virginia cancer rates and out-of-state treatment rates are used to calculate BCP for border populations.

Appendix B: List of Border Counties

County	State	Population
Boyd	KY	49,466
Lawrence	KY	16,035
Martin	KY	12,751
Pike	KY	64,904
Allegany	MD	74,692
Garrett	MD	30,051
Washington	MD	148,203
Athens	OH	63,026
Belmont	OH	68,066
Columbiana	OH	107,722
Gallia	OH	30,694
Jefferson	OH	67,691
Lawrence	OH	62,744
Meigs	OH	22,838
Monroe	OH	14,058
Washington	OH	61,048
Beaver	PA	171,673
Fayette	PA	142,605
Green	PA	39,245
Washington	PA	207,389
Alleghany	VA	16,242
Augusta	VA	72,020
Bath	VA	4,482
Bland	VA	6,791
Buchanan	VA	22,860
Clarke	VA	14,588
Craig	VA	4,969
Frederick	VA	74,972
Giles	VA	17,358
Highland	VA	2,338
Loudon	VA	301,171
Rockingham	VA	75,134
Shenandoah	VA	41,036
Tazewell	VA	44,907
Total		2,153,769

Appendix C: Economic Impact Definitions

Business Volume:

Sales plus net increase in finished inventories and the value of intra-corporate shipments. Equals output (see below) plus the cost of goods sold in retail and wholesale trade.

Employment:

The number of jobs in a business, industry, or region. Also, the number of jobs attributable to an impact (see below). This is a measure of the number of full-time and part-time positions, not necessarily the number of employed persons. Jobs are annual average by place of work. A job year is equivalent to one job for one year.

Employee Compensation:

Wages and salaries plus employers' contribution for social insurance (social security, unemployment insurance, workers compensation, etc.) and other labor income (pension contributions, health benefits, etc.). By place of work unless otherwise stated.

Impacts:

The results of the recirculation of funds throughout a regional economy due to the activity of a business, industry, or institution. Estimated by tracing back the flow of money through the initial businesses' employees and suppliers, the businesses selling to the employees and suppliers, and so on. Thus, they are a way to examine the distribution of industries and resources covered in the costs of the initial activity.

Output:

For most sectors, measured as sales plus net inventories and the value of intra-corporate shipments. For retail and wholesale trade, measured as gross margins (i.e. sales minus cost of goods sold, also equal to the mark-up on goods sold).

Value Added

A measure of the value created by a business or industry or attributable to an impact (see above). Equal to the value of production minus the cost of purchased goods and services. Also equal to employee compensation plus capital income (profits, interest paid, depreciation charges), and indirect business taxes (e.g. severance, excise). Corresponds to the aggregate concepts of gross domestic product (GDP).