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How the Supply of Labor Responds to Changes in Fiscal Policy

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In choosing how much to work, people respond to incentives that are partly determined by taxes on income from that work and by government benefits that vary with income. Those responses play a critical role in the Congressional Budget Office's (CBO's) analyses of the effects of changes in fiscal policy on economic outcomes.

CBO uses two models of the economy to analyze the medium- and long-term effects of federal tax and spending policies: a Solow-type growth model and a life-cycle growth model.[1] The models take different approaches toward capturing the ways in which the supply of labor responds to changes in fiscal policy. The Solow-type growth model uses estimates of how much the labor supply changes *at a given point in time* in response to a change in after-tax compensation that would result, for example, from a change in tax rates. The life-cycle growth model uses estimates of the responsiveness of the labor supply that depend on how people expect their after-tax compensation to change *over time*. CBO recently reviewed the extensive research literature on the magnitude of those responses, and this report describes the values the agency will be using in future analyses.

1. For a description of the two models and further discussion, see Congressional Budget Office, *The Economic Impact of the President's 2013 Budget* (April 2012), pp. 2–3 and 13–18. Both the Solow-type growth model and the life-cycle growth model address changes in the economy's underlying productive capacity, often measured as potential gross domestic product. The potential to produce goods and services is the key determinant of the nation's output over the medium term and the long term. However, economic activity deviates from its potential level in response to changes in demand for goods and services. Therefore, to analyze the short-term effects of federal tax and spending policies, CBO uses different models that focus on changes in such demand.

Responses at a Given Point in Time

Changes in taxes on labor income and in government benefits can create two countervailing pressures on people's willingness to work, a substitution effect and an income effect:

- *Substitution Effect.* Increased after-tax compensation for an additional hour of work—from a tax cut that reduces marginal tax rates, for example—makes work more valuable relative to other uses of a person's time.[2] That substitution effect by itself suggests that such a policy change would increase the number of hours worked.

- *Income Effect.* Increased after-tax income from a given amount of work—such as from a tax cut, which reduces average tax rates—allows people to maintain the same standard of living while working fewer hours.[3] That income effect by itself suggests that such a policy change would decrease the number of hours worked.

Because the substitution and income effects of tax rate cuts tend to push the labor supply in opposite directions, economic theory alone generally cannot predict how a policy change will affect the labor supply; rather, the outcome depends on the relative size of the two effects. In contrast, certain changes in government benefits generate substitution and income effects that push the labor supply in the same direction. For example, if a new benefit is provided for people with no income and is gradually diminished for people with higher income, then both the substitution and income effects would tend to reduce the labor supply of the people receiving the benefit.

The overall effects of a policy change on the labor supply can be expressed as an elasticity, which is the percentage change in the labor supply resulting from a 1 percent change in after-tax income. Drawing upon a substantial body of economic research, CBO uses separate elasticities for the substitution effect (that is, a substitution elasticity) and the income effect (an income elasticity). Those elasticities can be measured for labor supply changes by people who are working both before and after the policy change—which is the percentage change in hours worked resulting from a 1 percent change in after-tax income—and for the decision about whether or not to participate in the labor force—which is the percentage change in the labor force participation rate resulting from a 1 percent change in after-tax income. In its current modeling approach, CBO uses substitution and income elasticities that combine decisions about labor supply by workers and decisions about whether to participate in the labor force; the agency is working to develop the capability to model those responses separately.

Changes in taxes and benefits can also affect other aspects of the labor supply. For example, a worker might change the intensity of his or her work effort or change the

2. The marginal tax rate is the taxes paid on an additional dollar of income, in this case labor income.

3. The average tax rate is total taxes paid as a share of income.

amount he or she invests in education and training in response to a change in policy. CBO's estimates of labor supply elasticities are informed to an important extent by research on the responsiveness of labor earnings to changes in after-tax wages during periods of a few years or less. Because changes in work effort are probably reflected in changes in earnings, the elasticities used by CBO reflect those responses. However, changes in investments in education and training generally change earnings only gradually, so those responses are not captured in CBO's analyses.

CBO currently uses estimates of the substitution and income elasticities to gauge aggregate responses of the labor supply to changes in tax policies and in benefit, or transfer, policies that are administered through the tax system. The agency is working to develop the capability to incorporate substitution and income effects arising from changes in other transfer programs.

The aggregate labor supply responses that CBO estimates are inputs to the Solow-type growth model, which incorporates the assumption that people base their decisions about working and saving primarily on current economic conditions—especially wage levels, interest rates, and government taxes and benefits. In estimating those aggregate responses, CBO uses a microsimulation tax model, which contains a detailed representation of the tax system and incorporates estimated differences in the substitution elasticity across demographic and earnings groups.[4] Specifically, the substitution elasticities are different for primary and secondary earners; and among primary earners, the substitution elasticities vary according to where those earners fall in the earnings distribution. By capturing variation in elasticities across groups and differences in tax rates across groups, the model captures the effects of changes in fiscal policy that affect some groups differently from others.

Responses to Changes over Time

People choose how much to work and save over their lifetimes. How those choices respond to changes in fiscal policy depends on how willing people are to substitute work and consumption (or spending) for other uses of their time at a given point in time (the substitution elasticity described above) and how willing they are to substitute work and consumption at one point in time for work and consumption at a future point in time. The latter consideration leads people to work more in times when wages are higher and to work less and use savings to help finance their consumption when wages are lower. The degree of responsiveness of decisions about working to changes in tax rates can be summarized using the substitution and income effects described above and the so-called Frisch elasticity, which measures how people adjust their work behav-

4. For a detailed description of CBO's microsimulation model and its use in analyzing changes in fiscal policy that affect the labor supply, see Congressional Budget Office, *The Effect of Tax Changes on Labor Supply in CBO's Microsimulation Model*, Background Paper (April 2007). The assumptions about labor supply elasticity for CBO's models described in that paper have been updated with the ones described here.

ior in response to a one-time, temporary change in after-tax compensation (whereas the substitution elasticity measures how people adjust their work behavior in response to a permanent change in after-tax compensation). The Frisch elasticity equals the sum of the substitution elasticity and a measure of people's willingness to trade off work and consumption over time.[5]

In CBO's life-cycle growth model, people make choices about working and saving in response to current after-tax compensation, the current after-tax rate of return on saving, and current government transfer payments—and in response to anticipated future levels of those factors. In the model, the simulated economy consists of multiple cohorts of people (also known as overlapping generations), and compensation and rates of return on saving are determined by the aggregate effects of those people's work and saving choices (which is to say that the simulated economy constitutes a "general-equilibrium" model).[6] People's behavior in the model is calibrated so that macroeconomic variables such as the labor supply and the size of the capital stock match the amounts in the U.S. economy.

Responses in the Solow-Type Growth Model

CBO's analyses using the Solow-type growth model use a range of substitution and income elasticities—a lower estimate, a central estimate, and a higher estimate. Those ranges reflect the dispersion of estimates from various studies that CBO examined in its recent review of the research literature.[7]

Substitution Elasticities

CBO uses substitution elasticities that capture effects on hours worked and participation in the labor force and are applied in the agency's microsimulation tax model to all workers with earnings.[8]

5. For a technical discussion of how the Frisch elasticity relates to the substitution elasticity, see Raj Chetty, "Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply," *Econometrica*, vol. 80, no. 3 (May 2012), pp. 969–1018; and Martin Browning, "A Working Paper from April 1985: Which Demand Elasticities Do We Know and Which Do We Need to Know for Policy Analysis?" *Research in Economics*, vol. 59, no. 4 (2005), pp. 293–320.

6. For a detailed description of the life-cycle model, see Shinichi Nishiyama, *Analyzing Tax Policy Changes Using a Stochastic OLG Model with Heterogeneous Households*, CBO Technical Paper 2003-12 (December 2003).

7. For a detailed discussion, see Robert McClelland and Shannon Mok, *A Review of Recent Research on Labor Supply Elasticities*, CBO Working Paper 2012-12 (October 2012).

8. When simulating a policy that would increase labor force participation, for example, the model applies increases in earnings for existing workers as a proxy for earnings by workers entering the labor force. In its modeling, CBO is developing a method to more precisely capture the separate impact of changes in participation.

Table 1.

Labor Supply Elasticities in CBO's Models

	Lower Estimate	Central Estimate	Higher Estimate
		Solow-Type Growth Model	
Substitution Elasticity			
Primary earners	0.15	0.25	0.35
Lowest decile	0.15	0.31	0.47
Second decile	0.15	0.28	0.42
Third and fourth deciles	0.15	0.27	0.38
Fifth and sixth deciles	0.15	0.25	0.35
Seventh to highest deciles	0.15	0.22	0.29
Secondary earners	0.22	0.32	0.42
All earners, person-weighted	0.17	0.27	0.37
All earners, earnings-weighted	0.16	0.24	0.32
Income Elasticity (All earners)	-0.10	-0.05	0.00
		Life-Cycle Growth Model	
Frisch Elasticity	0.27	0.40	0.53

Source: Congressional Budget Office.

Note: A decile includes 10 percent of earners.

Primary and Secondary Earners. Combining elasticities for primary and secondary earners across the earnings distribution on a person-weighted basis, the overall substitution elasticity ranges from 0.17 to 0.37, with a central estimate of 0.27 (see Table 1). That range of estimates is built up from separate ranges of estimates for primary and secondary earners. All single workers and the person having greater earnings within each couple are considered primary earners. Although CBO does not distinguish workers by sex in its microsimulation model, the agency relied on research about substitution elasticities for men and single women to construct elasticities for primary earners and on research about substitution elasticities for married women to construct elasticities for secondary earners.

On the basis of CBO's review of the literature, the total substitution elasticity (including both hours and participation effects) appears to range from 0.1 to 0.3 for men and single women and from 0.2 to 0.4 for married women.[9] Because many of the studies reviewed measure changes in hours over relatively short periods of time, they miss any further changes that might take place over longer periods if workers are able to find

9. Those estimates are consistent both with studies estimating overall substitution effects and with a larger body of research about substitution effects on two aspects of labor supply—hours worked and participation in the labor force—which CBO combined to assess the overall effects.

other jobs to accommodate their changed preferences.[10] To account for the potential downward bias in the measured elasticities from such delayed responses, CBO adds 0.05 to the elasticities in the literature for primary earners, resulting in a substitution elasticity ranging from 0.15 to 0.35. For secondary earners, CBO adds a smaller amount, 0.02, to the ranges from the literature because the hours elasticity affected by those delayed responses is estimated to be a smaller component of the total elasticity than it is for primary workers. After that adjustment, the substitution elasticity for secondary workers ranges from 0.22 to 0.42.

Those elasticities are CBO's starting points for examining effects of particular fiscal policies. CBO also incorporates variation in elasticities across earnings levels, and for any particular policy, the effective elasticities depend on weighted averages of those ranges, with the weights based on total earnings of different groups of workers affected by that policy.

Variation by Earnings Level. Research suggests that substitution elasticities tend to be smaller for primary earners with higher earnings because, for them, the effects on participation are smaller than they are for primary earners with lower earnings and the effects on hours worked do not appear to be different.[11] However, for secondary earners, neither of those effects seems to vary across the earnings distribution. Therefore, CBO uses different substitution elasticities for primary earners at different points in the income distribution but the same substitution elasticity for all secondary workers.

Specifically, for primary workers, CBO uses a participation elasticity that is roughly twice the mean elasticity for the bottom 10 percent of earners, declines as earnings rise until it approaches the average elasticity near the median of the earnings distribution, and levels off at about one-third of the average elasticity for the top 40 percent of earners. The results of that variation are the following:

- For the higher estimate of labor supply response, CBO's total substitution elasticity for primary workers is 0.35, consisting of a participation elasticity of 0.10 and an hours elasticity of 0.25. For the bottom 10 percent of earners, the participation component of the elasticity is 0.22, giving them a total substitution elasticity of 0.47. For earners near the median of the distribution, the participation component is 0.10, so the total substitution elasticity is 0.35, and for earners near the top of the earnings distribution, the participation component is 0.04, giving them a total substitution elasticity of 0.29 (see Table 1).

10. See Chetty, "Bounds on Elasticities with Optimization Frictions."

11. See Chinhui Juhn, Kevin M. Murphy, and Robert H. Topel, "Current Unemployment, Historically Contemplated," *Brookings Papers on Economic Activity*, vol. 1, no. 1 (2002), p. 114, www.brookings.edu/about/projects/bpea/past-editions.

- For the central estimate of labor supply response, CBO makes similar adjustments. The resulting total substitution elasticities for earners at comparable points in the earnings distribution are 0.31, 0.25, and 0.22.

- For the lower estimate of labor supply response, the participation elasticity used by CBO is zero, so it does not vary across earnings levels. The total substitution elasticity for earners at all points in the earnings distribution is 0.15.

Weighting by Earnings. Because the substitution elasticities vary by earnings and because primary earners collect a larger share of earnings than do secondary earners, the range of elasticities is different on an earnings-weighted basis than on a population-weighted basis. On an earnings-weighted basis, CBO's estimated overall substitution elasticity for all earners ranges from 0.16 to 0.32, with a central estimate of 0.24. That calculation incorporates different weights for primary earners at different points in the earnings distribution as well as the relative earnings of primary and secondary earners. The earnings-weighted range and central estimate are slightly smaller than the population-weighted range and central estimate that were discussed above.

Although the earnings-weighted measures show the magnitude of response for a policy that would affect all earnings by the same proportion, many policies affect workers differently. For a policy that affected only secondary earners, for example, the substitution elasticity for primary earners would not be relevant.

Income Elasticities

CBO uses an income elasticity that ranges from -0.10 to zero (meaning that no income effect occurs), with a central estimate of -0.05. Because the research literature does not identify differences in income elasticities across demographic or earnings groups, CBO uses the same elasticity for all earners. One consequence is that the population-weighted and earnings-weighted income elasticities are the same.

An Illustrative Calculation

The impact of substitution and income elasticities can be illustrated by considering a hypothetical change in tax policy—a 2 percentage-point increase in the tax rate applied to all income. (Given CBO's modeling approach, a 2 percentage-point *cut* in the tax rate on all income would have effects on the labor supply that would be nearly identical in magnitude but of the opposite sign.)

Elasticities of the labor supply are measured with respect to after-tax wage rates that show the percentage of earnings a worker receives after taxes have been paid. If the marginal tax rate on wages was 30 percent and the average tax rate on all income was 20 percent, the after-tax marginal wage rate would be 70 percent and the after-tax average wage rate would be 80 percent. A 2 percentage-point surcharge on all income would yield a 2.9 percent (2/70) decrease in the after-tax marginal wage rate and a 2.5 percent (2/80) decrease in the after-tax average wage rate. Those percent-

age changes can be multiplied by the substitution and income elasticities to obtain an estimate of the percentage change in the labor supply.

In CBO's central estimate, the substitution effect would reduce the labor supply by 0.70 percent (-2.9*0.24), and the income effect would increase the labor supply by 0.13 percent (-2.5*-0.05), for a net decrease of 0.57 percent. In CBO's higher and lower estimates, the net decreases in labor supply would be 0.92 percent and 0.21 percent, respectively. CBO's estimate of the change in the labor supply resulting from a proposed policy would depend on the specifics of that policy as well as the marginal and average tax rates that would exist in the absence of the policy.

Responses in the Life-Cycle Growth Model

CBO's analyses based on the life-cycle growth model use a range of Frisch elasticities and incorporate income effects on the labor supply.

Frisch Elasticity

As noted above, the Frisch elasticity used in CBO's life-cycle growth model can be expressed as the sum of the substitution elasticity and a measure of people's willingness to trade off work and consumption over time. CBO's review of research studies that provide estimates of both components of the Frisch elasticity suggests that it is about 50 percent larger than the substitution elasticity.[12] Given CBO's estimates of the earnings-weighted substitution elasticity, that relationship implies a Frisch elasticity ranging from 0.24 (1.5*0.16) to 0.48 (1.5*0.32), with a central estimate of 0.36 (1.5*0.24). Those estimates range between two-thirds and four-thirds of the central estimate.

In CBO's review of the literature, direct estimates of the Frisch elasticity—combining the effects on the hours worked and labor force participation—range from 0.1 to more than 1.0 but cluster around 0.40.[13] Estimates vary with the population group studied; for example, the estimated Frisch elasticity for men typically is smaller than that for women, meaning that men vary their hours of work less in response to a temporary change in after-tax compensation.

12. See James P. Ziliak and Thomas J. Kniesner, "The Effect of Income Taxation on Consumption and Labor Supply," *Journal of Labor Economics*, vol. 23, no. 4 (October 2005), pp. 769–796; James P. Ziliak and Thomas J. Kniesner, "Estimating Life Cycle Labor Supply Tax Effects," *Journal of Political Economy*, vol. 107, no. 2 (April 1999), pp. 326–359; Joseph G. Altonji, "Intertemporal Substitution in Labor Supply: Evidence from Micro Data," *Journal of Political Economy*, vol. 94, no. 3 (June 1986), pp. S176–S215; and Richard Blundell and Ian Walker, "A Life-Cycle Consistent Empirical Model of Family Labour Supply Using Cross-Section Data," *The Review of Economic Studies*, vol. 53, no. 4 (1986), pp. 539–558.

13. For additional information, see Felix Reichling and Charles Whalen, *Review of Estimates of the Frisch Elasticity of Labor Supply*, CBO Working Paper 2012-13 (October 2012).

On the basis of the direct estimates of the Frisch elasticity as well as estimates derived from CBO's estimates of the substitution elasticity, CBO uses a central estimate of the Frisch elasticity of the labor supply of 0.40, with a range from 0.27 (2/3*0.40) to 0.53 (4/3*0.40) (see Table 1).[14] Because of certain practical constraints, CBO typically provides results from the life-cycle model using only the central estimate of 0.40. In CBO's life-cycle growth model, the responsiveness of each person's decisions about work (that is, the labor supply of an individual) to changes in after-tax compensation depends not only on the Frisch elasticity but also on his or her age and economic attributes such as hours of work, assets, and current and expected future wage rates.

Income Effects

In CBO's life-cycle growth model, the income effect from a change in fiscal policy depends on how the policy affects both current and future income. Moreover, the model can be used to analyze only sustainable fiscal policies, in the sense that the present value of future taxes and the present value of future government spending are equal, so any changes in taxes or benefits must be combined with other changes in taxes or benefits at some point in time.[15] Thus, the income effect from a change in fiscal policy depends on whether the specified change is temporary or permanent and on the offsetting budgetary changes the government makes.

If a tax change is temporary, it will have a small effect on the present value of each person's current and future income. Thus, the income effect will be small regardless of the nature and timing of the offsetting policy changes.

If a tax change is permanent, however, the income effect can be large or small depending on the offsetting budgetary changes. The size of the income effect is also related to the design of CBO's life-cycle growth model, in which the income effect and the substitution effect are of equal and opposite signs for a permanent change in after-tax wages. CBO included that feature in the model so that the average person's labor supply would remain constant if wages trended upward, which is roughly consistent with historical evidence for men during the second half of the 20th century.[16]

If the government uses additional revenues from a permanent tax increase entirely to increase benefits, for example, there will be only a substitution effect because the impact of the increased benefits will approximately offset the impact of the tax increase

14. As with the substitution elasticity in the Solow-type growth model, the Frisch elasticity that CBO uses in the life-cycle growth model captures both the hours and participation effects. When simulating a policy that would increase employment, for example, the model applies increases in earnings for existing workers as a proxy for earnings by workers entering the labor force.

15. Present value is a single number that expresses the flow of current and future taxes or spending in terms of an equivalent lump sum received or paid out today.

16. See Mary T. Coleman and John Pencavel, "Changes in Work Hours of Male Employees, 1940–1988," *Industrial and Labor Relations Review*, vol. 46, no. 2 (1993), pp. 262–283.

on people's current and future after-tax income. In contrast, if the government uses the additional revenues entirely to increase spending on government services, the increase in such spending will not offset the higher taxes, and people's current and future after-tax income will decline. In that case, the income effect of the permanent tax increase will completely offset the substitution effect in CBO's life-cycle model, as noted in the preceding paragraph. Many changes in fiscal policy represent some combination of those two possibilities, so the income effect in CBO's life-cycle growth model generally lies somewhere between zero and a value fully offsetting the effect measured by the Frisch elasticity.

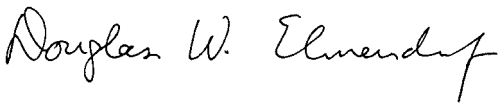
An Illustrative Calculation

In the life-cycle growth model, the effect of a change in tax policy on the labor supply depends on the Frisch elasticity, the substitution elasticity, and income effects. The impact of those factors can be illustrated by considering the hypothetical change in tax policy discussed above.

Suppose first that the hypothetical 2 percentage-point increase in the tax rate applied to all income is imposed for just one year. People's desire to work less during that year, combined with their willingness to substitute work and consumption between that year and future years, causes them to reduce the labor supply by 1.11 percent during the year of the tax surcharge, on the basis of CBO's central estimate of the Frisch elasticity. The proportional change in the overall labor supply is about equal to the change in the supply of labor by an average person, which would be 1.16 percent (the product of a Frisch elasticity of 0.40 and a 2.9 percent decline in the after-tax marginal wage rate). The percentage change in the overall labor supply does not exactly equal the percentage change in the labor supply for the average person because of the variation in response among people discussed above and because of some technical reasons.

If, instead, the surtax is permanent, people's desire to work less causes them to reduce the overall labor supply by 0.83 percent, according to CBO's life-cycle model. That change equals what would result from a 2.9 percent reduction in the after-tax marginal wage rate and a substitution elasticity of just under 0.29 (2.9*0.286=0.83). Thus, for CBO's central estimates, the equivalent of the substitution elasticity in CBO's life-cycle growth model for permanent changes in tax rates is slightly larger than the substitution elasticity in CBO's Solow-type growth model of 0.24. At the same time, the income elasticity for a permanent tax increase is also larger in CBO's life-cycle growth model than in the agency's Solow-type growth model. Therefore, whether the life-cycle growth model predicts a larger or smaller net change in the labor supply than the Solow-type growth model depends on the degree to which other changes to fiscal policy affect people's current and future income.

This Congressional Budget Office (CBO) report providing background information on the agency's estimates of how the supply of labor responds to changes in fiscal policy was written by Felix Reichling, with assistance from Shinichi Nishiyama and Charles Whalen, of the Macroeconomic Analysis Division, under the supervision of Wendy Edelberg and William Randolph, and by David Weiner of the Tax Analysis Division, under the supervision of Frank Sammartino. In keeping with CBO's mandate to provide objective, impartial analysis, this report makes no recommendations. This report and other CBO publications are available at the agency's Web site (www.cbo.gov).



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