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The Automatic Fiscal Stabilizers: Quietly Doing Their Thing

I. Introduction

The cyclical nature of the U.S. economy has undergone profound changes over the past century. As carefully documented by Diebold and Rudebusch (1992) and Romer (1999), since World War II, recessions have become less frequent and business expansions have become substantially longer. In addition, Romer argues that recessions are now less severe: Output loss during recessions is about 6 percent smaller on average in the post–World War II period than in the thirty-year period prior to World War I and substantially smaller than in the 1920 to 1940 interwar period. Furthermore, the variance of output growth has declined as well. Romer attributes these changes largely to the rise of macroeconomic policy after World War II; in particular, she argues that the automatic fiscal stabilizers—including the income-based tax system and unemployment insurance benefits—have played a prominent role in converting some periods of likely recession into periods of normal growth as well as in boosting growth in the first year following recession troughs. Given the Keynesian-style models used by Romer to support her claims, one would expect that personal consumption also would have been stabilized since World War II. Indeed, Basu and Taylor (1999) present evidence that the volatility of aggregate U.S. consumption has declined in the postwar period.

This paper presents theoretical and empirical analysis of automatic fiscal stabilizers. Using the modern theory of consumption behavior, we identify several channels through which optimal reaction of household consumption plans to aggregate income shocks is tempered by these stabilizers. Such automatic stabilization occurs even when households have full understanding of the constraints on their behavior implied by the government's intertemporal budget constraint and have full awareness of the difference between aggregate and idiosyncratic shocks to their labor income. This does not necessarily imply that the current fiscal stabilizers in the United States are set at optimal levels. The analysis of optimal tax rates, for example, is the subject of a large literature that involves comparing the benefits and costs of different settings and would take us well beyond the scope of this paper.

Moreover, our theoretical findings raise the issue of whether the insurance, wealth, and liquidity effects of the income tax system that we identify are realistic channels through which the effects of income shocks are stabilized. Furthermore, there is the issue of whether these channels are more or less empirically important than the wealth channel identified in earlier work, a channel whose effect requires that households have incomplete information about the nature of income shocks. We believe that these remain important open issues, although we would not be surprised if elements from each channel eventually were found to be empirically meaningful.

However, in an attempt to bring at least some evidence to bear on these issues, we present results from several empirical exercises using postwar U.S. data. Using standard time-domain

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techniques, we estimate elasticities of the various federal taxes with respect to their tax bases and responses of certain components of federal spending to changes in the unemployment rate. Using frequency-domain techniques, we confirm that the relationships found in the time domain are strong at the business-cycle frequencies. Together, these results showing strong ties between cyclical variation in income and federal government spending and taxes suggest the potential for the automatic fiscal stabilizers to play a quantitatively important role in the economic stabilization process.

Using the Federal Reserve Board's FRB/US quarterly econometric model, however, we find that the automatic fiscal stabilizers play a rather limited role in damping the short-run effect of aggregate demand shocks on real GDP, reducing the "multiplier" by about 10 percent, although they have a somewhat larger damping impact (in percentage terms) on personal consumption expenditures. Very little stabilization is provided in the case of an aggregate supply shock.

Before turning to the details of our analysis, it is worth mentioning the startling result developed by Lucas (1987). In the context of a standard model of an optimizing representative consumer, Lucas argues that perfect stabilization—that is, complete elimination of the variance of consumption in the United States—would yield virtually no utility gain to households both in absolute terms and relative to the huge utility gain associated with only a modest increase in the growth rate of consumption. Moreover, much of the subsequent literature has supported the robustness of this result. As such, this finding calls into question the act of devoting resources to the study (as well as to the practice) of stabilization policy.

While a complete response is well beyond the scope of this paper, we would make the following brief points. First, national election outcomes and, indeed, the very cohesiveness of societies appear to depend on the state of the business cycle; such factors generally are not captured in the standard utility-maximizing framework. Second, cyclical downturns have a negative and, quite possibly, sizable impact on a minority of the work force; thus, stabilization policy may generate a large welfare gain even if the gain averaged across the entire population is small.[1] Third, business-cycle variation and long-term growth (or the mean level of consumption) may not be completely independent, as assumed by Lucas; for example, the loss of human capital associated with job loss during a cyclical downturn might have long-lasting impacts. Fourth, the Lucas result depends partly on the actual variance of U.S. consumption over the post–World War II period, a variance that has declined relative to the prewar period to a fairly low level. If this outcome has resulted largely from macroeconomic stabilization policy, as argued by Romer (1999), then elimination of stabilization policy might cause a large enough increase in aggregate consumption variance to alter the Lucas result.

The rest of our paper is structured as follows. The next section offers three theoretical arguments for the effectiveness of automatic stabilizers; each is formally developed as a variation on the same underlying consumer optimization problem. While these modeling exercises, as well as a brief analysis of firms' investment demand, are carried out in a partial equilibrium context, there will be some discussion of general equilibrium issues as well. Section III reports simulations of the Federal Reserve Board's FRB/US quarterly econometric model. Section IV analyzes the business-cycle relationship between income and certain federal government taxes and spending using frequency-domain techniques. Section V presents a complete reestimation of the high-employment budget model used by staff at the Federal Reserve Board and the U.S. Congressional Budget Office (CBO) for the past twenty years. Section VI concludes.

II. The Analytics of Automatic Fiscal Stabilizers

A. Review of the Literature

This section examines theoretically the role of automatic fiscal stabilizers—in particular, the income tax—in modifying the response of consumption to income shocks. Perhaps surprisingly, there has been very little written on this subject in the academic literature since the mid-1980s, despite numerous legislative changes in individual income tax rates beginning with the Tax Reform Act of 1986.[2] We will briefly discuss earlier work on the role of automatic stabilizers, drawing on the excellent summary in Blinder and Solow (1974) in the context of the basic Keynesian model and on the seminal work in Christiano (1984) showing the possibility that the automatic stabilizers could work using an explicit framework of an optimizing consumer facing uncertain income prospects.[3] We then present new models of the effects of the income tax on optimizing consumers that we feel are a move toward greater realism. In contrast to the earlier Keynesian tradition, our models are not full general equilibrium exercises. However, we would argue that the consumer's decision problem must be central to any sensible analysis of the role of automatic stabilizers and, at the end of the section, we conjecture that general equilibrium feedback is unlikely to change qualitatively the results of the partial equilibrium analysis. At the end of the section, we also briefly discuss the relationship between investment demand and the automatic stabilizers.

The basic idea of the textbook Keynesian model is that the impact on aggregate current consumption and output of an exogenous shock to aggregate demand, for example, is mitigated by the automatic stabilizers, which damp any effect of the shock on current personal disposable income. By evaluating the multiplier (the impact of an exogenous change in aggregate demand on output) for positive and zero values of the income tax rate, one can show that automatic stabilizers reduce the multiplier by $\alpha\tau/(1-\alpha+\beta)(1-\alpha+\alpha\tau+\beta)$, where α denotes the marginal propensity to consume out of after-tax income, τ denotes the marginal income tax rate, and β is a term that captures the crowding-out effect of higher interest rates and prices on aggregate demand.[4] A key assumption underlying such results is that current—rather than permanent or lifetime—personal income and taxes are the only determinants of consumption demand.[5]

These Keynesian results are seemingly at odds with the predictions of the basic life-cycle permanent income models of consumer behavior with no government (Deaton 1992). Under several simplifying assumptions—including quadratic utility, equality of the interest rate and rate of time preference, and lack of borrowing constraints—those models suggest the feasibility and optimality of constant consumption throughout the life cycle. If a household's labor income is anticipated to rise over time, for example, then the household simply would borrow to support consumption in excess of labor income early in the life cycle. Furthermore, unanticipated changes in a household's income—for example, owing to temporary changes associated with the business cycle—would alter the level of the desired consumption path but not its slope. Moreover, the impact on the level of consumption would not be mitigated in the presence of an income tax provided that the change in income taxes (induced by the business-cycle shock to income) was offset by a change in future taxes necessary to keep the government's intertemporal budget constraint in balance, because the present value of household lifetime tax liabilities would be unchanged. How, then, can policies—in particular, government taxes and spending—help to stabilize household consumption when households optimally should be doing the stabilizing themselves?

Christiano (1984) appears to be the first to find a role for the automatic tax stabilizers in the context of an optimizing consumer choice problem. In his two-period model, consumers maximize expected utility; specifically, a constant absolute risk-aversion utility function of consumption in each period (but not leisure) is used. Labor income is uncertain in the first period owing to the possibility of both common (aggregate) and idiosyncratic shocks that are normally distributed, while labor income in the second period is certain. There is an income tax on wages in the first period and lump-sum taxes in the second period, which rules out the possibility that the income tax can play an insurance role (even if second-period wage income was uncertain). Also, any change in aggregate income taxes in the first period is offset by an equal present value increase in taxes in the second period. Borrowing is allowed by individuals and the government, and the interest rate is tied down by a storage technology.

Christiano first considers the full information case in which households are able to distinguish between the aggregate and idiosyncratic income shocks. In this case, the automatic income tax stabilizer has no effect on the positive correlation between aggregate income shocks and consumption, because there is no insurance effect provided by the tax structure and because there is no wealth effect, as the present value of tax payments is unchanged by assumption. However, the positive correlation between individual consumption and idiosyncratic income shocks is reduced by the presence of an income tax. This arises because the income shock has an imperceptible effect on aggregate taxes in both periods but does alter an individual's tax bill, thereby providing an offsetting wealth effect. In the case of incomplete information, households respond to a common shock as though it were partly idiosyncratic; based on the results in the full information case, the more the shock is perceived as being idiosyncratic, the more the income tax will serve as an automatic stabilizer.

The new analysis of automatic tax stabilizers developed below builds on the work of Christiano as well as that of Chan (1983) and Barsky, Mankiw, and Zeldes (1986), although the latter two do not consider automatic stabilizers. The basic framework of these three papers is remarkably similar. All develop two-period models of optimizing representative agents facing labor income uncertainty and a government intertemporal budget constraint that requires second-period taxes to adjust to maintain balance. Labor supply is fixed, and each allows for precautionary saving (a positive third derivative of the utility function). However, there are some interesting differences. For example, Christiano assumes that in period one there is labor income uncertainty and an income tax, but in period two there is no uncertainty and a lump-sum tax. By contrast, Barsky, Mankiw, and Zeldes assume that in period one there is a lump-sum tax and no income uncertainty, while in period two there is an income tax and idiosyncratic income uncertainty.

Chan makes the same assumptions as Barsky, Mankiw, and Zeldes about labor income uncertainty; however, in his benchmark model, second-period lump-sum taxes are randomly assigned to individuals (even though aggregate taxes in period two are known with certainty). He further assumes that a tax cut in period one is accompanied not only by higher taxes in period two (to maintain the government's intertemporal budget constraint) but by an increase in the cross-sectional randomness of tax shares as well. This additional randomness is understood by households who accordingly increase their precautionary saving or reduce first-period consumption; that is, the tax cut reduces consumption. We do not incorporate the uncertainty about future tax shares below because it is not clear that a current tax cut should necessarily raise future income uncertainty. There is always uncertainty about who will pay (and how much) in future taxes even without a current tax cut. For example, even if the budget is always balanced, there can be future revenue-neutral tax reforms that change the distribution of tax burdens.

B. New Results—Approach 1

Our first approach adopts the core two-period optimizing framework of the above models. In particular, we assume that there is future idiosyncratic labor income uncertainty and the absence of private insurance and financial instruments that can provide complete insurance. Moral hazard and anti-slavery laws often are cited as underlying reasons for the inability of individuals to privately diversify away labor income risk. We differ from the above models by assuming—perhaps more realistically—that there is an income tax in both periods; this allows an income shock in the first period automatically to affect taxes in the first period and hence the income tax rate in the second period. It is through this channel that the automatic stabilizers work. The idea is that the income tax provides insurance against otherwise uninsurable future uncertain variation in labor income, because a higher income tax rate reduces the variance of future after-tax income (for a given variance of before-tax income); as a result, the higher tax rate lowers precautionary saving or increases current consumption.

In the model, each individual $j(=1,\ldots,N)$ maximizes expected utility:

(1) $$EU(C_1, C_2, G_1, G_2) \ ,$$

where C_i denotes private consumption in period $i = 1,2$; G_i denotes government consumption in period i ; and E is the expectations operator conditional on information available in the first period. We assume that $U_{11} < 0$, $U_{22} < 0$, and $U_{12} \geq 0$. Derivatives with respect to G will be discussed below. In our first model, government consumption expenditures are fixed in both periods.

Each person (assumed identical) has labor income, Y , in period i :

(2) $$Y = \mu_i + \varepsilon_i \ ,$$

where μ_i denotes certain endowment labor income in period i , assumed the same for each individual; and ε_i denotes the idiosyncratic shock in period i , has zero mean, and is uncorrelated across individuals. We analyze the effects of unanticipated changes to each individual's endowment income and, in this sense, our approach is similar to the one in Barsky, Mankiw, and Zeldes.

There is a proportional tax on labor income in each period, where τ_i denotes the tax rate in period i . Individuals save by holding government bonds, which pay a gross return of $R(= 1 + r$, where r is the risk-free interest rate).[6] Note that there is no tax on interest income, an issue to which we return below. Also note that labor is supplied inelastically. At the end of the first period, the wealth of each individual, W , is given by:

(3) $$W = (\mu_1 + \varepsilon_1)(1 - \tau_1) - C_1 \ .$$

Consumption of each individual in the second period is:

(4) $$C_2 = RW + (\mu_2 + \varepsilon_2)(1 - \tau_2) \ .$$

Aggregate tax revenue in period i is denoted by T_i . Thus, the government's intertemporal budget constraint (assuming zero initial government debt) is:

(5) $$T_1 + R^{-1}T_2 = G_1 + R^{-1}G_2 \ .$$

But aggregate taxes in period i simplify to:

(6) $$T_i = \tau_i[\Sigma\mu_{ij} + N\Sigma\varepsilon_{ij}/N] = \tau_i\mu_{iA} \ ,$$

since $\Sigma\varepsilon_{ij}/N = 0$, and the summations are taken over j . Also, μ_{iA} denotes aggregate endowment labor income in period i ; because all N individuals are assumed identical, $d\mu_{iA} = Nd\mu_i$. Thus, the income tax rate in period i faced by individuals is $\tau_i = T_i/\mu_{iA}$. Because equation 5 implies that aggregate taxes in period two depend on taxes in period one, the tax rate in period two depends on T_1 and hence on the tax rate in period one:

(7) $$\tau_2 = (RG_1 + G_2)/\mu_{2A} - (R\tau_1\mu_{1A})/\mu_{2A} \ .$$

In analyzing this model, we adopt an approach similar to that in Chan (1983) and in Barsky, Mankiw, and Zeldes (1986). Consumers maximize expected utility (equation 1) subject to equations 2-7. Now, suppose that a recession, for example, causes a temporary (that is, period-one) shock to endowment income, μ_1 , of all individuals. Differentiation of the first-order conditions with respect to μ_1 establishes that:

(8) $$\begin{aligned} dC_1/d\mu_1 &= (1/H)\{-RE[RU_{22} - U_{12}] \\ &\quad + E(RU_{22} - U_{12})(-R(\varepsilon_2/\mu_{2A}))\tau_1 N\} \\ &= (1/H)(-RE[RU_{22} - U_{12}]) \\ &\quad -(R_{\tau 1}N/\mu_{2A}H)Cov[RU_{22} - U_{12}, \varepsilon_2] \ , \end{aligned}$$

where $H = -E[U_{11} - 2RU_{12} + R^2U_{22}] > 0$.

The first term on the right-hand side of equation 8 is the positive "wealth effect" associated with an unanticipated increase in before-tax labor income. Note that because higher first-period income taxes are exactly offset in present value terms by lower second-period income taxes, there is no impact of taxes on the wealth effect. The second term represents the offsetting negative effect on consumption owing to higher precautionary saving: higher aggregate first-period income tax receipts imply a lower second-period income tax rate and thus less insurance against idiosyncratic income shocks. As shown in Barsky, Mankiw, and Zeldes, the precautionary saving effect requires that $RU_{222} - U_{122}$ be positive (so that the covariance term in equation 8 is positive). We assume that the wealth effect dominates the precautionary saving effect and hence that a positive (negative) increment to labor income boosts (reduces) first-period consumption. Differentiation of equation 8 with respect to τ_1 establishes that a stronger automatic stabilizer (that is, a larger τ_1) reduces the positive impact of a temporary income shock on first-period consumption—that is, it establishes that $\partial[\partial C_1 / \partial\mu_1] / \partial\tau_1 < 0$; it does so by strengthening the precautionary saving effect.

Before moving on to our next models, we briefly discuss the assumption made here and in the prior literature: that interest income is not taxable. The introduction of interest income taxation into our model would tend to strengthen the above results regarding automatic stabilizers for two reasons. First, higher before-tax income in period one would lead to a reduction in the income tax rate in period two for the same reason as before, and because the second-period tax base is larger (higher labor income boosts first-period saving and hence interest income subject to tax in the second period) and total second-period tax receipts are determined completely by first-period taxes and government spending. The resulting lower income tax rate in period two further strengthens precautionary saving. Second, a lower second-period tax rate boosts the after-tax interest rate, for a given before-tax rate, which further increases the incentive to save (if the substitution effect exceeds the income effect).

C. New Results—Approach 2

We now modify the model to allow a change in income taxes induced by a temporary income shock to be matched by a change in government consumption spending; both are assumed to occur in the first period. It is thus useful to rewrite equation 7 as follows:

(9) $$G_1 = \tau_1\mu_{1A} + \tau_2\mu_{2A}R^{-1} - G_2R^{-1} .$$

In addition, it is assumed that private and government consumption expenditures are directly substitutable (although not necessarily perfect substitutes) within periods; that is, G_1 is a substitute for C_1 but not for C_2 , and similarly for G_2 . Thus, for the utility function in equation 1—that is, for $U(C_1, C_2, G_1, G_2)$ —we assume that $U_{13} < 0$ and $U_{24} < 0$ and $U_{23} = U_{14} = 0$. In our example, however, G_2 is fixed and hence only the conditions $U_{13} < 0$ and $U_{23} = 0$ are relevant.[7] To evaluate the effect of a shock to the first-period endowment labor income of each person, we again differentiate the first-order conditions, giving:

(10) $$dC_1 / d\mu_1 = (1/H)(-RE[RU_{22} - U_{12}])(1 - \tau_1) + (N\tau_1/H)(EU_{13}) ,$$

where H is defined above.

The first term on the right-hand side of equation 10, which is positive, represents the "wealth effect" of higher *after-tax* labor income; before-tax labor income is higher, but this is partially offset by higher income taxes in the first period. This offset, owing to the automatic stabilizers (that is, the income tax), is reinforced by the second term on the right-hand side of equation 10. The latter term, which is negative, represents the direct substitution effect of higher government consumption spending (owing to higher income taxes) on private consumption. We assume that the wealth effect dominates the direct substitution effect and hence $dC_1 / d\mu_1 > 0$. Differentiation of equation 10 with respect to τ_1 establishes that a stronger automatic stabilizer (that is, a higher τ_1) weakens the positive impact of a temporary shock to before-tax labor income, that is, it establishes that $\partial[\partial C_1 / \partial\mu_1] / \partial\tau_1 < 0$.

D. New Results—Approach 3

In the final variant of our model, we introduce explicit constraints on borrowing by households following the approach in Chan (1983). We assume that borrowing cannot exceed a fixed fraction of current after-tax labor income and, for simplicity, that $\varepsilon_1 = 0$. If L denotes household lending $(L > 0)$ or borrowing $(L < 0)$, the constraint can be written as:

(11) $$b(1 - \tau_1)\mu_1 + L \geq 0 ,$$

where b is some fixed, positive number. For example, if $b = 1$ and if the constraint is binding in the sense that household borrowing equals after-tax income, then first-period consumption is double after-tax income (that is, the sum of disposable income and the borrowed amount, also equal to disposable income). Such a constraint is consistent with home mortgage payment rules-of-thumb in which monthly interest payments cannot exceed a fixed fraction of income. The possibility of borrowing or liquidity constraints is appealing, especially in light of recent empirical work, such as that of Parker (1999) and Souleles (1999), which finds that individual consumption rises when fully anticipated increases in after-tax income are realized.

The rest of the model is the same as in Section II B, in which future income taxes are assumed to adjust to maintain the government's intertemporal budget constraint (and in which W is replaced by L in equations 3 and 4). We consider households for whom the borrowing constraint (equation 11) is binding. For such individuals, the model solution for first-period consumption follows immediately, as in the example above, because the borrowing constraint (along with current after-tax labor income) completely determines first-period consumption. It follows that a higher income tax rate—that is, stronger automatic stabilizers—reduces first-period consumption and hence reduces the effect of a labor income shock on first-period consumption. With an adverse shock to labor income, for example, private borrowing is reduced but, because income taxes decline, government borrowing is increased. As noted by Chan (1983) in a related problem, the government—which is not subject to a borrowing constraint—is effectively borrowing on households' behalf, thereby circumventing the household limit.

E. Investment and General Equilibrium Considerations

We now address some loose ends in the prior analysis. We begin with a discussion of the relationship between investment demand and the automatic stabilizers in a partial equilibrium, optimizing framework. We then discuss general equilibrium issues, offering several conjectures but not the development of a full model.

Conventional models of business-fixed investment—under the key assumptions of convex adjustment costs, complete information, and perfect capital markets—imply that a firm's investment demand depends on marginal "q," that is, on the present discounted expected value of profits from new investment. To the extent that business cycles are viewed as symmetric variations of economic activity (and hence profits) about trend, a recession will be followed by above-trend activity, implying that the recession likely would have little effect on the present value of a representative firm's expected profit stream and hence on investment demand. In this case, a corporate profits tax would not be expected to damp the effect of cyclical swings in economic activity on investment demand.

Other models, based on asymmetric information and the resulting incentive problems in capital markets, imply that information costs and the internal resources of firms influence the cost of external funds. Consequently, investment demand depends on the "financing constraint" of a firm's net worth, proxied for by current after-tax cash flow, in addition to marginal q. Hubbard (1998) provides an excellent discussion of such models, whose empirical importance is the subject of some controversy. These models imply that the impact of a cyclical downturn on before-tax cash flow and hence on investment demand would be attenuated by the presence of an income tax; thus, the tax would serve as an automatic stabilizer for investment demand.

We now briefly discuss general equilibrium issues. The most basic question is whether the economy is better modeled using the equilibrium real business-cycle approach, as in Baxter and King (1993), or using an approach that allows for nominal demand shocks to have real effects in the short run, as in New-Keynesian models. Although the appropriate framework has been the source of ongoing tension among macroeconomists, in qualitative terms the effectiveness of automatic stabilizers appears invariant to the choice of framework. For the remainder of this section, we assume that both frameworks embed the basic consumer optimization model analyzed above.

In the equilibrium business-cycle approach, a shock that reduces aggregate equilibrium output—such as a temporary negative labor income endowment shock—generally originates on the supply or production side of the economy, and the components of aggregate demand must adjust to maintain goods market equilibrium. Thus, if personal consumption falls (as the above analysis suggests) and if government purchases of goods and services are reduced to offset the budget impact of lower income tax receipts, then investment likely will decline to maintain goods market equilibrium.[8] The decline in real income net of tax, as well as the decline in government purchases, has no immediate effect on output unless labor supply adjusts in response to wealth and interest rate effects. However, over time, as the capital stock falls relative to baseline, output also declines, which in turn reduces consumption possibilities. The magnitude of the consumption decline will vary inversely with the strength of the automatic stabilizers.

By contrast, in a model with sticky wages and prices, negative shocks to any component of nominal aggregate demand (for example, export demand) can lead to short-run reductions in output as labor demand and hours worked decline. The resulting fall in after-tax income reduces private consumption demand (and government purchases fall if they are adjusted to maintain budget balance); the decline in consumption is mitigated by the automatic stabilizers for the same reasons as discussed earlier. Of course, investment demand likely will be boosted by lower interest rates, which implies subsequent increases in the capital stock and output; again, the magnitude of such increases will vary inversely with the strength of the automatic stabilizers. Simulation results from a general equilibrium econometric model with New–Keynesian-style features are presented in the next section.

III. Results from the FRB/US Model

In Sections III, IV, and V, we present our empirical results. This section presents estimates of the impact of automatic stabilizers—particularly income taxes—based on simulations of the Federal Reserve Board's FRB/US quarterly econometric model of the U.S. economy. Detailed discussions of the new model can be found in Brayton and Tinsley (1996) and in Reifschneider, Tetlow, and Williams (1999). Households and firms are optimizers whose current decisions are based on expectations of future conditions. For estimation purposes, sectoral expectations are derived from forecasts of small vector autoregressions (VARs). Each VAR has a common set of variables, including consumer price inflation, the output gap, and the federal funds rate. Inclusion of the funds rate means that this form of expectations incorporates an average sample view of how monetary policy was conducted historically. Simulation exercises in this paper also use the same VAR systems.

In terms of dynamic adjustments in the model, financial market variables such as interest rates and stock prices adjust immediately to changes in expectations because financial decisions are assumed unaffected by frictions, given the small cost of transacting in these markets. However, the response of nonfinancial variables such as consumption, investment, and employment to changes in fundamentals is not immediate because of (nonexplicitly modeled) frictions in the dynamic adjustment process such as contracts and capital adjustment costs. Indeed, prices and quantities do not adjust quickly enough to ensure full resource utilization at all times. In the long run, however, all adjustments are complete and all markets are clear.

Of particular relevance for the simulation results reported below—as well as for a comparison with the prior theoretical discussion of Section II and subsequent empirical analysis of tax elasticities in Section V—is the modeling of aggregate income taxes and consumption in FRB/US. Starting with taxes in FRB/US, the average federal personal income tax rate is procyclical, implying an elasticity of personal taxes with respect to the taxable income base somewhat greater than the corresponding elasticity of 1.4 estimated in Section V.[9] Social insurance contributions are specified as proportional to its tax base, implying a unitary elasticity; in Section V, we estimate that the elasticity is about 0.9. The average corporate income tax rate is mildly procyclical in FRB/US; this contrasts with the mildly countercyclical tax rate found in Section V.

Turning to the modeling of aggregate consumption in FRB/US, we see that a small fraction of consumption decisions is made by liquidity-constrained households; the share of after-tax income associated with this group of households is estimated at about 10 percent. This group's behavior would be consistent with the model in Section II D.

However, for most households, consumption depends on current property wealth plus the present value of expected after-tax labor (and transfer) income in FRB/US. Expected future income flows are discounted at a high—25 percent—annual rate in computing present values, because it is argued that households are quite averse to the uncertainty of future uninsurable income. As a result of the heavy discounting, current consumption is not affected much by changes in income taxes in the distant future that might be necessary to satisfy the government's intertemporal budget constraint. Put another way, the rate used by individuals to discount future taxes exceeds the government's borrowing rate.

Moreover, the simulations below are based on VAR expectations that do not incorporate expectations of future tax rate changes. Thus, a change in income taxes (owing, say, to an aggregate demand shock) has a wealth effect on consumption.[10] While this is similar to the wealth effect in the model of Section II C, there is a difference in that current government purchases are not adjusted in FRB/US (and so there is no substitution of private for government consumption).

Finally, FRB/US may be consistent with a precautionary saving motive. This is because prudent households act as if they apply a high discount rate to future uncertain income, which is the case in the model. Furthermore, consumption depends positively in FRB/US on the expected output gap, which is viewed as capturing countercyclical variation in the perceived riskiness of future before-tax income. Even granting these interpretations, the model does not capture the insurance effect of income tax rates developed in Section II B; that is, an anticipated change in the income tax rate has no effect in FRB/US on the variance of after-tax income. Summing up, FRB/US captures liquidity and wealth effects associated with the income tax system, but does not capture the insurance effect.[11] However, there is a sense in which the impact of changes in taxes (and transfers) on consumption demand is assumed: for example, there is no formal testing of the hypothesis that the effects of changes in before-tax income and in taxes are of equal and opposite signs (and separately statistically significant). Rather, after-tax income is the variable included in the FRB/US model consumption equations.

Results of the simulation exercises are reported in Tables 1 and 2. The model has four federal tax rates (for personal income taxes, corporate income taxes, indirect business taxes, and social insurance contributions). The effects of automatic stabilizers are measured by comparing simulations in which each federal tax rate is at its actual value with simulations in which each tax rate is set to zero and an add factor (essentially a lump-sum tax) is introduced that sets tax receipts equal to their baseline values (given the baseline values of the tax bases). A demand shock and a supply shock are considered. The demand shock (to state and local government purchases) is scaled to equal 1 percent of the level of real GDP in the baseline. The supply shock is a $5-per-barrel increase in the price of oil. Each simulation is run under two monetary policy settings. One setting holds the real federal funds rate constant and the other uses the Taylor rule—which relates the nominal federal funds rate to the output gap and to a four-quarter moving average of the inflation rate.[12]

As shown in Table 1 (panel A), with a fixed real federal funds rate, the model's real GDP "multiplier" is increased only modestly by the substitution of lump-sum for income (and social insurance and indirect business) taxes, from 1.23 to 1.35 at the end of four quarters (and increased by a similarly modest amount at the end of eight quarters) in the case of the demand shock. The impact of the demand shock on personal consumption expenditures is also increased only modestly at the end of four quarters (although by a much larger percentage amount).[13] This outcome owes largely to the model's property that consumption is not very sensitive to movements in after-tax income that are essentially transitory. Moreover, households expect (through the VAR system) a countercyclical policy response to the demand shock. When monetary policy is characterized by the Taylor rule (panel B), the multipliers on output and consumption are smaller than in the prior case, but the increase owing to the elimination of the income tax is about the same.

As shown in Table 2, the income tax has very little effect on the model multipliers in the case of the adverse supply (oil-price) shock. Because the shock pushes real output and prices in opposite directions, nominal taxable incomes are not affected much. As a result, the level of tax receipts is not very sensitive to the presence of income taxes. Of course, taxes in real terms are lower; similarly, in the lump-sum tax simulation, real taxes are lower following the shock (owing to a higher price level and an unchanged level of nominal taxes). Indeed, real taxes in the two simulations are similar enough following the shock that the tax structure (income versus lump-sum) makes little difference to multiplier values.[14] The fact that the presence of an income tax has virtually no effect on supply shock multipliers is interesting, because arguably it is optimal to have no automatic stabilization in the face of a supply shock.[15]

Finally—noting that FRB/US is approximately linear, so that positive and negative shocks of equal size have roughly the same absolute effect on the major endogenous variables—our simulation results shed light on the issue of whether the presence of automatic fiscal stabilizers reduces the variance of U.S. real GDP. To the extent that variation in real GDP is driven primarily by supply-side shocks, our results suggest an extremely limited stabilizing role of the income tax system. By contrast, if demand-side shocks are the primary driving force, income taxes provide a modest degree of stabilization. Unfortunately, because our results are based on a model estimated over the postwar sample period, they are of limited value in answering the question of whether the automatic stabilizers have contributed to the reduction in the

Table 1

Simulated Macroeconomic Effects of a Shock to Autonomous Aggregate Demand

Percentage Change from Baseline

	Historical Tax Rates			Tax Rates = 0		
Response in Quarter	Real GDP	Consumer Prices	Real PCE	Real GDP	Consumer Prices	Real PCE
Panel A: Fixed Real Federal Funds Rate						
Four	1.23	.10	.30	1.35	.10	.43
Eight	1.05	.56	.01	1.23	.58	.30
Panel B: Taylor Rule						
Four	.89	.01	.02	.97	.01	.12
Eight	.22	.13	-.57	.30	.14	-.46

Notes: The demand shock is to state and local government purchases and is scaled to equal 1 percent of the level of real GDP in the baseline. Real GDP is gross domestic product in chain-weighted 1992 dollars; consumer prices is the personal consumption expenditure chain-weighted price index; real PCE is personal consumption expenditure in chain-weighted 1992 dollars.

Table 2

Simulated Macroeconomic Effects of a $5-per-Barrel Increase in Oil Prices

Percentage Change from Baseline

	Historical Tax Rates			Tax Rates = 0		
Response in Quarter	Real GDP	Consumer Prices	Real PCE	Real GDP	Consumer Prices	Real PCE
Panel A: Fixed Real Federal Funds Rate						
Four	-.04	.36	-.15	-.05	.36	-.16
Eight	-.16	.78	-.51	-.16	.77	-.50
Panel B: Taylor Rule						
Four	-.22	.32	-.30	-.24	.32	-.32
Eight	-.47	.59	-.71	-.50	.59	-.75

Note: Real GDP is gross domestic product in chain-weighted 1992 dollars; consumer prices is the personal consumption expenditure chain-weighted price index; real PCE is personal consumption expenditure in chain-weighted 1992 dollars.

volatility of the U.S. macroeconomy that evidently has occurred over the past century.

IV. Empirical Results from the Frequency Domain

In this section, we examine the frequency-domain, or spectral, properties of certain federal taxes and tax bases as well as the properties of unemployment insurance benefits. To the best of our knowledge, this approach has not been taken before. We initially present the estimated spectral density functions for several types of taxes and then show the squared coherencies of these taxes with their respective tax bases. We use National Income and Product Account (NIPA) quarterly current-dollar tax and income data as well as unified budget tax data, both for most of the postwar period. The analysis of unemployment insurance benefits also utilizes postwar NIPA data as well as the civilian unemployment rate.

In evaluating our results, it is useful to recall that the area under the spectrum is simply the variance of a series; also, the spectrum is symmetric about the zero frequency, so we plot only the estimated spectra for frequencies, ω, between 0 and π.[16] Because the techniques of spectral analysis apply to stationary time series, we examine the growth rates of the various taxes (which are stationary series), rather than the dollar levels. In addition, to achieve stationarity, we examine unemployment insurance outlays as a percentage of nominal GDP. We focus attention on whether a sizable portion of the variance of a series is explained by variation at the business-cycle and seasonal frequencies—that is, we look for sizable peaks in the estimated spectra at these frequencies. In our charts (A1-A12 in the appendix), business-cycle frequencies occur between 0.2 and 1.0, which correspond to periods ($= 2\pi/\omega$) of roughly thirty-two quarters and six quarters, respectively (the range of values used in the recent literature). Seasonal frequencies are at (or near) $\pi/2$ and π, corresponding to periods of four quarters and two quarters, respectively.

We also present squared coherencies between taxes and tax bases.[17] The coherency measures the square of the linear correlation between the two variables at every frequency and is analogous to squared correlation coefficients; the coherency can vary between zero and one. For example, if the squared coherency is near one at frequency ω, it means that the ω-frequency components of the two series are highly related, but a value near zero means that the corresponding frequency components are not closely related. One must be careful in interpreting the squared coherencies in the business-cycle frequency range, because the coherency is simply a bivariate measure. While it undoubtedly reveals information about the "automatic" response of taxes to income (and unemployment insurance outlays to the unemployment rate), it also contains information about the relationship between business-cycle fluctuations in income and legislated changes in tax rates (and between fluctuations in the unemployment rate and legislated changes in the unemployment insurance program).

Beginning with the NIPA tax data, we see that personal income, corporate income, and indirect business tax receipts (all in growth rate form) display pronounced spectral peaks at business-cycle frequencies (see the charts in the appendix). Perhaps surprisingly, social insurance contributions show little spectral power at business-cycle frequencies although they show substantial power at the seasonal frequencies. The latter occurs, even though the data are seasonally adjusted, because of the NIPA convention of "level adjusting" this series once every four quarters to reflect the impact of a change in the taxable maximum wage base.

Squared coherencies at the business-cycle frequencies are quite high between the personal income tax and its tax base (personal income, less other labor income, less government transfer payments, plus personal contributions to social insurance) and between corporate income taxes and taxable corporate profits. Again, one must be careful in interpreting these results because the squared coherencies conceptually are picking up both automatic and discretionary changes in taxes.

To shed a bit more light on this matter, one can compute the gain at the business-cycle frequencies; the gain is interpretable as the regression coefficient of taxes on income. Because both variables are in growth-rate form, the gains provide estimates of tax elasticities at every frequency. The gain in the case of corporate income taxes varies within the narrow range of 1.0 to 1.1 across the business-cycle frequencies, only slightly larger than more standard time-series estimates (as in Section V) of the "automatic" effect of changes in profits on taxes. Thus, the squared coherency likely is showing that the automatic piece of the relationship is strong at the business-cycle frequencies. A somewhat different situation is revealed by the gain between the personal income tax and its base, which varies from about 1.0 to 2.9 across the business-cycle frequencies. Certainly, one could reasonably expect, as discussed in Section V, an elasticity owing to business-cycle-induced changes in incomes greater than or equal to 1, but it is likely that the high values of the gain might well be picking up a tendency for legislated personal tax cuts to occur during recessions as well as picking up the automatic decline in receipts.

Finally, on the NIPA tax side, squared coherencies between social insurance contributions and wages and salaries and between indirect business taxes and nominal GDP are only of moderate size (up to about 0.5).

We now discuss results using unified individual income tax data (on a quarterly basis). Because these data are not seasonally adjusted (NSA), we also need an NSA personal income tax base. Since this is not available, we use NSA nominal GDP, which is publicly available. The use of NSA data gives a pure reading of real-time fluctuations in taxes and income faced by households, but at the cost of introducing a lot of noise, especially into the analysis of individual nonwithheld taxes (declarations, paid four times per year, plus final payments, paid once each year). The squared coherency between NSA withheld income taxes and nominal GDP (again, both in quarterly growth-rate form) is sizable, both at the business-cycle frequencies and at the primary seasonal frequency ($\omega = \pi/2$). The former is strongly suggestive of the working of automatic stabilizers during business-cycle swings while the latter reflects seasonal patterns in labor incomes and withheld taxes (such as increases in each that often occur at the beginning of calendar years). The gain varies between 1 and 3 at the business-cycle frequencies, again suggestive of discretionary tax changes in addition to the automatic stabilizer component. Very similar results at the business-cycle frequencies arise when the raw data are filtered using four-quarter growth rates (although the strong seasonal relationship is eliminated, as would be expected).

By contrast, the squared coherency between NSA individual nonwithheld taxes and nominal GDP is not large at business-cycle frequencies; indeed, the relatively small coherencies apply both to declarations and final payments. Such results suggest the relative ineffectiveness of automatic stabilizers via this tax channel.

Finally, on the spending side of the budget, the squared coherency between unemployment insurance outlays as a percentage of GDP and the unemployment rate is very high at the business-cycle frequencies. Thus, even though there may be a short waiting period to collect benefits, the unemployment insurance program appears to operate as an effective, virtually automatic, income stabilizer for unemployed individuals.[18]

To sum up, the frequency-domain analysis establishes a very strong relationship between income taxes and tax bases at the business-cycle frequencies. In all cases, this reflects the automatic nature of tax variation—particularly of individual withheld taxes—when incomes change, and in some cases it likely reflects discretionary tax changes as well. Furthermore, unemployment insurance also appears effective as an automatic stabilizer of income.

V. The High-Employment Budget Surplus

In this section, using standard time-domain techniques, we present updated empirical estimates of the responsiveness of federal taxes and certain spending programs to cyclical swings in the economy. While such estimates are useful for many purposes, they are used here as a basis for computing the cyclically adjusted, or high-employment budget surplus (HEB), of the federal government. Although the HEB is not without its faults, as discussed in Blinder and Solow (1974), it nonetheless has been used as a summary measure of the stance of fiscal policy by many U.S. government agencies (and many countries) since the 1960s. Twenty years ago, an intergovernmental task force developed the "gross-up" methodology currently used by staff at the U.S. Congressional Budget Office and the Federal Reserve Board (see deLeeuw et al. [1980]).

Using taxes to illustrate the method, high-employment tax receipts equal a cyclical adjustment, or a gross-up, plus actual (or projected actual) tax receipts. The gross-up is the difference between an estimate of taxes at a benchmark (that is, high-employment) level of economic activity—computed by setting the GDP gap equal to zero in key econometric equations—and at the actual level of economic activity—computed by using the actual GDP gap. As a result, the gross-up method has the property that actual and high-employment taxes are equal when the economy is operating at potential. More fundamentally, the method has the property that unexplained shocks to taxable income shares and tax receipts are allowed to pass through to high-employment estimates. The remainder of this section presents detailed estimates.

A. High-Employment Receipts

The calculation of high-employment receipts involves three steps. First, income share equations are estimated to determine the level of the tax bases if actual GDP was equal to potential GDP. Second, the tax elasticities with respect to cyclical changes in income must be estimated. Finally, these two estimates are combined to obtain cyclical components of tax revenues, which are added to actual revenues to obtain high-employment revenues. The basic equations for receipts are:

(12) $SHAREK_{j,t} = SHARE_{j,t} - \Sigma\beta_i * GDPGAP_{t-i}$

(13) $BASEK_{j,t} = GDPK_t * SHAREK_{j,t}$

(14) $TAXK_{j,t} = TAX_{j,t} * (BASEK_{j,t} / BASE_{j,t})^{\varepsilon(j,t)}$

(15) $RECEIPTSK_t = \Sigma TAXK_{j,t}$,

where $SHARE$ is the ratio of the tax base to GDP; $BASE_j$ is the tax base applicable to the j th tax; TAX_j is tax revenues from tax j ; and $RECEIPTS$ is the sum of all taxes from all sources.

The suffix K denotes a high-employment estimate; β is the sensitivity of the share of the tax base in GDP to changes in the GDP gap ($GDPGAP$); and ε is the elasticity of the tax with respect to cyclical changes in the tax base.

On the income side, GDP is composed of labor compensation (wages and salaries, and supplements to wages and salaries such as employer-provided health insurance), capital income (corporate profits, proprietors' income, rental income, dividends, and net interest), and GDP less national income (the statistical discrepancy between income- and product-side measures of GDP as well as indirect taxes and net subsidies to businesses). We estimate the cyclical properties of each of these income sources using the U.S. Congressional Budget Office's estimates of potential GDP, the Non-Accelerating Inflation Rate of Unemployment (NAIRU), and the potential labor force. From these estimates, we construct estimates of the GDP gap, $(GDPK - GDP)/GDPK$, and the employment gap (Table 3).[19] Our regression equations for income shares are in first-difference forms of equation 13 because the shares are not stationary over the sample period.[20] The cyclically adjusted share is equal to the actual share less the sum of the products of the estimated gap terms and the coefficients. The cyclically adjusted shares are obviously smoother (Table 4).

NIPA personal taxes are roughly 45 percent of federal NIPA-based receipts. They are composed of personal income taxes, estate and gift taxes, and nontaxes (essentially fees and fines). As income taxes are about 97 percent of personal taxes, we use the personal income tax elasticity for all personal taxes. This elasticity, $Epersonal$, can be decomposed into two elasticities: the change in income taxes with respect to adjusted gross income (AGI), and the change in AGI with respect to NIPA-adjusted personal income, E_{agi} .[21] Furthermore, the elasticity of income taxes with respect to a change in AGI is a weighted sum of the elasticity of taxes to number of returns, En , and the elasticity of taxes with respect to average income per return, Ey , where the weights equal the relative contributions of changes in returns and average income to cyclical changes in income. Thus, $Epersonal$ may be written as:

(16) $$Epersonal = \{En^*ngap + Ey^*ygap^*(1 + ngap)\} / [ngap + ygap^*(1 + ngap)]\}^* E_{agi},$$ [22]

where:

$ngap$ is the percentage gap in number of income tax returns,

$ygap$ is the percentage gap in AGI per tax return,

En is elasticity of personal income taxes with respect to the change in number of returns,

Ey is elasticity of personal income taxes with respect to the change in AGI per return, and

E_{agi} is the elasticity of AGI with respect to NIPA-adjusted personal income.

Table 3

Potential GDP, NAIRU, and Labor Force Participation

Year	Potential GDP (Billions of Dollars)	NAIRU (Percent)	Potential Labor Force (Millions)	GDP Gap (Percent)	Employment Gap (Percent)
1951	327.5	5.3	61.9	-3.7	-2.3
1952	348.6	5.4	62.2	-2.9	-2.4
1953	367.2	5.4	62.7	-3.4	-3.1
1954	383.9	5.4	63.8	0.7	0.5
1955	402.2	5.4	65.0	-3.2	-1.1
1956	429.2	5.4	66.1	-2.0	-2.1
1957	458.6	5.4	67.1	-0.5	-0.9
1958	485.7	5.4	67.7	3.8	1.5
1959	508.6	5.4	68.2	0.3	-0.2
1960	534.9	5.5	68.9	1.6	-1.0
1961	562.0	5.5	70.1	3.1	0.7
1962	591.7	5.5	71.2	1.1	0.9
1963	622.6	5.5	72.4	0.8	0.8
1964	657.5	5.6	73.6	-0.8	0.2
1965	698.6	5.7	74.8	-2.9	-0.8
1966	749.9	5.8	76.0	-5.1	-1.8
1967	807.8	5.8	77.3	-3.2	-2.2
1968	879.4	5.8	78.5	-3.6	-2.7
1969	957.8	5.8	79.8	-2.5	-3.6
1970	1,046.1	5.9	82.0	1.0	-1.9
1971	1,138.2	5.9	84.4	1.1	-0.0
1972	1,225.9	6.0	86.8	-0.9	-0.7
1973	1,339.7	6.1	89.3	-3.2	-1.4
1974	1,510.5	6.2	91.8	0.9	-0.8
1975	1,705.9	6.2	94.2	4.4	2.9
1976	1,862.7	6.2	96.8	2.3	2.2
1977	2,045.9	6.2	99.4	0.9	1.2
1978	2,269.3	6.3	102.0	-1.0	-0.4
1979	2,544.5	6.3	104.8	-0.5	-0.6
1980	2,860.6	6.2	107.0	2.7	1.0
1981	3,208.4	6.2	108.8	2.9	1.6
1982	3,488.4	6.1	110.6	7.1	4.1
1983	3,721.1	6.1	112.3	5.6	4.4
1984	3,958.5	6.0	114.1	1.4	2.1
1985	4,206.8	6.0	115.9	0.6	1.6
1986	4,442.1	6.0	117.8	0.4	1.0
1987	4,709.1	6.0	119.7	0.4	0.1
1988	5,015.9	5.9	121.6	-0.7	-0.5
1989	5,366.1	5.9	123.6	-1.4	-0.9
1990	5,736.0	5.9	125.4	-0.1	-0.6
1991	6,092.7	5.9	126.9	2.9	1.4
1992	6,382.8	5.8	128.3	2.2	1.9
1993	6,679.4	5.8	129.7	1.8	1.6
1994	6,981.9	5.8	131.2	0.5	0.4
1995	7,312.3	5.7	132.6	0.6	0.1
1996	7,644.9	5.7	134.1	-0.2	-0.2
1997	8,005.5	5.7	135.9	-1.3	-1.1
1998	8,328.8	5.6	137.4	-2.2	-1.4

Source: U.S. Congressional Budget Office.

Note: NAIRU is the Non-Accelerating Inflation Rate of Unemployment.

Table 4
Share Equations

	Dependent Variable							
	Wages	Supplements	Profits	Proprietors' Income	Rental Income	Net Interest	Other Personal Interest	Dividends
Constant	-0.018	0.038	-0.005	-0.027	-0.010	0.022	0.010	0.004
	(-1.15)	(5.27)	(-0.21)	(-1.69)	(-1.56)	(1.98)	(2.09)	(0.85)
Gap	0.221	0.030	-0.319	-0.009	0.021	0.030	0.016	0.003
	(12.6)	(3.81)	(12.5)	(-0.53)	(2.93)	(2.45)	(3.20)	(0.60)
Gap[*t-1*]	-0.106	-0.010	0.054	0.015	-0.010	0.010	-0.019	-0.008
	(-5.89)	(-1.21)	(2.05)	(0.85)	(-1.38)	(0.76)	(-3.78)	(-1.67)
Gap[*t-2*]	-0.059	0.002	0.052	-0.010	0.002	-0.012	-0.005	-0.013
	(-3.26)	(0.30)	(1.97)	(-0.54)	(0.25)	(-0.94)	(-1.05)	(-2.67)
Gap[*t-3*]	-0.056	-0.011	0.006	-0.023	0.001	-0.016	-0.001	-0.002
	(-3.09)	(-1.31)	(0.24)	(-1.30)	(0.08)	(-1.28)	(-0.02)	(-0.41)
Gap[*t-4*]	-0.018	0.001	0.067	0.006	-0.004	0.003	-0.008	0.006
	(-1.06)	(0.16)	(2.67)	(0.34)	(-0.58)	(0.26)	(-1.71)	(1.20)
Sum of gap coefficients	-0.018	0.013	-0.139	-0.021	0.010	0.015	-0.017	-0.014
Adjusted R^2	0.55	0.07	0.50	0.02	0.03	0.03	0.12	0.06
Durbin-Watson	1.63	1.78	2.20	2.02	2.05	1.27	1.80	1.37

Notes: The sample period is first-quarter 1955 to fourth-quarter 1997. Dependent variables are measured as first differences of the variable divided by GDP. Gap terms are first differences of *(GDPK-GDP)/GDPK*; *t*-statistics are shown in parentheses.

En is set equal to 1 by assuming that changes in the number of tax filers occur in proportion to the existing distribution. By assuming that En is 1, we see that Ey should account for the elasticity of the tax code, given the distribution of income, and the change in the distribution of income over the cycle. Our estimate of Ey, though, is based solely on the tax structure and the existing distribution of income; thus, it abstracts from any potential cyclical sensitivity of the income distribution. Equation 16 was modified to account for two types of filers, as the number of returns and the incomes of single filers appear to exhibit different cyclical properties than those of nonsingle filers.

We calculate Ey for single and nonsingle filers (overwhelmingly married filing jointly, but also heads of households, married filing separately, and surviving spouses) using SOI cross-sectional data for each year. Ey for a given type of filer is the weighted sum of the elasticities of the AGI groups shown in the SOIs where the weights equal the tax shares of the groups. The elasticity is estimated by dividing the *effective* marginal tax rate by the average tax rate for the group.[23] The effective marginal tax rates are lower than the statutory rates because the effective rates incorporate the rise in deductions that occurs as income rises and include the tax preference for capital-gains realizations.[24]

Table 5 displays the resulting elasticity estimates, Ey. Over the 1951-96 period, the AGI per return elasticity for nonsingle returns averaged 1.6, and was 1.5 for single returns. This largely reflects differences in the 1950s and 1960s owing to lower average tax rates faced by nonsingles in the lower income brackets because of the relatively more generous personal exemptions in place at the time. Focusing on nonsingle filers, we see that their elasticity fell by 0.1 as a result of the Reagan tax cuts in the early 1980s and fell by another 0.1 with the 1986 Tax Reform Act. During the 1990s, the overall elasticity of the tax schedule has hardly changed, as the elasticity-boosting effects of the expansion of the Earned Income Credit (EIC) and increased marginal income tax rates for high-income filers have been offset by the decrease in the tax rate on capital-gains realizations and the shift in income distribution toward high-income filers who have lower elasticities.

Table 5

Personal Income Tax Elasticities

	Ey				Ey				Ey		
Year	Single	Nonsingle	*Epersonal*	Year	Single	Nonsingle	*Epersonal*	Year	Single	Nonsingle	*Epersonal*
1951	1.55	1.71	1.48	1967	1.50	1.61	1.39	1983	1.55	1.59	1.40
1952	1.55	1.70	1.47	1968	1.49	1.56	1.35	1984	1.53	1.58	1.40
1953	1.54	1.69	1.46	1969	1.53	1.56	1.36	1985	1.57	1.57	1.40
1954	1.52	1.70	1.46	1970	1.54	1.56	1.36	1986	1.52	1.53	1.36
1955	1.53	1.69	1.45	1971	1.58	1.59	1.38	1987	1.51	1.54	1.37
1956	1.46	1.68	1.44	1972	1.61	1.61	1.39	1988	1.46	1.51	1.34
1957	1.48	1.67	1.43	1973	1.59	1.60	1.39	1989	1.45	1.48	1.33
1958	1.56	1.67	1.44	1974	1.57	1.59	1.38	1990	1.46	1.46	1.31
1959	1.47	1.64	1.41	1975	1.63	1.67	1.45	1991	1.46	1.49	1.33
1960	1.46	1.65	1.41	1976	1.64	1.69	1.46	1992	1.46	1.49	1.33
1961	1.45	1.62	1.39	1977	1.71	1.73	1.50	1993	1.46	1.50	1.33
1962	1.45	1.61	1.38	1978	1.68	1.70	1.48	1994	1.47	1.51	1.34
1963	1.38	1.64	1.39	1979	1.64	1.68	1.47	1995	1.46	1.49	1.32
1964	1.52	1.67	1.43	1980	1.62	1.66	1.45	1996	1.44	1.47	1.31
1965	1.52	1.67	1.43	1981	1.58	1.63	1.43				
1966	1.51	1.63	1.40	1982	1.53	1.59	1.40				

The weights applied to *En* and *Ey* are estimated by calculating relative magnitudes of the effects of the GDP gap on filing a return and the cyclical change in income per return. The change in returns is modeled as a function of changes in employment, tax filing rules, and a dummy variable to capture the apparent change in the coefficients after 1977. Regression results in Table 6 indicate that until 1977 a 1 percent change in employment led to a 2 percent change in single returns, while after 1977 there is a one-to-one relationship. The reduction probably reflects a variety of demographic factors such as the falloff in marriage rates and the entry of married women into the labor force over the later period. By contrast, changes in employment have a negligible impact on nonsingle filers, probably owing to lower levels of unemployment and higher levels of income-generating assets of married households. Similar results hold for our estimates of the cyclical response of AGI per return (Table 7): average income is more cyclically sensitive for single filers than for nonsingles. A 1 percent increase in aggregate per-employee income results in a 1.41 percent increase in income on returns of singles (there is no break in the 1970s), while the estimate of the coefficient in the case of nonsingles is 0.81, but it has not been stable over time.

With these regression results, we can construct the weights on *En* and *Ey* for single returns (the weight on *En* for nonsingles is zero owing to the lack of response of the number of returns to economic activity). The return gap, *ngap*, equals

Table 6

Personal Income Tax Elasticity Regressions, Number of Returns Elasticity

	Dependent Variable	
	Single Returns	Nonsingle Returns
Constant	-0.016	0.012
	(-3.14)	(5.28)
Employment	2.33	0.16
	(10.07)	(1.49)
Employment*T78	-1.21	—
	(-3.12)	
Filing requirements	-0.072	-0.032
	(-4.42)	(-2.56)
T78	0.014	—
	(1.66)	
D87	0.064	—
	(3.49)	
Adjusted R^2	0.77	0.15
Durbin-Watson	1.58	1.54

Notes: The sample period is 1951 to 1996. All variables are first differences of the log of the series. Employment is civilian payroll employment. Filing requirements is the nominal threshold for filing an income tax return. T78 is a dummy of ones beginning in 1978 and D87 is a dummy to capture the change in filing requirements from the Tax Reform Act of 1986, which raised the number of returns from minors.

the product of the coefficient on employment in the returns equation and the employment gap. The income per return gap, *ygap*, is the product of the coefficient estimate for the average income per return and the per-capita income gap. The resulting annual weights on *En* and *Ey* vary wildly over time and are quite sensitive to the GDP and employment gap measures. In response, we opted to make the weights constant over time by taking their average value: the weights on *En* and *Ey* are both 0.5.[25] The regressions, in panel B of Table 7, provide us with estimates of the elasticity of aggregate AGI to NIPA-adjusted personal income—the final elasticity needed to evaluate equation 16, the elasticity of personal income taxes to adjusted personal income. Our estimate, *Epersonal*, is shown in Table 5, and it has varied between 1.3 and 1.5.

Social insurance taxes currently exceed 35 percent of NIPA-based federal revenues. The major components of these taxes are Social Security taxes (for Old-Age, Survivors, and Disability Insurance [OASDI], Medicare [HI], and railroad retirement benefits), federal and state unemployment taxes, federal civilian and military retirement contributions, and supplemental medical insurance (SMI) premiums.[26] An estimate of the overall elasticity of social insurance taxes is calculated by estimating separate elasticities for employed Social Security taxes (FICA), self-employed Social Security taxes (SECA), and unemployment insurance taxes. It is assumed that railroad retirement taxes have the same elasticity as FICA taxes and that other taxes and contributions have a zero elasticity with respect to cyclical changes in the economy.[27]

The cyclical income elasticity of FICA contributions—EFICA—and similarly of SECA contributions, is estimated as a weighted average of the elasticities of taxes to changes in employment and changes in wages per employee.

$$EFICA = \{En*ngap + Ey*ygap*(1 + ngap)\} / [ngap + ygap*(1 + ngap)], \tag{17}$$

where:

ngap is the percentage gap in wage earners,

ygap is the percentage gap in average wage,

En is the elasticity of FICA contributions to a change in employment, and

Ey is the elasticity of FICA contributions to a change in average wages.

As with personal income taxes, we assume that *En* equals 1 and *Ey* should account for the elasticity of the tax code, given the distribution of income.[28] *Ey* is less than 1 because wages and salaries above a maximum amount of taxable earnings are not subject to OASDHI taxes. The share of workers above the wage cap has fallen from 25 percent in the 1960s to about 6 percent now (and the Medicare portion of the OASDHI tax covers full wages). Equation 18 states that aggregate FICA taxes are the product of the FICA tax rate and the wages subject to tax, broken into two parts: earnings by those below the wage cap and

Table 7

Elasticities of AGI per Return and AGI to NIPA-Adjusted Personal Income

	Dependent Variable						
	AGI per Return: Singles			AGI per Return: Nonsingles			
	1951-96	1951-77	1977-96	1951-96	1951-77	1977-96	1987-96
Panel A							
Constant	-0.008	-0.002	-0.001	0.012	-0.006	0.012	-0.010
	(-1.13)	(-1.02)	(-0.19)	(1.57)	(-0.50)	(1.01)	(-0.53)
NIPA-adjusted income per employee	1.13	1.07	1.08	0.79	1.18	0.82	1.32
	(8.34)	(3.58)	(10.06)	(5.28)	(5.37)	(4.15)	(2.30)
Filing requirements	0.064	0.067	0.004	0.020	-0.008	0.154	.214
	(4.05)	(3.45)	(0.11)	(0.82)	(-.36)	(2.72)	(2.30)
Adjusted R^2	0.64	0.45	0.86	0.37	0.52	0.47	0.50

	Dependent Variable				
	AGI: Singles	AGI: Nonsingles			
	1951-96	1951-96	1951-77	1977-96	1987-96
Panel B					
Constant	-0.027	0.013	0.011	0.013	-0.010
	(-2.55)	(2.38)	(2.22)	(1.34)	(-0.67)
NIPA-adjusted income	1.41	0.81	0.84	0.79	1.20
	(10.14)	(11.01)	(11.68)	(6.30)	(4.57)
Filing requirements	0.008	0.000	-0.027	0.086	.161
	(0.31)	(0.00)	(-1.91)	(1.86)	(2.50)
Adjusted R^2	0.70	0.74	0.85	0.67	0.77

Note: All variables are first differences of the log levels.

the taxable portion of earnings of those with earnings above the cap. A little algebra yields the elasticity of taxes with respect to an increase in income, equation 19.

(18) $T(t, w, y, x, n) = t*[y*x*n + w*(1-x)*n]$,

where:

t = the statutory tax rate,
y = the average wage of those below the wage cap,
x = the fraction of wage earners below the wage cap,
w = the maximum wages subject to taxation, and
n = the number of wage earners.

(19) $Ey = (y*x)/(y*x + w*(1-x))$.

Calculations using data on the distribution of earners and earnings above the wage cap from the annual *Social Security Bulletin* yield the tax-schedule elasticities, Ey, shown in Table 8. The elasticity of FICA taxes with respect to wages and salaries rises after the early 1970s because the share of workers below the wage cap rises as a result of the 1972 and 1977 amendments to the Social Security Act. Similar calculations were made for the elasticity of SECA taxes; the elasticity of the SECA tax schedule is, on average, 25 percent lower than the elasticity of the FICA schedule because a smaller share of the income earned by the self-employed is earned by those below the caps.[29]

The next step is to estimate the relative shares of the cyclical changes to aggregate wage and salary income that result from greater employment and greater income per worker. The percentage gap in wage earners and percentage gap in average wages are estimated by the following regressions (with *t*-statistics in parentheses):

FICA:

$$\Delta ln(covemp) = .001 + 1.00\Delta ln(emp) + .013*law,$$
(.23) (10.0) (3.74)

adj. R^2 =.72

$$\Delta ln(avecovwage) = .000 + 1.031*\Delta ln(avewage),$$
(.20) (12.5)

adj. R^2 =.79

SECA:

$$\Delta ln(covemp) = -.013 + 1.71*\Delta ln(emp) + .066law,$$
(-.61) (2.43) (2.50)

adj. R^2 =.21

Table 8

FICA and SECA Tax Elasticities

	Ey		Esocial				Ey		Esocial		
Year	FICA	SECA	FICA	SECA	Total	Year	FICA	SECA	FICA	SECA	Total
1951	.49	.26	.81	.72	.80	1974	.61	.30	.85	.74	.84
1952	.45	.26	.79	.72	.79	1975	.60	.31	.85	.74	.84
1953	.41	.25	.78	.72	.77	1976	.60	.32	.85	.74	.84
1954	.40	.25	.77	.72	.77	1977	.60	.34	.85	.75	.84
1955	.46	.34	.80	.75	.79	1978	.58	.32	.84	.74	.83
1956	.43	.31	.79	.74	.78	1979	.68	.40	.88	.77	.87
1957	.41	.29	.78	.73	.77	1980	.71	.45	.89	.79	.88
1958	.40	.29	.77	.73	.77	1981	.73	.49	.90	.81	.89
1959	.45	.31	.79	.74	.79	1982	.74	.51	.90	.81	.90
1960	.43	.31	.78	.74	.78	1983	.76	.52	.91	.82	.90
1961	.41	.30	.78	.74	.77	1984	.75	.49	.91	.81	.90
1962	.39	.27	.77	.73	.76	1985	.75	.48	.90	.80	.90
1963	.37	.25	.76	.72	.76	1986	.75	.48	.91	.80	.90
1964	.35	.23	.75	.71	.75	1987	.74	.47	.90	.80	.90
1965	.33	.18	.75	.69	.74	1988	.72	.43	.89	.79	.89
1966	.48	.25	.80	.72	.80	1989	.73	.45	.90	.79	.89
1967	.45	.22	.79	.71	.78	1990	.75	.47	.90	.80	.90
1968	.52	.26	.82	.72	.81	1991	.77	.52	.91	.82	.91
1969	.47	.25	.80	.72	.79	1992	.76	.53	.91	.82	.90
1970	.45	.23	.79	.71	.79	1993	.77	.54	.91	.83	.91
1971	.41	.22	.78	.71	.77	1994	.80	.60	.92	.85	.92
1972	.45	.25	.79	.72	.79	1995	.78	.60	.92	.85	.91
1973	.52	.26	.82	.72	.81	1996	.78	.60	.92	.85	.91

$\Delta ln(avecovwage) = .027 + .24 * \Delta ln(avepro)$,
(3.30) (3.39)

adj. R^2 =.25,

where:

$covemp$ = covered employment, from the Social Security Administration,

emp = civilian employment,

law = a dummy for changes in coverage, 1 for 1955, 1957, 1966, 1983, 1984, 1988, 1991,

$avecovwage$ = the average wage for covered employment, from the Social Security Administration,

$avewage$ = average wage: total wages and salaries divided by civilian employment, and

$avepro$ = proprietor's income divided by covered workers.

As with the personal income tax elasticity estimates, the weights on En and Ey implied by the regressions move dramatically over time—especially when the sum of $ngap$ and $ygap$ is close to zero—and thus they are very sensitive to estimates of potential GDP. As before, we decided to use the average weight over time, which placed 62 percent of the weight on the employment term for FICA. The resulting point estimate for the weight on the employment elasticity for SECA was 1.1. This value seemed unreasonable and probably reflected the poor fit of the SECA equations, so we opted to use the weights from the FICA. Plugging this information into equation 17 gives the cyclical income elasticities of FICA and SECA, summarized in the *Esocial* columns in Table 8. The weighted average of these two elasticities is shown in the total columns.

The elasticity of unemployment taxes to cyclical income was approached in a distinct manner. The unemployment insurance (UI) tax system has two key features. In most states, the wage cap is quite low: indeed, in twelve states the cap is $7,000, and the weighted average across states was only $9,000 in 1997.[30] The second key feature of the system is that tax rates for firms are experience-rated. Thus, tax rates tend to rise for several years after a recession and fall during an expansion. To capture this endogenous behavior, we modeled the UI tax rate ($UIrate$) as a function of lagged unemployment rates and changes in federal tax laws concerning the Federal Unemployment Tax (FUTA) wage cap and statutory tax rate.[31] Lagged changes in unemployment rates for four years and the change in the wage cap were significant, but changes in the statutory tax rate—which have been small and infrequent—had no explanatory power (with *t*-statistics in parentheses):

$$\Delta UIrate = -.026 + .042\Delta UR_{t-1} + .074\Delta UR_{t-2}$$
(-2.85) (4.25) (7.77)
$$+ .004\Delta UR_{t-3} + .025\Delta UR_{t-4} + .60\Delta WAGECAP ,$$
(-.32) (2.65) (5.51)

adj. R^2 =.84

Corporate profits taxes, excluding Federal Reserve earnings, are about 10 percent of federal revenues. Corporate profits tax liability (CPT) is defined as the product of the average tax rate on income subject to tax (τ) and income subject to tax before credits (IST), less tax credits (C): $CPT = \tau * IST - C$. The average tax rate is derived from the data, given the BEA's estimates for the other three terms. Income subject to tax equals modified NIPA economic profits (corporate profits less Federal Reserve earnings and rest-of-world profits), CP, less adjustments, ADJ. The adjustments are losses and capital gains, which are added to CP, as well as tax-exempt interest, state and local corporate taxes, and deductions for loss carryovers, which are subtracted. These data are found in *SOI Corporate Income Tax Returns* and in the BEA's reconciliation tables between IRS measures of profits and taxes and the NIPA economic profits and profits taxes. Tax credits are primarily for foreign taxes and the investment tax credit. The elasticity of corporate profits taxes to changes in modified corporate profits (CP) is determined as follows:

$$E_{cpt,cp} = (\tau * IST(E_{\tau,cp} + E_{ist,cp}) - C * E_{c,cp}) / (\tau * IST - C) , \quad (20)$$

where $E_{\tau,cp} = E_{\tau,ist} * E_{ist,cp}$,

and $E_{ist,cp} = (CP - \Sigma ADJ_i * E_{adj,cp}) / (CP - \Sigma ADJ_i)$.

The elasticity of income subject to tax with respect to modified corporate profits in equation 20 is found by estimating the cyclical sensitivity of the major adjustments to corporate profits (Table 9). The elasticities are calculated in two steps. In the first step, the adjustments and modified profits are regressed against the GDP gap and potential GDP.[32] The elasticity with respect to GDP is estimated by evaluating the marginal change at mean GDP. Second, the elasticities of the adjustments with respect to GDP are divided by the elasticity of modified profits with respect to GDP to produce the estimates of the elasticity with respect to modified profits. When we plug these results back into equation 20, we obtain an average elasticity of income subject to tax with respect to modified profits of 0.8; the annual figures vary from 0.3 in 1982 to 0.96 in 1968 (Table 10).[33] These estimates are similar to those of deLeeuw et al. (1980). The low elasticity reflects the importance of corporate losses, which is the only adjustment that causes the elasticity to fall below one.

$E_{\tau,ist}$ is the elasticity of the corporate profits tax rate. This is only slightly higher than zero because the corporate income tax is not very progressive and few corporate profits are generated by firms in the lower tax bracket.[34] We have assumed that the elasticity of credits with respect to modified profits varies with the share of credits that are for foreign taxes (which appears to have a zero elasticity) and the share of credits owing to investment tax credits (with an assumed 1.0 elasticity). Combining the elasticities in equation 20 produces an overall

Table 9

Elasticities of Adjustments to Modified Corporate Profits

	Dependent Variable					
	Modified Profits	State Profits Taxes	Tax-Exempt Interest	Capital Gains	Losses	Loss Carryovers
Constant	17.4	-2.23	-1.53	-0.25	-1.87	-0.96
	(4.26)	(-13.0)	(-17.0)	(-0.50)	(-2.36)	(-5.62)
Gap	-0.262	-0.003	-0.001	-0.048	0.038	-.005
	(-3.34)	(-0.94)	(-0.72)	(-4.97)	(2.47)	(-1.66)
Potential GDP	0.063	0.006	0.005	0.007	0.015	0.004
	(19.0)	(44.5)	(65.3)	(17.2)	(22.9)	(30.5)
Elasticity with respect to GDP at mean	3.75	0.58	0.37	7.05	-2.90	1.64
Elasticity with respect to modified profits	N.A.	0.16	0.11	2.13	-0.88	0.50
Adjusted R^2	.94	.99	.99	.93	.96	.98

Note: The sample period is 1956 to 1994.

Table 10

Corporate Income Tax Elasticities

Year	$E_{ist, cp}$: Income Subject to Tax Relative to Modified Profits	$E_{cpt, ct}$: Corporate Tax Accruals Relative to Profits	Year	$E_{ist, cp}$: Income Subject to Tax Relative to Modified Profits	$E_{cpt, ct}$: Corporate Tax Accruals Relative to Profits
1954	.94	1.00	1975	.76	1.11
1955	.94	1.01	1976	.84	1.23
1956	.94	1.01	1977	.88	1.28
1957	.90	.97	1978	.90	1.26
1958	.88	.96	1979	.85	1.29
1959	.92	.99	1980	.68	.90
1960	.85	.92	1981	.54	.64
1961	.89	.98	1982	.31	.22
1962	.90	.98	1983	.52	.60
1963	.90	.99	1984	.58	.67
1964	.92	1.01	1985	.63	.78
1965	.95	1.05	1986	.70	.88
1966	.95	1.06	1987	.66	.81
1967	.94	1.06	1988	.64	.82
1968	.96	1.08	1989	.58	.72
1969	.88	.99	1990	.49	.62
1970	.74	.86	1991	.48	.60
1971	.81	.96	1992	.59	.72
1972	.88	1.05	1993	.70	.85
1973	.87	1.08	1994	.70	.85
1974	.73	1.07			

elasticity of corporate profits taxes to NIPA economic profits of 0.9 on average (Table 10).

Indirect business taxes, which constitute only 5 percent of federal receipts, are composed of excise taxes, customs duties, and business nontaxes. As before, the elasticity is the weighted sum of the elasticities of each tax, where the weights are the share of the receipts in total taxes and the elasticity of excise taxes and customs duties are the demand elasticities with respect to cyclical GDP.

The share estimates are constructed using the BEA's annual estimates of these taxes. The elasticities for excise taxes and nontaxes are built up from the elasticities of their components. The elasticities of the various components are assumed to be constant over time; thus, the variation over time in the excise tax and nontax elasticities reflects changes in the composition of these taxes. The elasticity of customs duties is set at 2.0, the cyclical elasticity found in the FRB/US model. Our estimates of the elasticities of indirect business taxes and their components with respect to cyclical income are shown in Table 11.

The elasticity of excise taxes with respect to cyclical income is obtained by taking the sum of the products of the share of each tax receipt in total excise taxes and the demand elasticity of the taxed good (the latter drawn from various prior studies). Table 11 shows the change in the composition of excise taxes over the years and the elasticities used for each tax. The rise and decline of importance of auto excise taxes and windfall profits taxes are the major contributors to changes in the elasticity of excise taxes over time.

The elasticity of business nontaxes has risen over time owing to the rising share of deposit insurance premiums in nontaxes. We assume that the cyclical income elasticity of deposit premiums is equal to one, reflecting the income elasticity of deposits. Note that the cyclical elasticity will be different than one to the extent that the opportunity costs of deposits are cyclical. The other major element of nontaxes is rents and royalties from resource extraction on the outer continental shelf; we assume that it has a zero elasticity. Finally, other nontaxes consist largely of proprietary receipts paid to the Department of Agriculture (for example, inspection fees), the Department of the Interior (timber, mineral, and water), and fines. Some of the fees are a condition of doing business and presumably are inelastic with respect to the level of output, while others depend upon the level of business activity and thus are more elastic. As a guess, we assume that these other nontaxes

Table 11

Indirect Business Taxes: Shares of Receipts for Selected Years

	1955	1965	1975	1980	1985	1990	1995	Elasticity
Share in indirect business taxes								
Excise	91	80	71	68	59	54	63	—
Customs	7	12	19	18	21	27	21	2.0
Nontaxes	3	8	9	14	20	19	16	—
Share in excise								
Alcohol	30	26	32	21	16	16	13	0.75
Gas	10	18	24	15	26	29	36	0.5
Tobacco	17	15	14	9	13	12	10	0.0
Diesel	0	1	2	2	8	9	11	0.5
Airline	2	1	5	6	7	10	10	1.5
Telephone	6	7	12	3	7	8	7	1.0
Windfall oil profits	0	0	0	35	15	0	0	0.0
Motor vehicle	13	18	4	3	3	4	3	2.7
Other manufacturing	7	10	8	0	0	0	0	2.0
Other	14	3	0	6	6	11	9	1.0
Share in nontaxes								
Off-shore oil	0	9	30	42	30	19	18	0.0
Deposit insurance premiums	33	18	20	12	27	39	29	1.0
Other	67	73	50	46	43	42	52	0.5

Note: Figures in the first seven columns are in percent.

Table 12

Indirect Business Tax Elasticities

Year	Excise Taxes	Customs Duties	Business Nontaxes	Indirect Business Taxes	Year	Excise Taxes	Customs Duties	Business Nontaxes	Indirect Business Taxes
1951	1.03	2.0	.75	1.09	1974	0.82	2.0	.49	0.99
1952	0.97	2.0	.75	1.03	1975	0.82	2.0	.45	1.08
1953	1.02	2.0	.75	1.07	1976	0.78	2.0	.44	0.99
1954	1.03	2.0	.75	1.06	1977	0.75	2.0	.42	0.98
1955	1.02	2.0	.67	1.08	1978	0.76	2.0	.42	1.03
1956	1.09	2.0	.67	1.13	1979	0.79	2.0	.39	1.03
1957	1.04	2.0	.67	1.09	1980	0.50	2.0	.35	0.75
1958	1.04	2.0	.67	1.09	1981	0.32	2.0	.34	0.58
1959	1.00	2.0	.66	1.07	1982	0.40	2.0	.36	0.67
1960	1.04	2.0	.67	1.11	1983	0.49	2.0	.40	0.74
1961	0.99	2.0	.54	1.05	1984	0.53	2.0	.41	0.81
1962	1.01	2.0	.55	1.07	1985	0.60	2.0	.49	0.87
1963	1.05	2.0	.55	1.10	1986	0.70	2.0	.55	1.01
1964	1.07	2.0	.55	1.12	1987	0.72	2.0	.57	1.04
1965	1.12	2.0	.55	1.16	1988	0.72	2.0	.58	1.04
1966	1.03	2.0	.55	1.11	1989	0.75	2.0	.56	1.07
1967	0.99	2.0	.52	1.07	1990	0.76	2.0	.60	1.06
1968	0.98	2.0	.53	1.08	1991	0.72	2.0	.65	0.98
1969	1.05	2.0	.52	1.13	1992	0.71	2.0	.64	0.99
1970	1.04	2.0	.51	1.13	1993	0.73	2.0	.67	1.01
1971	1.03	2.0	.46	1.14	1994	0.73	2.0	.65	0.98
1972	0.86	2.0	.44	1.00	1995	0.73	2.0	.55	0.98
1973	0.81	2.0	.49	0.97	1996	0.68	2.0	.62	0.93

had an elasticity of 0.5. Table 12 reports our estimates of the elasticity of indirect business taxes with respect to cyclical GDP.

After calculating the high-employment income shares and elasticities, we calculated HEB taxes using the gross-up method by adjusting actual taxes by the tax elasticity times the percentage difference between the actual and the high-employment tax base. To compute HEB taxes through 1998, we extend forward the various tax elasticities using the most recent historical estimate. The results are summarized in Tables 13 and 14. The far right column of Table 13 shows the cyclical change in tax revenues as a percentage of potential GDP per 1 percentage point of GDP growth. Thus, in 1998, a pick-up of GDP growth of 1 percentage point would boost revenues by 0.31 percent of GDP. This corresponds to an elasticity of receipts to cyclical changes in GDP of 1.5, a figure in excess of the individual tax elasticities because of the relatively elastic changes of the tax bases. Over time, this 0.3 response of taxes with respect to cyclical changes in GDP has been relatively constant, ignoring the values obtained when the GDP gap is small, despite the large changes in marginal tax rates, because the individual tax elasticities have not changed as much as implied by the changes in statutory rates and because the downward drift in the personal income tax elasticity has been offset by the rise in the elasticity of social insurance taxes.

Table 14 highlights the sources of cyclical variation in receipts. Historically, 40 to 50 percent of the change has come from personal taxes while another 33 to 50 percent has come from corporate taxes. Social insurance contributions have grown in importance over time and now account for roughly 20 percent of the cyclical variation in taxes. Corporate income taxes generate more of the cyclical response than social insurance contributions, despite their smaller share of overall receipts and similar tax elasticity, because their tax base—profits—is much more cyclical than wages.

Table 13
High-Employment Receipts

Year	HEB Receipts (Billions of Dollars)	Actual Receipts (Billions of Dollars)	Cyclical Receipts (Billions of Dollars)	Cyclical Receipts (Percentage of GDPK)	GDP Gap	Response of Taxes to a 1 Percent GDP Change (Percentage of GDP)
1951	60.2	64.7	-4.5	-1.4	-3.7	0.37
1952	64.5	67.8	-3.3	-1.0	-2.9	0.33
1953	66.5	70.5	-4.0	-1.1	-3.4	0.32
1954	65.7	64.3	1.4	0.4	0.7	0.54
1955	69.3	73.2	-3.8	-1.0	-3.2	0.30
1956	75.9	78.6	-2.7	-0.6	-2.0	0.31
1957	82.2	82.6	-0.4	-0.1	-0.6	0.15
1958	85.7	79.5	6.2	1.3	3.8	0.34
1959	91.2	90.6	0.6	0.1	0.3	0.45
1960	99.3	97.0	2.3	0.4	1.5	0.29
1961	105.0	99.0	6.0	1.1	3.1	0.35
1962	109.1	107.2	1.9	0.3	1.1	0.29
1963	117.0	115.5	1.5	0.2	0.8	0.29
1964	114.5	116.2	-1.7	-0.3	-0.8	0.30
1965	119.5	125.8	-6.4	-0.9	-2.9	0.31
1966	131.5	143.5	-12.0	-1.6	-5.1	0.32
1967	144.8	152.6	-7.8	-1.0	-3.2	0.30
1968	167.2	176.9	-9.6	-1.1	-3.6	0.31
1969	192.0	199.5	-7.5	-0.8	-2.6	0.30
1970	199.5	195.1	4.4	0.4	1.0	0.43
1971	208.9	203.3	5.6	0.5	1.1	0.44
1972	230.5	232.6	-2.0	-0.2	-0.9	0.18
1973	250.9	264.0	-13.1	-1.0	-3.2	0.30
1974	299.5	295.2	4.4	0.3	0.8	0.34
1975	321.9	297.4	24.5	1.4	4.4	0.32
1976	357.6	343.1	14.5	0.8	2.3	0.33
1977	395.0	389.6	5.4	0.3	0.9	0.28
1978	438.8	446.5	-7.7	-0.3	-0.9	0.36
1979	504.1	511.1	-6.9	-0.3	-0.5	0.52
1980	581.9	561.5	20.3	0.7	2.6	0.27
1981	674.3	649.3	25.0	0.8	2.9	0.27
1982	696.9	646.4	50.5	1.4	7.0	0.21
1983	725.5	671.9	53.6	1.4	5.6	0.26
1984	757.5	746.9	10.6	0.3	1.4	0.19
1985	812.4	811.3	1.2	0.0	0.6	0.04
1986	850.5	850.1	0.5	0.0	0.4	0.02
1987	937.5	937.5	0.1	0.0	0.4	0.00
1988	983.9	997.2	-13.3	-0.3	-0.7	0.40
1989	1,056.9	1,079.4	-22.4	-0.4	-1.4	0.31
1990	1,124.8	1,129.8	-5.0	-0.1	-0.2	0.56
1991	1,192.8	1,149.0	43.8	0.7	2.9	0.25
1992	1,240.7	1,198.5	42.2	0.7	2.2	0.30
1993	1,307.1	1,275.1	32.1	0.5	1.8	0.26
1994	1,380.4	1,374.7	5.7	0.1	0.5	0.16
1995	1,466.1	1,460.4	5.8	0.1	0.6	0.14
1996	1,577.8	1,584.7	-6.9	-0.1	-0.2	0.42
1997	1,687.1	1,720.0	-32.8	-0.4	-1.3	0.31
1998	1,788.1	1,844.2	-56.1	-0.7	-2.2	0.31

Table 14

Decomposition of Cyclical Taxes

Billions of Dollars

Year	Total Cyclical Receipts	Personal Taxes	Corporate Income Taxes	Social Insurance	Indirect Business Taxes	Year	Total Cyclical Receipts	Personal Taxes	Corporate Income Taxes	Social Insurance	Indirect Business Taxes
1951	-4.5	-1.4	-2.6	-0.1	-0.4	1975	24.5	8.0	11.4	3.9	1.2
1952	-3.3	-1.4	-1.8	0.2	-0.3	1976	14.5	6.4	5.9	1.6	0.6
1953	-4.0	-1.7	-2.3	0.4	-0.4	1977	5.4	3.7	2.3	-0.8	0.2
1954	1.4	0.0	0.8	0.5	0.1	1978	-7.7	-1.4	-4.5	-1.6	-0.3
1955	-3.8	-1.1	-2.7	0.3	-0.4	1979	-6.9	-3.0	-1.6	-2.2	-0.2
1956	-2.7	-1.3	-1.3	0.1	-0.3	1980	20.3	7.8	9.6	2.0	0.9
1957	-0.4	-0.6	-0.2	0.5	-0.1	1981	25.0	13.3	6.9	3.8	1.0
1958	6.2	1.9	3.2	0.6	0.5	1982	50.5	30.4	8.6	9.0	2.5
1959	0.6	0.5	-0.1	0.2	0.0	1983	53.6	29.7	13.5	8.0	2.3
1960	2.3	0.7	1.4	-0.1	0.2	1984	10.6	10.2	3.0	-3.3	0.7
1961	6.0	2.2	2.9	0.5	0.5	1985	1.2	4.1	2.1	-5.4	0.3
1962	1.9	1.0	0.8	-0.1	0.2	1986	0.5	2.1	2.6	-4.5	0.2
1963	1.5	0.8	0.8	-0.2	0.1	1987	0.1	2.9	1.7	-4.8	0.2
1964	-1.7	-0.4	-1.1	-0.1	-0.2	1988	-13.3	-2.8	-4.5	-5.6	-0.4
1965	-6.4	-1.8	-3.6	-0.4	-0.5	1989	-22.4	-8.3	-8.0	-5.2	-0.9
1966	-12.0	-4.2	-6.3	-0.7	-0.8	1990	-5.0	-3.8	0.3	-1.5	-0.1
1967	-7.8	-3.5	-3.6	-0.1	-0.5	1991	43.8	16.5	15.1	9.8	2.3
1968	-9.6	-3.7	-5.4	0.2	-0.7	1992	42.2	19.8	11.7	8.9	1.8
1969	-7.5	-3.8	-3.6	0.5	-0.5	1993	32.1	13.8	12.8	3.8	1.6
1970	4.4	0.3	2.1	1.9	0.2	1994	5.7	4.4	2.3	-1.5	0.5
1971	5.6	1.5	1.7	2.1	0.3	1995	5.8	2.3	4.5	-1.6	0.5
1972	-2.0	-0.4	-2.3	0.8	-0.2	1996	-6.9	-1.4	-2.7	-2.5	-0.2
1973	-13.1	-4.8	-6.8	-0.8	-0.7	1997	-32.8	-12.2	-12.8	-6.6	-1.1
1974	4.4	-0.2	3.3	1.0	0.2	1998	-56.1	-24.1	-20.6	-9.4	-1.9

B. High-Employment Expenditures

Among expenditures, only those transfers and grants that are oriented toward income support respond automatically to changes in economic activity. Among these, unemployment benefits rise rapidly during a downturn in activity. The number of beneficiaries of low-income and disability programs—such as Food Stamps, the Earned Income Credit, welfare (Aid to Families with Dependent Children, or AFDC, and Temporary Assistance for Needy Families, or TANF), and disability insurance—expand as well, but only to a small extent. The large retirement transfers are essentially unaffected by fluctuations in the economy.[35]

Unemployment benefits are available for involuntarily unemployed workers who were recently employed and meet certain criteria. In general, benefits can last for up to twenty-six weeks, or up to thirty-nine weeks under the extended benefits program for workers in areas with high unemployment. This permanent extended benefits program was instituted in 1970. The HEB excludes expenditures by the permanent program. However, both before and after that time, temporary extended benefits programs were enacted near the end of each recession. HEB estimates typically include these expenditures because they are not automatic; they result from discretionary policies. However, for some uses of the HEB it may be appropriate to exclude these payments as well. Table 15 provides a summary of the temporary programs.

Unemployment benefits have become less sensitive to business-cycle fluctuations over the past two decades as the criteria for obtaining benefits have been tightened and the taxation of benefits effectively reduced their value. In 1975, 76 percent of the unemployed qualified for benefits, but this share had fallen to only 52 percent by 1992. Excluding the temporary extended benefits programs (but not benefits paid under the 1970 Extended Unemployment Compensation Act), a 1-percentage-point increase in the unemployment rate would boost unemployment benefits by about $5 billion in 1998 and would boost the permanent extended benefits program by varying amounts depending on the level of unemployment.[36]

The Aid to Families with Dependent Children program was never very cyclically sensitive. Its successor program, Temporary Assistance for Needy Families, is essentially a block grant to states and thus it is no longer sensitive to the business cycle from the federal government's perspective. Our estimates of the cyclical response of AFDC are based on Blank (1997). She finds that a 1-percentage-point increase in the unemployment rate raises traditional AFDC caseloads (single-parent households) by 3½ percent over an eighteen-month period, which then declines to about a 2 percent increase after three years. About 10 percent of AFDC expenses are for AFDC-Unemployed Parent (AFDC-UP), a program for couples that appears to be much more cyclically responsive. AFDC-UP caseloads rise by about 20 percent during the first one and a half years, before easing to a 15 percent rise after three years.[37] The following equation approximates the dynamic response of total caseloads to an increase in unemployment as estimated by Blank:

$$\begin{aligned} \Delta AFDC = AFDC^{*} (&.006\Delta UR_{t-1} + .006\Delta UR_{t-2} \\ &+ .006\Delta UR_{t-3} + .006\Delta UR_{t-4} \\ &+ .006\Delta UR_{t-5} + .006\Delta UR_{t-6} \\ &- .003\Delta UR_{t-7} - .003\Delta UR_{t-8} \\ &- .003\Delta UR_{t-9} - .003\Delta UR_{t-10} \\ &- .003\Delta UR_{t-11} - .003\Delta UR_{t-12}). \end{aligned}$$

A rise in the unemployment rate of 1 percentage point would boost AFDC payments by 5 percent after one and a half years and by only 2½ percent after three years. In its peak year—1994—the federal government spent $13 billion for program

Table 15

Temporary Unemployment Insurance Extended Benefits

Year	Provisions	Expenditures
1958-59	Temporary Unemployment Compensation Act provided a voluntary program under which states could extend benefits for up to thirteen weeks. Financed by interest-free loans to the states.	2 million workers received $0.6 billion from June 1958 to April 1959.
1961-62	Temporary Extended Unemployment Compensation Act extended benefits for thirteen weeks. Financed by a temporary tax.	2.8 million workers received $0.82 billion from March 1961 to June 1962
1970	Extended Unemployment Compensation Act initiated permanent extended benefits program.	Outlays under this program have been made every year.
1971-72	Emergency Unemployment Act provided thirteen weeks beyond the extended benefits period, for a total of fifty-two weeks.	$0.6 billion in 1971 and 1972
1974-78	Emergency Unemployment Compensation Act of 1974 (plus three subsequent extensions) extended benefits for up to sixty-five weeks.	$6.5 billion in 1975-78
1974	Emergency Jobs and Unemployment Assistance Act provided a temporary program for the uninsured: farm workers, domestic workers, and S&L employees.	$2.5 billion
1982-85	Federal Supplemental Compensation Program (and six subsequent extensions) provided for up to fourteen weeks of assistance to workers who had exhausted their benefits.	$9.3 billion: $1.2 billion in 1982 $5.4 billion in 1983 $2.3 billion in 1984 $0.7 billion in 1985
1991-94	Emergency Unemployment Compensation Act (and four extensions).	$27.8 billion: $0.8 billion in 1991 $13.6 billion in 1992 $11.9 billion in 1993 $1.4 billion in 1994

benefits (and another $1.5 billion for administrative expenses): thus, a 1-percentage-point increase in the unemployment rate would have raised federal outlays by only $0.5 billion, or $1 billion for the combined federal and state governments. The equation is set to zero beginning in 1997.[38]

The Food Stamp program has similar responsiveness to unemployment rates as found in AFDC. Thus, we used the same estimates. By contrast, this program may have become more cyclically sensitive for the federal government because the eligibility rules enacted in 1996 limit the amount of time nonworking individuals are eligible for benefits. Here, a 5 percent increase in expenditures after one and a half years implies that expenditures would rise by $1 billion.

Medicaid expenditures will also be raised by an increase in unemployment, as more individuals qualify for AFDC/TANF and become eligible for benefits. Only one-third of Medicaid payments go to the nonaged poor; thus, a 5 percent increase in AFDC enrollments would boost overall Medicaid expenditures by 1½ percent, or about $1.5 billion in 1998.

The Earned Income Credit was greatly expanded in the 1990s, from a minor program to the federal government's largest low-income support program. The portion of the credit that exceeds the income tax due is recorded in the budget as an outlay.[39] There is no cyclical experience with this greatly expanded credit. To fill the gap, we estimated the elasticity using the personal income tax methodology, assuming that all changes occur owing to income per family rather than to number of families.[40]

For a family with one child, the EIC in 1996 rose by 34 percent per dollar of earned income until annual earned

Table 16

High-Employment Current Expenditures

Year	Total Expenditures: HEB (Billions of Dollars)	Total Expenditures: Actual (Billions of Dollars)	Cyclical Expenditures (Billions of Dollars)	Cyclical Expenditures (Percentage of GDPK)	Unemployment Rate Gap
1951	55.0	54.4	0.6	0.2	-2.0
1952	64.2	63.3	1.0	0.3	-2.3
1953	69.2	68.1	1.1	0.3	-2.4
1954	65.4	65.5	-0.1	-0.0	0.2
1955	67.2	66.9	0.3	0.1	-1.0
1956	70.6	70.0	0.5	0.1	-1.3
1957	78.9	78.4	0.6	0.1	-1.1
1958	84.0	84.9	-0.9	-0.2	1.4
1959	87.9	88.0	-0.1	-0.0	0.0
1960	89.6	89.6	-0.0	-0.0	0.0
1961	95.4	96.1	-0.7	-0.1	1.2
1962	104.3	104.4	-0.1	-0.0	0.1
1963	110.1	110.2	-0.0	-0.0	0.1
1964	115.6	115.4	0.3	0.0	-0.4
1965	123.1	122.5	0.7	0.1	-1.2
1966	142.1	140.9	1.2	0.2	-2.0
1967	162.3	160.9	1.4	0.2	-1.9
1968	181.3	179.7	1.6	0.2	-2.2
1969	192.7	190.8	1.9	0.2	-2.4
1970	210.1	209.1	1.0	0.1	-0.9
1971	228.5	228.6	-0.1	-0.0	0.0
1972	253.3	253.1	0.2	0.0	-0.4
1973	276.5	275.1	1.4	0.1	-1.3
1974	313.1	312.1	1.1	0.1	-0.5

Year	Total Expenditures: HEB (Billions of Dollars)	Total Expenditures: Actual (Billions of Dollars)	Cyclical Expenditures (Billions of Dollars)	Cyclical Expenditures (Percentage of GDPK)	Unemployment Rate Gap
1975	367.2	371.3	-4.1	-0.2	2.3
1976	397.0	400.3	-3.3	-0.2	1.5
1977	434.2	435.9	-1.7	-0.1	0.8
1978	478.6	478.1	0.4	0.0	-0.2
1979	530.7	529.5	1.2	0.0	-0.4
1980	620.4	622.5	-2.0	-0.1	1.0
1981	703.1	707.1	-4.0	-0.1	1.4
1982	770.8	781.1	-10.3	-0.3	3.6
1983	836.0	846.4	-10.3	-0.3	3.5
1984	898.3	902.9	-4.6	-0.1	1.5
1985	971.7	974.2	-2.5	-0.1	1.2
1986	1,024.9	1,027.6	-2.7	-0.1	1.0
1987	1,065.5	1,066.3	-0.8	-0.0	0.2
1988	1,120.1	1,118.5	1.7	0.0	-0.4
1989	1,195.7	1,192.7	3.0	0.1	-0.6
1990	1,286.3	1,284.5	1.7	0.0	-0.3
1991	1,340.3	1,345.0	-4.8	-0.1	1.0
1992	1,479.8	1,479.4	-9.6	-0.1	1.7
1993	1,518.4	1,525.8	-7.3	-0.1	1.1
1994	1,559.0	1,561.4	-2.4	-0.0	0.3
1995	1,636.3	1,634.7	1.6	0.0	-0.1
1996	1,697.6	1,695.0	2.6	0.0	-0.3
1997	1,745.1	1,741.0	4.1	0.1	-0.7
1998	1,778.8	1,771.4	7.4	0.1	-1.1

Table 17

Decomposition of Cyclical Expenditures

Billions of Dollars

Year	Cyclical Expenditures	Unemployment Insurance Benefits	Other	Memo: Extended Unemployment Insurance Benefits	Year	Cyclical Expenditures	Unemployment Insurance Benefits	Other	Memo: Extended Unemployment Insurance Benefits
1951	0.6	0.6	0.0	0.0	1975	-4.1	-3.5	-0.6	5.3
1952	1.0	0.9	0.1	0.0	1976	-3.3	-2.0	-1.3	6.0
1953	1.1	1.0	0.1	0.0	1977	-1.7	-1.1	-0.6	3.6
1954	-0.1	-0.1	0.0	0.0	1978	0.4	0.3	0.2	0.9
1955	0.3	0.4	-0.0	0.0	1979	1.2	0.6	0.6	0.2
1956	0.5	0.5	0.0	0.0	1980	-2.0	-2.0	0.0	1.6
1957	0.6	0.5	0.1	0.0	1981	-4.0	-2.8	-1.3	1.3
1958	-0.9	-0.9	-0.0	0.0	1982	-10.3	-8.1	-2.2	3.5
1959	-0.1	-0.0	-0.1	0.0	1983	-10.3	-7.1	-3.2	7.2
1960	-0.0	-0.0	0.0	0.0	1984	-4.6	-2.7	-1.9	2.3
1961	-0.7	-0.7	-0.0	0.6	1985	-2.5	-2.4	-0.1	0.8
1962	-0.1	-0.0	-0.1	0.2	1986	-2.8	-2.3	-0.4	0.1
1963	-0.0	-0.1	0.0	-0.0	1987	-0.8	-0.5	-0.3	0.1
1964	0.3	0.2	0.0	-0.0	1988	1.7	1.1	0.6	0.0
1965	0.7	0.6	0.1	-0.0	1989	3.0	1.8	1.2	0.0
1966	1.2	1.0	0.2	-0.0	1990	1.7	0.9	0.9	0.0
1967	1.4	1.1	0.2	-0.0	1991	-4.8	-3.7	-1.0	1.0
1968	1.6	1.4	0.2	-0.0	1992	-9.6	-5.9	-3.7	13.5
1969	1.9	1.6	0.3	-0.0	1993	-7.3	-3.7	-3.6	12.0
1970	1.0	0.7	0.3	-0.0	1994	-2.4	-1.2	-1.2	1.8
1971	-0.1	-0.0	-0.1	0.7	1995	1.6	0.5	1.1	0.0
1972	0.2	0.4	-0.2	0.5	1996	2.6	1.2	1.3	0.0
1973	1.4	1.2	0.2	0.0	1997	4.1	3.0	1.1	0.0
1974	1.1	0.6	0.5	0.0	1998	7.4	5.1	2.2	0.0

Note: The temporary portion of extended benefits is not included in cyclical expenditures.

income reached $6,330. It was constant for earned income up to $11,610 and then was phased out at the rate of sixteen cents per dollar until $25,078. Thus, the sign of the elasticity to an increase in earned income depends upon the relative magnitudes of the amount of earnings in the three regions. Most EIC payments go to those in the phase-out range, and a 1 percent increase in incomes would, on net, reduce the EIC by 0.9 percent.[41] Using our earlier result—that a 1 percent increase in NIPA-adjusted personal income raises AGI for nonsingles by 0.8 percent—we obtain the following equation for the cyclical component of the EIC:

$$\Delta EIC = EIC(t)*(100 + YADJGAP(t-1) *0.8*(-0.9))/100,$$

where $YADJGAP$ is the gap of adjusted personal income (in percentage points) and is lagged one year because EIC outlays are paid out largely when tax returns are filed. With refundable credits totaling $24 billion, a 1-percentage-point increase in NIPA-adjusted personal income would reduce outlays by $0.2 billion.

The federal government provides cash benefits for persons with severe disabilities through two programs: the Disability Insurance (DI) program of OASDI and the Supplemental Security Income (SSI) program. Eligibility for the DI program is based on work experience while the SSI program does not require work experience and is means-tested. Econometric evidence indicates that one of the factors that affects applications and awards for these programs is the unemployment rate. While the unemployment rate appears to have a stronger impact on DI applications than it does on SSI applications, the impacts on

Table 18

Current Surplus (+)/Deficit (-)

Year	HEB (Billions of Dollars)	Actual	Cyclical	HEB (Percentage of GDP)	Actual	Cyclical	Year	HEB (Billions of Dollars)	Actual	Cyclical	HEB (Percentage of GDP)	Actual	Cyclical
1951	5.2	10.3	-5.1	1.6	3.1	-1.6	1975	-45.3	-73.9	28.6	-2.7	-4.3	1.7
1952	0.2	4.5	-4.3	0.1	1.3	-1.2	1976	-39.4	-57.2	17.8	-2.1	-3.1	1.0
1953	-2.7	2.4	-5.1	-0.7	0.7	-1.4	1977	-39.2	-46.3	7.1	-1.9	-2.3	0.3
1954	0.3	-1.2	1.5	0.1	-0.3	0.4	1978	-39.8	-31.7	-8.1	-1.8	-1.4	-0.4
1955	2.1	6.3	-4.2	0.5	1.6	-1.0	1979	-26.6	-18.5	-8.1	-1.0	-0.7	-0.3
1956	5.3	8.6	-3.3	1.2	2.0	-0.8	1980	-38.5	-60.9	22.4	-1.3	-2.1	0.8
1957	3.3	4.2	-1.0	0.7	0.9	-0.2	1981	-28.8	-57.8	29.0	-0.9	-1.8	0.9
1958	1.7	-5.5	7.1	0.3	-1.1	1.5	1982	-73.9	-134.7	60.8	-2.1	-3.9	1.7
1959	3.3	2.6	0.7	0.6	0.5	0.1	1983	-110.5	-174.4	63.9	-3.0	-4.7	1.7
1960	9.7	7.3	2.4	1.8	1.4	0.4	1984	-140.8	-156.0	15.2	-3.6	-3.9	0.4
1961	9.5	2.8	6.7	1.7	0.5	1.2	1985	-159.3	-163.0	3.7	-3.8	-3.9	0.1
1962	4.8	2.8	2.0	0.8	0.5	0.3	1986	-174.3	-177.5	3.2	-3.9	-4.0	0.1
1963	6.9	5.3	1.5	1.1	0.9	0.2	1987	-128.0	-128.9	0.9	-2.7	-2.7	0.0
1964	-1.1	0.9	-2.0	-0.2	0.1	-0.3	1988	-136.3	-121.3	-15.0	-2.7	-2.4	-0.3
1965	-3.7	3.4	-7.1	-0.5	0.5	-1.0	1989	-138.7	-113.3	-25.4	-2.6	-2.1	-0.5
1966	-10.6	2.6	-13.2	-1.4	0.4	-1.8	1990	-161.5	-154.7	-6.8	-2.8	-2.7	-0.1
1967	-17.5	-8.3	-9.2	-2.2	-1.0	-1.1	1991	-147.5	-196.1	48.5	-2.4	-3.2	0.8
1968	-14.1	-2.8	-11.3	-1.6	-0.3	-1.3	1992	-229.1	-280.9	51.8	-3.6	-4.4	0.8
1969	-0.7	8.7	-9.4	-0.1	0.9	-1.0	1993	-211.3	-250.7	39.4	-3.2	-3.8	0.6
1970	-10.7	-14.1	3.4	-1.0	-1.3	0.3	1994	-178.6	-186.7	8.0	-2.6	-2.7	0.1
1971	-19.6	-25.4	5.7	-1.7	-2.2	0.5	1995	-170.2	-174.3	4.2	-2.3	-2.4	0.1
1972	-22.8	-20.5	-2.3	-1.9	-1.7	-0.2	1996	-119.8	-110.3	-9.5	-1.6	-1.4	-0.1
1973	-25.6	-11.1	-14.5	-1.9	-0.8	-1.1	1997	-58.0	-21.1	-36.9	-0.7	-0.3	-0.5
1974	-13.6	-16.9	3.3	-0.9	-1.1	0.2	1998	9.3	72.8	-63.5	0.1	0.9	-0.8

awards are equivalent. In each case, a rise in the unemployment rate of 1 percentage point raises awards by 2 percent.[42] In the case of the DI program, new awards represent about 10 percent of the total caseload. For SSI, only half of the caseload is disabled working-age adults (the rest are disabled children and the elderly), and new awards are about 10 percent of this subset of the overall caseload. In 1998, expenditures on these two programs were $50 billion for DI and $30 billion for SSI. Thus, a 1-percentage-point increase in the unemployment rate would boost outlays by $0.1 billion in the DI program and by $0.03 billion in the SSI program.[43]

C. The High-Employment Surplus

As shown in Table 16, in 1998 the actual unemployment rate was 1.1 percentage points below the CBO estimate of the NAIRU, which depressed expenditures by $7 billion, about 0.4 percent of total expenditures (a 4 percent increase in the affected programs).[44] Most of the increase occurred as increased unemployment benefits (Table 17). To put this in context with receipts, a 1 percent fall in GDP is comparable to about a ½ percent increase in unemployment; thus, a 1 percent fall in GDP would boost expenditures by $3 billion, compared with a $30 billion reduction in receipts in the first year.

Table 18 shows the effects of the business cycle on the budget surplus. Over the past decade, the cyclical component of the surplus has swung by 1.5 percentage points of GDP, from adding 0.8 percentage point to the *deficit* in 1992 to boosting the *surplus* by 0.7 percentage point in 1998.

VI. Conclusion

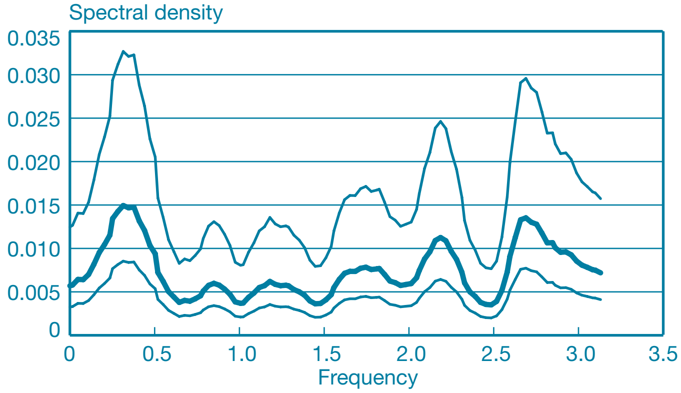
This paper presents theoretical and empirical analysis of automatic fiscal stabilizers, such as the income tax and unemployment insurance benefits. Using the modern theory of consumption behavior, we identify several channels through which the optimal reaction of household consumption plans to aggregate income shocks is tempered by the automatic fiscal stabilizers.

The insurance channel—through which higher anticipated income tax rates reduce the variance of uncertain future after-tax income—is effective, provided that the precautionary motive for saving is important and that individuals understand the implications of the government's intertemporal budget constraint. The wealth channel—in which current income taxes are lower as a result of, say, a recession—is effective if individuals expect government purchases (rather than income tax rates) to adjust to maintain the government's intertemporal budget constraint. This channel can also be effective if the rate used by individuals to discount future income tax hikes exceeds the government's borrowing rate (as in the FRB/US model). The liquidity channel—in which lower current income taxes relax borrowing or liquidity constraints—is effective to the extent that such constraints are in fact binding for a nontrivial fraction of the population.

To bring some evidence to bear on these issues, we present results from several empirical exercises using postwar U.S. data. Using standard time-domain techniques, we estimate elasticities of the various federal taxes with respect to their tax bases and responses of certain components of federal spending to changes in the unemployment rate. Such estimates are useful for analysts who forecast federal revenues and spending; the estimates also allow high-employment or cyclically adjusted federal tax receipts and expenditures to be estimated. Using frequency-domain techniques, we confirm that the relationships found in the time domain are strong at the business-cycle frequencies. Such results suggest the potential for the automatic fiscal stabilizers to play a quantitatively important role in the economic stabilization process.

However, in one large-scale, macroeconometric model of the U.S. economy—FRB/US—the automatic fiscal stabilizers are found to play a modest role in damping the short-run effect of aggregate demand shocks on real GDP, reducing the multiplier by about 10 percent, although they have a somewhat larger damping impact (in percentage terms) on personal consumption expenditures. Very little stabilization is provided in the case of an aggregate supply shock. In light of the findings from the FRB/US simulations, perhaps the title and conclusion of our paper should be "The Automatic Fiscal Stabilizers: Quietly *and Modestly* Doing Their Thing."

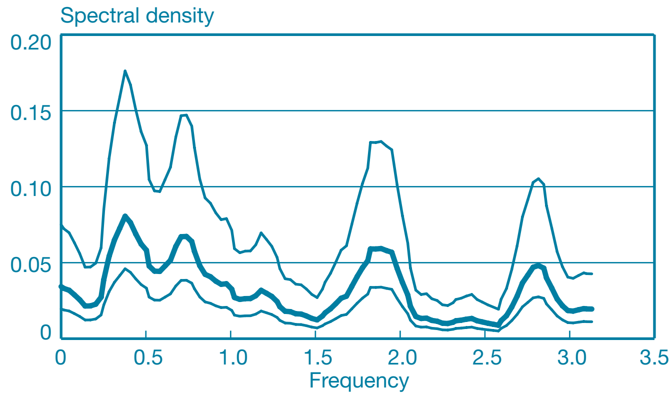
CHART A1
Personal Receipts
Second-Quarter 1946 to First-Quarter 1999



Source: National Income and Product Accounts.

Note: Growth rate, seasonally adjusted annual rate.

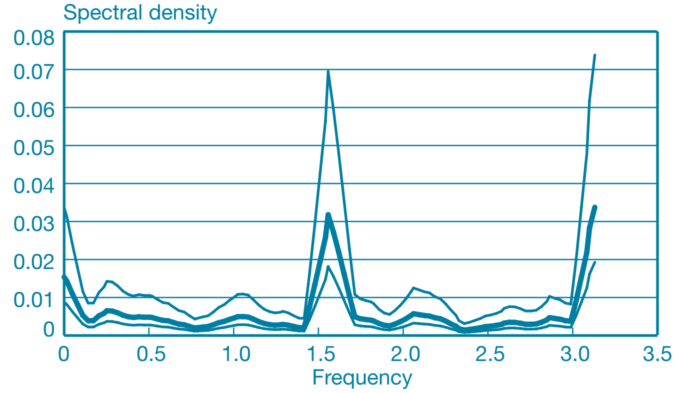
CHART A2
Corporate Receipts
Second-Quarter 1946 to First-Quarter 1999



Source: National Income and Product Accounts.

Note: Growth rate, seasonally adjusted annual rate.

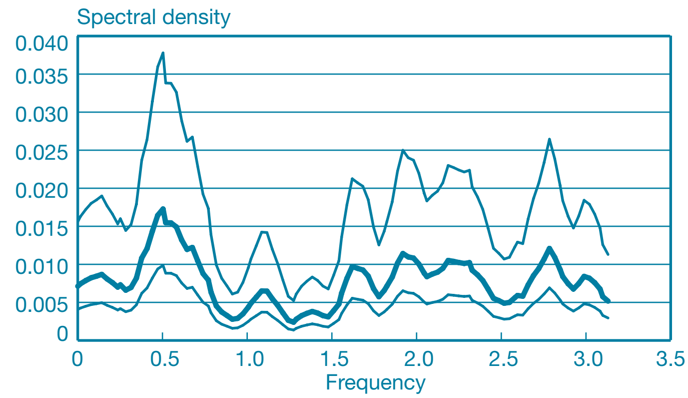
CHART A3
Social Insurance Contributions
Second-Quarter 1946 to First-Quarter 1999



Source: National Income and Product Accounts.

Note: Growth rate, seasonally adjusted annual rate.

CHART A4
Indirect Business Taxes
Second-Quarter 1946 to First-Quarter 1999



Source: National Income and Product Accounts.

Note: Growth rate, seasonally adjusted annual rate.

Chart A5

Growth Rate of Personal Income Taxes and Growth Rate of Tax Base

Second-Quarter 1946 to First-Quarter 1999

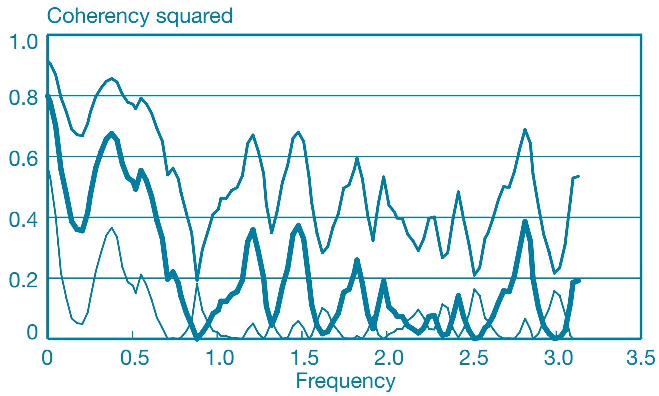


Chart A6

Growth Rate of Corporate Taxes and Growth Rate of Tax Base

Second-Quarter 1946 to First-Quarter 1999

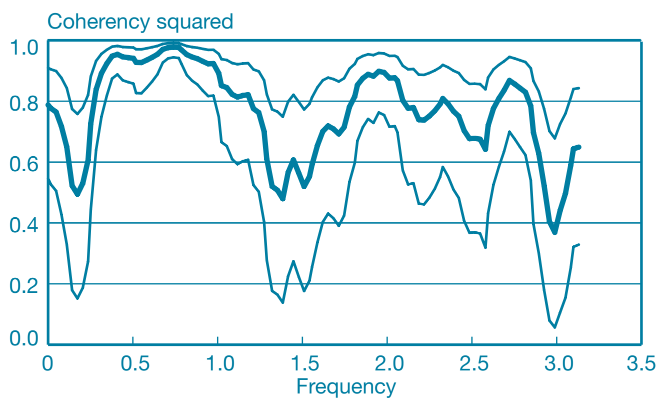


Chart A7

Growth Rate of Social Insurance Contributions and Growth Rate of Tax Base

Second-Quarter 1946 to First-Quarter 1999

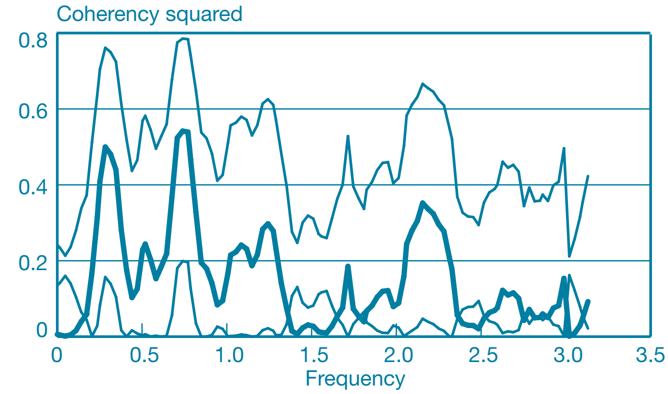


Chart A8

Growth Rate of Indirect Business Taxes and Growth Rate of Nominal GDP

Second-Quarter 1946 to First-Quarter 1999

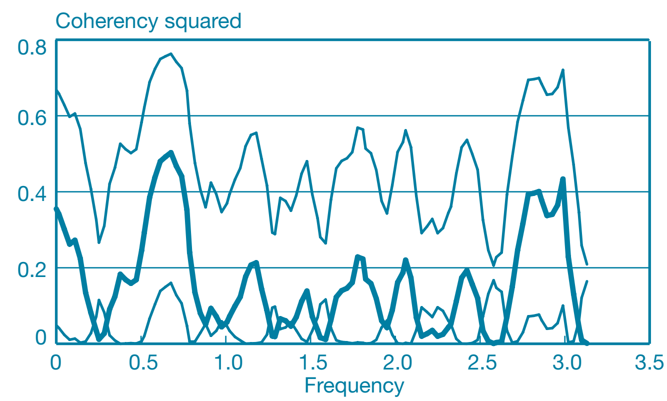
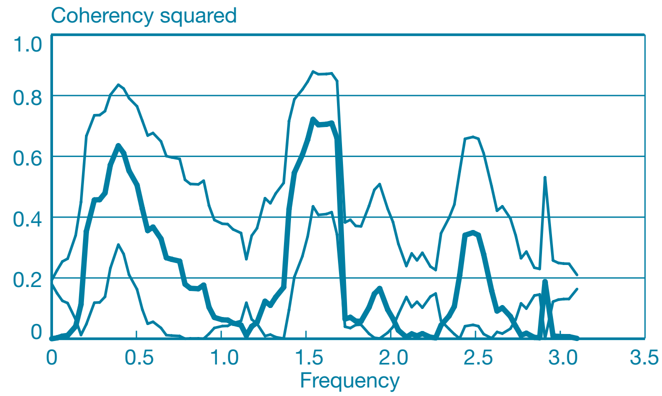


CHART A9

Growth Rate of Withheld Taxes and Growth Rate of Nominal GDP

First-Quarter 1955 to Fourth-Quarter 1997

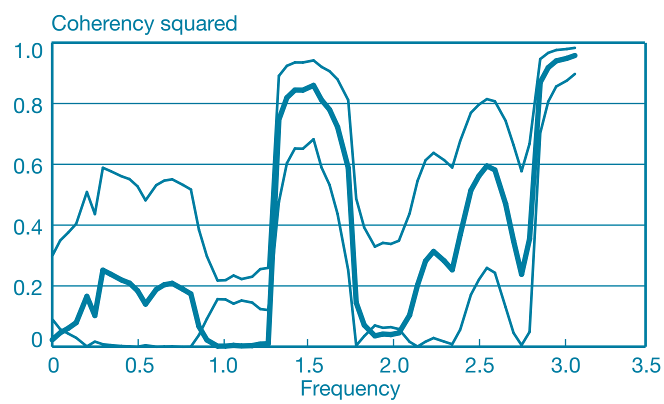


Note: Not seasonally adjusted.

CHART A10

Growth Rate of Declarations and Growth Rate of Nominal GDP

First-Quarter 1968 to Fourth-Quarter 1997

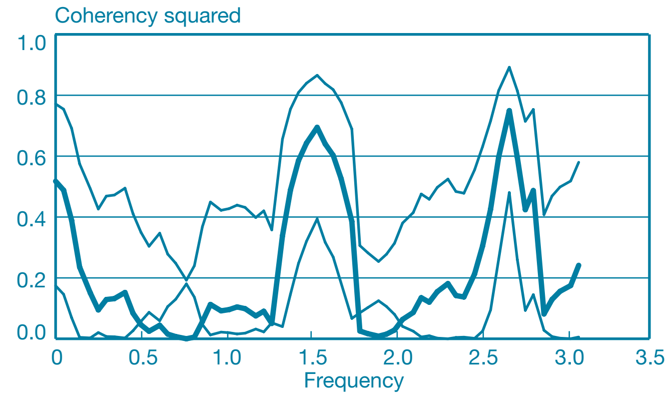


Note: Not seasonally adjusted.

CHART A11

Growth Rate of Final Payments and Growth Rate of Nominal GDP

First-Quarter 1968 to Fourth-Quarter 1997

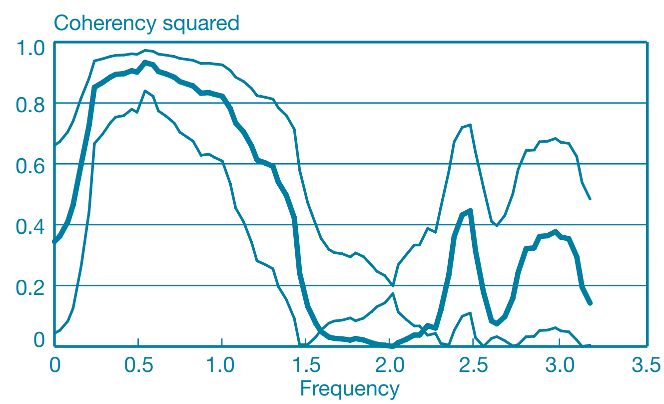


Note: Not seasonally adjusted.

CHART A12

Unemployment Insurance as a Percentage of Nominal GDP and the Unemployment Rate

Second-Quarter 1959 to First-Quarter 1997



Endnotes

1. For an opposing view, see Atkeson and Phelan (1994).

2. One notable exception is Auerbach and Feenberg (1999).

3. Blinder and Solow (1974) do not evaluate automatic fiscal stabilizers under the assumption of rational expectations. In a rational expectations macroeconomic model, McCallum and Whitaker (1979) establish that automatic stabilizers can be effective at stabilizing output; however, like those of Blinder and Solow, their results are not based on an explicit set of optimizing models for consumers and firms.

4. The basic Keynesian model result—that the automatic stabilizers, in fact, stabilize—obviously does not hold in versions of the model in which the aggregate demand multiplier is zero and stabilization is unnecessary. For example, the automatic stabilizers are irrelevant when there is a completely inelastic aggregate supply of goods (the full-employment version of the model) or flexible exchange rates. In these cases, flexible wages, prices, or exchange rates do the stabilizing.

In addition to possibly being irrelevant, the automatic stabilizers may be a destabilizing force. An example involves forward-looking expectations (and thus deviates from the basic Keynesian framework). If an income tax rate is varied countercyclically (but not completely automatically, if Congress must first recognize that a recession is under way), employed households may optimally reduce labor supply at the start of a recession (in response to an anticipated increase in after-tax wages), further reducing output. Similarly, if an investment tax credit were varied countercyclically, firms might postpone investments at the start of a recession and accelerate them during booms, thereby exacerbating cyclical fluctuations.

5. Indeed, it is not clear how best to incorporate (expected) future taxes into the basic Keynesian framework; perhaps the present discounted value of the tax stream could be included as a component of private nonhuman wealth, itself a determinant of consumption demand. Alternatively, one could modify the simple textbook model to allow for dynamic and forward-looking elements along the lines of Blanchard (1981).

6. Chan (1983) and Christiano (1984) both allow for households to invest in a private, risky asset. We abstract from such investment opportunities. Also, implicitly households are allowed to borrow and lend at the risk-free interest rate, r.

7. A way to motivate this setup is found in Aschauer (1985). In his model, utility is a function of effective consumption in period i, C^*_i, defined as $C_i + \theta_i G_i$, where θ_i is positive if C and G are substitutes. That is, for a given level of effective consumption, an additional unit of government spending will induce the individual to reduce private consumption by θ units. Defining $U_1 = \partial U / \partial C^*_1$, $\partial U_1 / \partial G_1 = U_{11} \partial C^*_1 / \partial G_1 = U_{11} \theta_1 < 0$ since $U_{11} < 0$. $\partial U_1 / \partial G_1 < 0$ corresponds to our assumption $U_{13} < 0$.

8. For example, if income falls temporarily by $100, personal consumption should fall by about $5 (given econometric estimates of the marginal propensity to consume out of wealth); with a 20 percent income tax rate, taxes and hence government purchases would fall by $20. Thus, investment would fall by $75. The decline in investment likely will be larger if future income taxes are raised, rather than if government purchases are reduced, to maintain a budget balance.

9. The elasticity estimated in FRB/US probably captures discretionary changes in the tax code as well as endogenous changes in receipts.

10. When fully rational (rather than VAR) expectations are incorporated into the simulations, the model assumes that the government's intertemporal budget constraint is satisfied by altering future income tax rates to stabilize the government's debt-to-GDP ratio.

11. In addition, after-corporate-tax cash flow has a positive impact on investment in producers' durable equipment and on personal consumption expenditures (via stock market wealth) in FRB/US. However, these channels of influence play only a minor role in the subsequent simulation results.

12. Note that there can be a slight tension between the expected federal funds rate generated by the VAR system and the "actual" federal funds rate resulting under either of the two monetary policy assumptions; that is, policy misperceptions are possible, at least in the short run.

13. Note that the table shows increases in the *percentage* deviation from baseline in real PCE; this translates into an increase in the PCE "multiplier" from about 0.2 to 0.3.

14. Although we have not explicitly considered non-oil-price supply shocks, results reported in Reifschneider, Tetlow, and Williams (1999) suggest that the role of the automatic stabilizers in the face of other supply shocks would differ somewhat from those described above. For example, in FRB/US, a productivity shock affects supply and demand (the latter by altering permanent income) and thus the impact of the automatic stabilizers on model multipliers would be intermediate to the separate demand and supply shock cases considered above.

15. The idea is that the sensitivity of the output gap (actual minus potential) with respect to an aggregate supply shock is greater the stronger the automatic stabilizers are in a simple textbook model of aggregate demand and supply. For example, with a negative aggregate supply shock that reduces desired output, actual output will also decline as prices rise; however, the price rise will be smaller—and hence the narrowing of the output gap more limited—the stronger the automatic stabilizers are.

16. See the appendix in Cohen (1999) for a review—aimed at the practitioner—of the key results of spectral analysis used in this paper as well as references to the literature.

17. We utilize PROC SPECTRA from SAS to generate the basic spectral densities and squared coherencies. We use kernel estimation of the spectrum with a bandwidth parameter of 4. The respective 95 percent confidence bands were programmed by us. On rare occasions, the squared coherencies will lie outside the lower 95 percent confidence band; this is possible because of the squaring operation.

18. Furthermore, as shown in Cohen (1999), other federal transfer programs—such as Social Security, Medicare, Medicaid, and Food Stamps—have low squared coherencies with the unemployment rate at business-cycle frequencies, implying that these programs are weak automatic stabilizers at best.

19. The CBO data are based on Bureau of Economic Analysis (BEA) estimates of GDP before the comprehensive revision, which was published in October 1999. Our estimates use the same data.

20. Indeed, this was a problem for deLeeuw et al. (1980), which they addressed by using time trends. Our difference approach creates stationary series and does not rely on deterministic time trends. That said, levels specifications, using cubic-spliced time trends, yield similar results for the coefficients on the $GDPGAP$ terms.

21. Using the annual Statistics of Income (SOI) data on tax liabilities implies that we are estimating a liability elasticity. Both the NIPA budget estimates and the unified budget record taxes on a payments basis. Our estimates may not capture the precise timing of the changes in payments being estimated. For example, during a downturn in the economy, tax payments may be accelerated relative to liabilities.

22. Simplifying to the case where AGI equals adjusted personal income ($E_{agi} = 1$), equation 16 is obtained by taking the total differential of the tax function, $T = F(n, y)$—which implicitly allows tax revenues to respond differently to changes in the number of returns and changes in income per return—and dividing the resulting expression by the total differential of the aggregate income function, $AGI = n*y$, all multiplied by AGI/T.

23. The elasticity of each group equals the slope of the line traced out by the natural logarithms of average taxes and average income. The slope for an AGI group is estimated by calculating the derivative of the parabola defined by three points consisting of the group and the groups above and below.

24. Some deductions—mortgage interest, for example—may be more closely related to permanent income than cyclical income while other deductions—such as state and local income taxes—are closely related to cyclical income. Thus, our calculations may understate the true cyclical marginal tax rate. The lower tax rate for capital gains may also unduly reduce the effective cyclical marginal tax rate to the extent that realizations do not reflect cyclical factors.

25. The chief problem is that the weights become unstable when the gaps are very small. By contrast, our 0.5 estimate is consistent with the swings in the gaps—and the weights—from business-cycle peaks to troughs throughout the sample period. For example, we estimate that the gap in the number of returns swung from -1.0 in 1989 to 1.6 in 1991, while the gap in the average income per return swung from -0.5 to 2.0 over the same period. Thus, the changes in the gaps were approximately equal. Similar results were obtained across earlier business cycles.

26. In addition, there is a small amount collected for veteran's life insurance, workmen's compensation, CHAMPUS (the military health program for dependents), and private employer pension benefits (PBGC premiums).

27. The elasticity of federal employee retirement contributions is assumed to be zero because there have been no endogenous changes in federal employment or pay owing to the business cycle. The income elasticity of SMI is approximately zero because Medicare status is based largely on age.

28. Our analysis indicates that the distribution of income between those above the taxable wage cap and those below the cap is not sensitive to the business cycle. We developed two parameters that are sufficient to describe the distribution of wages to make OASDI tax calculations—the share of wage earners below the cap, and the ratio of wages of those above the cap to those below the cap. The former is not

Note 28 continued
correlated with the business cycle; the latter has only a weak correlation. Thus, we ignore cyclical sensitivity of the income distribution.

29. For example, in 1997 6 percent of the self-employed had income exceeding the caps, and they earned 21 percent of total self-employed income. Among wage earners, only 5 percent were above the caps, and they earned 14 percent of total income.

30. Program specifics are legislated at the state level subject to general federal criteria as well as strong incentives to tax at least $7,000.

31. This exercise may also capture legislated changes by state governments in response to UI trust fund reserves.

32. This step is identical to the deLeeuw et al. (1980) procedure, which has potential econometric problems as the adjustments and potential GDP are nominal values in level terms. “Share style” equations showed no explanatory power.

33. The elasticity tends to fall during recessions owing to the rise in losses.

34. deLeeuw et al. (1980) estimated that the elasticity of the tax code declined from 0.08 in 1955 to 0.02 in 1979. We have assumed that it has remained at that level.

35. Medicare enrollments are insensitive to business-cycle fluctuations because enrollment is based largely on age. OASI enrollments and outlays are boosted during recessions because some workers take early retirement when faced with poor employment prospects. This factor would raise benefit payments by about 0.3 percent for each percentage-point change in the unemployment rate. However, OASI payments are held down by the effects of previous recessions because the additional claimants from those recessions receive lower benefits than they would have if they had retired at the normal age. Given that the present value of the benefit stream is approximately the same for those who take early retirement as it is for those who retire at age sixty-five, we have assumed that the net cyclical effect for the government is zero.

36. Until the extended benefits program is triggered by high levels of unemployment, an increase in the unemployment rate will have little effect on these expenditures. For example, in 1982 $2.5 billion was spent on extended benefits, but only $0.3 billion was spent in 1991, largely because the latter recession was milder.

37. This result appears to be dependent on the states included in the sample. The reported result is obtained when the sample is limited to the nineteen states that provided the AFDC-UP program continuously over the 1975-95 period. When the sample is enlarged to include states that were forced to initiate the program in the 1990s, the unemployment rate becomes insignificant.

38. The zeroing out of welfare abstracts from the small contingency program ($2 billion over five years) for states with high and rising unemployment.

39. The rest appears as lower taxes and is captured by our tax elasticity estimates.

40. The regressions for the personal income tax indicated that the number of nonsingle filers is not sensitive to the business cycle and the lion’s share of EIC beneficiaries is nonsingles.

41. The actual elasticity for the expenditure portion may be smaller, as the refundable portion (about $24 billion of the $28 billion in 1996) would be less heavily weighted in the phase-out region.

42. See Rupp and Stapleton (1995).

43. These calculations ignore any hysteresis that is probably especially evident in the DI program, where few leave the rolls. But if the rolls do tend to ratchet up over time, it is not clear that the increases owing to recessions should be included in cyclical measures.

44. The ultimate effect would be somewhat larger owing to the lagged response of these programs.

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