Research

Wealth Taxes and Workers

DOUGLAS HOLTZ-EAKIN, GORDON GRAY | JANUARY 10, 2020

Executive Summary

Senators and presidential candidates Elizabeth Warren and Bernie Sanders have recently proposed taxes on household wealth. Ostensibly, these taxes would impose the burden of government expansion on a small number of wealthy individuals. In reality, however, the disincentives created by the wealth tax would shift the burden of the tax away from its narrow base to affect the entire economy, as this study demonstrates.

Workers, in particular, would suffer from the loss of labor earnings created by less innovation and investment. In particular:

- The Warren wealth tax would cost workers $1.2 trillion (in 2018 dollars) in lost earnings over the first 10 years, and ultimately, for every dollar of revenue raised, workers would lose more than 60 cents of earnings (see Executive Summary Table);
- The Sanders wealth tax would cost workers $1.6 trillion (in 2018 dollars) in lost earnings over the first 10 years, and similarly impose over 60 percent of the burden of the proposal on workers (see Executive Summary Table);
- The magnitudes of the results are large despite a conservative approach to the analysis; and
- This study indicates that if the federal government needs to raise more revenue, these specific proposals are poorly designed and would have a uniquely negative impact on workers' real wages – ultimately imposing an effective tax of 63 cents on workers for every dollar the government raises in revenue from the wealthy.

Executive Summary Table

	Warren	Sanders
Wealth Tax Revenue ($ billions)		
2021-2025	$1,498	$1,882
2026-2030	$1,754	$2,205

2021-2030	*$3,252*	*$4,087*
Long Run* (annually)	$380	$478
Lost Labor Income ($ billions) (% of Wealth Tax)		
2021-2025	$437 (29%)	$625 (30%)
2026-2030	$785 (45%)	$999 (45%)
2021-2030	*$1,222*	*$1,624*
Long Run (annually)	$241 (63%)	$301 (63%)

**Long Run indicates the impact after the economy has fully adjusted to the tax.*

Introduction

Senators and presidential candidates Elizabeth Warren and Bernie Sanders have proposed new taxes on household wealth, with the stated goal of raising large amounts of revenue from a small number of affluent households. These wealth taxes impose high effective rates on investment returns of a narrow segment of the population. But more fundamentally the tax constitutes a reduction in the supply of capital, and as a result it will reduce investment in innovation, lower productivity growth, and thus reduce wage growth. These responses shift, at least in part, the effective burden of the taxes to the average worker.

This economic logic does not depend on a particular "model" or specific computer simulation. The reality of a market economy is simply at odds with the assertion that workers can be insulated from a significant change in the environment in which their work facilities, capital equipment, and intellectual property is accumulated. The only remaining question is the magnitude of the burden shifted to workers.

The American Action Forum (AAF) examines that magnitude in this analysis. The report is organized as follows. It first briefly describes the proposed wealth taxes by Warren and Sanders. Next, it describes the methodology employed in the study – choosing an independent entity to do the formal modeling and assumptions that describe a reasonable base case that isolates the effects of the tax. In the next two sections, it covers the basic results and provides some sensitivity analysis. The final section summarizes and concludes. Included as Appendices is the entire work product exactly as provided to AAF by the modelers.

Description of the Proposals

Senator Elizabeth Warren's proposed wealth tax would apply to U.S. households with net wealth above $50 million. The top rate is 6 percent. The wealth tax rate would start at 2 percent on wealth above $50 million and rise to 6 percent on wealth above $1 billion. The proposal does not distinguish between married and single

taxpayers. Impacts are estimated assuming the tax is imposed beginning in 2021 and that the tax bracket thresholds would not be indexed for inflation.

Senator Bernie Sanders has proposed a wealth tax that would apply to U.S. households with net wealth above $32 million. Its top rate would be 8 percent. In contrast to the Warren proposal, Sanders's wealth tax distinguishes between married and single taxpayers. For taxpayers filing jointly, the wealth tax rate would be 1 percent of wealth from $32 million to $50 million, 2 percent of wealth from $50 million to $250 million, 3 percent of wealth from $250 million to $500 million, 4 percent of wealth from $500 million to $1 billion, 5 percent of wealth from $1 billion to $2.5 billion, 6 percent of wealth from $2.5 billion to $5 billion, 7 percent of wealth from $5 billion to $10 billion, and 8 percent of wealth over $10 billion. The tax bracket thresholds for single taxpayers would be half those of taxpayers filing jointly. Impacts are estimated assuming the tax is imposed beginning in 2021 and that the tax bracket thresholds would not be indexed for inflation.

Analytic Strategy

To move past a qualitative discussion of the wealth tax requires a formal model of the U.S. economy. AAF retained Robert Carroll, James Mackie, and Brandon Pizzola of EY's Quantitative Economics and Statistics (QUEST) Group to conduct the analysis precisely because their "overlapping generations model" (see the Appendices) is similar to those used by the non-partisan Congressional Budget Office, the non-partisan Joint Committee on Taxation, and the U.S. Treasury Department. It thus embodies the consensus impacts in the research literature.

Base Case

As a base case, AAF assumes that affluent households are able to legally avoid 15 percent of the wealth tax, which conforms to the official Warren and Sanders estimates. This assumption avoids the unrealistic (in AAF's view) assumption of no avoidance whatsoever but acknowledges that a new enforcement regime may be able to improve compliance. Regarding the disposition of the revenue, it is assumed that the wealth tax revenue is given back to the household sector as transfer payments; i.e., the government taxes the money away and then gives it right back. This assumption helps to isolate the impact of the wealth taxes without conflating the possibly productivity-enhancing effects of government spending with the wealth tax effects.

In addition, AAF views the underlying model used to analyze the effects of the wealth tax as conservative because it is built on the assumption that one-half of households are non-savers. These households are not, as a result, directly influenced by the changes in the net rate of return to capital that are central to our interpretation. This assumption tends to reduce the likely impact.

Base Case Results

The basic results are contained in Table 1 (Warren) and Table 2 (Sanders). Consider Table 1. The first row shows that the wealth tax reduces the level of gross domestic product (GDP) by an average of 0.6 percent annually over the first five years, 0.8 percent annually over the second five years, and 1.0 percent annually over the long run (with "long run" meaning the effect of the tax after the economy has fully adjusted to it). These rate declines translate into corresponding losses of $706 billion in GDP over the first five years, $1.1 trillion over the second five years, and then $283 billion annually over the long run (in 2018 dollars).

The next row shows the impact on consumption, which gets an initial boost because 50 percent of households will simply spend the transfer payments from the government. By the second five years, however, this effect gets outweighed by the smaller economy and reduced labor income. Over the long run, consumption declines by 1.0 percent.

Rows 3 and 4 indicate that (as expected) the incentives to invest are diminished, with the result that the capital

stock is smaller than it would otherwise be. Over the long run, both decline by 1.7 to 1.8 percent.

The reduced accumulation of capital translates directly into lower productivity and real wages. Rows 5 and 6 show that the reduced real wages diminish the number of people working and their average hours of work – amounting to diminished total labor supply of 0.5 percent over the long run. Total labor earnings also decline markedly, down an average of 0.7 percent annually in the first five years, 1.1 percent annually over the second five years, and 1.6 percent annually over the long run.

These losses in labor income amount to $437 billion in the first five years, $785 billion in the second five years, and $241 billion (annually) over the long run. Compared with estimated wealth tax receipts (row 7), the earnings losses imply that workers are bearing a burden of the tax ranging from 29 percent in the near term to 63 percent over the long run.

In short, over the long run Warren's wealth tax is more damaging to workers than anyone else.

Table 1

Impact of Warren Wealth Tax

($ billions)

	2021-25 (average annual loss)	**2026-30 (average annual loss)**	**Long Run (annually)**	**2021-25 (cumulative)**	**2026-30 (cumulative)**	**Long Run (annually)**
GDP	-0.6%	-0.8%	-1.0%	-$706	-$1,075	-$283
Consumption	0.3%	-0.3%	-1.0%	$240	-$274	-$193
Private Investment	-5.2%	-3.4%	-1.8%	-$1,050	-$785	-$88
Private Capital Stock	-0.2%	-0.7%	-1.7%	-$532	-$2,129	-$1,090
Labor Supply	-0.8%	-0.7%	-0.5%			
Labor Income	-0.7%	-1.1%	-1.6%	-$437 29%	-$785 45%	-$241 63%
Tax Revenue				$1,498	$1754	$380

Table 2 tells precisely the same story, with the bad news coming in bigger magnitudes due to the higher wealth tax rates. In short, the Sanders wealth tax is even worse for workers than anyone else.

Table 2

Impact of Sanders Wealth Tax

($ billions)

	2021-25 (average annual loss)	2026-30 (average annual loss)	Long Run (annually)	2021-25 (cumulative)	2026-30 (cumulative)	Long Run (annually)
GDP	-0.8%	-1.0%	-1.3%	-$941	-$1,344	-$368
Consumption	0.4%	-0.4%	-1.3%	$320	-$366	-$251
Private Investment	-6.6%	-4.5%	-2.3%	-$1,333	-$1,038	-$112
Private Capital Stock	-0.2%	-0.9%	-2.2%	-$532	-$2,738	-$1,411
Labor Supply	-1.0%	-0.9%	-0.6%			
Labor Income	-1.0%	-1.4%	-2.0%	-$562 30%	-$999 45%	-$301 63%
Tax Revenue				$1,882	$2,205	$478

Sensitivity of Results

As noted above, the numerical results are expected to change in response to differing assumptions. This analysis focuses on three kinds of sensitivities: 1) more or less tax avoidance, 2) more or less productivity-generating government spending, and 3) more or less responsiveness by individuals to tax-based incentives. The Appendices contain a complete documentation of these variants.

The results are as one would expect. Higher productivity from government spending tends to offset the loss of productivity from the wealth taxes *per se*, diminishing the loss in labor earnings and the fraction of the burden shifted to labor. In the extreme, one could hope for productivity effects large enough to offset the wealth taxes entirely.

Increased avoidance lowers the effective taxation of wealth and diminishes the impacts on capital accumulation and labor; the reverse is true for less avoidance. In the same way, having households be more sensitive to the after-tax return to capital raises the level of impact on workers, and *vice versa*.

Another issue is the mix of capital income that is a “normal” return as opposed to a “supra-normal” return. The former is the risk-free opportunity cost of funds, while the latter is composed of a mix of economic rents (pure profits) and a risk premium. Of note, only the tax burden on the “normal” return creates a disincentive to save and invest. To check the sensitivity, and based on an average of the results in the literature, a scenario was run that assumed that 70 percent of the overall return to capital is the “normal” return. The impacts on GDP were similar but somewhat smaller. (See the Appendices for details.)

Conclusion

To date, the discussion of the Warren and Sanders wealth taxes has focused on issues such as “fairness” – always in the eye of the beholder –constitutionality, and the ability of individuals to legally avoid the taxes. These are important issues but miss some basic nuts and bolts of tax policy. Good tax policy has a broad base and low rates, thereby minimizing the distortions of economic incentives.

On the former, note that if the annual rate of return to capital is 6 percent, the Warren top rate constitutes a 100 percent tax rate on the return to capital, while the Sanders top rate is fully 133 percent. While only a small segment of the population would be subject to this top rate, its wealth holdings constitute a significant share of the investable wealth in the economy. As a matter of construction, the proposed taxes are a significant distortion of the economic incentives presented to capital accumulation in the United States.

AAF's assessment of how the economy will respond to these taxes indicates they will have broad impacts. In particular, the Warren and Sanders wealth taxes will mean an effective tax as large as 63 cents on American workers for every dollar the wealth tax raises in revenue.

There are many ways to raise revenue, and many of these are highly progressive. This examination of the potential effects of the Warren and Sanders wealth tax proposals suggests, however, that the impact of a tax targeting much of the economy's investable capital imposes a disproportionate burden on workers.

Appendix A. Estimated macroeconomic impacts of Warren wealth tax with top 6% rate*

Table A-1. Estimated macroeconomic impacts of Warren wealth tax (top 6% rate) proposal – With 15% avoidance behavior

No productivity increase from government transfers			
	2021-25	**2026-30**	**Long run**
GDP	-0.6%	-0.8%	-1.0%
Consumption	0.3%	-0.3%	-1.0%
Private investment	-5.2%	-3.4%	-1.8%
Private capital stock	-0.2%	-0.7%	-1.7%
Labor supply	-0.8%	-0.7%	-0.5%
After-tax wage rate	0.1%	-0.4%	-1.1%
Job equivalents	-0.7%	-1.1%	-1.6%
Moderate productivity increase from government transfers			
	2021-25	**2026-30**	**Long run**
GDP	-0.6%	-0.7%	0.0%
Consumption	0.4%	-0.2%	0.3%
Private investment	-5.7%	-3.5%	-0.6%

Private capital stock	-0.2%	-0.8%	-0.6%
Labor supply	-0.8%	-0.5%	0.6%
After-tax wage rate	0.0%	-0.7%	-1.3%
Job equivalents	-0.8%	-1.2%	-0.7%

Note: All estimates assume wealth tax revenue is used to fund government spending. Different scenarios are provided assuming 0%, 15%, and 50% tax avoidance behavior and assuming government transfers have a zero, moderate, or high impact on productivity, as indicated. The model and key assumptions are described in Appendix C.

*Impacts estimated by Robert Carroll, James Mackie, and Brandon Pizzola of the Quantitative Economics and Statistics (QUEST) group of Ernst & Young LLP, using an overlapping generations general equilibrium model of the US economy. A technical description of the model, methodology, and key assumptions is provided in Appendix C.

Table A-2. Estimated macroeconomic impacts of Warren wealth tax (top 6% rate) proposal – With 50% avoidance behavior

No productivity increase from government transfers

	2021-25	**2026-30**	**Long run**
GDP	-0.3%	-0.4%	-0.6%
Consumption	0.2%	-0.2%	-0.6%
Private investment	-3.3%	-1.8%	-1.1%
Private capital stock	-0.1%	-0.4%	-1.0%
Labor supply	-0.4%	-0.4%	-0.3%
After-tax wage rate	0.0%	-0.2%	-0.6%
Job equivalents	-0.4%	-0.6%	-0.9%

Moderate productivity increase from government transfers

	2021-25	**2026-30**	**Long run**
GDP	-0.3%	-0.4%	0.0%
Consumption	0.3%	-0.1%	0.2%
Private investment	-3.6%	-1.8%	-0.3%
Private capital stock	-0.1%	-0.4%	-0.3%
Labor supply	-0.4%	-0.3%	0.4%
After-tax wage rate	0.0%	-0.4%	-0.7%
Job equivalents	-0.4%	-0.7%	-0.3%

Note: All estimates assume wealth tax revenue is used to fund government spending. Different scenarios are provided assuming 0%, 15%, and 50% tax avoidance behavior and assuming government transfers have a zero, moderate, or high impact on productivity, as indicated. The model and key assumptions are described in Appendix C.

Table A-3. Estimated macroeconomic impacts of Warren wealth tax (top 6% rate) proposal – With no avoidance behavior

No productivity increase from government transfers

	2021-25	**2026-30**	**Long run**
GDP	-0.7%	-0.9%	-1.2%
Consumption	0.3%	-0.3%	-1.2%
Private investment	-6.0%	-4.1%	-2.2%
Private capital stock	-0.2%	-0.8%	-2.0%
Labor supply	-0.9%	-0.9%	-0.6%
After-tax wage rate	0.1%	-0.5%	-1.3%
Job equivalents	-0.9%	-1.3%	-1.9%

Moderate productivity increase from government transfers

	2021-25	**2026-30**	**Long run**
GDP	-0.7%	-0.8%	0.0%
Consumption	0.5%	-0.2%	0.4%
Private investment	-6.6%	-4.2%	-0.7%
Private capital stock	-0.2%	-0.9%	-0.7%
Labor supply	-0.9%	-0.6%	0.8%
After-tax wage rate	0.0%	-0.8%	-1.5%
Job equivalents	-0.9%	-1.3%	-0.8%

Note: All estimates assume wealth tax revenue is used to fund government transfers. Different scenarios are provided assuming 0%, 15%, and 50% tax avoidance behavior and assuming government transfers have a zero, moderate, or high impact on productivity, as indicated. The model and key assumptions are described in Appendix C.

Table A-4. Estimated macroeconomic impacts of Warren wealth tax (top 6% rate) proposal – Sensitivity to model parameters

Low behavior parameters			
	2021-25	**2026-30**	**Long run**
GDP	-0.4%	-0.5%	-0.5%
Consumption	0.0%	-0.4%	-0.5%
Private investment	-2.7%	-1.2%	-0.7%
Private capital stock	-0.2%	-0.4%	-0.5%
Labor supply	-0.4%	-0.4%	-0.3%
After-tax wage rate	-0.4%	-0.7%	-0.8%
Job equivalents	-0.8%	-1.1%	-1.1%
High behavior parameters			
	2021-25	**2026-30**	**Long run**

GDP	-0.9%	-1.1%	-1.7%
Consumption	0.6%	-0.1%	-1.7%
Private investment	-8.5%	-6.4%	-3.5%
Private capital stock	-0.1%	-1.0%	-3.4%
Labor supply	-1.3%	-1.1%	-0.7%
After-tax wage rate	0.4%	-0.2%	-1.5%
Job equivalents	-0.9%	-1.4%	-2.2%

Note: All estimates assume wealth tax revenue is used to fund government transfers. These estimates assume 15% tax avoidance behavior and that government transfers have no impact on productivity. Key model parameters are modified to illustrate sensitivity of this scenario to parameter values that yield low and high estimated impacts. The model and key assumptions are described in Appendix C.

Table A-5. Estimated macroeconomic impacts of Warren wealth tax (top 6% rate) proposal – With 15% avoidance behavior

High productivity increase from government transfers

	2021-25	**2026-30**	**Long run**
GDP	-0.6%	-0.6%	0.8%
Consumption	0.5%	-0.1%	1.3%
Private investment	-6.1%	-3.6%	0.3%
Private capital stock	-0.2%	-0.8%	0.3%
Labor supply	-0.8%	-0.4%	1.4%
After-tax wage rate	0.0%	-0.8%	-1.4%
Job equivalents	-0.8%	-1.2%	0.0%

Note: All estimates assume wealth tax revenue is used to fund government transfers. These estimates assume 15% tax avoidance behavior and that government transfers have a high impact on productivity. The model and key assumptions are described in Appendix C.

Appendix B. Estimated macroeconomic impacts of Sanders wealth tax with top 8% rate

Table B-1. Estimated macroeconomic impacts of Sanders wealth tax (top 8% rate) proposal – With 15% avoidance behavior

No productivity increase from government transfers

	2021-25	2026-30	Long run
GDP	-0.8%	-1.0%	-1.3%
Consumption	0.4%	-0.4%	-1.3%
Private investment	-6.6%	-4.5%	-2.3%
Private capital stock	-0.2%	-0.9%	-2.2%
Labor supply	-1.0%	-0.9%	-0.6%
After-tax wage rate	0.1%	-0.5%	-1.4%
Job equivalents	-1.0%	-1.4%	-2.0%

Moderate productivity increase from government transfers

	2021-25	2026-30	Long run
GDP	-0.8%	-0.9%	0.0%
Consumption	0.5%	-0.2%	0.4%
Private investment	-7.3%	-4.5%	-0.8%
Private capital stock	-0.2%	-1.0%	-0.7%
Labor supply	-1.0%	-0.7%	0.8%
After-tax wage rate	0.0%	-0.8%	-1.6%
Job equivalents	-1.0%	-1.5%	-0.8%

Note: All estimates assume wealth tax revenue is used to fund government transfers. Different scenarios are provided assuming 0%, 15%, and 50% tax avoidance behavior and assuming government transfers have a zero, moderate, or high impact on productivity, as indicated. The model and key assumptions are described in Appendix C.

Table B-2. Estimated macroeconomic impacts of Sanders wealth tax (top 8% rate) proposal – With 50% avoidance behavior

No productivity increase from government transfers

	2021-25	2026-30	Long run
GDP	-0.4%	-0.6%	-0.7%
Consumption	0.3%	-0.2%	-0.8%
Private investment	-4.3%	-2.4%	-1.4%
Private capital stock	-0.1%	-0.5%	-1.3%
Labor supply	-0.6%	-0.5%	-0.4%
After-tax wage rate	0.1%	-0.3%	-0.8%
Job equivalents	-0.5%	-0.8%	-1.2%

Moderate productivity increase from government transfers

	2021-25	2026-30	Long run
GDP	-0.4%	-0.5%	0.0%
Consumption	0.4%	-0.1%	0.2%
Private investment	-4.6%	-2.4%	-0.5%
Private capital stock	-0.1%	-0.6%	-0.4%
Labor supply	-0.6%	-0.3%	0.5%
After-tax wage rate	0.0%	-0.5%	-0.9%

Job equivalents	-0.6%	-0.9%	-0.5%

Note: All estimates assume wealth tax revenue is used to fund government transfers. Different scenarios are provided assuming 0%, 15%, and 50% tax avoidance behavior and assuming government transfers have a zero, moderate, or high impact on productivity, as indicated. The model and key assumptions are described in Appendix C.

Table B-3. Estimated macroeconomic impacts of Sanders wealth tax (top 8% rate) proposal – With no avoidance behavior

No productivity increase from government transfers			
	2021-25	**2026-30**	**Long run**
GDP	-0.9%	-1.2%	-1.5%
Consumption	0.4%	-0.4%	-1.5%
Private investment	-7.7%	-5.3%	-2.7%
Private capital stock	-0.3%	-1.0%	-2.6%
Labor supply	-1.2%	-1.1%	-0.7%
After-tax wage rate	0.1%	-0.6%	-1.7%
Job equivalents	-1.1%	-1.7%	-2.4%
Moderate productivity increase from government transfers			
	2021-25	**2026-30**	**Long run**
GDP	-0.9%	-1.0%	0.0%
Consumption	0.6%	-0.2%	0.4%
Private investment	-8.5%	-5.4%	-1.0%
Private capital stock	-0.3%	-1.1%	-0.9%
Labor supply	-1.2%	-0.8%	0.9%
After-tax wage rate	0.0%	-1.0%	-1.9%
Job equivalents	-1.2%	-1.8%	-1.0%

Note: All estimates assume wealth tax revenue is used to fund government transfers. Different scenarios are provided assuming 0%, 15%, and 50% tax avoidance behavior and assuming government transfers have a zero, moderate, or high impact on productivity, as indicated. The model and key assumptions are described in Appendix C.

Table B-4. Estimated macroeconomic impacts of Sanders wealth tax (top 8% rate) proposal – Sensitivity to model parameters

Low behavior parameters

	2021-25	**2026-30**	**Long run**
GDP	-0.5%	-0.6%	-0.6%
Consumption	0.0%	-0.5%	-0.6%
Private investment	-3.4%	-1.6%	-0.9%
Private capital stock	-0.3%	-0.6%	-0.6%
Labor supply	-0.5%	-0.5%	-0.3%
After-tax wage rate	-0.5%	-0.9%	-1.0%
Job equivalents	-1.0%	-1.4%	-1.4%

High behavior parameters

	2021-25	**2026-30**	**Long run**
GDP	-1.1%	-1.4%	-2.1%
Consumption	0.7%	-0.2%	-2.2%
Private investment	-10.9%	-8.3%	-4.3%
Private capital stock	-0.2%	-1.3%	-4.3%
Labor supply	-1.7%	-1.5%	-0.9%
After-tax wage rate	0.5%	-0.3%	-1.8%
Job equivalents	-1.2%	-1.8%	-2.7%

Note: All estimates assume wealth tax revenue is used to fund government transfers. These estimates assume 15% tax avoidance behavior and that government transfers have no impact on productivity. Key model parameters are modified to illustrate sensitivity of this scenario to parameter values that yield low and high estimated impacts. The model and key assumptions are described in Appendix C.

Table B-5. Estimated macroeconomic impacts of Sanders wealth tax (top 8% rate) proposal – With 15% avoidance behavior

High productivity increase from government transfers

	2021-25	2026-30	Long run
GDP	-0.8%	-0.8%	1.0%
Consumption	0.6%	-0.1%	1.6%
Private investment	-7.7%	-4.6%	0.4%
Private capital stock	-0.3%	-1.0%	0.3%
Labor supply	-1.0%	-0.5%	1.8%
After-tax wage rate	0.0%	-1.1%	-1.8%
Job equivalents	-1.0%	-1.6%	0.0%

Note: All estimates assume wealth tax revenue is used to fund government transfers. These estimates assume 15% tax avoidance behavior and that government transfers have a high impact on productivity. The model and key assumptions are described in Appendix C.

Appendix C. Technical description of macroeconomic model used to estimate economic impacts of Senator Warren's (D-MA) and Senator Bernie Sanders' (I-VT) proposed wealth taxes

Senator Elizabeth Warren's (D-MA) proposed wealth tax would apply to US households with net wealth above $50 million at a top rate of 6%. The wealth tax rate would be 2% on wealth above $50 million with a 4% surtax on wealth above $1 billion. The proposal does not distinguish between married and single taxpayers.

Senator Bernie Sanders' (I-VT) proposed wealth tax would apply to US households with net wealth above $32 million at a top rate of 8%. For married taxpayers, the wealth tax rate would be 1% of wealth from $32 million

to $50 million, 2% of wealth from $50 million to $250 million, 3% of wealth from $250 million to $500 million, 4% of wealth from $500 million to $1 billion, 5% of wealth from $1 billion to $2.5 billion, 6% of wealth from $2.5 billion to $5 billion, 7% of wealth from $5 billion to $10 billion, and 8% of wealth over $10 billion. The tax bracket thresholds for single taxpayers would be half that of married taxpayers.

This analysis estimates the impacts of both the Warren and Sanders wealth taxes assuming imposition beginning January 1, 2021 and that the tax bracket thresholds would not be indexed for inflation.

This analysis uses an overlapping generations (OLG) general equilibrium model of the US economy to estimate the macroeconomic impacts of the Warren and Sanders wealth taxes. This appendix provides a description of the OLG model, the methodology, and various assumptions underlying the estimates. Important assumptions about how the wealth taxes might operate are also described, as well as caveats and limitations.

Overview of OLG general equilibrium model

The OLG model used for this analysis is similar to those used by the Congressional Budget Office, Joint Committee on Taxation, and US Treasury Department.[1] In this model, tax policy affects the incentives to work, save and invest, and to allocate capital and labor among competing uses. Representative individuals and firms incorporate the after-tax return from work and savings into their decisions on how much to produce, save, and work.

The general equilibrium methodology accounts for changes in equilibrium prices in factor (i.e., capital and labor) and goods markets and simultaneously accounts for the behavioral responses of individuals and businesses to changes in taxation. Behavioral changes are estimated in the OLG framework, whereby representative individuals with perfect foresight incorporate changes in current and future prices when deciding how much to consume and save in each period of their life.

High-level description of model's structure

- *Production*

Firm production is modeled with the constant elasticity of substitution (CES) functional form, in which firms choose the optimal level of capital and labor subject to the gross-of-tax cost of capital and gross-of-tax wage. The model includes industry-specific detail through use of differing costs of capital, factor intensities, and production function scale parameters. Such a specification accounts for differential use of capital and labor between industries as well as distortions in factor prices introduced by the tax system. The cost of capital measure models the extent to which the tax code discriminates by asset type, organizational form, and source of finance.

The industry detail included in this model corresponds approximately with three-digit North American Industry Classification System (NAICS) codes and is calibrated to a stylized version of the 2014 US economy. Each of 36 industries has a corporate and pass-through sector except for owner-occupied housing and government production. Because industry outputs are typically a combination of value added (i.e., the capital and labor of an industry) and the finished production of other industries (i.e., intermediate inputs), each industry's output is modeled as a fixed proportion of an industry's value added and intermediate inputs to capture inter-industry linkages. These industry outputs are then bundled together into consumption goods that consumers purchase.

- *Consumption*

Consumer behavior is modeled through use of an OLG framework that includes 55 generational cohorts (representing adults aged 21 to 75). Thus, in any one year, the model includes a representative individual

optimizing lifetime consumption and savings decisions for each cohort aged 21 through 75 (i.e., 55 representative individuals) with perfect foresight. The model also distinguishes between two types of representative individuals: those that have access to capital markets (savers) and those that do not (non-savers or rule-of-thumb agents).

Non-savers and savers face different optimization problems over different time horizons. Each period non-savers must choose the amount of labor they supply and the amount of goods they consume. Savers face the same tradeoffs in a given period, but they must also balance consumption today with the choice of investing in capital or bonds. The model assumes 50% of US households are permanently non-savers and 50% are permanently savers across all age cohorts.

The utility of representative individuals is modeled as a CES function, allocating a composite commodity consisting of consumption goods and leisure over their lifetimes. Representative individuals optimize their lifetime utility through their decisions of how much to consume, save, and work in each period subject to their preferences, access to capital markets, and the after-tax returns from work and savings in each period. Representative individuals respond to the after-tax return to labor, as well as their overall income levels, in determining how much to work and thereby earn income that is used to purchase consumption goods or to consume leisure by not working. In this model the endowment of human capital changes with age — growing early in life and declining later in life — following the estimate of Altig et al. (2001).[2]

- *Government*

The model includes a simple characterization of both federal and state and local governments. Government spending is assumed to be used for either: (1) transfer payments to representative individuals, or (2) the provision of public goods. Transfer payments are assumed to be either Social Security payments or other transfer payments. Social Security payments are calculated in the model based on the 35 years in which a representative individual earns the most labor income. Other transfer payments are distributed on a per capita basis. Public goods are assumed to be provided by the government in fixed quantities through the purchase of industry outputs as specified in a Leontief function.

Government spending in the model can be financed by collecting taxes or borrowing. Borrowing, however, cannot continue indefinitely in this model. Eventually, the debt-to-GDP ratio must stabilize so that the government's fiscal policy is sustainable. The model allows government transfers, government provision of public goods, or government tax policy to be used to achieve a selected debt-to-GDP ratio after a selected number of years. This selected debt-to-GDP ratio could be, for example, the initial debt-to-GDP ratio or the debt-to-GDP ratio a selected number of years after policy enactment. The baseline of the model is calibrated such that federal revenue as a share of GDP, federal spending on Social Security as a share of GDP, and the federal debt-to-GDP ratio matches the Congressional Budget Office's *The 2019 Long-Term Budget Outlook*.[3]

- *Modeling the United States as a large open economy*

The model is an open economy model that includes both capital and trade flows between the United States and the rest of the world. International capital flows are modeled through the constant portfolio elasticity approach of Gravelle and Smetters (2006).[4] This approach assumes that international capital flows are responsive to the difference in after-tax rates of return in the United States and the rest of the world through a constant portfolio elasticity expression. Trade is modeled through use of the Armington assumption, wherein products made in the United States versus the rest of the world are imperfect substitutes.

Table B-1. Key model parameters

Intertemporal substitution elasticity	0.4
Intratemporal substitution elasticity	0.6
Leisure share of time endowment	0.4
International capital flow elasticity	3.0
Capital-labor substitution elasticity	0.8
Adjustment costs	2.0

Source: Key model parameters are generally from Joint Committee on Taxation, *Macroeconomic Analysis of the Conference Agreement for H.R. 1, The 'Tax Cuts and Jobs Act,'* December 22, 2017 (JCX-69-17) and Jane Gravelle and Kent Smetters, "Does the Open Economy Assumption Really Mean that Labor Bears the Burden of a Capital Income Tax?" *Advances in Economic Analysis and Policy* 6(1) (2006): Article 3.

Assumptions important to modeling the wealth tax

- *Baseline level and distribution of wealth*

This analysis uses the baseline level and distribution of wealth underlying the wealth tax estimates as described in an open letter by Emmanual Saez and Gabriel Zucman.[5] The baseline stock of wealth is assumed to grow over time at a rate determined to roughly correspond to Saez and Zucman's ten-year revenue estimates for the Warren and Sanders wealth tax proposals.[6]

The revenue estimates are then used to calculate the tax revenue generated by the wealth taxes in the context of and as an input to the OLG model. Wealth tax revenue in the model is computed using the ratio of wealth tax revenue to GDP from the combination of this analysis' conventional revenue estimates (taking into account avoidance behavior described below) and GDP projections.

- *Avoidance behavior*

Revenue from the wealth taxes depends on the degree of tax avoidance. The Warren and Sanders wealth taxes envision several anti-avoidance measures including:

1. an increase in the IRS enforcement budget;
2. auditing of taxpayers subject to the wealth tax;
3. a 40% exit tax on those with net worth above $50 million who renounce their US citizenship and so would not be subject to the tax; and
4. third-party reporting including on wealth held outside the United States.

Nevertheless, expert opinion differs widely on the extent of avoidance under the proposed wealth taxes. To reflect this variation in opinion and in acknowledgement of the uncertainty underlying the estimates, this analysis estimates macroeconomic impacts assuming:

1. 15% avoidance – approximating the assumption made by Saez and Zucman in their estimates; and
2. 50% avoidance – based roughly on the degree of avoidance suggested by Summers and Sarin and on the Penn Wharton Budget Model's "conventional avoidance" assumption for the Warren wealth tax.[7]

Estimates without any avoidance behavior are also provided to facilitate comparison of baseline estimates with other researchers.

Tax avoidance reduces the revenue from the wealth tax and that, in turn, reduces the burden of the wealth tax on the economy. The net effects of the revenue reduction depend in part on how the revenue is used, which is discussed below. Tax avoidance could have other effects. One might be a direct reduction in wealth available for use in the United States. Another might be the imposition of avoidance costs on the economy to the extent resources are expended to reduce the wealth tax's burden. Costly tax avoidance would reduce the resources available for productive use in the economy. Neither is accounted for in this analysis.

- *Modeling wealth tax through the cost of capital*

The revenue estimate and wealth distribution allow a calculation of an average marginal wealth tax rate on wealth (i.e., wealth subject to and not subject to the tax). This tax rate is used to capture the disincentive effects of the wealth taxes in the OLG model used for this analysis. Investment and savings effects of the wealth taxes are included using a Hall-Jorgenson cost of capital/marginal effective tax rate framework. In particular, the approach of King and Fullerton (1984)[8] is used, in which personal wealth taxes are modeled as reducing the after-all-tax rate-of-return earned on an investment. In effect, wealth taxes raise the opportunity cost of funds that businesses must pay to investors. In measuring the average marginal wealth tax rate, this analysis does not distinguish between types of assets, real or financial, but uses a common tax rate for all.

- *Modeling the wealth taxes as residence-based taxes and foreign ownership of US capital*

The analysis assumes that the wealth taxes would be residence-based taxes, implying that US wealth owned by foreigners would not be included in the tax base. Accordingly, the analysis' modeling of the burden of the wealth taxes recognizes that not all of the capital used in the United States is owned by US residents. For example, according to the Tax Policy Center, foreign holdings account for about 25% of the total value of US equity.[9] Similarly, data from Morgan Stanley, compiled from Federal Reserve data, suggests that about 29% of corporate bonds are held by foreigners.[10]

To account for the foreign ownership of US capital, this analysis assumes that roughly 10% of the stock of total US capital is held by foreigners and so not subject to the wealth taxes.

- *Modeling use of wealth tax revenues*

How the revenue generated by the wealth taxes is used by the government is an important component of a macroeconomic analysis of fiscal policy changes, including a wealth tax. An important aspect of the type of macroeconomic model used for this analysis is that the use of revenues must be explicitly modeled. Moreover, the structure of the model requires that the government eventually return to a fiscally sustainable path after a policy change. Accordingly, tax cuts must eventually be paid for and, conversely, revenue from a tax increase must eventually be used in some way.

It is envisioned by Senator Warren's and Senator Sanders' campaigns that the revenue from the proposed wealth

taxes be used in a manner that could potentially increase productivity in the United States.[11]

Increases in public infrastructure, provision of health care or education, or changes in inequality could all impact productivity. The empirical evidence on the extent that these and other government policies might raise productivity is mixed and variable. Despite, or perhaps even because of this uncertainty, it is important to gauge the effects of allowing for a productivity boost from programs that might be funded by a wealth tax. Consequently, this analysis considers three alternative uses of wealth tax revenue:

1. government transfers with no productivity boost;
2. government transfers with a modest productivity boost; and
3. government transfers with a larger productivity boost.[12]

Considering multiple cases is broadly in line with the approach of the recent Penn Wharton Budget Model analysis of the Warren wealth tax.[13]

- *Importance of supra-normal returns*

A recurrent issue in measuring the effects of capital income taxes is the extent to which capital income represents a "normal" return as opposed to a "supra-normal" return. The "normal" return typically is taken as something like a risk-free opportunity cost of funds. The "supra-normal" return is composed of a mix of economic rents (pure profits) and a risk premium.

In the present context, the main issue is the extent to which a wealth tax acts as a disincentive for saving and investment. It is typically held that only the tax burden (including that imposed by a wealth tax) on the "normal" return creates a disincentive. Taxes on pure profits don't discourage investment because the tax is on a return that exceeds the opportunity cost of funds. Taxes on the risk premium do not discourage investment because in taking a share of the return, the government takes an equal share of the risk. This leaves the risk/return calculus of the private investor unaffected.

As in much of economics, there are a variety of views on the extent to which the measured return to capital represents a "normal" return and on the effects of taxes on the "supra-normal" return. Nevertheless, for this analysis one scenario was run that includes an adjustment to suggest the potential importance of the issue. Based on an average of results from the US Treasury, the Tax Policy Center, Jennifer Gravelle, Jeremy Seigel, and Brealey and Myers,[14] this scenario estimates macroeconomic impacts assuming that 70% of the overall return to capital (not just corporate equity) in the US represents a "normal" return. In this scenario (not reported above), the wealth tax is estimated to have somewhat smaller negative effects on GDP than otherwise.

Caveats and limitations

Any modeling effort is only an approximate depiction of the economic forces it seeks to represent, and the economic model developed for this analysis is no exception. Although various limitations and caveats might be listed, several are particularly noteworthy. These caveats and limitations are both additions to and re-emphasis of those covered in the description of our modeling of the Warren and Sanders wealth taxes:

- **Estimated macroeconomic impacts based on stylized depiction of US economy.** The general equilibrium model used for this analysis is, by its very nature, a stylized depiction of the US economy. As such, it cannot capture all of the detail of the US economy, the existing US tax system, or the proposed wealth tax.
- **Estimated macroeconomic impacts based on stylized modeling of the wealth taxes.** The incentive effect of the wealth taxes is modeled as an investor-level property tax that is applied to all capital used in

the United States. The tax is assumed to affect the decisions of all of the households that save. In the analysis' model, this group represents the top 50% of the income distribution. Other approaches to modeling the effects of a wealth tax could lead to larger or smaller incentive effects.

- **Revenue effect of the wealth taxes based on an assumed initial wealth distribution and level combined with an assumed growth rate for the stock of wealth.** This analysis of the wealth taxes uses the level, distribution, and growth of wealth developed by Saez and Zucman for the Warren and Sanders campaigns as a starting point.[15] Assuming a different level, distribution, or growth of wealth could produce different results.
- **Estimated macroeconomic impacts presented under three different avoidance assumptions.** This analysis presents estimates based on three different assumptions on tax avoidance: 0%, 15%, and 50%. This analysis makes no judgement regarding what level of avoidance is likely, but instead presents the range of estimates to indicate how the macroeconomic impacts vary under each.
- **Macroeconomic estimates are sensitive to the particular way that tax revenue is used.** As noted above, because of the government's budget constraint, it is not possible to separate entirely the impact of a given tax increase from the impact of the use of the revenues it may generate. Revenue raised in this analysis must be used in some way and how the revenue is used can affect the estimated impacts. Typical uses of the revenue in analyses like this have included deficit reduction, government spending or transfer increases, tax reductions, or a combination thereof. Because of the uncertainty regarding exactly how the wealth tax revenue would be used, this analysis reports results for three assumptions: (1) an increase in government transfer spending that does not enhance productivity, and (2) an increase in government transfer spending that enhances productivity moderately, and an increase in government transfer spending that increases productivity more significantly.

Assuming other uses of the revenue could produce different results than those obtained in this analysis. For example, if used for deficit reduction, the revenue would generate effects from "crowding in", and the subsequent increase in the capital stock would help to prop up wages by increasing the marginal productivity of labor. Deficit reduction is not considered because that use of the revenue has not been considered in the policy debate over wealth taxes.

Furthermore, when revenue is used to increase government transfers, transfer recipients would have an increase in disposable income (inclusive of transfers) that could offset the deleterious effects the wealth taxes might otherwise impose on them. The tax per se may nonetheless impose costs on them which could be avoided if a more efficient tax was used to fund the transfers. And on net, overall, the economy may be less productive than without the tax (or than with a more efficient tax), even if the transfers shield or dampen the losses for some citizens. Finally, results are sensitive to the level and pattern of productivity gains that might occur, and assuming larger or smaller gains, or a faster or slower phase-in of gains, could yield different results.

- **Estimated macroeconomic impacts limited by calibration.** This model is calibrated to represent the US economy and then forecast forward. However, because any particular year may reflect unique events and also may not represent the economy in the future, no particular baseline year is completely generalizable.
- **Estimates are limited by available public information.** The analysis relies on information reported by government agencies (primarily the Bureau of Economic Analysis and Internal Revenue Service). The analysis did not attempt to verify or validate this information using sources other than those described in this appendix.
- **Full employment model.** This analysis' model, like many general equilibrium models, focuses on the long-run growth effects of policy changes and thus relies on a full employment assumption (i.e., there is no involuntary unemployment). Any increase in labor supply is a voluntary response to a change in

income or the return to labor that makes households choose to substitute between consumption and leisure. To provide a high-level measure of the potential employment impacts, a job-equivalents measure has been included in this analysis' results. Job-equivalent impacts are defined as the change in total labor income divided by the baseline average labor income per job.[16]

- **State policies are not modeled.** The simulations do not account for interactions with or potential changes in state policies.

[1] See, for example, Shinichi Nishiyama, "Fiscal Policy Effects in a Heterogeneous-Agent Overlapping-Generations Economy With an Aging Population," Congressional Budget Office, Working Paper 2013-07, December 2013; Joint Committee on Taxation (JCT), *Macroeconomic Analysis of the 'Tax Reform Act of 2014,'* February 2014 (JCX-22-14); JCT, *Macroeconomic Analysis of Various Proposals to Provide $500 Billion in Tax Relief*, March 2005 (JCX-4-05); and, US Department of the Treasury, *The President's Advisory Panel on Federal Tax Reform, Simple, Fair, & Pro-Growth: Proposals to Fix America's Tax System*, November 2005.

[2] See David Altig, Alan Auerbach, Laurence Koltikoff, Kent Smetters, and Jan Walliser, "Simulating Fundamental Tax Reform in the United States," *American Economic Review* 91(3) (2001): 574-595.

[3] See Congressional Budget Office, *The 2019 Long-Term Budget Outlook*, June 2019.

[4] See Jane Gravelle and Kent Smetters, "Does the Open Economy Assumption Really Mean That Labor Bears the Burden of a Capital Income Tax?" *Advances in Economic Analysis and Policy* 6(1) (2006): Article 3.

[5] This letter provides details on their revenue estimates for Senator Warren's original wealth tax proposal and Senator Sanders' wealth tax proposal. See Gabriel Zucman and Emmaunal Saez, Open letter dated September 22, 2019

(http://gabriel-zucman.eu/files/saez-zucman-wealthtax-sanders-online.pdf?mod=article_inline).

[6] By construction, this analysis' ten-year revenue estimates roughly correspond to those of Saez and Zucman for similar levels of tax avoidance. There is substantial disagreement over the size, distribution, and growth of the stock of wealth. These disagreements feed into significant disagreements over the revenue (and other economic effects) of a wealth tax, even setting aside the issue of tax avoidance. Alternative, unreported, calculations based on an EY calculated wealth distribution using the underlying data sources that informed the Penn-Wharton Budget Model's analysis of Senator Warren's wealth tax generated revenue estimates similar to theirs, for comparable growth and avoidance assumptions.

[7] See, Lawrence H Summers and Natasha Sarin, "Be very skeptical about how much revenue Elizabeth Warren's wealth tax could generate," *The Washington Post*, June 28, 2019

(https://www.washingtonpost.com/opinions/2019/06/28/be-very-skeptical-about-how-much-revenue-elizabeth-warrens-wealth-tax-could-generate/); Lawrence H Summers and Natasha Sarin, "A 'wealth tax" presents a revenue estimation puzzle," *The Washington Post*, April 4, 2019

(https://www.washingtonpost.com/opinions/2019/04/04/wealth-tax-presents-revenue-estimation-puzzle/); and, Senator Elizbeth Warren's Wealth Tax: Projected Budgetary and Economic Effects, Penn Wharton Budget Model, University of Pennsylvania, December 12, 2019

(https://budgetmodel.wharton.upenn.edu/issues/2019/12/12/senator-elizabeth-warrens-wealth-tax-projected-budgetary-and-economic-effects

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[8] Mervyn King and Don Fullerton, *The Taxation of Income from Capital: A Comparative Study of the United States, the United Kingdom, Sweden, and Germany*, (Boston: National Bureau of Economic Research, 1984). See especially chapters on The Theoretical Framework and Sweden.

[9] Steven M. Rosenthal and Lydia S. Austin, "The Dwindling Taxable Share of U.S. Corporate Stock," *Tax Notes*, May 16, 2016.

[10] See Patti Domm, "Foreigners are Loading up on Corporate Debt", CNBC Market Insider, April 21, 2017, available at (https://www.cnbc.com/2017/04/21/foreigners-are-loading-up-on-corporate-americas-debt.html).

[11] For example, comments by Saloni Sharma, spokesperson for the Warren campaign, in Laura Davison, "Warren's Wealth Tax May Fall $1 Trillion Short, Study Finds, *Bloomberg*, December 12, 2019 (https://www.bloomberg.com/news/articles/2019-12-12/warren-s-wealth-tax-may-fall-1-trillion-short-estimate-finds).

[12] The productivity increases included in the government transfer scenarios are consistent with estimates of productivity found in the economic literature on public infrastructure. Our approach is to impose productivity increases that are consistent with those found in the literature on the effects of increases in the stock of public capital, such as roads, bridges, and other types of public infrastructure. There is no consensus in the academic literature on the responsiveness of private output with respect to changes in the stock of public capital. However, this report is consistent with the Congressional Budget Office's review of the academic literature and related analysis that estimated a 1% increase in public capital would be associated with an increase in private output of between 0.04% and 0.09% in the long run. The moderate increase in productivity scenarios are calibrated such that a 1% increase in public capital is associated with a 0.04% increase in private output. The lower bound of the Congressional Budget Office's range is used because there are likely to be significant diminishing returns to investment in public capital as well as potentially high adjustment costs associated with the sizable increase in public capital modeled in this analysis. See Congressional Budget Office, *The Macroeconomic and Budgetary Effects of Federal Investment*, June 2016.

Depending on the specifics of a policy proposal, the effects could be significantly different than those reported in this analysis. That is, specific policy proposals could result in differences in the overall magnitude of the impact, the adjustment costs associated with the investment, and the sector-specific impact resulting from the investment. Overall, the results of this analysis should be viewed as illustrative of the potential impact of a stylized increase in productivity associated with government spending. Any specific policy proposal should be explicitly modeled to examine its economic impact.

An additional area of uncertainty is the time horizon in which funding for public infrastructure investment is spent and when this public infrastructure investment, in turn, impacts productivity in the private sector. Specifically, while public infrastructure can generally be used and impact the productivity of the private sector once it is built, large increases in federal infrastructure can be subject to significant delays. For example, in the aftermath of the American Recovery and Reinvestment Act of 2009, less than 10% of infrastructure funds had been spent by the end of fiscal year 2009. This analysis assumes that investment in public infrastructure is spent ratably over four years. See Congressional Budget Office, *Policies for Increasing Economic Growth and Employment in 2012 and 2013*, November 2011.

[13] Senator Elizbeth Warren's Wealth Tax: Projected Budgetary and Economic Effects, Penn Wharton Budget Model, University of Pennsylvania, December 12, 2019

(https://budgetmodel.wharton.upenn.edu/issues/2019/12/12/senator-elizabeth-warrens-wealth-tax-projected-budgetary-and-economic-effects

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[14] US Treasury, Office of Tax Analysis, Distribution Table 2019 002 Distribution of Income by Source, available at https://www.treasury.gov/resource-center/tax-policy/tax-analysis/Documents/Distribution-of-Income-by-Source-2019.pdf; Jim Nunns, "How the TPC Distributes the Corporate Income Tax," September 13, 2012, available at https://www.urban.org/sites/default/files/publication/25796/412651-How-TPC-Distributes-the-Corporate-Income-Tax.PDF; Jennifer Gravelle, "Corporate Tax Incidence with Excess Profits", presented *at The National Tax Association's 108th Annual Conference*, November, 2015, available at https://ntanet.org/wp-content/uploads/proceedings/2015/160-gravelle-corporate-tax-incidence-effect.pdf; Jeremy J. Seigel, *Stocks for the Long Run*, 3rd ed. (New York: McGraw-Hill, 2002), cited at http://finance.wharton.upenn.edu/~acmack/Chapter_09_app.pdf; Richard A. Brealey and Stewart Myers, Principles of Corporate Finance, (New York: McGraw-Hill, 1996), p. 146.

[15] *Supra*, note 5.

[16] Because job-equivalents are defined as total labor income divided by the baseline average labor income per job, the change in job-equivalents may or may not be in the same direction as the change in labor supply. This is because total labor income depends on both the labor supply and the wage rate paid to that labor. The job-equivalents measure has also been used, for example, by the Congressional Budget Office. See, for example, Edward Harris and Shannon Mok, "How CBO Estimates the Effects of the Affordable Care Act on the Labor Market," Congressional Budget Office, Working Paper 2015-09, December 2015.