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# Fiscal Policy and Uncertainty*

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**Abstract**

**Government fiscal aggregates are often manipulated over the course of the business cycle in order to provide counter-cyclical stimulus. Changes that are not discretionary – the so-called 'built-in stabilizers' – also significantly vary over the business cycle, in a manner that is even more predicatable than the periodic discretionary measures.**

**Such measures introduce important bi-directional interactions between policy and uncertainty. On the one hand, activist policy may heighten the general level of uncertainty in the economy, by adding policy ambiguity to the more fundamental sources of uncertainty. On the other hand, the design of optimal policy itself depends crucially on levels of uncertainty concerning the state of the economy in the short and long run. In this paper we review recent work that explores the impact of uncertainty on optimal policy design, proceeding from the short to the long run.**

## I. Introduction

On 9 March 2002, President Bush signed the Job Creation and Worker Assistance Act. The Act included a temporary increase in depreciation

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allowances for business spending on equipment and software, in the form of 30% partial expensing. At the time, the motivation of the Act was that it would provide fiscal stimulus that could help the economy to recover from the first recession in a decade. Such fiscal actions are the rule rather than the exception. Indeed, Cummins et al. (1994) document that Congress introduced or modified the investment tax credit (ITC) in the majority of post-war US recessions prior to the recent one. Less frequent, but also important, have been discretionary changes in personal income tax rates that are intended to shorten recessions. The tax reduction passed in 2001, for example, was described by its advocates as an 'insurance policy' against a long recession. In addition, changes in government fiscal aggregates that are not discretionary – the so-called 'built-in stabilizers' – also significantly vary over the business cycle, in a manner that is even more predictable than the periodic discretionary measures.

Such measures introduce important bi-directional interactions between policy and uncertainty. On the one hand, activist policy may heighten the general level of uncertainty in the economy, by adding policy ambiguity to the more fundamental sources of uncertainty. On the other hand, the design of optimal policy itself depends crucially on levels of uncertainty concerning the state of the economy in the short and long run, and on the impact of a policy proposal on that uncertainty.

In this paper, we discuss recent research that has shed new light on these interactions, proceeding from the short to the long run. We first investigate a number of different channels through which short-run policies can influence the economy. Our analysis gives primary attention to investment behaviour at the outset, because the Permanent Income Hypothesis offers less room for temporary tax policy to change consumption, and because of space constraints. In the first channel, expected changes in tax rates alter the time pattern of the level of the marginal incentive to invest, inducing predictable swings in the level of investment – the 'first moment' effect. We discuss, in detail, a model that allows investigators to identify the direct effect of policy on investment, and describe the relative impact of permanent and transitory policies. We then turn to the question of 'automatic' stabilizers, i.e. policies that provide a short-term stimulus in downturns that are built in to the tax system. To the extent that these are successful, they can lower volatility and uncertainty in the economy, without introducing new policy uncertainties.

Finally, short-run policies often interact in important ways with long-run commitments, with large low-frequency imbalances providing 'third rail' constraints on the ability of policy makers to pursue counter-cyclical policies. For example, in the most recent US stimulus debate, many observers argued that the looming bankruptcy of the Social Security system made new tax cuts unwise, while others argued that the imbalances are so uncertain that they can be ignored. Drawing on our recent research (Auerbach and Hassett 2002), we discuss the impact that constraints on long-run government policy may exert on the nature of optimal countercyclical policy.

## II. Discretionary Fiscal Policy and the Business Cycle

While the theoretical response of the economy to tax cuts depends on monetary policy as well as fiscal policy, economists who have analysed the history of US tax policy have generally found that the stimulus associated with a tax cut is 1–2 times the size of the cut.[1] In other words, policy can have a large effect on the economy.

Yet, there appears little evidence that fiscal policy has successfully counteracted recessions. For example, in a detailed historical analysis of the US post-war period, Romer and Romer (1994) found that fiscal measures, generally, have failed to push the economy out of recession because those measures that had the right timing have typically been too small to have had much of an effect on the probability of exiting a recession. Indeed, large fiscal stimulus packages have generally not been passed near cyclical troughs. Instead, they have historically emerged only because of slow recoveries, as was the case, for example, with the 1964 tax cut. Since delayed tax cuts generally arrived when the economy was recovering on its own, these large stimulus packages were ill-advised. Such a sequence of events was likely repeated in 2002, when the stimulus bill was passed 3–4 four months after the likely end of the recession.[2]

The view that a stimulus *could* be effective is not necessarily an endorsement or confirmation of traditional Keynesian tax policy, driven by consumption responses of liquidity-constrained or myopic agents, as tax changes also influence the incentive to invest. Indeed, recent evidence suggests that the consumption response to temporary tax cuts may be modest; see, for example, Shapiro and Slemrod (2001). Investment, a much more cyclically volatile component of output, is responsive to tax policy and, contrary to consumption, is likely to be more responsive when tax policy is perceived to be temporary.

It will be useful to begin with a brief review of the theory of how taxes affect investment. In the most basic theoretical set-up envisioned by Hall and

[1]See, for example, Blanchard and Perotti (1999), who find that the tax effect on output peaks in 5–7 quarters.

[2]One possible reason for the delay is that the official dating of the NBER significantly lags the actual turning points. Chauvet et al. (2002), for example, find that the real-time data mark the end of the recession in January 2002. They propose a government statistical bureau begin reporting recession probabilities from a nonlinear time-series filter originally developed by Hamilton. Using their preferred model and unrevised real-time data, they are able to announce peaks on average two months before the NBER, and troughs six months before. If such a procedure becomes commonplace, fiscal policy may have a better chance of achieving success.

Jorgenson (1967), firms choose an optimal capital stock at each instant and the tax law does not change over time. In this case, maximization of the present discounted value of after-corporate-tax cash flows over an infinite horizon implies that the pretax nominal value of the gross marginal product of capital today equals today's user cost of capital, *c*, is given by

$$c = \frac{q}{p}\left(\rho + \delta - \frac{\Delta q}{q}\right)\frac{1 - k - \tau z}{1 - \tau} \tag{1}$$

where $p$ is the price of output, $q$ is the price of new capital goods, $\rho$ is the nominal discount rate, $\delta$ is the exponential rate at which capital actually depreciates, $k$ is the investment tax credit, $\tau$ is the corporate tax rate, and $z$ is the present value of depreciation allowances per dollar of capital purchased.

According to this theory, taxation affects the incentive to invest in a straightforward manner, with increases in the corporate tax rate raising the cost of capital and discouraging investment (assuming that $z < 1$) and increases in the investment tax credit or the present value of depreciation allowances lowering the cost of capital and encouraging investment. Indeed, if one modifies the assumptions to incorporate changes in tax policy, it is evident that temporary tax changes can significantly stimulate investment even if the tax change occurs for only one period. In this case, the Hall–Jorgenson user cost of capital becomes (Auerbach 1983)

$$c = \frac{q}{p}\left(\rho + \delta - \frac{\Delta\left[q(1-\Gamma)\right]}{q(1-\Gamma)}\right)\frac{1-\Gamma}{1-\tau} = \frac{q}{p}\left(\rho + \delta - \frac{\Delta q}{q}\right)\frac{1-\Gamma}{1-\tau} + \frac{q}{p}\frac{\Delta\Gamma}{1-\tau} \tag{2}$$

where $\Gamma$ equals the sum of the investment tax credit and the present value of tax savings from depreciation deductions. This sum equals $k + \tau z$ if $\tau$ is constant over time. If $\tau$ is expected to change over time, then the present value of tax savings from depreciation deductions is not the simple product of the current value of $\tau$ and the present value of depreciation deductions, $z$.

According to (2), the price of capital goods is effectively the underlying price, $q$, multiplied by a factor that nets out the tax benefits associated with the purchase of capital, $\Gamma$. The presence of the additional term on the right-hand side of (2) means that there are now two ways in which tax policy may affect investment: first, as already discussed, it can affect the overall level of desired capital, given a constant tax regime; second, if the regime is expected to change, it may encourage firms to alter the timing of their capital purchases. It is reasonable to suppose that firms and investors have anticipations about changes over the coming period in the tax-adjusted price of new capital goods and may be motivated to accelerate purchases into this year if a favourable tax environment is expected to become less favourable. Indeed, a change such as the elimination of an investment tax credit has a powerful effect on the user cost as computed from (2).

To study these acceleration affects, though, a model that assumes instantaneous capital stock adjustment is inadequate. Although there are many ways to recognize the realistic situation that investment cannot respond immediately and fully to changes in the economic environment, the most common approach in the literature is to assume the presence of adjustment costs. Theoretical models that incorporate adjustment costs commonly assume that the cost of adjustment rises at an increasing rate with the level of capital expenditures, implying that it is desirable for the firm to spread the expenditures over time. Moreover, expectations of future changes in the incentive to use capital in production lead to immediate changes in investment, so as to minimize the adjustment costs incurred in closing the gap between the current and future desired capital stocks.

As shown in Auerbach (1989) and Auerbach and Hassett (1992), the presence of adjustment costs causes the desired capital stock at date $t$ to vary inversely with the weighted average of the current and expected future user costs of capital,

$$c_t^* = E_t \sum_{s \geqslant t} w_{s-t} c_s \tag{3}$$

where the weights, $w_i$, sum to unity. Since the weights also decline exponentially, expected changes in the distant future will have relatively small effects on the current value of the user cost, $c_t^*$. Also, the rate at which the weights decline varies with the marginal cost of adjustment and with other fundamental parameters such as depreciation and the discount rate. Intuitively, with low adjustment costs, the weight applied to near-term values of the user cost is relatively high so that current investment is not much affected by expected future values of the cost of capital. At the limit, with no adjustment costs, we have the Hall–Jorgenson case in which current investment depends only on the current cost of capital, as presented in expression (2). By contrast, high adjustment costs lower the weight applied to relatively near-term levels of the user cost relative to levels in the more distant future, implying a greater sensitivity of current investment to future user costs. This is because investment is very sluggish; decisions regarding today's investment must therefore take account of the desirability of using capital far into the future.

Expression (3) for the weighted sum of user costs has some straightforward implications. If the user cost suddenly changed today – for example, because of a change in tax law designed to deliver the economy from recession – and this change were expected to last indefinitely, then the weighted average is simply the new current value (because the weights add to unity). However, if today's change in the user cost is not expected to persist – for example, because the change in tax law is expected to be temporary – then the user cost relevant for current investment must reflect this anticipation.

There will be two offsetting effects of this lack of permanence that may be illustrated with the case of a temporary investment incentive: first, the future removal of the incentive to invest encourages the firm to time the purchase of capital to occur before the incentive is removed, thus encouraging a change in the timing of investment to the present; second, though, the incentive to use capital in the future will be lower than at present, and this attenuates the incentive to purchase capital now, for it will be less desirable to have on hand in the future. Normally, we would expect the former effect to dominate and boost investment during the period that the new tax incentive is in play, but, for high enough adjustment costs, a temporary tax change may have a minimal impact on current investment.

The possible effects of temporary incentives can be illustrated with the new US law passed this year, which increases the present value of depreciation allowances, $z$, by allowing purchases of new equipment and software to receive a tax deduction of 30% of the cost in the first year the asset is placed in service. The remaining 70% is recovered according to pre-existing law. Cohen et al. (2002) show that this lowers the user cost for equipment by approximately 2%, ignoring the 'use it or lose it' provision associated with the temporary measure. Intuitively, investment in years 1–3 should be boosted by the incentive effect of lower user costs, with the largest effect being realized in the third year as investment is pulled forward in time when capital is at its cheapest. However, the previous discussion highlights that there is an offsetting effect that mitigates the desire to invest currently.

Is it possible that the current investment incentive is smaller than if the 3-year expensing provision had been made permanent? Mechanically, this might happen if the weight on the future user costs is high enough relative to the weight on the near-term user costs. Theoretically, however, the possibility of this result depends crucially on what appear to be relatively arbitrary assumptions concerning the adjustment cost function. For example, in a model of investment with convex adjustment costs, Abel (1982) shows that a temporary tax change has *at least as large* an effect as a permanent tax change of equal size on current investment, thus ruling out the possibility that the permanent effect is larger. The same weak inequality holds in the specification of Auerbach and Hassett (1992). Yet, Auerbach (1989) finds that a reversal is theoretically possible. The three papers differ in the specification of adjustment costs: Abel assumes that costs relate to the level of investment; Auerbach that costs relate to the ratio of investment to capital; and Auerbach and Hassett that the costs relate to investment and capital separately.

That three similar specifications – which would be difficult to distinguish empirically – could lead to different theoretical predictions suggests that,

**Table 1: Percentage Change of User Cost with Respect to Old Law**

| Asset life | (1) $\omega$* | (2) New law | (3) 1-year | (4) Permanent | (5) Uncertain policy** |
|---|---|---|---|---|---|
| 7 year | 0.3 | –3.56 | –11.64 | –2.8 | –3.18 |
| | 0.5 | –4.19 | –8.30 | –2.8 | –3.49 |
| | 0.7 | –3.84 | –4.96 | –2.8 | –3.32 |
| 5 year | 0.3 | –2.49 | –6.99 | –2.06 | –2.28 |
| | 0.5 | –2.78 | –5.01 | –2.06 | –2.42 |
| | 0.7 | –2.53 | –2.99 | –2.06 | –2.29 |
| 3 year | 0.3 | –1.32 | –2.94 | –1.18 | –1.25 |
| | 0.5 | –1.39 | –2.11 | –1.18 | –1.29 |
| | 0.7 | –1.23 | –1.25 | –1.18 | –1.21 |

*Source*: Cohen et al. (2002)
*$\omega$ is the weight on future user costs.
**Users believe there is a 50% chance of the new law becoming permanent and a 50% chance of it remaining a temporary tax break.

ultimately, the relative strengths of temporary and permanent tax changes must be resolved empirically, through estimates of the weight of future capital costs on investment decisions.

Table 1 summarizes the immediate fiscal stimulus for different assets associated with the latest bill, for a variety of assumptions about the weight placed on future capital costs and the permanence of the tax change. The weights on future capital costs reflect a plausible range, based on the estimates in Auerbach and Hassett (1992).

Table 1 illustrates how, with significant weight on future capital costs (a value of $\omega = 0.7$), there is relatively little difference between permanent and temporary incentives. However, for a lower value of $\omega$, the temporary nature of an investment stimulus can dramatically increase its fiscal effect. For example, from the first row, a permanent 30% expensing measure would reduce the user cost by 2.8%, but a 1-year temporary expensing measure would reduce it 11.64%. The final column in the table reflects the fact that investors are not endowed with perfect foresight and hence they must base investment decisions on expectations of future policy. While the table provides illustrative calculations under the plausible assumption that investors assign equal weight to the provision elapsing as enacted and remaining in place permanently, actual expectations ought to be informed by past policy patterns; one could also use such patterns in forming alternative estimates of expectations-based user costs (Auerbach and Hines 1988). Similar analysis would suggest that temporary ITCs of past cycles might well have had a significant impact on aggregate investment, particularly given the relatively large responsiveness of investment to the user cost of capital – elasticities between 0.5 and 1 – estimated by Auerbach and Hassett (1991) and Cummins et al. (1994).

However, the stimulus of investment tax credits often lasted well past the end of the recession. Did the credits tend to push at the wrong times? To evaluate whether tax policy stabilized investment, we turn to a discussion of this question based on Auerbach and Hassett (1992).

Given an estimated impact of the user cost on investment, a simple approach to analysing whether tax policy stabilized investment would be to consider whether tax-induced changes in the user cost reduced some measure of investment fluctuations, say the variance of investment. There are two significant problems one must confront, though: first, the *expected* tax rate may be correlated with the contemporaneous shock to investment, if policy reacts to shocks to the investment process; second, observed, *ex post* costs of capital are not the true expected values.

We constructed a measure that, conditional on a set of variables used to forecast future investment and user costs, measured the extent to which investment policy has been stabilizing as a function of the coefficient estimates and the correlation of the user cost and investment over time. Applying these bounds to post-war US data, we found that tax policy had been, on balance, destabilizing – the entire range of estimates was positive, indicating that tax policy fluctuations had increased the variance of investment. This accords well with the conventional wisdom that stimulus bills have – like the most recent one – tended to be passed too late.

To summarize, temporary tax measures could, in principle, have a very large positive effect on investment during recessions. Actual experience, however, suggests that these have not been timed very well.

## III. Built-in Stabilizers

One reason that discretionary spending may be ill-timed is that it often takes many months for a bill to be signed into law. Automatic stabilizers are those elements of fiscal policy that operate without any explicit government action. From the traditional Keynesian perspective, automatic stabilizers could include any components of the government budget that act to offset fluctuations in effective demand by reducing taxes and increasing government spending in recession, and doing the opposite in expansion. Perhaps the most commonly discussed automatic stabilizer is the federal income tax. A progressive income tax with high marginal tax rates reduces fluctuations in after-tax income, without the need for any explicit policy changes. Moreover, automatic stabilizers avoid the slow implementation that can cause discretionary policy to lag so far behind events.

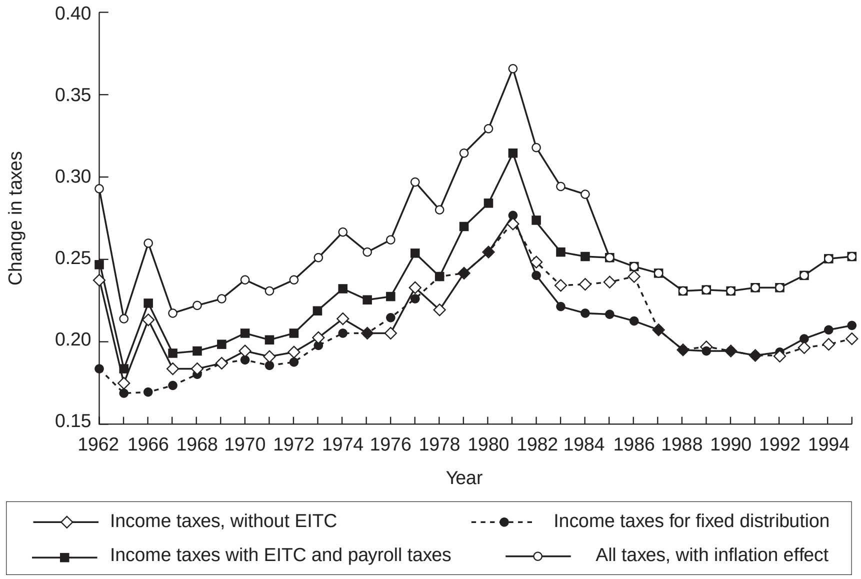
Automatic stabilizers 'kick-in' when a shock causes aggregate economic activity to fall or rise. If fiscal policy is to stimulate aggregate demand without doing so directly through government purchases, it must do so by stimulating private purchases. This may occur through an increase in disposable income, or through a change in some marginal incentive.

However, the effectiveness of an automatic stabilizer depends not only on how much of an increase in disposable income it produces, but also on how large a private response in consumption this increase in disposable income generates. This response, in turn, will depend on how the increase in disposable income is distributed, for households with different income levels will differ in the extent to which they spend increases in current disposable income. Since an automatic stabilizer effect is of necessity temporary, this latter observation is crucial.

In the public finance literature, perhaps the most familiar measure of the sensitivity of taxes to income changes is the elasticity of aggregate income taxes with respect to changes in aggregate income. A proportional income tax has an elasticity of 1.0, while progressive tax systems whose tax–income ratios increase with income have an elasticity greater than 1.0.

For purposes of measuring the tax system's role as an automatic stabilizer, the income elasticity of taxes has a severe shortcoming: it is invariant with respect to whether the share of income taken as taxes is high or low. If taxes take a large share of the economy, they will be more able to act as an automatic stabilizer than if they take a smaller share A more direct measure of the potential stabilization effect of the tax system is the ratio of the change in taxes with respect to a change in before-tax income; i.e. the ratio of the changes not expressed, as in the case of the elasticity, in percentage terms. Pechman (1973) refers to this measure as the tax system's 'built-in flexibility' and that Auerbach and Feenberg (2000) refer to it as the 'normalized tax change'.

Figure 1 presents estimates of this ratio for income tax, for the period 1962–95. The figure indicates that built-in stabilizers have been a fairly important stabilizing influence, in terms of their impact on after-tax income. The basic income tax without the Earned Income Tax Credit (EITC) has served to cushion 18–28% of the fluctuations in before-tax income over the sample period. The second series in Figure 1 repeats the exercise of the first series, but holds the distribution of income constant at that of the 1980 tax year. This hypothetical experiment was implemented by applying the tax law for each respective year to the 1980 sample of individual tax returns, with incomes and income-related deductions adjusted to reflect the ratio of that year's aggregate adjusted gross income to the adjusted gross income for 1980. In the 1960s, the normalized tax change would have been lower had the 1980 income distribution prevailed, which indicates a greater share of income among those in higher brackets – a more unequal distribution – during these very early years of the sample. This pattern reverses by the mid-1970s, with the gap between




*Source*: Auerbach and Feenberg (2000)

**Figure 1:** The change in taxes with respect to before-tax income

the two series reaching relative peaks in 1978 and 1986, relatively early in the well-documented period of increasing income inequality that ensued. However, the trend in more recent years is weak, surprising perhaps in light of the underlying movement in the income distribution. The third series in the figure is a reprise of the first, with varying income distribution, but now the EITC and payroll tax are added. Overall, the payroll tax increases the normalized tax change substantially, particularly in later years. By 1995, roughly one-sixth of the overall tax response is attributable to the payroll tax.

The final series shown in Figure 1 takes into account the indirect effects of inflation on tax payments. The existence of a short-run Phillips curve implies that a decline in the rate of economic activity, as represented by a rise in the unemployment rate, will be associated with a fall in the inflation rate. Prior to the indexation of the federal income tax, in 1985, inflation raised the *real* value of taxes paid, so a reduction in the rate of inflation would have decreased this effect, adding to the stabilizing impact of the tax system. The impact of this additional effect is, as expected, to raise the normalized tax response in the years prior to 1985.

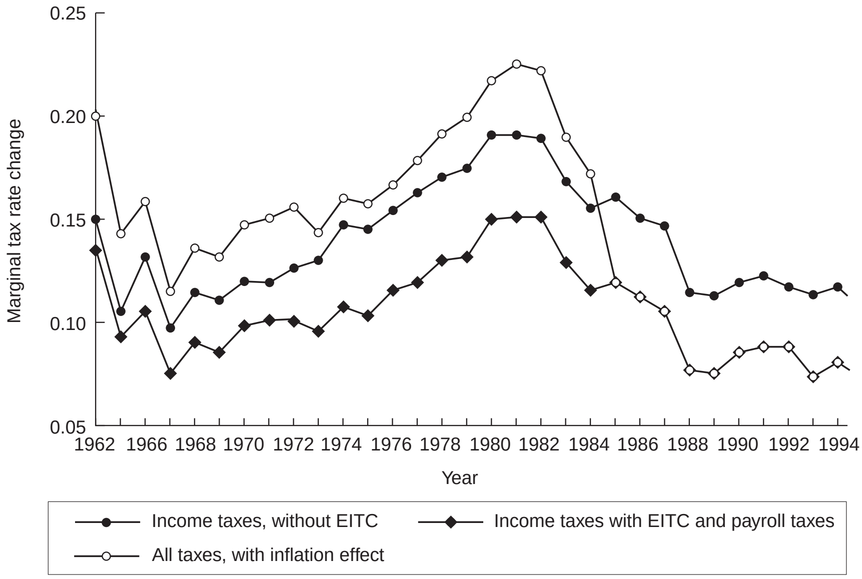
The evidence in Figure 1 suggests that the US tax system's capacity to provide automatic stabilization is roughly what it was several decades ago, but substantially below what it was around 1980, after several years of high inflation had driven households into higher tax brackets, but before marginal rates were reduced by a succession of tax reforms, including the one that indexed the tax system. What this picture leaves out, though, is the ultimate impact on aggregate demand, which involves the important additional step that translates changes in taxable income into changes in consumption. As discussed above, recent evidence suggests that this last connection may be weak, particularly if the tax change is thought to be temporary – as it would be if brought about by a recession.[3]

However, there is another way in which the tax system may act as an automatic stabilizer that has generally been overlooked, and this mechanism actually is enhanced by changes being temporary. In the past, references to the automatic stabilization of output have almost always referred to the stabilization of aggregate demand. This is consistent with the assumption that the level of employment is demand-determined and not on the labour supply curve. In this framework, only changes in the demand for labour will affect the quantity of labour hired in the market.

However, to the extent that employment levels are also determined by labour *supply* conditions, a tax system with rates rising with respect to income might also serve to stabilize output. When output fell, tax rates do as well and this could encourage greater labour supply; conversely, when output rose, the higher marginal tax rates could discourage labour supply. The impact would work through incentive effects of marginal tax rates, rather than through changes in tax payments and, hence, would not rely on credit constraints for any of its punch. Moreover, the temporary nature of the change in income, which works against the effectiveness of demand-side stabilization, reinforces the supply-side impact. If leisure is a normal good, permanent increases in the after-tax wage have an income effect that discourages labour supply and works against the substitution effect of the wage change. However, this offsetting income effect is largely absent from temporary wage changes. This is not just speculative; Mulligan (1999), for example, finds evidence that labour substitution across time periods is much larger than would be implied by previous estimates in the literature.

How large an effect might such marginal tax rate changes have? If we focus only on first-round effects (i.e. ignoring subsequent effects of the induced increase in labour supply on the before-tax wage and marginal tax rate), there are two steps here: first, it is necessary to calculate how much the initial change in output will affect the after-tax wage rate though the mechanism of changing the marginal tax rate; then, the question is what change in labour income will result from the labour supply response to the change in the after-tax wage rate. The net stabilization offset will equal the product of these two

[3]In addition to the recent paper by Shapiro and Slemrod (2001), see also Wilcox (1990), Shapiro and Slemrod (1995), Parker (1999) and Souleles (1999, 2002).




*Source:* Auerbach and Feenberg (2000)

**Figure 2:** The response of marginal tax rates to before-tax income

terms: the change in the after-tax wage with respect to the change in income times the change in labour income with respect to the change in the after-tax wage. This product, in turn, is roughly equal to the product of the labour supply elasticity and the change in the marginal tax rate with respect to a unit proportional change in income.

To be more specific, for a fixed before-tax wage, $w$, the change in the after-tax wage with respect to income $Y$ is $w\mathrm{d}t/\mathrm{d}Y$, where $t$ is the household's marginal tax rate. The change in labour income with respect to the change in the after-tax wage is $w\mathrm{d}L/\mathrm{d}[w(1-t)]$. The product of these two terms may be written $-(\alpha/(1-t))\eta\mathrm{d}t/\mathrm{dln}\,Y$, where $\eta$ is the elasticity of labour supply with respect to the after-tax wage, $w(1-t)$, and $\alpha$ is labour's income share, $wL/Y$. As the terms $\alpha$ and $(1-t)$ are about the same size (around 0.75), the stabilization term is roughly equal to the response of the marginal tax rate to a unit proportional income change, $\mathrm{d}t/\mathrm{dln}Y$, multiplied by the labour supply elasticity, $\eta$.

Figure 2 presents estimates of the first of these components, the impact of income changes on marginal tax rates (averaged over the population in proportion to income). The three series in the figure correspond to those in Figure 1 (except for that holding the income distribution fixed) to all but those for the fixed income distribution in Figure 1. As one would expect, the patterns in this figure are similar to that in Figure 1, with the sensitivity of marginal tax rates peaking around 1980, when tax progressivity peaked. The impact of the payroll tax is to reduce the sensitivity, because of individuals near the payroll tax ceiling whose marginal rates *rise* as their income falls.[4] Taking account of the second component of the calculation, the labour supply elasticity, Auerbach and Feenberg (2000) suggest that this supply effect may be quite significant and, perhaps, as large as the demand effect.

In summary, automatic stabilizers have long been suggested to be an effective tool for overcoming the lags of discretionary policy. According to the traditional approach to estimating the tax system's capacity for automatic stabilization, the US tax system is less effective than it was two decades ago. There is an additional issue that must be confronted regarding automatic stabilizers: that their ability to stimulate aggregate demand depends on the transmission of temporary after-tax income shocks to consumption, an effect that has been challenged by recent evidence. On the other hand, though, there may be an impact on the supply side that has typically been ignored, which provides a stronger impact on output, particularly in the case of temporary tax shocks. As yet, the relative importance of automatic stabilizers on the demand and supply sides remains to be determined.

## IV. What Is the Economic Effect of Random Tax Policy?

To the extent that tax policy has fluctuated over time, and has done so in a manner that is unpredictable and destabilizing, tax policy has increased the level of economic uncertainty in the economy. For example, in the USA, the median duration of a period within which there was an ITC was 3.7 years, and, as of the early 1990s, the duration of the state of the world within which there is no ITC is about the same. What impact does such volatility in tax policy have?

While intuition suggests that the volatility may discourage economic activity, the case is theoretically certain. Except for the special case of irreversible investment, which we discuss in detail below, uncertainty has generally been found to increase investment (Hartman 1972; Abel 1983). The intuition for these results is quite straightforward and can be illustrated with a simple graph, as in Figure 3.

Suppose the economy starts out at price $P_0$ but that a random tax is introduced that causes the economy to fluctuate between prices $P_1$ and $P_2$. The price-taking producer increases his profit in this case, since the profit gained

[4]This effect may be somewhat overstated, because it does not take into account the fact that earnings above the ceiling also do not count in subsequent benefit calculations.

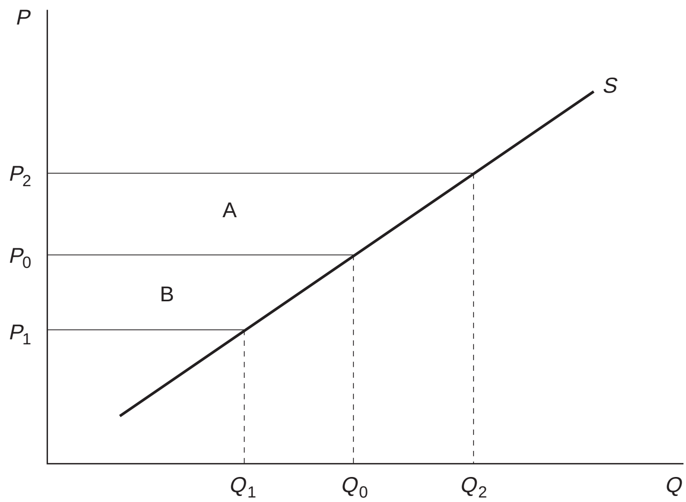



**Figure 3:** Volatility is not necessarily bad

in the good states is area A and that lost in the bad states is area B, which is smaller. Thus, volatility is not necessarily bad. However, Pindyck (1988) has shown that, if investments are irreversible, then investment can be significantly lowered by higher uncertainty. This is also a very intuitive result.

The traditional view is that one should invest in any project that has a positive net present value of cash flows. Recent advances in economic theory have shown, however, that this rule is not always correct. On the contrary, it is often better to wait until some uncertainty is resolved.

Consider, for example, a firm that traditionally powers its furnaces with coal, deciding whether to buy a new, more energy-efficient gas-powered furnace that costs $100 today but has an uncertain return tomorrow (Table 2). If the price of natural gas does not change, then the firm stands to make $400 profit by operating the new furnace. If there is bad news, however, and the price of natural gas goes up, then the new furnace will remain idle and the firm will gain

**Table 2: Investing Today Versus Waiting Until Tomorrow**

| | Tomorrow | | |
|---|---|---|---|
| Today | If good news (Probability = 0.5) | If bad news (Probability = 0.5) | Expected return |
| Scenario 1: *The expected profit if you buy a new gas-powered furnace today that costs $100 and has an uncertain return tomorrow* | | | |
| Pay $100 | Earn $400 | Earn nothing | $100 |
| Scenario 2: *Expected profit if you wait and decide tomorrow* | | | |
| Pay nothing | Earn $400–$100 = $300 | Earn nothing | $150 |

nothing from owning it. If the probability of either outcome is 0.5, then the expected net present value of purchasing the machine, ignoring discounting, is

$$(0.5 \times \$400) + (0.5 \times 0) - \$100 = \$100$$

Since the project has a positive expected cash flow, you might think it optimal to buy the furnace today. but it is not. Consider what happens if the firm waits until the news is revealed before deciding. By waiting, the firm will actually increase its expected profit by $50. The firm is better off waiting because, by not purchasing the furnace in the bad state, it can avoid the loss of $100. Note that the two examples would have the same expected return if the firm were allowed to resell the furnace at the original purchase price if there is bad news. However, this is patently unrealistic for two reasons:

1 Many pieces of equipment are customized so that, once installed, they would have little or no value to anyone else.
2 If gas prices rise, the gas-powered furnace would have no value to anyone else.

Moving from this simple example to the real world, one can show that there is a gain to waiting if there is uncertainty and the installation of the machine entails sunk costs. Under these circumstances, the gain to waiting increases with the level of uncertainty. The exact quantification of this gain to waiting is quite intuitive: the traditional hurdle rate that one should use is modified by a 'mark-up factor' that incorporates the effects of uncertainty and of any trends in the relevant prices.

One might be tempted to conclude from this that uncertainty introduced because of random tax policy likely lowers investment, at least to the extent that equipment investment is considered irreversible. Hassett and Metcalf (1999), however, demonstrate theoretically that this is not correct. They construct a model of irreversible investment with an ITC that jumps according to a Poisson process, calibrate the jumps to the US experience and discover that random tax policy has likely worked to increase investment in the USA. The reason is simple. When an ITC is in effect, a cautious firm that is tempted to wait and allow more uncertainty to be resolved faces a powerful countervailing force. If it waits too long, then the ITC will disappear. Since investment incentives like the ITC or accelerated depreciation occur quite frequently, firms are jolted out of delay by the randomness in policy.

The implication of this discussion, then, is that the particular form of the policy randomness is of great consequence. The stochastic policy environment brings with it not only greater variance in policy variables, but also possibly predictable shifts in the means of these variables. If there is no investment tax credit in force, for example – and only positive investment credits are possible

– then the introduction of uncertainty about policy also, necessarily, increases the expected value of the investment tax credit in future periods. Likewise, if the credit is currently at its maximum feasible value, uncertainty increases the value of today's credit relative to its expected future value.

## V. Costly Policy Adjustment and Optimal Policy in the Long Run

The previous discussion has established three conclusions:

1 Investment policies, in particular, hold promise for affecting the economy but, historically, these have been timed poorly.
2 Automatic stabilizers are indeed automatic and stabilizing, although the strength of their impact through the consumption channel is uncertain and may have declined in recent decades.
3 Uncertainty associated with fluctuating investment policy likely raises investment.

Together, these three conclusions suggest that the division between policies that are automatic and those that are discretionary is an important area for future study. To the extent that fluctuating tax incentives might be highly effective, separating them from the political process and making them automatic might increase the probability of their being timed correctly, provided it is possible to specify in advance the appropriate circumstances under which they should take effect.

Unless and until such circumstances are found, however, it remains true that political constraints that make it difficult to pass changes in fiscal policy in a timely fashion may significantly affect the design of optimal policies. To the extent that policies cannot be built in, or changed readily, then this can impose significant economic costs on society. As a first step at evaluating these constraints and their effects, in Auerbach and Hassett (2002), we introduce into a dynamic stochastic computational general equilibrium model that has overlapping generations and an infinite horizon, the constraint that policy makers cannot change tax policy very often. We model this as a constraint that tax policy cannot change in the current period if it changed in the previous one. Such circumstances approximate well such longer-run fiscal policies as Social Security and Medicare.

We find that such constraints have a very significant effect on optimal policies. When policy is sticky, then a significant amount of additional precautionary saving is necessary. In addition, optimal tax policy has a highly asymmetric form. If the current law is excessively generous to current generations at the expense of those alive in the future, then government may optimally choose to leave the law in place (preserving its option to change law in the future). If, on the other hand, current law places too high a tax burden on those currently alive, then the government should be much more likely to change the law immediately. Such a pattern exists because low current taxes can be compensated for by a tiny increase on all future generations, whereas high current taxes reduce the consumption of those alive today, focusing the damage from the sub-optimal policy on a single cohort.

Thus, our model of policy stickiness suggests that, when it is adjusted, fiscal policy may be 'too tight', but that there will be a general drift toward looser policy during periods of inaction. This may have implications for the cyclical properties of automatic stabilizers. In particular, policies incorporated into the fiscal system that reduce burdens when economic activity is relatively low, more than burdens are increased when economic activity is high, will serve to provide the drift that is appropriate during periods of inaction given long-run objectives and constraints. In this sense, long-run targets interact in important ways with short-run objectives.

## VI. Conclusion

Recent research has found that economic policies can significantly alter the path of the economy, but that they often do so in undesired ways. This is likely because the political process makes it difficult for policy makers to adopt changes in a timely fashion and because information concerning the current state of the economy at any point in time is incomplete. Our own recent research suggests that the costs of such implicit policy constraints may be high, but that these may be mitigated if policies that, in the past, have been left to discretion could somehow become 'built in'. Absent such an adaptation, however, long-run constraints influence the design of short-run policies.

The question of optimal policy design in such circumstances is an important one, and one that has, for the most part, been neglected by the literature. The key question of whether a particular policy should be built in will clearly depend on the extent to which policy makers can accurately assess policy signals, and the extent to which private agents can react in possibly undesirable ways. If, for example, the unemployment rate increases, then it may be sensible to introduce an ITC. This may be less true if the unemployment rate increase is attributable to a change in the natural rate of unemployment, or short-run lay-offs by firms hoping to activate an automatic stabilizer. The optimal design of such a policy is clearly an important area for future research.

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## Appendix: Measuring Stabilization with Empirical Estimates of a Rational Expectations Model of Investment

Suppose that investment behaviour follows the process

$$I_t = \alpha + \beta(c_t + \tau_t) + \varepsilon_t + \nu_t \tag{A1}$$

where $c_t$ is the cost of capital in the absence of taxes and $c_t + \tau_t$ the cost of capital in the presence of taxes.[5] The terms $\varepsilon_t$ and $\upsilon_t$ are stochastic shocks, with $\varepsilon_t$ observable to policy makers. Let tax policy be determined by the rule:

$$\tau_t = \gamma z_t + \zeta c_t + \omega\varepsilon_t + \eta_t \tag{A2}$$

where $\eta_t$ is another stochastic term and $z_t$ is a vector of additional determinants of tax policy (budget deficit, unemployment rate, etc.). Expression (A2) says that tax policy is affected by the no-tax cost of capital (interest rates, profitability, etc.) as well as the current shock to investment, $\varepsilon_t$. To stabilize investment, one would want $\zeta$ to be negative and $\omega$ to be positive. Note that, because $\tau_t$ is the *expected* effective tax burden on new investment, (A2) is not really a policy rule, but a relationship characterizing the determination of expected tax policy. Presumably, this will incorporate not only announced policy changes, but anticipated ones as well.

In Auerbach and Hassett (1992), we estimated equation (A1) consistently, using a consistent procedure that started from *ex post* observed values of $c_t$ and $\tau_t$, say $\bar{c}_t$ and $\bar{\tau}_t$, and used instruments to form the projections $\tilde{c}_t$ and $\tilde{\tau}_t$. To measure the stabilizing effects of tax policy, we wish to measure the change in variance of $I_t$ due to tax policy, or

$$\Delta = V(I) - (V \mid \tau = 0) = V[\alpha + \beta(c_t + \tau_t) + \varepsilon_t + \nu_t] - V[\alpha + \beta c_t + \varepsilon_t + \nu_t] \tag{A3}$$

After several steps, we showed there that

$$\Delta = \beta^2[V(\bar{c}_t + \bar{\tau}_t) - V(\bar{c}_t)] + X \tag{A4}$$

where the first term on the right-hand size of (A4) provides the 'naïve' measure of the impact on tax policy on the variance of investment. To estimate this first term, we simply multiply $\hat{\beta}^2$, the square of the coefficient estimate in (A1), by the difference in the variances of $\bar{c} + \bar{\tau}$ and $\bar{c}$. The second term on the

[5]The notation here follows the original presentation in Auerbach and Hassett (1992); so, variables such as $\tau$ and $z$ take on different meaning than in the discussion in the text.

right-hand side of (A4), $X$, is a correction term that takes into account the two complications mentioned above, that we do not observe the true user cost of capital and that policy may be responding to contemporaneous investment shocks. The term $X$ has lower and upper bounds,

$$\begin{aligned} \underline{X} &= 2\beta C(I - \hat{I}, \tilde{\tau} - \bar{\tau}) - \beta^2 V(\tilde{\tau} - \bar{\tau}) \\ \overline{X} &= 2\beta C[I - \hat{I}, \tilde{\tau} - \bar{\tau}] \end{aligned} \quad \text{(A5)}$$

where $\hat{I} = \hat{\alpha} + \hat{\beta}(\bar{c} + \bar{\tau})$ is the fitted value of investment, based on the observed, *ex post* user cost measure. The lower bound corresponds to the case where investors have perfect foresight and the latter corresponds to the case where the econometrician makes no error.