Problems in Using Measures of Taxpayer Return on Investment to Evaluate Work Force Programs

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Abstract: This paper contrasts social and taxpayer return on investment measures of the Vocational Rehabilitation (VR) program in Virginia. To do this, we use the analyses in Dean et al. (2015, 2017, 2018) which demonstrate substantial social return to Virginia's VR program. Using this estimated model and administrative data on VR clients in Virginia, we simulate earnings that would be realized before and after VR service receipt by each client and estimate the costs of the services provided to each client. Then, given these simulation results, we compute the taxpayer ROI for the state of Virginia. Since most VR recipients have a weak attachment to the labor market (i.e., relatively low employment rates and earnings), the relatively large estimated impact of VR on earnings translates into only a small impact on the taxpayer return. That is, the cost of VR is large relative to the lifetime changes in tax receipt. For example, while the estimated median annualized rate of return for clients with physical impairments is 174% (Dean et al., 2018), we estimate that only 2.8% of VR recipients with physical impairments have a positive taxpayer return. This finding illustrates why the consensus in the economics literature is that taxpayer rates of return are not appropriate measures of program value.

I. Introduction

The public vocational rehabilitation program (VR) has faced increasing demands to demonstrate its effectiveness (Chan, Rosenthal and Pruett, 2008; GAO, 2012; Bua-Iam, Hampton, Sink, & Snuffer, 2013). The passage of the Workforce Innovation and Opportunity Act in 2014, which adds VR to the core programs that must report on participants' post-closure employment and earnings, has intensified the need for clear and convincing evidence of the program's impact. But the appropriate measure of what outcome VR programs impact is not a settled matter.

In response to the need for credible analyses of VR programs, Dean et al. (2015, 2017, 2018) (hereafter referred to as DPSS) present and estimate methodologically sound return on investment (ROI) models for Virginia's VR agency.[1] The DPSS ROI models provide estimates on the long-run social rate of return.[2] Specifically, DPSS use detailed longitudinal data on all persons who applied to receive VR services from the Virginia Department of Aging and Rehabilitation Services (DARS) in state fiscal year (SFY) 2000. With quarterly employment and earnings data from 1995 to 2008, they observe labor market outcomes before, during, and after service receipt. With these data, they estimate a novel model of service provision and labor market outcomes and present estimates of the social rate of return. In particular, they report a median annualized rate of return of 30% for clients with mental illness, 20% for clients with cognitive impairments, and 174% for clients with physical impairments. Thus, by any conventional standard, the social rate of return of VR services for this cohort is positive and substantial. That is, they estimate that VR has a large, positive impact on overall well-being in society via improved economic conditions for people with disabilities net of the cost of producing those improvements.

Although there are good reasons to favor the social rate of return as the appropriate measure of a government program's efficacy, policymakers, program administrators, and taxpayers are often interested in the return to the taxpayer.[3] In contrast to the social return on investment, taxpayer return measures the impact VR has on the government budget via increased tax returns caused by the program net of the costs of the program. Examining the ROI for VR programs from the taxpayers' perspective may be of critical importance to assessing the value and political viability of these work-force training programs.

In this paper, we estimate the taxpayer ROI for the VR program in Virginia and compare it to existing estimates of VR's social ROI. To do this, we take the findings from the DPSS analyses of the effects of VR on employment and earnings as given and examine the implications of their results on taxpayer ROI. In particular, we use the estimates reported in DPSS to simulate changes in state income and sales tax revenues in Virginia. In contrast to the positive social rates of return in DPSS, we find starkly different taxpayer rates of return for the same individuals.

To arrive at this finding, we proceed as follows: Section 2 provides an overview of the ROI analysis framework as well as some key caveats to consider when applying it. Importantly, in this section, we also explain how the social return may differ from the taxpayer return. After describing the basic framework, we then undertake a three-step process to compute the taxpayer ROI of the VR program in Virginia. In the first step, we assemble the basic information on the effects and costs of VR services from DPSS. This is summarized in Section 3, which reviews the DPSS model, the estimated effects of VR on labor market outcomes and the cost of VR services. Using longitudinal data on service receipt and labor market outcomes, DPSS find VR has substantial earnings effects and a positive social return. Then, using the estimated model from DPSS, Section 4 presents the simulated earnings that would be realized with and without VR service receipt and the estimated costs of service provided to each client. The final step, described in Section 5, examines the taxpayer ROI for the state of Virginia. It is well documented that most VR recipients have a weak attachment to the labor market (i.e., relatively low employment rates and earnings), implying that the relatively large estimated impact of VR on earnings translates into only a small impact on the taxpayer return (U.S. Census Bureau (2019); and Houtenville and Rafal (2020)). Our basic finding is that the benefits to the taxpayer are negligible, even though the social benefits are substantial. Section 6 draws conclusions. While administrators and policymakers are often interested in the taxpayer returns, there is little direct benefit of VR program on state tax revenues. The benefits of VR come from improving the economic and emotional well-being of VR clients at a relatively minimal cost to taxpayers.

2. ROI Framework

The basic ROI framework is summarized in Table 1.[4] Only the monetary benefits and costs are listed in this table. In particular, we display the expected signs of effects of VR on earnings, tax payments, government transfer programs, and operating costs. The plus and minus symbols

indicate whether each effect is expected to be a benefit (+) or cost (-) from the perspectives of the VR client, the taxpayer, and society, and question marks indicate that theory does not imply a clear effect.

Social benefits equal the sum of benefits to VR clients and to the taxpayer. Some factors, such as increased tax revenue and reduced government transfer payments, have no social benefit because any improvement for the taxpayer is a loss of equal size to the client. For example, if VR services cause an increase in tax payments from recipients, this is regarded as a cost to program group members, as an equal savings or benefit to taxpayers, and as neither a benefit nor a cost to society. Additional taxes from VR clients are simply a transfer of income from one segment of society (VR clients) to another (taxpayers). Increases in earnings, in contrast, benefit VR clients but are neither benefits nor costs to taxpayers. Because VR clients benefit from the increase in earnings without offsetting costs occurring elsewhere, society as a whole also benefits.

In general, an ROI analysis provides a simple indicator of whether the VR program has positive or negative net benefits (i.e., benefits minus costs). DPSS focus on net social benefits. The social perspective is usually viewed by economists as the appropriate one for measuring the efficiency of social programs because it accounts for the total impact VR has on well-being across all members of society, not just a subset of those members (i.e., those who pay income and other taxes). It is crucial for understanding the contribution of VR to social welfare and improved living conditions for people with disabilities. Policymakers, however, often focus on the taxpayer perspective, that is, on whether the program increases or decreases the government budget balance (surplus or deficit), and by extension, the taxes of their constituents.

2.1 The Effect of VR on Other Taxes and Transfer Payments

Our focus is on state income and sales tax revenues. There are other ways in which positive labor market changes may benefit taxpayers and other nonrecipients of VR services. However, our focus on taxpayers in Virginia means that any changes to federal tax collections or the federal share of VR costs will have a negligible impact. Likewise, there may also be an effect on other state taxes (e.g., property taxes) but these are likely to be second order amounts relative to the possible impact on state income and sales tax collections.

There has also been some discussion in the literature that programs like vocational rehabilitation can lead people with disabilities to go to work and stop collecting benefits from programs such as Social Security Disability Insurance and Supplemental Security Income programs (DI/SSI).[5] The effects of VR on participation in social welfare programs is an empirical question. If VR services improve labor market outcomes of potential DI/SSI beneficiaries, some clients may choose to fully participate in the labor market rather than take up DI/SSI. Yet, for those with medical needs, limited abilities, or interest in working, VR programs may instead serve to help clients understand Federal Disability Insurance programs and rules and consequently lead to an increase in take-up (Stapleton and Martin, 2012; Dean et. al., 2017). In fact, Dean et al. (2017) estimate that VR programs increase the probability VR clients with mental illness take-up or continue receiving DI/SSI.

2.2 Intangible Effects of VR

While the traditional ROI framework is simple and appealing, it does not account for a number of factors that may be important for understanding the social and taxpayer rates of return. There may be many important benefits and costs that are not easy to observe or cannot be monetized easily and, as such, are difficult to value in the standard framework. That is, there are aspects of VR programs that may have true social value or cost but are much more difficult to measure. Because they are difficult to measure, these intangible effects are rarely assigned a value in evaluations of government job training programs and are not included in our analysis either.

At the most basic level, VR services may lead to other social benefits associated with attachment to the labor market and the resulting reduction in use of the social welfare system. For society, the increased attachment to the labor market may lead to reductions in criminal activity. For recipients, there may be nonpecuniary benefits associated with working. For example, working may have an intangible benefit of increasing a recipient's utility due to the satisfaction associated with working and reduced welfare dependence (LaLonde, 1995). Likewise, independent living skills may be valuable to VR recipients in ways that are not reflected in their earnings or result in increased earnings of other family members or other caregivers. At the same time, losses in nonmarket time (e.g., leisure) that result if VR programs lead a recipient to work more hours may reduce the recipient's utility.

A more subtle issue is that the traditional ROI framework accounts for earnings, not well-being. VR clients have much lower incomes, on average, than do taxpayers/non-clients. Thus, the marginal utility of income may differ between the two groups. An extra dollar to a poor person may be worth more than an extra dollar to a wealthy taxpayer (Friedlander, 1997). Another problem is that the tax and transfer system distort behaviors. For example, income taxes may reduce the incentive to work. This creates behavioral distortions with economic cost that may not be directly reflected in earnings or taxes. Economists refer to these costs as deadweight losses.

Finally, some of the estimated earnings benefits may reflect the displacement of non-VR participants, particularly if services do not improve VR participant skills or the job-matching process. In this case, there would be partially offsetting costs to persons not enrolled in VR. In general, however, training programs for low-skilled workers are not thought to cause notable labor market displacements (Lalonde, 1995).

3. DPSS Analysis of Impact of VR on Earnings

DPSS estimate the effect of VR on employment and log-quarterly earnings (conditional on employment) for people with cognitive impairments (2015), mental illness (2017), and physical impairments (2018). To do this, they use data from the administrative records from DARS for a cohort of applicants in 2000 merged with state unemployment insurance (UI) data on quarterly earnings. The administrative records of the Virginia DARS include information on the 10,323 individuals who applied for VR services in SFY 2000 (July 1, 1999 - June 30, 2000) including measures of VR services, impairments, years of schooling, and other standard socioeconomics factors (e.g., gender, race, access to transportation). Using detailed service provision information, DPSS examine the impact of six types of services rather than just a single treatment indicator.[6]

Importantly, these administrative data from the 2000 applicant cohort in Virginia are merged with UI data from the Virginia Employment Commission on quarterly employment and earnings from 1995 to 2008. By observing individual quarterly employment and earnings prior to, during, and after service receipt, DPSS examine both the short- and long-term effects of VR services. To do this, they compare the differences in employment and conditional log earnings before and after VR service receipt within a structural model of VR service receipt decisions.

In particular, DPSS formalize and estimate a structural model of endogenous service provision and labor market outcomes, accounting for the selection problem that arises when unobserved factors associated with VR service receipt are correlated with labor market outcomes. They include three jointly determined equations to reflect the mix of services provided, the client's choice to work, and the client's earnings conditional on working. Since the selection problem occurs because unobserved characteristics may affect both service and labor market outcomes, DPSS model all three relationships as a function of random, unobserved components or error terms. Using this model, they allow services to be assigned based in part on expected labor market outcomes through those unobserved components. The parameters of this model are identified using pre-program labor market outcomes that control for differences between those who do and do not receive services, and two instrumental variables for each service choice that are assumed to impact service receipt but not the latent labor market outcomes.[7]

Long-run effects of service receipt, defined as effects from 2 years after to 10 years after service application, on the employment probability and conditional log quarterly earnings can be derived from estimates reported in DPSS and are summarized in Table 2. Vocational rehabilitation services have two labor market effects estimated in DPSS: a) they change the employment probability, and b) they change quarterly earnings conditional on being employed. For example, the estimated labor market effects of training services on people with cognitive impairments increase the probability of being employed in a particular quarter by 16% and increase quarterly earnings conditional on being employed by 28.5%.

These results are then combined to determine the total unconditional earnings effect for each service. For people with cognitive impairments, the only VR services that have negative effects on unconditional earnings are restoration services and maintenance services. For people with mental illness, all services except diagnosis and evaluation services have a positive total effect, and, for people with physical impairments, all services have positive effects. The composition of total effects between employment and conditional earnings effects vary across disability groups, VR services, and interactions. For example, education services have small employment effects and large conditional earnings effects, while training effects are more evenly distributed between

the two; and restoration services have negative effects for people with cognitive impairments but large positive effects for people with physical impairments.

Finally, to measure the social rate of return, DPSS approximate cost as

$$f + \sum_{j=1}^{J} s_{ij} c_j$$

where f is a combination of the average administrative and non-purchased service costs, s_{ij} is an indicator for receipt of service j by person i, and c_j is the average cost associated with purchased service j conditional on purchasing service j.

DARS data include measures of purchased service receipt, s_{ij}, and costs, c_j. The average costs for purchased services is $2,418 for clients with cognitive impairments, $1,500 for clients with mental illness, and $1,617 for clients with physical disabilities. The average costs of DARS-provided services, similar benefits, and administrative costs, f, are not included in the DARS administrative records. Instead, using program cost data reported annually by DARS to the Rehabilitation Services Administration (RSA), DPSS provide lower and upper bounds for f.[8] Non-purchased service costs are estimated to be between $2,000 to $4,200 for clients with cognitive impairments, $1,800 and $3,600 for clients with mental illness, and $2,000 to $3,000 for the clients with physical impairments.

Given these benefit and costs estimates, DPSS find impressive distributions of the ROR across VR recipients. In particular, they estimate median annual rates of return for people with cognitive impairments of 20% using the upper bound of fixed costs (Dean et al., 2015), for people with mental illness of 30% using the lower bound of fixed costs (Dean et al., 2017), and for people with physical impairments of 174% using the lower bound of fixed costs (Dean et al., 2018).[9]

4. Simulated Income and Estimated Cost of Services

Our first step in evaluating taxpayer ROI is to estimate the tax revenue benefits of Virginia's vocational rehabilitation program. To do this, we use the data sets from DPSS to simulate these benefits. Clients who have prior spells of service are included in our analysis, while in Dean (2017, 2018), people with prior spells were excluded. Using the client-specific data, we simulate

annual income with and without VR services and estimate the costs of VR services. Then, we compute tax revenues using Virginia (2017) for the full data set and for subsets of people with cognitive impairments, people with mental illness, and people with physical impairments.

4.1 Simulated Income

Using the models and estimates in DPSS, we simulate income for each client with and without VR services according to the DPSS models. To do this, we simulate earnings separately for the quarters prior to VR application and the quarters after VR application.[10] All income numbers are simulated quarterly because that is the time unit of observation used in DPSS. Then simulated quarterly income is multiplied by 4 to turn it into an annual estimate (because taxes depend on annual income).

Simulated annual income, conditional on employment, prior to VR application is denoted as base annual income. Figure 1 shows the distribution of the simulated base annual income for each of the three disability groups. Most people receiving VR work training services in the United States (US) have very low incomes. The median base annual incomes of the three groups are $2,560 for people with cognitive impairments, $2,246 for people with mental illness, and $6,194 for people with physical impairments. The highest decile earns $11,600 or more for people with cognitive impairments, $7,067 or more for people with mental illness, and $14,160 for people with physical impairments. One can see that almost all individuals have base annual incomes, conditional on employment, less than $20,000 for each of the three disability groups.

The moments of the income distributions shown in Figure 1 are reported in the "Without" column of Table 3. The probability of being employed varies from 0.327 for people with mental illness to 0.910 for people with physical impairments.[11] The means of the conditional quarterly income distributions vary from $991 for people with mental illness to $2,483 for people with physical impairments, and the means of the unconditional quarterly income distributions vary from $369 for people with mental illness to $2,265 for people with physical impairments.

The effect of VR service receipt is reported in the "Difference" columns. For example, for people with cognitive impairment, the mean probability of employment increases from 0.486 (without) to 0.605 (with), an increase of 0.119 (difference). The effect of VR receipt is positive for each of the three disability groups for each of the three reported outcomes. The one that

matters most for state tax revenue is unconditional income. This increases by $746 for people with cognitive impairments, $220 for people with mental illness, and $2,098 for people with physical impairments.

4.2 Cost of Services

A key component for an ROI analysis is the costs of services. With data on services choices and the average cost of purchased services, we compute the expected cost of services for each VR client. Assuming fixed costs are $4,200 for people with cognitive impairments, $1,800 for people with mental illness, and $2,000 for people with physical impairments, mean cost estimates associated with providing VR services are reported in Table 4.[12] There are two features of the estimated costs worth highlighting. First, the mean cost of VR services for mental illness is notably less than the mean costs for those with other impairments. Second, fixed costs are important. Consistent with DPSS, our main analysis uses the upper-bound fixed costs estimate for people with cognitive impairments, and the lower bound for those with other disabilities. However, the overall return on investment results are not particularly sensitive to whether we use the upper or lower bound of fixed cost estimates in DPSS (see Section 5.3).

Relative to cost of services, the accumulated unconditional income increases are large. For example, for clients with physical impairments, the total average cost of VR is $5,556 and the average annual increase in unconditional earnings is $2,098. However, the resulting extra state tax revenue, which will only be a fraction of the increase in earnings, may not be large enough to offset the costs of VR services.

5. Taxpayer ROI

Given the simulated income with and without VR service receipt, we compute changes in state income and sales tax revenue caused by VR. Formally, for each client i, we can compute the difference in revenues with and without VR service receipt as $\Delta_i=\tau_i(s_i)-\tau_i(0)$ where $\tau_i(s_i)$ is the estimated state income taxes under the realized services s_i with service receipt and $\tau_i(0)$ is the estimated taxes that would be observed with no service receipt. To do this, we first formalize a simplified version of the Virginia income and sales tax code and then simulate tax revenues with and without VR service receipt for each client.

5.1 Modeling State Income and Sales Tax

5.1.1 Income Tax

To measure the impact of VR on state income tax revenues, we need to model the Virginia income tax. We use a standard deduction of $3,000, an exemption of $930, an earned income tax credit of $300 with a maximum income threshold of $11,770, and a tax rate schedule shown in Table 5 (see Virginia, 2017). This results in the simplified tax schedule on annual income shown in Figure 2. One can have income as high as $11,770 and pay no income tax.[13]

5.1.2 Sales Tax

To measure the impact of VR on state sales tax revenues, we need to model both the sales tax rate on different goods and services and the effect of changes in income on consumption of those goods and services. The tax code has a 5.25% tax rate on most goods and services but a lower 2.5% rate on food (meant for eating at home). To implement the tax rates varying with goods, we use the approach outlined in Sharpe and Abdel-Ghany (1999) to create a sales tax revenue formula. [14]

5.2 Change in Virginia Tax Revenues

The simulated distribution of annual changes in income tax collections due to VR receipt, displayed in Figure 3, shows that VR receipt has very little impact on income tax collections. For VR recipients with physical impairments, the disability group with the most potential for increased income tax payments (implied by the very high rates of return), 0.5% have reductions in income tax payments, 62.3% have no change in income tax payments, and 37.2% have increases in income tax payments. However, only 2.9% have increases of $2,000 or more. The 62.3% are people who earn below the $11,770 threshold with VR services and thus pay no income tax. For VR recipients with cognitive impairments, 1.8% have reductions, 80.1% have no change, 18.1% have increases, and 1.9% have increases of $1,000 or more. For VR recipients with mental illness, 0.5% have reductions, 88.1% have no change, 11.4% have increases, and 0.7% have increases of $1,000 or more.

The simulated distribution of annual changes in sales tax collections due to VR receipt, displayed in Figure 4, shows that VR receipt also has very little impact on sales tax collections. For VR recipients with physical impairments, 2.3% have reductions in sales tax payments, 40.7% have no change in sales tax payments, and 57% have increases in sales tax payments.

However, only 4.3% have increases of $500 or more. For VR recipients with cognitive impairments, 10.7% have reductions, 55.5% have no change, 33.8% have increases, and 2.7% have increases of $500 or more. For VR recipients with mental illness, 4.7% have reductions, 72.9% have no change, 23.4% have increases, and 1.1% have increases of $500 or more.

The numbers associated with Figures 3 and 4 concern individual tax years. But policymakers should be more interested in the change in discounted lifetime tax collections, as displayed in Figure 5 using a 4% discount rate. In this figure, there is significant smoothing over years as very little of the distribution mass for change in tax revenues is at zero. In effect, while there are many years where the receipt of VR services results in no increase in taxes (Figures 3 and 4) most VR recipients have at least some years where the receipt of VR services results in some tax increases. The discounted tax revenue is sensitive to the discount rate used as can be seen in Figure 7.

5.3 Return on Investment

The taxpayer return on investment displayed in Figure 6 is the present value of the increase in lifetime tax receipts using a 4% discount rate minus the cost of the VR service (whose variable and fixed cost components are discussed in Section 3 and are summarized in Table 4). Because the marginal costs and fixed costs are large relative to the lifetime changes in tax receipt in Figure 6, the distribution of taxpayer returns is almost totally to the left of zero for all three disability groups. For example, for people with physical impairments, only 9.1% of the distribution has positive returns. The distribution for people with cognitive impairment is to the left of the other two partially because we used the higher fixed cost. Had we used the lower fixed cost of $2,000, the distribution curve for people with cognitive impairments would have been shifted to the right by $2,200, which would make it similar to the curves for the other two disability groups.[15]

Figure 7 shows how the aggregate return to taxpayers varies with the discount rate used. The proportion of VR recipients with positive taxpayer returns is sensitive to the discount rate used but is relatively small whether the discount rate is 2%, 5%, or 8%. For example, at a discount rate of 2%, only 6.9% of VR recipients have positive taxpayer returns. At a discount rate of 5%, the proportion falls to 1.1% with positive taxpayer returns.

6. Conclusions

Extending the DPSS analyses, we estimate the taxpayer ROI of VR programs in Virginia. DPSS find that VR programs have substantial labor market effects on VR clients that translate into large social returns (see Section 3). Yet, at the same time, VR clients have weak attachments to the labor market and low annual earnings. Thus, the large labor market effects do not translate into notable changes in state tax revenues.

To measure the effects of VR on tax revenues, we use the estimated DPSS models to simulate employment and earnings with and without VR service receipt. Without VR service receipt, we simulate an employment rate of 64% and unconditional mean quarterly earnings of approximately $1,400 (see Table 3). With VR service receipt, the simulated employment rate is 71% and mean quarterly earnings is $2,630. There is significant heterogeneity in these numbers across disability groups with a mean increase of $220 in earnings for people with mental illness, $746 for people with cognitive impairments, and $2,098 for people with physical impairments. Even so, for each disability group, while the labor market impact of VR is substantial relative to the base, the dollar change in earnings is modest.

In fact, with an income tax threshold of $11,770, our simulations imply that just over 60% clients with physical impairments and 80% of clients with mental illness and cognitive impairments pay no income tax in any given year. Thus, VR has very little impact on state income tax revenues. State sales taxes do not have the same threshold issue represented in Figure 2, but they are relatively small and still generate small amounts of tax revenue. The cost of VR services average just over $5,000 per client.

While administrators and policymakers are often interested in taxpayer returns, VR programs have very little impact on state tax revenues and, for most clients, the cost of VR services far exceed any change in state tax revenues. As a result, the median taxpayer ROI is negative. For example, while the estimated median annualized rate of return for clients with physical impairments is 174% (Dean et al., 2018), only 2.8% VR recipients with physical impairments have a positive taxpayer return. For the vast majority of clients, the cost of VR is not fully offset by increases in state tax revenue. Instead, the impressive benefits of VR come from substantially improving the economic (and probably emotional) well-being of VR clients at a relatively minimal cost to taxpayers.

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[1] DPSS report the rate of return (ROR) rather than the ROI. The ROR is the discount rate that equilibrates the sum of discounted returns from an investment to the cost of the investment. The ROI is the return of an investment for a given discount rate. In this paper, we present the taxpayer ROI.

[2] A number of other recent papers examine the return on investment for VR programs in different states. See, for example, Uvin et al. (2004), Hollenbeck and Huang (2006), Wilhelm and Robinson (2013), and Dean et al. (2019). McGuire-Kuletz and Tomlinson (2015), Hollenbeck (2019), Clapp et al. (2019), Schmidt et al. (2019) provide a detailed description and literature review of VR analyses.

[3] Alternatively, taxpayer return is sometimes referred to as a budget impact analysis or revenue-expenditure analysis (Boardman et al., 2018). That policymakers and bureaucrats often focus on the taxpayer rather than economic return has long been recognized (see Widavsky, 1966; Hudak and Wallack, 2015; Boardman et al., 2018). Policymakers and program administrators in Virginia have often asked us about state taxpayer return of the VR program in Virginia, and many articles in the popular press and government documents focus on taxpayer rate of return (e.g., Kiernan, 2020; Soergel, 2020; U.S. Dept of Treasury, 2020).

[4] This is a modified version of Table 5 from Friedlander, Greenberg, and Robins (1997).

[5] For example, see Benitez-Silva et al. (1999); Kreider (1999); Uvin, Karaaslani, and White (2004); Hollenbeck and Huang (2006); Loprest (2007); Kisker et al. (2008); Drake et al. (2009); Wilhelm and Robinson (2010); Stapleton and Martin (2012); Dean et al. (2014, 2017); French and Song (2014).

[6] In particular, following Dean et al. (2002), they aggregate VR services into diagnosis and evaluation, training, education, restoration, maintenance, and other services and allow these six service types to have different labor market effects. Diagnosis and evaluation service is provided at intake in assessing eligibility and developing an individualized plan for employment (IPE) and possibly later in the form of job counseling and placement services. Training includes vocationally oriented expenditures, including those for on-the-job training, job coach training, work adjustment, and supported employment. Education includes tuition and fees for a General Educational Development (GED)

program, a vocational or business school, a community college, or a university. Restoration, which is designed to reduce the impact of one's disability, covers a wide variety of medical expenditures, including dental services, hearing/speech services, eyeglasses and contact lenses, drug and alcohol treatments, psychological services, surgical procedures, hospitalization, prosthetic devices, and other assistive devices. Maintenance includes cash payments to facilitate everyday living while receiving other VR services and covers such items as transportation, clothing, motor vehicle and/or home modifications, and services to family members. Other services consist of payments outside of the previous categories, such as for tools and equipment.

[7] For each service, the first is the proportion of other clients of the individual's counselor who were provided with the service, and the second is the proportion of other clients of the individual's VR field office who were provided with the service.

[8] Using RSA data, which do not distinguish between disability types, DPSS use two different approaches to estimate these costs. First, non-purchased services and administrative costs represent about 55% of total DARS costs. Combining that percentage with average purchased service cost provides disability-specific fixed cost estimates. Second, DARS fixed costs average about $200 per client per month. That average is applied to the average number of months in the VR program to provide a second set of disability-specific fixed cost estimates.

[9] These are the primary results focused on in three different papers. There is no particularly good reason to use the upper or lower bounds of fixed costs across disability groups. But the results are not very sensitive to the choice (see Section 5.3).

[10] Following Dean et al. (2017), we exclude diagnosis and evaluation services for the disability group with mental illness. Also, we exclude the quarter immediately prior to VR application (i.e., the Ashenfelter dip, Ashenfelter, 1978).

[11] As discussed in Dean et al. (2018), the high employment probability for people with physical impairments is, to some degree, due to the fact that many of the people with physical impairments at

the time of application had only recently become physically impaired.

[12] The actual cost to Virginia taxpayers may be lower than the estimates reported in Table 4. First, to the extent the purchased services are provided over multiple quarters, these mean conditional cost estimates have not been discounted. Second, of the total cost of VR services in the Commonwealth, the federal government pays 78.7% and VA covers 21.3%. Thus, the direct cost to Virginia taxpayers is only a fraction (0.213) of the total cost estimates in Table 4, but federal taxes paid by Virginians are used to indirectly support VR programs across the country. Since the total cost to Virginia taxpayers for the VR program includes both direct and indirect payments, we use the total cost estimates in Table 4.

[13] Approximately 20% of the VR recipients are married. If the VR recipient's spouse earns a significant salary, then that could affect the income taxes one pays. Unfortunately, we have no information on the income of the spouses in our data. We assume it is zero. However, we also performed an exercise where we assumed that the annual income of the other spouse for those who were married was $40,000, more than enough to make the discontinuity in Figure 2 irrelevant. Because increases in income are quite small in the program, the results of the exercise showed very small effects; for people with a cognitive impairment, the median increase in income taxes was $4, and for people with mental illness or a physical impairment, it was $9.

[14] The estimates in Sharpe and Abdel-Ghany (1999) are well suited for this application. The timing of their data is similar to ours, their estimates are specific to people with low income, and they report derivatives instead of elasticities. The formula is

$$[(1.19\times0.02\times0.025)+((1-(1.19\times(0.02+0.18+0.03)))\times0.0525)]\Delta\text{Income}.$$

The 1.19 represents the ratio of expenditure to income implied by the estimates in Sharpe and Abdel-Ghany (1999). The 0.02 represents the estimated derivative of home food consumption with respect to income, and the 0.025 is the sales tax rate for such food. Thus, the first term in parentheses is the change in food sales taxes. The 0.18 is the estimated derivative for housing expenses with respect to

income, and the 0.03 is the estimated derivative of health expenditures with respect to income, and the 0.0525 is the tax rate on other goods. Thus, the second term in parentheses (starting with 1-) is the change in sales taxes collected on other goods and services.

[15] Our analysis focuses on taxpayers, not the impact of VR on the Commonwealth of Virginia's budget. From the perspective of a budget impact analysis for the Commonwealth, the federal government subsidy (see endnote 12) substantially reduces the cost of VR and would shift the distribution curves to the right by around $4000. Still, even in this limited case, the median return is still negative for all three groups.

Table 1: Accounting Framework for Return on Investment Analyses of VR Programs

Program Effect	VR Clients	Taxpayers/ Nonclients	Society
Earnings	+	0	+
State Income Taxes	-	+	0
State Sales Taxes	-	+	0
Federal Income Taxes	-	+	0
Government Transfer Programs	?	?	0
Operating Costs	0	-	-
Net Effect	+	?	?

Table 2: Parameter Estimates from DPSS for Long-Run Labor Market Effects

Services	Cognitive Impairment		Mental Illness		Physical Impairment	
	Employment Probability	Conditional Quarterly Earnings	Employment Probability	Conditional Quarterly Earnings	Employment Probability	Conditional Quarterly Earnings
Diagnosis & Evaluation	0.108 **	0.307 **	-0.154 **	0.032 *	0.044 **	0.318 **
Training	0.160 **	0.285 **	0.181 **	0.136 **	0.140 **	0.172 **
Education	0.188 **	0.555 **	-0.038 **	0.146 **	0.194 **	0.364 **
Restoration	-0.160 **	-0.241 **	-0.042 **	0.206 **	0.123 **	0.442 **
Maintenance	-0.021 **	-0.069 **	-0.025 **	0.217 **	-0.005	0.029
Other Services	0.146 **	0.224 **	0.016 **	0.146 **	0.092 **	0.148 **

Notes:

1) Employment Probability estimates are the change in employment probability evaluated at the mean employment probability. This is approximated as the difference in the long-run employment propensity minus the prior employment propensity reported in the first estimates table of each paper in DPSS, then multiplied by the standard normal density evaluated at the inverse standard distribution evaluated at the mean probability. The mean probabilities are all approximately 0.29.

2) Conditional Quarterly Earnings estimates are the percentage change in quarterly earnings conditional on being employed.

3) Double-starred items are statistically significant at the 5% level, and single-starred items are statistically significant at the 10% level. Standard errors are available from the authors.

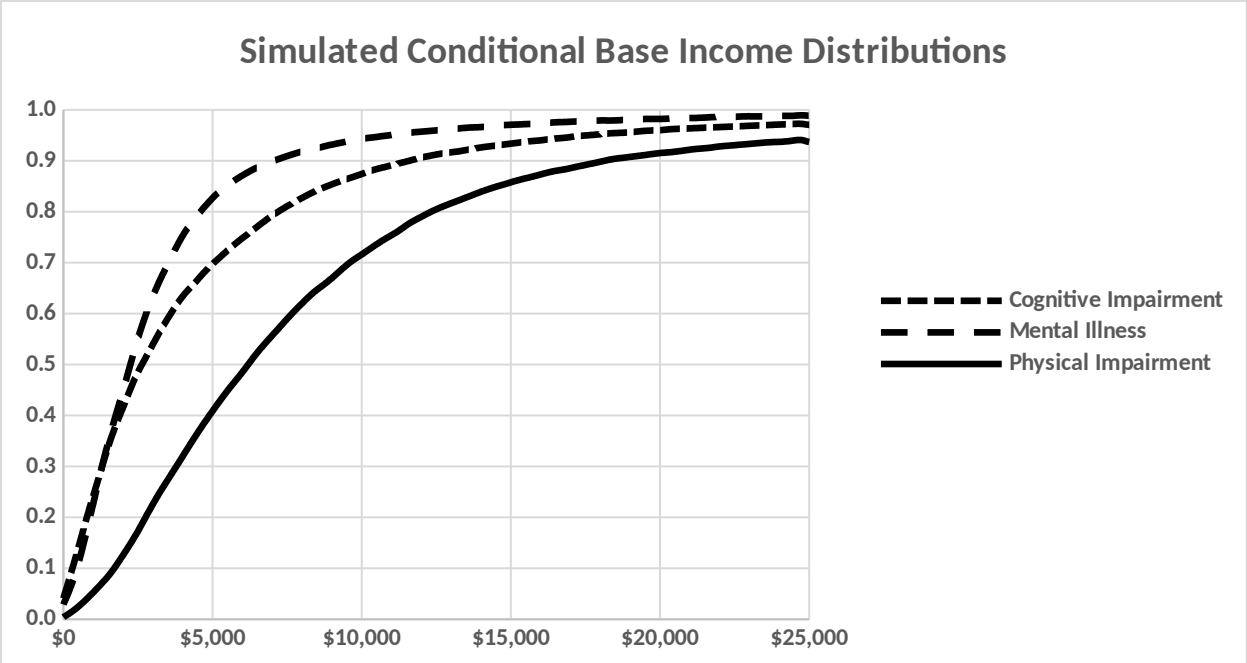
Simulated Conditional Base Income Distributions
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
$0
$5,000
$10,000
$15,000
$20,000
$25,000
Cognitive Impairment
Mental Illness
Physical Impairment

Figure 1

Table 3: Simulated Quarterly Income With and Without Service Delivery

Variable	Without	With	Difference
Cognitive Impairment			
Employment Probability	0.486	0.605	0.119
Conditional Income ($1K)	1.418	2.161	0.743
Unconditional Income ($1K)	0.946	1.692	0.746
Mental Illness			
Employment Probability	0.327	0.386	0.059
Conditional Income ($1K)	0.991	1.388	0.398
Unconditional Income ($1K)	0.369	0.588	0.220
Physical Impairment			
Employment Probability	0.910	0.965	0.054
Conditional Income ($1K)	2.483	4.520	2.037
Unconditional Income ($1K)	2.265	4.363	2.098
Aggregate			
Employment Probability	0.640	0.710	0.071
Conditional Income ($1K)	1.796	3.050	1.254
Unconditional Income ($1K)	1.400	2.630	1.231

Notes:

1) Conditional income is conditional on employment.

2) Unconditional income is conditional income multiplied by employment probability.

3) The numbers in the "Without" column are means across all quarters prior to VR application excluding the immediately preceding quarter (Ashenfelter dip).

4) The numbers in the "With" column are means across all quarters after VR application (both SR and LR).

Table 4: Cost Moments

Disability Group	# Obs	Mean	Std Dev
Cognitive Impairment	1156.0	6.595	1.597
Mental Illness	1491.8	3.934	1.250
Physical Impairment	2383.5	5.556	2.255
Aggregate	5031.3	5.314	2.104

Notes:

1) Cost moments are reported in $1K.

2) The existence of fraction observations is explained above.

Table 5: Virginia

Marginal Tax Rates

Lower Bound	Upper Bound	Marginal Rate
$0	$3,000	2.00%
$3,000	$5,000	3.00%
$5,000	$17,000	5.00%
$17,000	up	5.75%

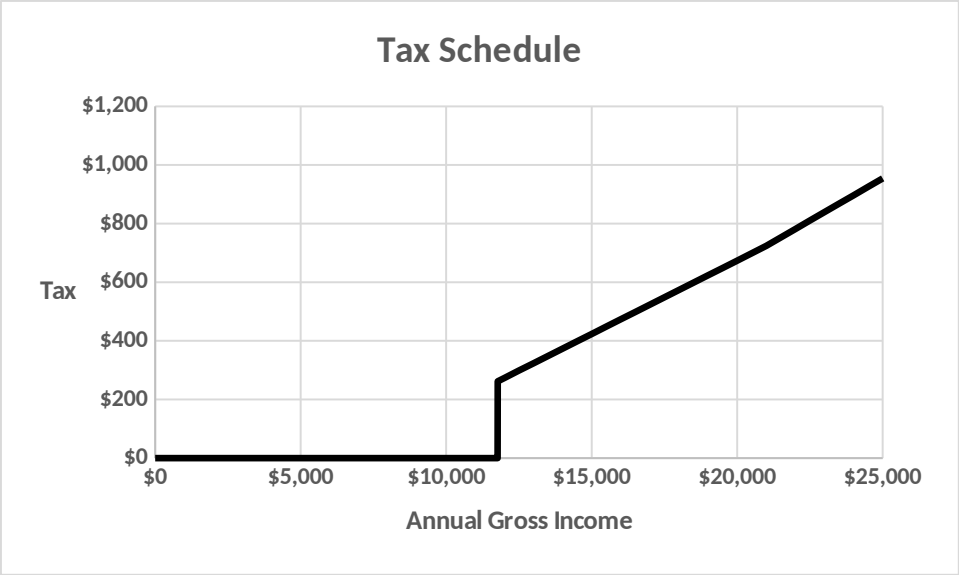
Tax Schedule
$1,200
$1,000
$800
$600
$400
$200
$0
Tax
$0
$5,000
$10,000
$15,000
$20,000
$25,000
Annual Gross Income

Figure 2

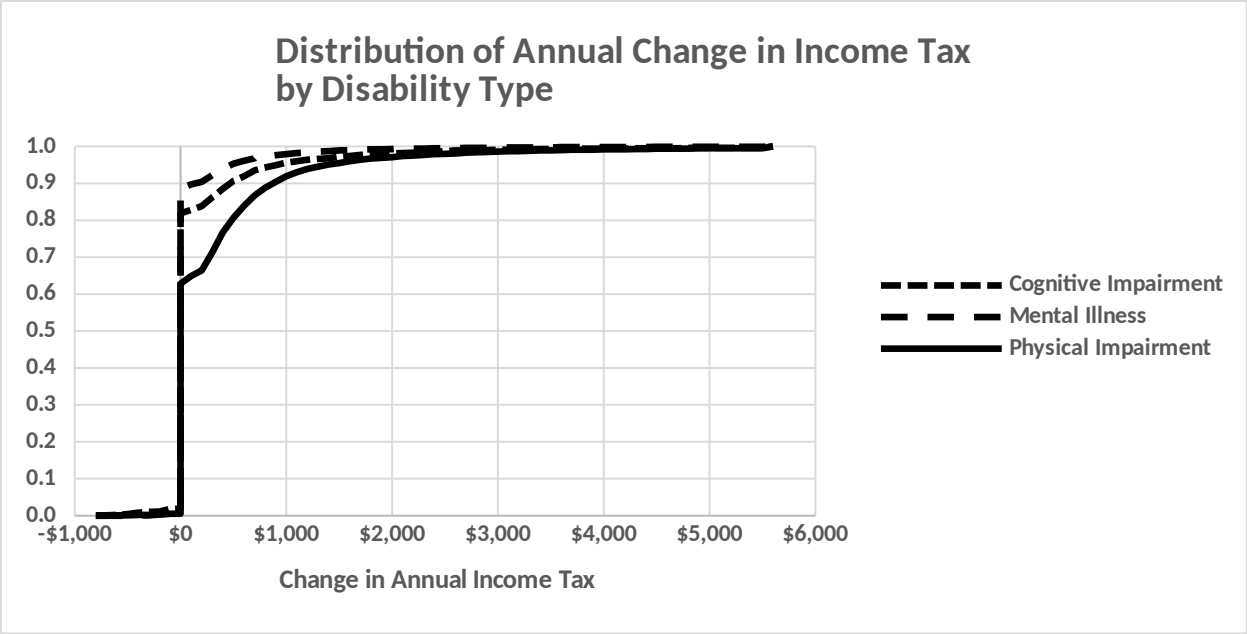
Distribution of Annual Change in Income Tax by Disability Type
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-$1,000
$0
$1,000
$2,000
$3,000
$4,000
$5,000
$6,000
Change in Annual Income Tax
Cognitive Impairment
Mental Illness
Physical Impairment

Figure 3

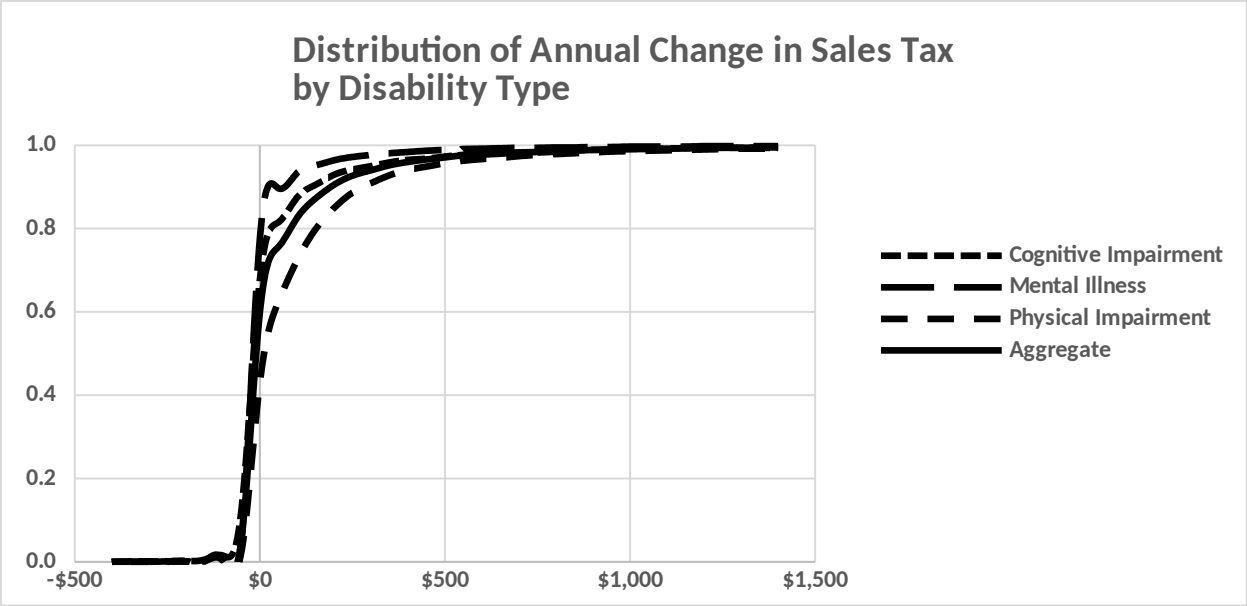
Distribution of Annual Change in Sales Tax by Disability Type
1.0
0.8
0.6
0.4
0.2
0.0
-$500
$0
$500
$1,000
$1,500
Cognitive Impairment
Mental Illness
Physical Impairment
Aggregate

Figure 4

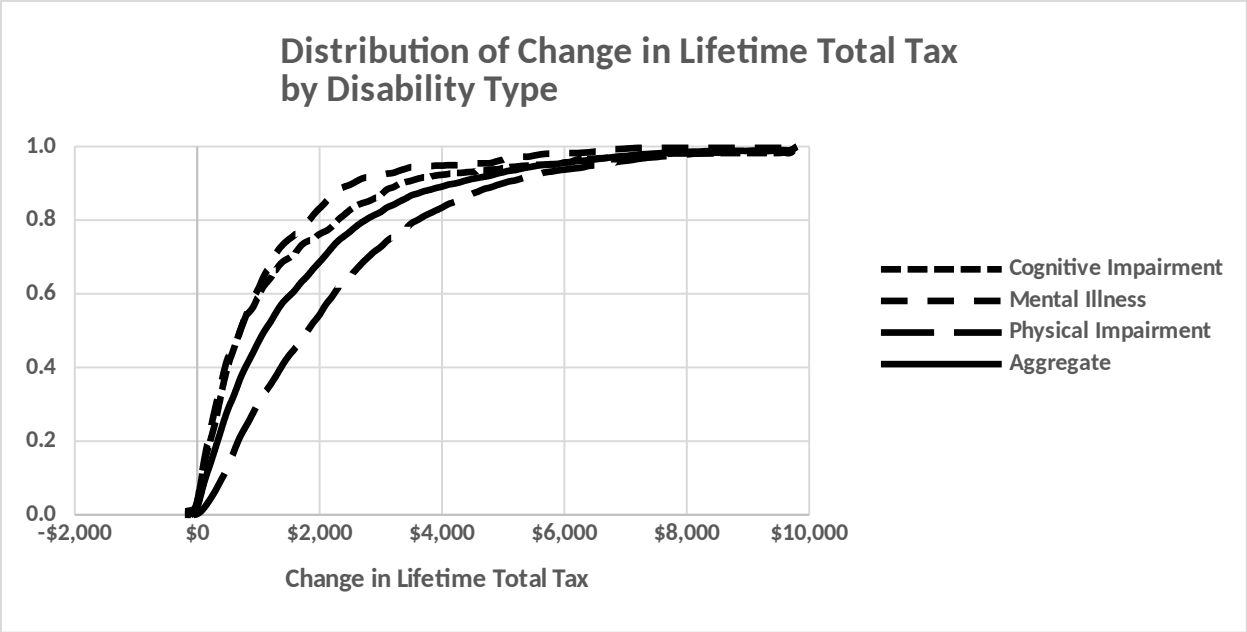
Distribution of Change in Lifetime Total Tax by Disability Type
1.0
0.8
0.6
0.4
0.2
0.0
-$2,000
$0
$2,000
$4,000
$6,000
$8,000
$10,000
Change in Lifetime Total Tax
Cognitive Impairment
Mental Illness
Physical Impairment
Aggregate

Figure 5

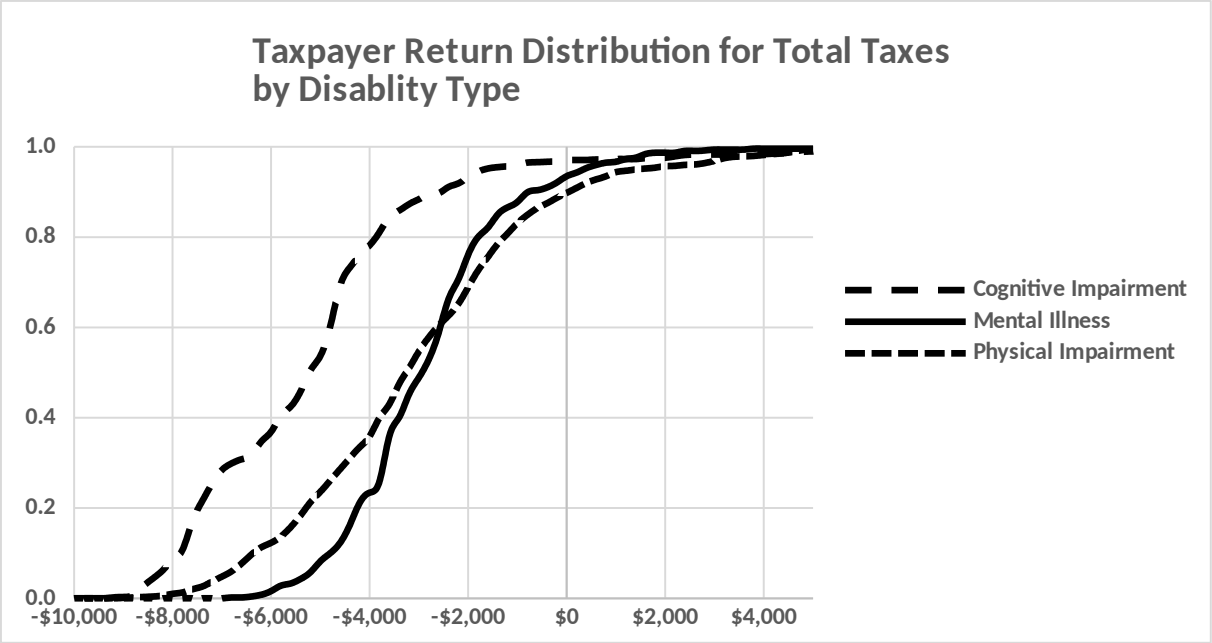
Taxpayer Return Distribution for Total Taxes by Disablity Type
1.0
0.8
0.6
0.4
0.2
0.0
-$10,000
-$8,000
-$6,000
-$4,000
-$2,000
$0
$2,000
$4,000
Cognitive Impairment
Mental Illness
Physical Impairment

Figure 6

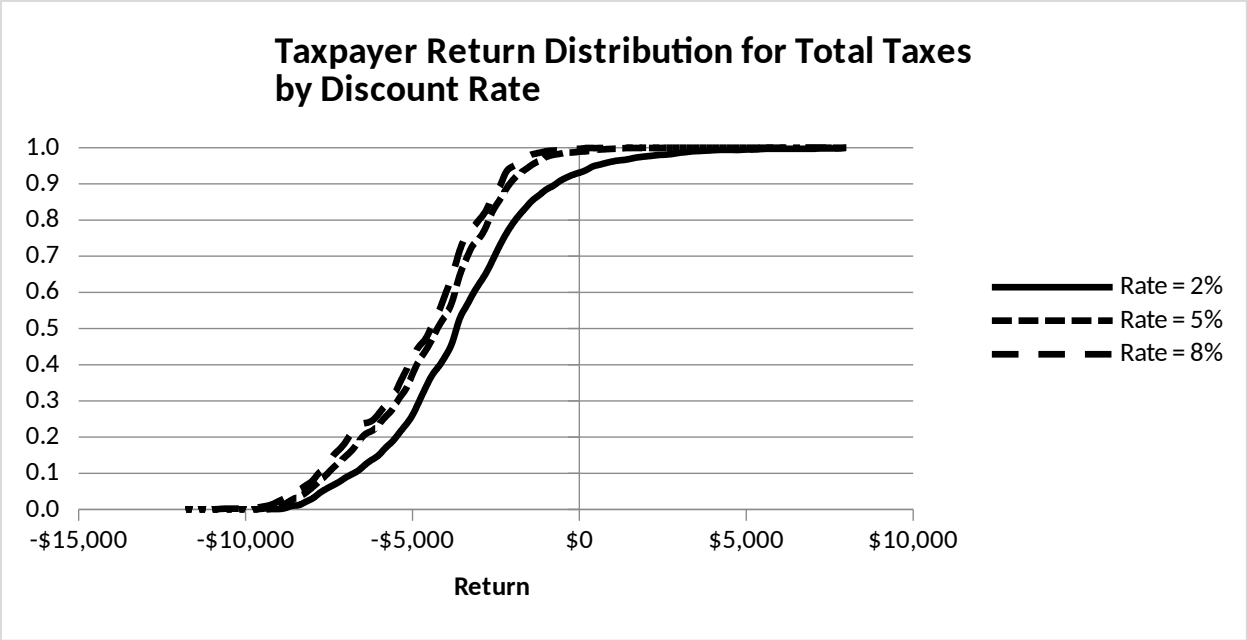
Taxpayer Return Distribution for Total Taxes by Discount Rate
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-$15,000
-$10,000
-$5,000
$0
$5,000
$10,000
Return
Rate = 2%
Rate = 5%
Rate = 8%

Figure 7