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MONETARY SCIENCE, FISCAL ALCHEMY

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ABSTRACT

Monetary policy decisions tend to be based on systematic analysis of alternative policy choices and their associated macroeconomic impacts: this is science. Fiscal policy choices, in contrast, spring from unsystematic speculation, grounded more in politics than economics: this is alchemy. In normal times, fiscal alchemy poses no insurmountable problems for monetary policy because fiscal expectations can be extrapolated from past fiscal behavior. But normal times may be coming to an end: aging populations are causing promised government old-age benefits to grow relentlessly and many governments have no plans for financing the benefits. In this era of fiscal stress, fiscal expectations are unanchored and fiscal alchemy creates unnecessary uncertainty and can undermine the ability of monetary policy to control inflation and influence real economic activity in the usual ways.

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Monetary Science, Fiscal Alchemy*

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I Introduction

Ten years ago Clarida et al. (1999) proclaimed the arrival of "The Science of Monetary Policy." Although the past few years' experiences may have raised some questions about the robustness of the science, the paper's general theme continues to resonate: modern monetary analysis has progressed markedly from the days of monetary metaphors like "removing the punch bowl" and "pushing on a string." Key elements in the progress include modeling dynamic behavior and expectations, understanding some of the critical economic frictions in the economy, discussing explicitly central banks' objectives, communicating policy intentions to the public, developing operational rules that characterize good monetary policy, and deriving general principles about optimal monetary policy.

In a surprising twist of fate, the practice of monetary policy marched along side the theory. Central banks around the world have adopted clearly understood objectives—such as inflation targeting and output stabilization—and central bankers espouse and articulate the science in public discussions about managing expectations, the transmission mechanism of monetary policy, and the role of uncertainty in policymaking. Modern monetary research and practical policymaking are united in aiming to make monetary policy scientific.

No analogous transformation has occurred with macro fiscal policy. Although academic research has progressed, policy discussions reflect little of it. In the place of dynamics and expectations are Keynesian hydraulics and multipliers. Instead of clear objectives and rules, there are one-off "reforms" and Blue Ribbon Commissions.

I mark monetary policy's transition from alchemy to the time when central bankers realized that the question "What are the effects of raising the short-term interest rate by 50

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basis points?" is ill-posed because the answer hinges on the expected path of short rates, among other things.

Fiscal policy will shed its alchemy label when the question "What is the fiscal multiplier?" is no longer asked and detailed analyses of "unsustainable fiscal policies" are no longer conducted without explicit analysis of expectations and dynamic adjustments. Multipliers depend on the type of spending or tax change, as well as on a host of other factors: expected sources and timing of future fiscal financing, whether the initial change in policy was anticipated or not, and how monetary policy behaves. "Unsustainable policies" can't happen. When investors believe current policies will last forever, they bid the value of government bonds to be consistent with those expectations; in severe cases, that value may be zero. But in economies, like the United States, whose policies are deemed "unsustainable" despite highly valued debt, traders must not believe current policies will persist. The notion of "unsustainable policies" builds in assumptions about future policies that are chronically at odds with bond holders' beliefs.

The science-alchemy terminology doesn't mean monetary policy has achieved the scientific pinnacle. Neither does it imply that all fiscal analysis is voodoo.[1] The terminology is designed to call attention to the generalization that monetary policy tends to employ systematic analytics, while fiscal policy relies on unsystematic speculation. If you explicitly model the things that we *know* matter—expectations, purposeful behavior, dynamic adjustments, uncertainty—then you are engaged in science. Otherwise, you are doing alchemy.

How is the claim of monetary science sustained? We have known at least since Friedman (1948) that monetary and fiscal policies are intricately intertwined and their distinct impacts are difficult to disentangle. We also know from work over the past few decades that recalcitrant behavior by one policy authority can easily thwart the other authority's efforts to achieve its objectives. One major macro policy tool cannot hope to be scientific if the other major tool practices alchemy. Going forward, the sustainability of monetary science may be in jeopardy.

The sharp contrast between the science of monetary policy and the alchemy of fiscal policy is puzzling when viewed from the perspective of a macroeconomist. There are clear parallels between the two macro policy tools. Both can have strong effects on aggregate demand, inflation, and economic activity. Dynamics, expectations, and asset prices play central roles in transmitting the impacts of both policies. Dynamic private behavior creates

[1] In fact, there is quite a lot of fiscal science being conducted, for example, in the public finance and optimal fiscal policy fields [for example, Golosov et al. (2006) and Kocherlakota (2010)]. On the more applied side, Bryant et al. (1993) and Bryant and Zhang (1996) are examples of fiscal science that explored the impacts of alternative fiscal rules that ensure policy is sustainable. That science, however, does not seem to have spilled over significantly into macro fiscal policy analyses or into practical fiscal policy evaluation.

time inconsistency problems for both policies. And both are most effective when they are credible and predictable. Fiscal alchemy is all the more puzzling because in many ways it is the more powerful tool. Fiscal policy can also have important supply-side impacts through infrastructure expenditures, spending aimed at human capital accumulation, and taxes that directly affect the after-tax returns to labor and capital. Adjustments to fiscal actions occur over decades, giving fiscal policy long-lasting impacts. Investments in developing the science of fiscal policy are likely to have high social returns.

Responsibility for the application of fiscal alchemy in policymaking falls squarely on governments and legislatures who, for many years, have refused to invest in the intellectual capital that could lead to more economically sound policy decisions. Political leaders much prefer the discretion that alchemy offers over the discipline that science imposes. Resistance of policymakers to adopting rules to guide their fiscal decisions is a key example of this revealed preference. It's also an odd state of affairs. One would imagine that political leaders who seek to implement good economic policies might welcome the cover that fiscal rules provide.[2] It is far easier to tell a constituency that it's impossible to give them more fiscal goodies because the rules prevent it than it is to explain that doing so is unsound macroeconomic policy. Perhaps it is possible to design institutional reforms that would be good politics, as well as good economics.

I.A Anchoring Fiscal Expectations

Monetary and fiscal policies and their interactions is a vast topic that requires an organizing principle. The anchoring of expectations is such a principle because it embeds the central tenets of modern economic science: dynamic behavior, purposeful decision making, the roles of information and uncertainty, and the ongoing nature of policymaking. Anchoring expectations has become so ingrained in monetary policy that it is something of a mantra; fiscal authorities rarely discuss it.[3]

In normal times, fiscal alchemy poses no insurmountable problems for central banks. Even if policy institutions do not firmly anchor fiscal expectations, people can use past fiscal behavior to guide their beliefs about the future. But normal times may be nearing their end. The International Monetary Fund calculates that the net present value impact on deficits of aging-related government spending averaged across the advanced G-20 countries is over 400 percent of GDP [International Monetary Fund (2009b)]. Gokhale and Smetters (2007) project that the long-term budget imbalance associated with Social Security and Medicare in the United States this year is over $75 trillion in present value. In the face of fiscal adjustments of these magnitudes, past policy behavior may be a weak reed on which to base

[2]Maya MacGuineas made this point to me.

[3]A recent exception—the only one I know—comes, not from a fiscal authority, but from International Monetary Fund (2009a).

expectations.

These numbers portend an extended era of fiscal stress. Problems for central banks become far more pressing during periods of fiscal stress. Combined with fiscal alchemy, fiscal stress threatens to undermine the advances made by monetary policy. Threats do not arise only from insufficient resolve by central bankers to control inflation. Threats arise from unanchored fiscal expectations that can make it difficult or impossible for central banks to control inflation, regardless of the central bankers' resolve.[4]

Unanchored fiscal expectations also make it more difficult for consumers and firms to make good economic decisions. Should I be saving more in anticipation of entitlements reform that will reduce my old-age benefits? Should firms build factories on the planned interstate route or will new fiscal austerity measures rescind the authorized infrastructure spending? Will the sunset provisions in the 2001 and 2003 U.S. tax cuts be enforced or will the cuts be extended? Fiscal institutions do not provide the incentives and constraints necessary to induce policymakers to take actions that would reduce this uncertainty. Consequently, the private sector treats future policies probabilistically to hedge against possible outcomes. Hedging retards economic activity and, inevitably, some decisions will turn out to be bad *ex post*. Anchoring fiscal expectations is a worthy goal in its own right.

But why should central bankers care whether fiscal expectations are anchored? It turns out that the central bank's ability to control inflation and influence real activity rests fundamentally on fiscal behavior and people's expectations of fiscal behavior. When those expectations center on the appropriate fiscal behavior, the central bank can affect economic activity and inflation in the usual ways. But when fiscal expectations are anchored elsewhere, it's quite possible that monetary policy can no longer do its job controlling inflation and stabilizing real activity. In the coming era of fiscal stress with no credible government plans to confront the growing fiscal strains, unanchored fiscal expectations become a certainty.

Differences between the practices of monetary and fiscal policy are not intrinsic to their respective policy tools. Instead, the contrast is an outgrowth of the different institutional settings that societies have chosen for the two types of macro policies. Many countries have made monetary policy independent, while keeping fiscal policy politicized. There is a fairly clear consensus on the objectives of monetary policy, but none for fiscal policy (besides the minimal requirement that the government be solvent).[5] Even "independent" monetary pol-

[4]In an insightful new paper, Eusepi and Preston (2010) obtain similar results in an environment in which individuals are learning about the monetary and fiscal policy regimes.

[5]Leeper (2009) points out that solvency is the one objective fiscal authorities around the world share. Beyond that rather minimal goal, fiscal authorities claim a laundry list of inevitably more politicized objectives, including maximizing economic growth, combatting climate change, reducing smoking, raising productivity, strengthening national security, predicting and preventing economic and financial crises, reducing poverty at home and abroad, equalizing income distribution, and building infrastructure. These are all worthy goals,

icy decisions are scrutinized by governments; governments' fiscal choices are not scrutinized in any organized form (except obliquely through elections and, in s small handful of countries, by independent fiscal policy councils or related agencies). As a consequence of these institutional differences, public discourse about monetary policy is far more sophisticated and helpful to private decision makers than are discussions of fiscal policy.

I.B Policy Analysis is Hard Faust (2005) observes that applied monetary policy analysis is "hard" in the sense that even the best dynamic models are "grossly deficient" and this condition is not likely to improve dramatically in the near term. Despite their shortcomings, Faust argues that models, appropriately used, can contribute to policymaking.

For all the reasons that Faust articulates, plus its complex and political nature, fiscal policy analysis is "harder." And even though fiscal models are still more deficient and urgently need further development, they nevertheless can be used to highlight and understand elements of fiscal policy that policymakers often do not consider. This paper raises some of these elements and shows how models can help policymakers think about them.

Fiscal complexity stems from several sources. Myriad tax and spending instruments produce a wide range of macroeconomic and distributional effects. Deficit financing introduces issues of debt management—the level at which to stabilize debt, the speed of stabilization, and the maturity structure of the debt. Fiscal changes affect intra- and intertemporal margins, which induce responses in expectations and behavior over time. Those responses can take decades to play out, giving fiscal actions long-lasting impacts. Fiscal initiatives are debated at length and individuals continually update and act on their beliefs about future taxes and spending, which creates intricate interactions between fiscal news and private behavior. Finally, fiscal effects also vary with the monetary policy environment, so that studying fiscal policy in isolation may distort our understanding of fiscal effects. I draw on results that my coauthors and I have obtained to illustrate many of these complexities.

Because fiscal actions can have strong distributional consequences, fiscal decisions are intrinsically political. A given fiscal change almost inevitably has winners and losers who feel the effects directly and often can link those effects to a specific policy decision. Democracy demands that these decisions be ground out by the political process, a process that rarely conforms to scientific standards.

Does this mean we must abandon the aim of elevating fiscal analysis to the level to which monetary policy aspires? I sure hope not. But elevating fiscal analysis requires isolating those

but until they are prioritized and checked for internal consistency, they cannot help guide fiscal expectations. This partial list of objectives comes from publications by Australian Treasury (2008), New Zealand Treasury (2003), Government Offices of Sweden (2009), HM Treasury (2009), and U.S. Department of the Treasury (2007).

aspects of fiscal policy that are less political and more amenable to science. Less political aspects of fiscal policy, on which societal and professional consensus may be possible, include: whether a debt target is desirable and what that target should be; how rapidly tax rates and spending should adjust to stabilize debt; circumstances, if any, when changes in the debt target are permissible.

That fiscal policy is "harder" calls for *more* dynamic modeling, *more* emphasis on expectations, *more* attention to information and uncertainty, *more* effort to confront dynamic political economy models with data, *more* professional scrutiny, and *more* focus on institutional design. In a phrase, *more science*. It is ironic that fiscal policy receives less of all these things than does monetary policy.

I.C What the Paper Does The next section presents three topical examples where fiscal alchemy is finding a voice in current policy debates. Section III steps back to the abstract world to explain how monetary and fiscal policy *jointly* stabilize inflation and the value of government debt. That section establishes two general principles. First, inherent symmetry in the two macro policies implies that either policy can stabilize inflation and aggregate demand, so long as the other policy maintains the value of debt. Second, if monetary policy is to successfully control inflation and stabilize the real economy, then fiscal policy must free monetary policy to pursue those objectives. This imposes restrictions on fiscal behavior that may be difficult to achieve in times of fiscal stress. Section IV turns to the literature on fiscal multipliers, which is precisely the morass that we would expect alchemy to produce. The section reports results that coauthors and I have obtained that show how sensitive fiscal multipliers are to aspects of the fiscal-monetary policy environment. Unfortunately, I cannot claim that the research provides all the right answers, but it does ask some of the right questions and it aims to address them in ways consistent with fiscal science.

Section V presents long-term fiscal projections to explain why many advanced economies are heading into an era of fiscal stress. It defines the "fiscal limit," the point at which, for economic or political reasons, fiscal policy can no longer adjust to stabilize debt, and explores some surprising implications that arise when an economy is staring at the prospect of a fiscal limit. For example, information that shifts expected paths of spending or taxation can have important effects on aggregate demand today, well before the fiscal changes occur. Research discussed in section VI describes one constructive route to modeling economic behavior in an era of fiscal stress. That route posits what people might believe about how future policies may adjust in response to fiscal stress and derives the macroeconomic consequences of those adjustments. Section VII suggests some roles that central banks and their leaders could play

in the era of fiscal stress. Key among these is for central bankers to break the taboo against saying anything substantive about fiscal policy and, instead, to talk precisely and forcefully about how unresolved fiscal stresses can make it difficult or impossible for monetary policy to do its job.

Skeptics might say that fiscal policy is intrinsically political and efforts to make it more scientific are pie in the sky. To those skeptics I address the final section. There I offer some thoughts about separating fiscal policy into its micro and its macro components. Micro components involve distributional issues and rightfully belong in the political realm. But I try to identify some macro aspects that are largely technical matters that lend themselves to fiscal science. Economists may be able to coalesce on the macro fiscal issues, even while the micro issues remain contentious.

II Fiscal Alchemy in Action: Recent Examples

Fresh examples of alchemy in fiscal policymaking appear in the news regularly [for example, Hilsenrath (2010)]. In this section I highlight three prominent examples of fiscal alchemy in policymaking. I select these examples because they are timely and they are at the forefront of important policy debates. Far more egregious but less current examples abound.

Fiscal multipliers: A report authored by Romer and Bernstein (2009) provided important support for the Obama administration's effort to stimulate the U.S. economy through the $787 billion American Recovery and Reinvestment Act of 2009. Fiscal multipliers associated with government spending increases and tax cuts, which appear in the report, are reproduced in figure 1. Government spending packs more punch than taxes, as shown in the figure. The report also provides detailed estimates of the number and types of jobs that a stimulus package would create.

Graphics like figure 1, and hundreds of others that pepper the empirical fiscal policy literature, leave the reader wanting to know more. What are the economic mechanisms through which the stimulus would add to employment? How will "permanent" changes in spending or taxes be supported by adjustments in other fiscal instruments in the future? How might alternative adjustments affect the multipliers? Are the fiscal changes anticipated or unanticipated? What happens to the output multiplier in the medium to long run, beyond the four-year horizon reported? Sources for the multiplier numbers are given as "a leading private forecasting firm and the Federal Reserve's FRB/US model," which are not in the public domain and cannot be professionally scrutinized. How would a researcher reproduce the multipliers that Romer and Bernstein (2009) report? Overall, the report's rationale for the stimulus package do not rise to the scientific standards to which monetary policy analyses

aspire.[6]

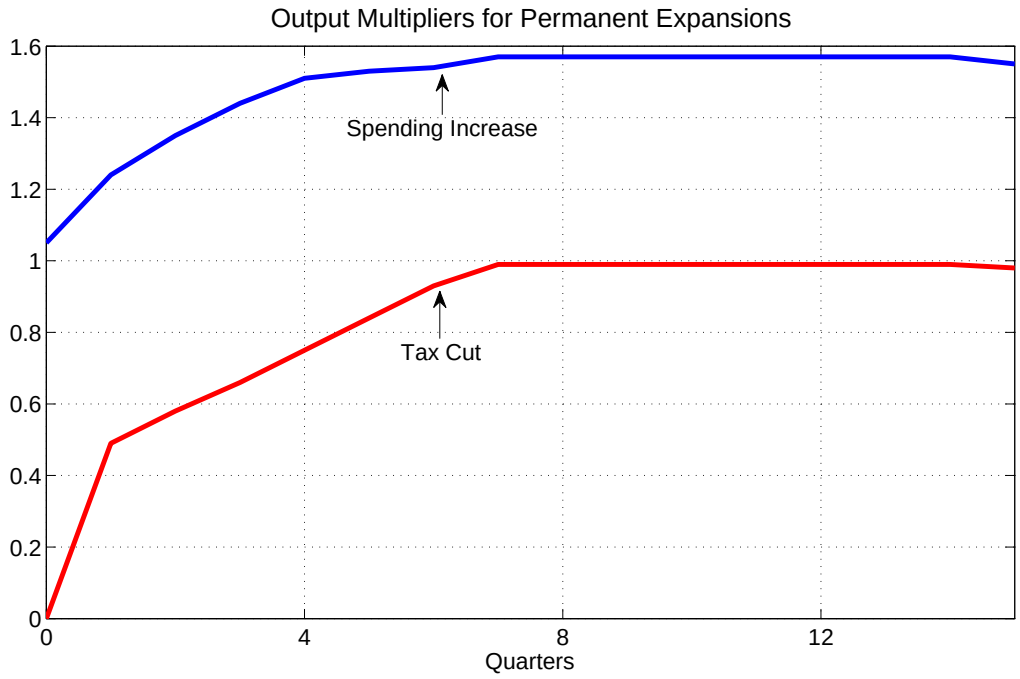

Figure 1: Output multipliers for a permanent increase in government spending or a permanent decrease in taxes, as reported in Romer and Bernstein (2009).

Fiscal retrenchments: Defenders of fiscal retrenchment often argue that retrenchment can actually be expansionary. Research has found some evidence that under some circumstances fiscal consolidations have had beneficial economic effects, or at least have not produced declines in economic activity [Giavazzi and Pagano (1990), Bertola and Drazen (1993), Alesina and Ardagna (1998)]. Much of that evidence comes from case studies that examine a single country that undertakes a sizeable, isolated fiscal consolidation. There is no evidence that if many countries—say, much of Europe—undertake fiscal austerity measures simultaneously, then economic activity will improve.

To be sure, fiscal multipliers depend on the state of the economy and can change over time. But can they change *sign* in a little over a year? Does any model exist to show that 18 months ago it made sense for the United Kingdom to expand fiscal policy, while now it makes sense to implement the recently announced 25 percent nearly across-the-board budget cuts? As Alesina and Ardagna (1998) make clear, an intricate set of conditions needs to be in place

[6]To be fair, U.S. fiscal actions are rarely supported by research that meets generally accepted standards. U.S. Department of the Treasury (1984) followed the Reagan tax cuts and argued that deficits had no effects on interest rates. The Bush tax cuts in 2001 initially were justified by little more than the observation that the federal budget surpluses were "your money" along with the claim that lower marginal tax rates would stimulate economic activity.

for consolidations to be expansionary—"the tightening must be sizeable and occur after a period of stress when the budget is quickly deteriorating and public debt is building up.... To be long lasting, it must include cuts in public employment, transfers and government wages. To be politically possible, such a policy must be supported by trade unions." Those authors also point out that several issues are "not settled," but are critical to determining which fiscal consolidations will contract the economy and which will expand it.

Fiscal flip-flops are being justified in the name of credibility. Countries feel the need to contract fiscal policy in the midst of a weak recovery because fiscal institutions provide no other mechanism by which fiscal decision makers can establish the longer run soundness of their policies; as a consequence, with fiscal expectations unanchored in general, political leaders speculate that bold contractionary actions will prove their mettle and, in some unspecified way, improve economic conditions. Paul Volcker was forced into an analogous difficult situation in the early 1980s to demonstrate the Fed's bona fides as an inflation fighter. But at that time there was no pretense that tight monetary policy would not hurt the economy. Current fiscal flip-flops are about solving today's problem; but credibility is inherently a long-run trait that can be established only by changing the fiscal institutions on which fiscal expectations are based. One-time fiscal consolidations most often do not morph into permanent fiscal reforms. Many countries institutionalized monetary policy reforms by adopting inflation targeting. There is, at best, ambiguous scientific support for the coordinated fiscal contraction that is taking place.

Long-term fiscal projections: In some countries a fiscal agency issues regular reports on its country's long-term fiscal situation. The reported paths of endogenous fiscal variables, like government debt, typically do not emerge as implications of an *economic* model: given a set of assumptions, debt paths pop out from an accounting relation that equates current debt to past debt plus current deficits. When the resulting paths show debt growing exponentially at a rate faster than the economy, the agency declares that fiscal policy is on an "unsustainable path." Logically, though, unsustainable policies cannot occur, so the agency's projections cannot happen. Reporting things that cannot happen cannot help people make economic decisions.

The Congressional Budget Office's (2009; 2010c) long-term projections in 2009 and 2010 make clear how unhelpful government macro fiscal analyses can be. This year's baseline projection differs dramatically from 2009, with debt at almost 300 percent of GDP at the end of the projection period in the 2009 report, but at just over 100 percent of GDP in the 2010 exercise [figure 2]. That's the rosy scenario. The alternative projections build in policy changes the CBO deems likely to occur—for example, curtailing the reach of the Alternative Minimum Tax and extending most of the provisions of the 2001 and 2003 tax cuts—and

have debt exceeding 700 percent and 900 percent in the 2009 and 2010 projections.

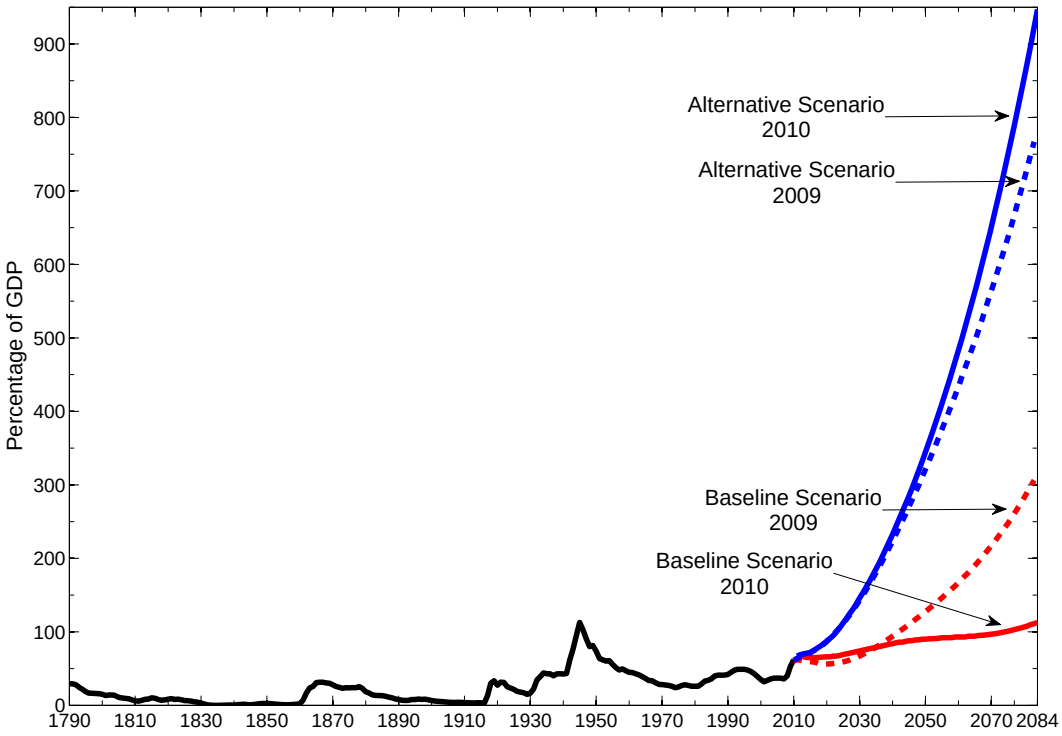

Figure 2: Projections of U.S. federal government debt as a percentage of GDP from Congressional Budget Office (2009, 2010c).

Figure 2 is amenable to alternative interpretations. (1) According to the baseline, the long-term U.S. fiscal position improved sharply over the past year, in large part because of substantial cost savings from the recent health reform bills, so the need for serious fiscal reform is less pressing.[7] (2) The alternative projection, in contrast, suggests that the fiscal position has deteriorated further, with the debt-GDP ratio rising to almost 1000 percent at the end of the projection period. (3) Viewing the baseline and alternative as two points on a probability distribution, the dispersion in the distribution has increased dramatically, suggesting a significant increase in uncertainty about future fiscal actions. (4) Because the

[7]This is the interpretation adopted by some economic bloggers. See, for example, http://www.angrybearblog.com/2010/06/cbo-releases-long-term-budget-outlook.html, which refers to "deficit hysterics" and then comments: "Interestingly if we examine the above two figures we see that 'Extended baseline' which essentially means 'Current law' shows the deficit vanishing by 2014 and Debt Held by the Public stabilizing through 2035. Making some of the 'If this goes on the sky will fall!' rhetoric around Obama policy a little overstated, just as with Social Security a plan of 'Nothing' getting oddly some pretty good projected results."

projections are accounting exercises and do not come from any coherent economic model, they are not economic forecasts and it's foolhardy to try to draw meaningful economic inferences from them. This is confusing economics. Because the baseline is a scenario that nobody believes *will* happen and the alternative is an outcome that everyone know *cannot* happen, the CBO's projections do little to help people form expectations over future fiscal policies and they do not constitute science.[8]

As the introduction suggests, the source of the CBO's less-than-informative long-term projections is the tightly circumscribed mandate that the U.S. Congress imposes on the CBO. By law the CBO must construct projections assuming that current law remains in effect. Baseline and alternative scenarios are two interpretations the CBO ascribes to "current law." But when "current law" is unsustainable, projections conditioned on it have little economic content. It is important to acknowledge, though, that the CBO is simply a conduit for Congress' alchemy.

III Monetary-Fiscal Interactions in Normal Times

Most macroeconomists were raised on the belief that inflation is determined by monetary policy, especially in the long run. Full stop. Sure, especially egregious fiscal policy or wartime finance might force the central bank to print money, accumulate government bonds, and generate inflation. But even in this instance, the overall price level is being determined by the interaction of money supply and money demand: inflation is a monetary phenomenon. New Keynesian models couch monetary policy in terms of controlling a nominal interest rate, rather than high-powered money, but otherwise new Keynesian and old monetarist are close cousins in terms of thinking about how inflation gets determined.

Central bankers need a broader perspective on price level determination—to at least understand and acknowledge that there is another channel through which inflation can be determined. The broader perspective is important because the new Keynesian/old monetarist view implicitly embeds a *dirty little secret*: for monetary policy to successfully control inflation, fiscal policy must behave in a particular, circumscribed manner.[9] When fiscal policy fails to behave appropriately—as it may during economic crises or periods of fiscal

[8] In fact, these long-term projections build in a variety of assumptions about the economy's evolution over the projection period: within a few years, inflation is constant at 2.5 percent, real interest rates at 3 percent, unemployment at 5 percent, and so on. Taken on face value, the economy chugs along just fine *even as government debt explodes*. The CBO reports then lapse into wordy bits about the dire consequences of rapid growth in government debt. These wordy bits are speculative and not derived from some economic model employed by the CBO. Wordy speculation about the possibility and likely consequences of a fiscal crisis in the United States appears in a special CBO report, Congressional Budget Office (2010b).

[9] Although Friedman (1960) is explicit about this necessity in his *A Program for Monetary Stability*, as is Tobin (1980) in his monograph *Asset Accumulation and Economic Activity*.

stress—then inflation can get determined in a very different, unconventional, way. In this section I focus on inflation, but this should be construed more broadly as aggregate demand. In a more detailed model, some inflation effects would manifest as effects on output and employment.

In the simple model sketched below, macro policies have only two objectives: determine the inflation rate and stabilize government debt. The conventional assignment problem gives monetary policy responsibility for providing a nominal anchor—inflation—and fiscal policy the role of providing a real anchor—the real value of government debt. Because fiscal policy is assigned to stabilize debt, monetary policy is free to target inflation. As a logical matter, however, the assignments can be reversed: fiscal policy can determine inflation, while monetary policy prevents debt from becoming unstable. This alternative assignment may be necessary if, for political or economic reasons, fiscal policy simply cannot make the adjustments needed to stabilize debt.

III.A Fixing Ideas with a Model To fix ideas about how monetary and fiscal policies must interact to determine inflation and stabilize government debt, I draw on results from an extremely simple model that captures many of the important features of the models used to study price-level determination [Leeper (1991), Sims (1994), Woodford (1995)]. The model abstracts from "money," but this does not mean monetary policy cannot have powerful effects through changes in the nominal interest rate. The abstraction merely reflects the fact that seigniorage is a trivial fraction of total revenues in most advanced countries, so for simplicity I set it to zero. Appendix A presents the formal model. Here I bring out key features of the model and of policy behavior and then jump to their implications.

Expectations enter the model in two ways. First, individuals' savings decisions ensure that the expected returns on real and nominal assets are equalized. This behavior produces a Fisher relation that connects the nominal interest rate on short-term government bonds to the real interest rate and the expected inflation rate

$$R_t = r_t + E_t \pi_{t+1} \tag{1}$$

where R and r are the nominal and real interest rates and $E_t \pi_{t+1}$ denotes the expected rate of inflation between today and tomorrow.

A second role for expectations comes from individuals' consumption decisions, which depend on their wealth. Wealth is composed of the value of current asset holdings plus the expected present value of after-tax labor income. Because monetary and fiscal policies influence expectations of both inflation and taxes, individuals will track policy behavior and use that information to help them form those expectations.

Policy behavior is stylized. Government transfer payments to individuals, denoted by z, evolve autonomously. Behavior of the monetary and tax authorities is purposeful. Monetary policy adjusts the short-term nominal interest rate to target inflation at π^*, with the degree to which policy leans against inflationary winds given by α

$$R_t = R^* + \alpha\left(\pi_t - \pi^*\right) \tag{2}$$

Tax policy targets the real value of government debt (or the debt-output ratio) at b^* by adjusting taxes in response to the state of government debt with the strength of adjustment determined by γ

$$\tau_t = \tau^* + \gamma\left(\frac{B_{t-1}}{P_{t-1}} - b^*\right) \tag{3}$$

where B is the nominal value of bonds outstanding and B/P is their real value. R^* and τ^* are the instrument settings when inflation and debt are on target.

A final piece of this stylized model is the government's budget constraint, which equates sources of financing—new bond sales and taxes—to uses—transfer payments and principal plus interest on old bonds

$$\frac{B_t}{P_t} + \tau_t = z_t + \frac{R_{t-1}B_{t-1}}{P_t} \tag{4}$$

Policy behavior is not completely described until we take a stand on the sizes of the two critical policy parameters, α and γ, which describe how strongly policies react to deviations of variables from their targets. It turns out that there are two different combinations of monetary and fiscal policies that can jointly stabilize both the inflation rate and the value of debt. I label those two ways Regime M and Regime F.[10]

III.A.i Regime M The first policy mix is familiar to most macroeconomists, accords well with how many central bankers perceive their behavior, and frequently applies to policy behavior in normal times. I label this "Regime M" because it is consistent with the monetarist aphorism "inflation is always and everywhere a monetary phenomenon." Regime M emerges when the central bank aggressively targets inflation by raising the nominal interest rate sharply in response to incipient inflation. This is Taylor's (1993) principle and is called "active" monetary policy, following the terminology in Leeper (1991). An active authority is free to pursue its objectives in an unconstrained manner. Naturally, if monetary policy is attending to inflation targeting, then fiscal policy must handle debt targeting by adjusting taxes enough to achieve the debt target. When an increase in debt induces taxes to rise by

[10]The present model is too simple to provide any insights into which combination of policies is "better"; it is sufficient for our purposes that two such combinations exist.

more than the real interest rate, future taxes are assured to be sufficient both to service the new debt and to eventually retire debt back to target. This is called "passive" fiscal policy.

Many variants of this regime exist in the literature. Older models of monetary policy typically couched policy behavior in terms of setting high-powered money, rather than the nominal interest rate. But the maintained assumption that fiscal policy is committed to targeting the real value of government debt is identical, although the assumption frequently is not explicitly articulated.

The equilibrium in this regime implies that inflation always equals its target, as does expected inflation

$$\pi_t = \pi^* \tag{5}$$

Tax policy stabilizes debt gradually by raising taxes enough to cover interest payments and to retire a bit of the principal each period. For example, if transfers rise today, they are initially financed entirely through new sales of government bonds. Those new bonds, though, raise expected and actual future taxes through the tax rule in equation (3).

In this simple model the only source of uncertainty is random transfers. It appears as though monetary policy single-handedly keeps inflation on target by preventing shocks to transfers, which in principle affect household wealth and demand for goods, from transmitting into the inflation rate. To understand how monetary policy achieves this, we need to revisit monetary policy's dirty little secret: fiscal policy is ensuring that higher debt-financed transfers today create the expectation of higher taxes in the future. Those higher taxes are just sufficient to gradually retire debt back to target, eliminating the wealth effect of the higher transfers and relieving the pressure on inflation to rise.

Another perspective on the fiscal financing requirements when monetary policy is targeting inflation emerges from a ubiquitous equilibrium condition. In any dynamic model with rational agents, government debt derives its value from its anticipated backing. In this model, that anticipated backing comes from tax revenues net of transfer payments, $\tau_t - z_t$. The value of government debt can be obtained by imposing equilibrium on the government's flow constraint, and taking conditional expectations to arrive at

$$\frac{B_t}{P_t} = \text{expected present value of primary surpluses from } t+1 \text{ onward} \tag{IEC}$$

This intertemporal equilibrium condition, (IEC), provides perspective on the crux of passive tax policy. Because monetary policy nails down the price level and the expected path of transfers, the z's, is being set independently of both monetary and tax policies, any increase in transfers at t, which is financed by new nominal bond sales, B_t, *must* generate an expectation that taxes will rise in the future by exactly enough to support the higher value

of debt.

Although here only transfers can change debt, passive tax policy implies that this pattern of fiscal adjustment must occur regardless of the reason that debt increases: economic downturns that automatically reduce taxes and raise transfers, changes in household portfolio behavior, changes in government spending, or central bank open-market operations.

To expand on the last example, we could modify this model to include money and imagine that the central bank decides to tighten monetary policy at t by conducting an open-market sale of bonds. If monetary policy is active, then the monetary contraction both raises B_t—the dollar value of bonds held by households—and it lowers P_t; real debt rises. This can be an equilibrium *only if* fiscal policy is expected to support it by passively raising future tax revenues.[11] That is, given active monetary policy, (IEC) imposes restrictions on the class of tax policies required for equilibrium; those policies are labeled "passive" because the tax authority has limited discretion in choosing policy. A passive authority is constrained both by the inflation process that the active authority determines and by the optimal choices of private economic agents. Refusal by tax policy to adjust appropriately undermines the ability of open-market operations to affect inflation in the conventional manner.[12] Evidently, predictable and reliable fiscal adjustments—in a phrase, *anchored fiscal expectations*—are essential for monetary policy to succeed in targeting inflation.

Although conventional, this regime is not the only mechanism by which monetary and fiscal policy can jointly deliver an equilibrium with stable inflation and debt. We turn now to the other case, which becomes increasingly pertinent in times of fiscal stress.

III.A.ii Regime F Passive tax behavior that occurs in Regime M is a stringent requirement: the fiscal authority must be willing and able to raise taxes or otherwise adjust surpluses in the face of rising government debt. For a variety of reasons, this does not always happen. Sometimes political factors—such as the electorate's resistance to higher taxes—prevent taxes from rising as needed to stabilize debt. Some countries simply do not have the fiscal infrastructure in place to generate the necessary tax revenues. Others might be at or near the peaks of their Laffer curves, constraining their ability to raise revenues. In these cases, tax policy is active. Analogously, there are also periods when the concerns of monetary policy move away from inflation stabilization and toward other matters, such as output or financial stabilization [see, for example, Board of Governors of the Federal Reserve System (2009) or Bank of England (2009)]. These are periods in which monetary policy

[11] Higher future taxes also eliminate any wealth effect arising from the higher level of debt in agents' portfolios, reinforcing the contractionary effects of the open-market sale.

[12] This is an application of the general insight contained in Wallace (1981). Sargent and Wallace's "Unpleasant Monetarist Arithmetic" (1981) outcome emerges because the tax authority refuses to respond "appropriately," forcing monetary policy in the future to abandon its inflation target.

is no longer active, instead adjusting the nominal interest rate only weakly in response to inflation. The global recession and financial crisis of 2008-2010 is a striking case when central banks' concerns shifted away from inflation. Then monetary policy is passive.

We focus on a particular policy mix that yields clean economic interpretations: the nominal interest rate is set independently of inflation, $\alpha = 0$ and the nominal rate is pegged at R^*, and taxes are set independently of debt, $\gamma = 0$ and taxes are constant at τ^*. These policy specifications might seem extreme and special, but the qualitative points that emerge generalize to other specifications of passive monetary/active tax policies.

One result pops out immediately. Applying the pegged nominal interest rate policy to the Fisher relation, (1), yields

$$E_t \pi_{t+1} = R^* - r_t \tag{6}$$

Since we are assuming that the real interest rate is independent of monetary policy—a strong and unrealistic assumption in practice—expected inflation is anchored on the inflation target, an outcome that is perfectly consistent with one aim of inflation-targeting central banks.[13] It turns out, however, that another aim of inflation targeters—stabilization of actual inflation—which can be achieved by active monetary/passive fiscal policy, is no longer attainable.

The intertemporal equilibrium condition, (IEC), can be written in a more suggestive manner as

$$\frac{R^* B_{t-1}}{P_t} = \text{expected present value of primary surpluses from } t \text{ onward} \tag{IEC–2}$$

At time t, the numerator of this expression, $R^* B_{t-1}$, is already determined by past debt and the pegged interest rate and represents the nominal value of household wealth carried into the current period. The right side is the expected present value of autonomously set primary fiscal surpluses from date t on, which reduces to a fixed number in each date. This expression reveals how the price level is determined each period: it must adjust to set the market value of debt equal to expected discounted surpluses. Regime F leads to a sharp dichotomy between the roles of monetary and fiscal policy in price-level determination: monetary policy alone appears to determine *expected* inflation by choosing the level at which to peg the nominal interest rate, R^*, while conditional on that choice, fiscal variables appear to determine *actual* inflation.

Some economists have found this equilibrium to be peculiar in some way. Although it may not describe most economies in normal times, it is not so strange. To understand the nature of this equilibrium, we need to delve into the underlying economic behavior. This is

[13] As I show in section VI, when the real interest rate is endogenous, fiscal stress can undermine the central bank's ability to target expected inflation also.

an environment in which changes in debt do *not* elicit any changes in expected taxes, unlike in Regime M. First consider a one-off increase in current transfer payments, z_t, financed by new debt issuance, B_t. This reduces the right side of (IEC–2). With no offsetting increase in current or expected tax obligations, at the initial price level households feel wealthier and they try to shift up their consumption paths. Higher demand for goods drives up the price level, and continues to do so until the wealth effect dissipates and households are content with their initial consumption plan when the two sides of (IEC–2) are equalized.

Now imagine that at time t households receive news of higher transfers in the future. There is no change in nominal debt at t, but there is still an increase in household wealth at initial prices. Through the same mechanism, P_t must rise to revalue current debt to be consistent with the new lower expected path of transfers: the value of debt falls in line with the lower expected present value of surpluses.

Cochrane (2010) offers another interpretation of the equilibrium in which "aggregate demand" is the mirror image of demand for government debt. An expectation that transfers will rise in the future reduces the household's assessment of the value of the government debt they hold. Households can shed debt only by converting it into demand for consumption goods; hence, the increase in aggregate demand that leads to higher prices.

Expression (IEC–2) indicates that in this policy regime the impacts of monetary policy change dramatically. When the central bank chooses a higher rate at which to peg the nominal interest rate, with no expected change in surpluses, the effect is to *raise* the price level next period. This echoes Sargent and Wallace (1981), but the economic mechanism and the associated policy behavior are different. In the current policy mix, a higher nominal interest rate raises the interest payments the household receives on the government bonds it holds. Higher nominal interest receipts, with no higher anticipated taxes, raise household wealth and trigger the same adjustments as above. In this sense, as in Sargent and Wallace, monetary policy has lost control of inflation.[14]

Regime F emphasizes that expectations about fiscal policy can have important effects on aggregate demand and inflation today. For example, in (IEC–2) news of a future tax cut makes forward-looking agents feel wealthier, inducing them to shift up their demand for goods today and in the future. That higher demand translates into higher current inflation. But all these adjustments begin *before the tax cut takes place*. Current and past budget deficits may contain little, in any, information about fiscal effects on the economy.

[14]One-period debt implies that if R^* rises at t, the inflation rate rises at $t+1$. With long-term debt, the inflation increase is delayed and, as Sims (2010) shows, monetary policy retains its ability to raise nominal rates and reduce inflation in the short run. See also Cochrane (2001).

III.B Generalizing Policy Behavior Regimes M and F above maintain the conventional assumption that policy rules do not change over time, so the rule in place today determines expected future policy behavior. Of course, rules can and do change. The possibility that future policy rules may differ from current rules can have a profound effect on expectations and on the resulting equilibrium. For example, Davig and Leeper (2007) show that if monetary policy fluctuates between being active and passive, then a wider range of equilibrium outcomes are possible than under Regime M (even though fiscal behavior is perpetually passive), including ones in which temporarily passive monetary policy behavior amplifies volatility in the macro economy even when monetary policy is active.

If both monetary and fiscal rules fluctuate in a way that shifts the economy between regimes, say between Regimes M and F, then fiscal disturbances *always* affect inflation—just as they do if Regime F were in place forever—even if monetary policy is currently active. This idea is explored in Davig and Leeper (2006, 2010b) and Chung et al. (2007). Two key points come from this reasoning. First, the effects of both monetary and fiscal policy can vary over time, depending on the prevailing mix of monetary and fiscal policies, how long the mix is expected to prevail, and the mix of policies expected in the future.

Second, the unusual fiscal impacts on inflation that come from Regime F will be larger the more time the economy is expected to spend in Regime F now and in the future. These points underscore the central role of expectations in transmitting fiscal policy to the macro economy.

Once policy behavior is generalized to allow for changes in regime, surprising results emerge because in forward-looking models like those commonly employed at central banks, beliefs about policies in the long run anchor expectations and determine the nature of the equilibrium. If policy rules can fluctuate, then economic agents' expectations will depend on both current and future rules, weighted by the probabilities of the rules. When agents believe that at times fiscal policy will not respond systematically to stabilize debt, then the properties of Regime F spill over to Regime M and monetary policy's ability to control inflation will be curtailed.

Heading into an era of fiscal stress, as many advanced economies are, it may be reasonable for individuals to ascribe some probability to a future fiscal regime in which fiscal policy is no longer able or willing to target government debt. And the longer that governments delay making the fiscal reforms that will anchor expectations on the fiscal behavior in Regime M, the more likely it is that central banks will be unable to control inflation.

IV Fiscal Multiplier Morass

Fiscal multipliers are extraordinarily complex creatures. Little professional consensus exists on their magnitudes, in part because it is difficult to perform the same thought experiment across data sets, econometric techniques, and economic models. There are two significant branches of work on fiscal multipliers. One branch, strongly data driven, is represented in recent work by the research of Blanchard and Perotti (2002), Perotti (2007), Mountford and Uhlig (2009), and Romer and Romer (2010).[15] A second branch employs fully specified optimizing models—either estimated or calibrated—and is exemplified by Christiano et al. (2009), Cogan et al. (2009), Traum and Yang (2009), Coenen et al. (2010), Davig and Leeper (2010b), Leeper et al. (2010), and Uhlig (2010).

One clear message emerges from this vast literature: estimates of multipliers are all over the map, providing empirical support for virtually any policy conclusion. The diversity of findings, often based on *the same U.S. time series data*, highlights the difficulties in obtaining reliable estimates of fiscal effects and points to the need for systematic analyses that confront fiscal policy's complexities. Remarkably, Coenen et al. (2010) and Cogan et al. (2009) are intended as meta-studies designed to examine the size of fiscal multipliers across a wide range of dynamic optimizing models, yet they arrive at diametrically opposed conclusions. Coenen et al. (2010) finds substantial economic stimulus from government spending increases in the short and medium run, while Cogan et al. (2009) argue that even in the short run government spending is not efficacious. To date, no effort has been made to reconcile the divergent findings from the two groups of respected economists.

As scientists, we know that a wide range of factors influence the macroeconomic impacts of fiscal actions. When these factors are inadequately accounted for, we would expect the inconclusive conclusions that come from alchemy. Of course, even if research economists were to converge on a consensus about the size of various multipliers based on historical data, going forward it is dicey to apply those findings to practical policymaking in an era of fiscal stress when future fiscal adjustments are anyone's guess.

Much of my work with coauthors attempts to understand whether the forward-looking issues we emphasize can help to sort through the multiplier morass. Because the work is at an early stage, I cannot say with confidence what the multipliers are. But our work does show that dynamic behavior and expectations formation matter a great deal for understanding how fiscal policy affects the macro economy.

[15] But see the important work of Caldara and Kamps (2010), which carefully examines whether this literature has successfully isolated fiscal shocks.

IV.A Fiscal Complexities Fiscal effects are complex for all the reasons that monetary effects are, plus some. Whereas monetary policy normally has a single primary instrument—the short-term nominal interest rate—fiscal policy has many types of spending and taxes and each instrument has its distinct impacts.[16] But multiple instruments is not the most important source of fiscal complexity. Fiscal multipliers also depend on the expected sources—taxes, spending, transfers—and timing—soon or in the distant future—of fiscal financing. Alternative fiscal financing schemes change the future intertemporal margins facing decision makers and can also have important effects on wealth; these two channels can dramatically alter the dynamics of fiscal multipliers, including changing their *signs* over time.

I illustrate these points with results from a recent paper. Leeper et al. (2010) fit post-war U.S. time series to a conventional neo-classical growth model, extended to include substantial fiscal detail: government purchases and transfers and proportional taxes levied against capital and labor income and against consumption expenditures. Fiscal behavior follows simple rules that allow each instrument to respond contemporaneously to output, reflecting automatic stabilizers, and to the lagged debt-GDP ratio. Each instrument also contains a component that evolves autonomously.

Neo-classical growth models cannot produce large multipliers for changes in unproductive government spending, a fact that is well-documented [Monacelli and Perotti (2008)], so the results I present are not intended as definitive measures of "the multiplier." I seek to highlight how the dynamic patterns of estimated government spending multipliers vary systematically with alternative fiscal financing schemes, a feature that will survive across other dynamic models. The results put a sharp point on the difference between fiscal science, which acknowledges and grapples with these complexities, and fiscal alchemy, which sweeps them under the rug.

Figure 3 reports over a 10-year horizon the output multipliers associated with a persistent but transitory increase in government consumption. The figure shows the paths of multipliers under four financing schemes: "All instruments adjust" is the best-fitting model in which all instruments except consumption taxes respond to stabilize government debt; the remaining three paths are counterfactuals in which only a single type of instrument adjusts to finance the increase in government consumption. Short-run multipliers are nearly identical across financing schemes, but within a year of the initial increase in spending, important differences appear. Largest and most persistent positive multipliers emerge when higher spending is financed by lower lump-sum transfers. When higher spending brings forth lower future spending, the multiplier turns negative in about two years and remains negative even 10 years

[16] Although recent unusual central bank operations make clear that in non-normal times monetary policy has many more tools at its disposal.

out. The sharpest difference occurs when capital and labor tax rates rise to finance spending, with the multiplier turning negative in six quarters and remaining strongly negative.[17]

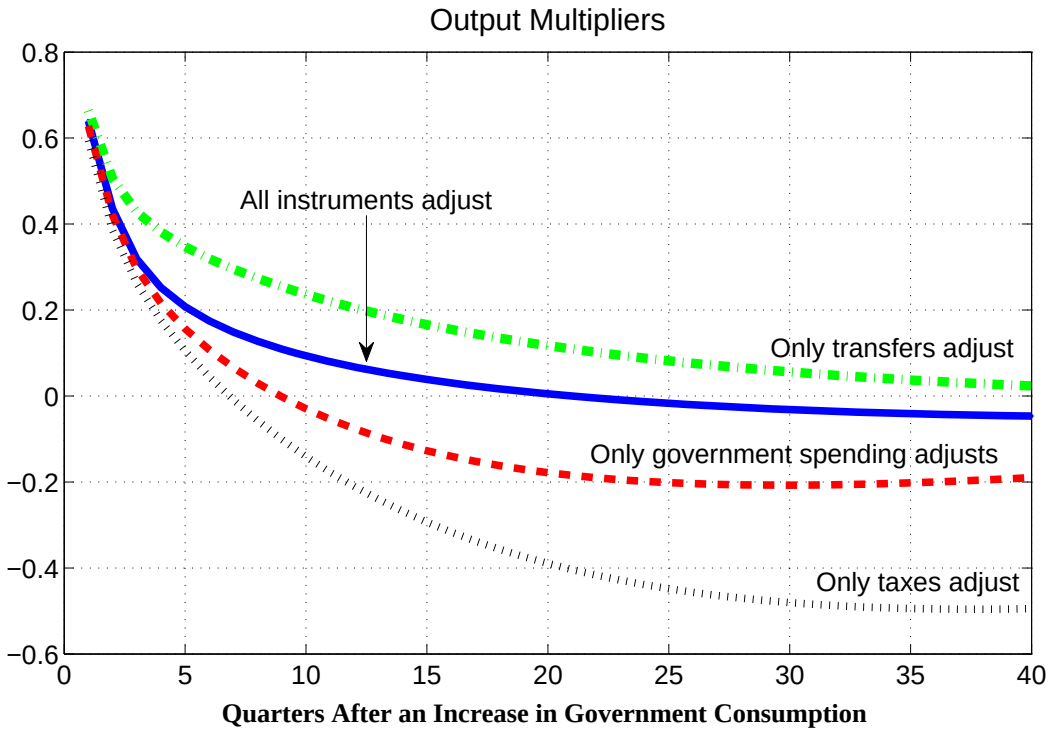

Figure 3: Output multipliers estimated in a neo-classical growth model using post-war U.S. data, as reported in Leeper et al. (2010). Various counterfactual exercises.

The thought experiment underlying figure 3 is controlled in the sense that the only difference across the multiplier paths is the policy rules in place, which determine the sources of future fiscal adjustments and the model agents' expectations of future policies. Evidently, those expectations are of central importance to determining the dynamic impacts of government spending. Statistically, the "All instruments adjust" path is probably the best guess of the multipliers associated with an exogenous increase in spending, but because in practice fiscal authorities do not follow well-understood rules, any of the adjustments depicted is possible and the values of multipliers, particularly at longer horizons, should be treated as

[17]Multipliers are present-value multipliers, computed for horizon k as

$$\text{Present-Value Multiplier}(k) = \frac{E_t \sum_{j=0}^{k} \left(\prod_{i=0}^{j} R_{t+i}^{-1} \right) \Delta Y_{t+j}}{E_t \sum_{j=0}^{k} \left(\prod_{i=0}^{j} R_{t+i}^{-1} \right) \Delta G_{t+j}}$$

where Y and G are real GDP and real government consumption and R is the model-derived discount rate. Often the k-period multiplier is calculated as $\Delta Y_k / \Delta G_0$, where ΔG_0 is the initial change in spending. This textbook-style multiplier, however, is inadequate when changes in government spending generate dynamics in both spending and output.

highly uncertain.

Timing of fiscal adjustments can also be important for determining the size of multipliers. Postponing adjustments pushes changes in taxes and spending into the future and rational economic agents discount distant changes more heavily than near-term changes. Within a week of signing the American Recovery and Reinvestment Act of 2009 (ARRA) into law, President Obama pledged to cut the fiscal deficit in half by 2013 [Calmes (2009)], a promise that would accelerate the adjustment to rising debt. Figure 4 uses the same neo-classical model to show how changes in the speed of adjustment of policy instruments affect the path of the government spending multiplier. Larger multipliers come from slower adjustments, while faster adjustments can reverse the positive output effects rapidly. Again, fiscal expectations are driving the differences.

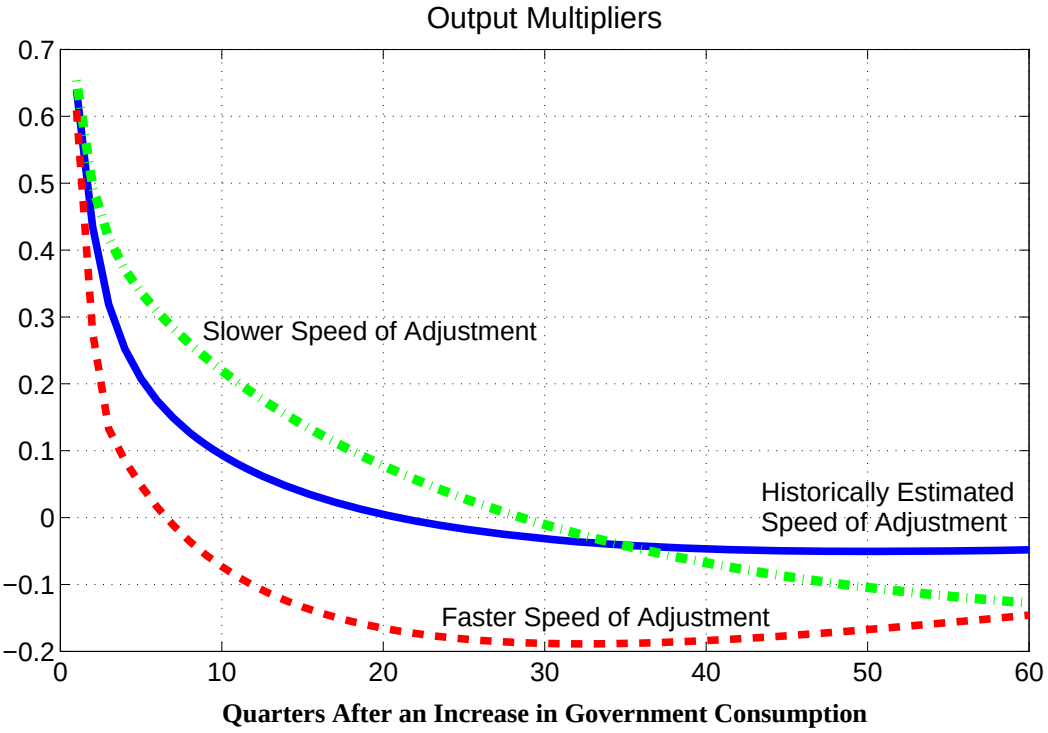

Figure 4: Output multipliers estimated in a neo-classical growth model using post-war U.S. data, as reported in Leeper et al. (2010). Various counterfactual exercises in which all fiscal instruments adjust to stabilize debt.

Fiscal dynamics can take decades to play out. With an estimated dynamic model of fiscal policy in hand, one can ask, "How long does it take for long-run fiscal balance to be restored after various fiscal actions?" Leeper et al. (2010) estimate that fiscal adjustments in the United States have been extremely gradual, taking three or more decades. This is roughly consistent with the U.S. experience after World War II: debt fell from a peak of 113

percent in 1945 to about 33 percent in the mid-1960s. Adjustments have been most gradual for government spending and labor tax shocks.

Another twist in the tale of the multiplier comes from recognizing that fiscal policy changes usually come about only after significant delay. Legislative and implementation lags ensure that private agents receive clear signals about the tax rates they will face and when important changes in government spending will occur. This phenomenon, which Leeper et al. (2009) dub "fiscal foresight," can have powerful effects on fiscal multipliers, particularly over the short horizons relevant for countercyclical policy actions [see also Ramey (2010)].

Infrastructure spending, which composed $132 billion of the ARRA, is an excellent example of how fiscal foresight can dramatically alter short-run fiscal multipliers. Table 1 records that in 2009 the Act authorized $27.5 billion spending on highways, but the actual outlays will occur through 2016, with most occurring several years after the authorization. Tracking the effects on expectations, the "news" about highway spending arrived in 2009 with passage of the Act, but the outlays over the next six years are fully anticipated. Because a highway does not contribute to productivity until construction is completed, a firm planning to build a new factory will postpone its construction until the highway is nearly completed. More generally, private investment and employment may be delayed until the new public capital is on line and raises the productivity of private inputs.

American Recovery and Reinvestment Act of 2009

	2009	2010	2011	2012	2013	2014	2015	2016	2009-16
Budget Authority	27.5	0	0	0	0	0	0	0	27.5
Estimated Outlay	2.75	6.875	5.5	4.125	3.025	2.75	1.925	.55	27.5

Table 1: Estimated costs in billions of dollars for highway construction in Title XII of the American Recovery and Reinvestment Act of 2009. Source: Congressional Budget Office, www.cbo.gov/ftpdocs/99xx/doc9989/hr1conference.pdf.

Leeper et al. (2010) estimate a dynamic model with government investment and contrast the impacts of higher infrastructure spending with different periods of implementation delays, the time between authorization and outlays. Figure 5 reports the estimated paths of employment and output following an injection of new infrastructure spending. The three lines in the figure are based on the same level of authorized spending, but represent different implementation delays: one-quarter delay (dashed lines), one-year delay (dotted-dashed lines), and three-year delay (solid lines). With a one-quarter delay, government investment today is transformed into public capital tomorrow, which raises employment and output immediately. With more plausible delays, such as a year, the boost to employment is also delayed and in the very short run, output may actually fall. As the implementation delay

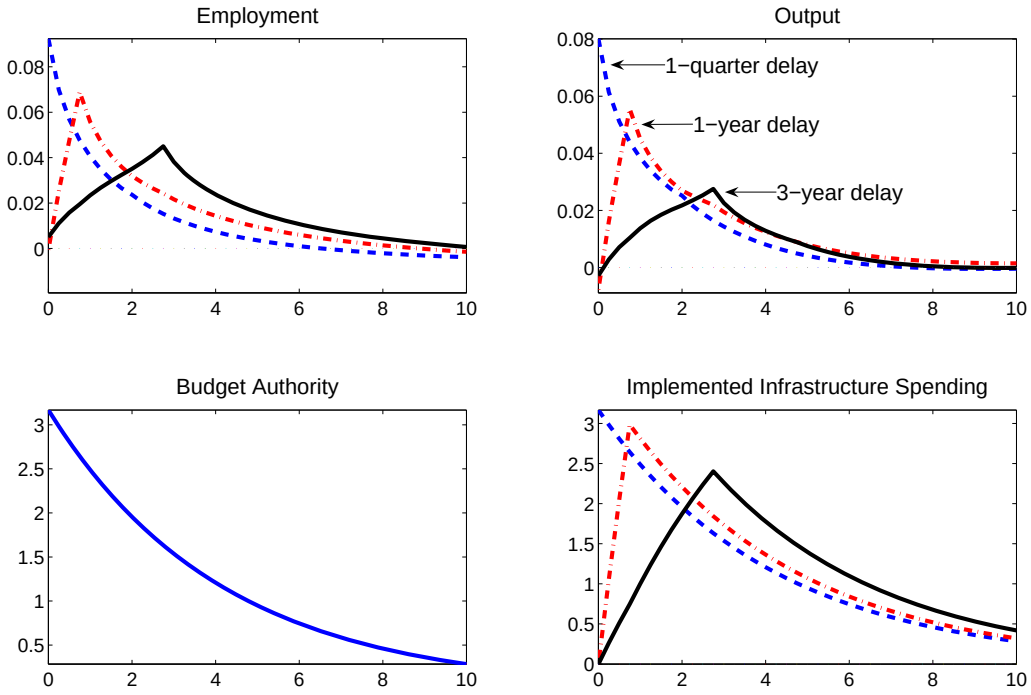

Figure 5: Impacts of higher government investment under various lengths of implementation delays in a neo-classical growth model using post-war U.S. data. Dashed lines: one-quarter delay; dotted-dashed lines: one-year delay; solid lines: three-year delay. All variables are in percentage deviations from steady state. X-axis is in years. Source: Leeper et al. (2010).

grows, the short-run stimulus to employment and output becomes more muted. Delayed stimulus arises because private decisions depend on the timing with which infrastructure spending is expected to affect productivity.

Up to now, the discussion of multipliers has made no mention of monetary policy. In principle, though, the monetary policy stance can have major implications for fiscal impacts. Higher current and expected government spending, for example, will tend to raise current and expected inflation. If monetary policy is active and raises the nominal rate more than one-for-one with inflation, then real interest rates rise, inducing individuals to postpone consumption, offsetting some of the increase in demand for goods. On the other hand, passive monetary policy, which raises nominal rates only weakly with inflation, will tend to reduce real interest rates—government spending raises expected inflation, but the nominal rate now rises by less—and encourage higher current consumption. Recent research bears out this reasoning [Christiano et al. (2009), Erceg and Lindé (2009), Eggertsson (2009), Davig and Leeper (2010b)].

Table 2 reports present-value government spending multipliers for a new Keynesian model

similar to those in use at central banks, but in an environment in which monetary and fiscal policies are regularly switching between active and passive stances, as in Regimes M and F above. Davig and Leeper (2010b) use U.S. time series to estimate more general versions of the policy rules in section III, where the coefficients on the rules can be different in different policy regimes. Those rules are then embedded in a dynamic optimizing model and the model agents form expectations over future policies using the probability distributions estimated for the policy rules. Because regimes recur, even if policies today are in Regime M, agents know that there is some probability policies will switch to Regime F in the future.

	$\frac{PV(\Delta Y)}{PV(\Delta G)}$ after			
Regime	5 quarters	10 quarters	25 quarters	∞
M: AM/PF	.79	.80	.84	.86
F: PM/AF	1.72	1.58	1.40	1.36

Table 2: Output multipliers for government spending from new Keynesian model with fluctuating monetary and fiscal policy rules. AM: active monetary policy; PM: passive monetary policy; PF: passive tax policy; AF: active tax policy. Source: Davig and Leeper (2010b).

Conditional on being in Regime M, the government spending multipliers are modest—less than unity—at all horizons [table 2, row labeled M: AM/PF]. These estimates are close to the ones that emerge from neo-classical growth models without monetary policy. But when monetary policy is passive, the same spending impulse is substantially more stimulative, with output multipliers nearly twice as large [row labeled F: PM/AF]. Accounting for monetary policy behavior, and modeling that behavior explicitly, is essential to determine the potency of fiscal policy.[18]

Multipliers in themselves are not directly interesting to policymakers. But multipliers are a critical input to predict a particular legislation's consequences, about which policymakers

[18] "Modeling that behavior explicitly" means that the details of how monetary policy accommodation is handled matter. In table 2, it is the policy *rule* that changes and, because agents know rules can change, possible fluctuations in rules are embedded in their expectations. An alternative modeling strategy would be to posit an active monetary policy rule, such as $R_t = R^* + \alpha(\pi_t - \pi^*) + \varepsilon_t$ with $\alpha > 1$ and ε_t an exogenous stochastic process. In the face of a fiscal expansion, the modeler could suspend this rule temporarily by feeding in a sequence of ε_t's that allow R_t to track any desired interest rate path. This is a completely different exercise than regime change because agents in the model base their expectations on the active monetary policy rule and the realized path of the nominal interest rate comes as a surprise to the agents. Substantive issues rest on the details of the thought experiment. Researchers are not always clear about how their experiments are conducted.

do care. Davig and Leeper (2010b) feed into their model the path of government spending associated with the ARRA—as calculated by Cogan et al. (2009)—to compute the resulting paths of macro variables. Solid lines labeled AM/PF in figure 6 condition on being in Regime M with monetary policy actively targeting inflation and fiscal policy passively raising taxes to stabilize debt. Higher current and expected government purchases raise employment and output modestly, as the multipliers in table 2 suggest. Inflation rises but monetary policy sharply increases the nominal interest rate, which raises the real interest rate and induces model agents to postpone consumption. An initial budget deficit turns to surplus, retiring debt.

Output and inflation effects are substantially larger under the alternative assignment of macro policies that most closely resemble actual American policy in 2008–2010. Passive monetary policy stabilizes debt and active fiscal policy drives inflation [dashed lines labeled PM/AF]. A weak response of monetary policy to inflation allows higher expected inflation to reduce real interest rates and stimulate consumption.

So far the Federal Reserve has signaled its willingness to continue its passive behavior by keeping the federal funds rate low. Eventually, though, as the recovery gains strength and inflation picks up, it is likely that the Fed will return to its usual active policy stance. In the absence of a coordinated switch in fiscal policy to a passive stance, both policies would be active, at least for a time. If regime were permanent and both policies were active, debt would explode and there would be no equilibrium. In this model, as in actual economies, agents do not expect the active/active regime to last forever, and it is possible for the economy to visit such a regime temporarily. Doubly active policies mean that no one is attending to debt stabilization and this produces markedly different paths for macro variables [dotted-dashed lines labeled AM/AF]: inflation rises and remains well above its initial level; output and consumption boom even though the real interest rate rises; government debt grows with no tendency to stabilize. By conditioning on remaining in the active/active regime, this counterfactual generates a series of surprisingly low taxes, which boost demand for consumption goods and induce firms to demand more labor.

The message of the doubly active policy scenario in figure 6 should be disturbing to central bankers. A switch in monetary policy to fighting inflation is doomed to failure if fiscal policy does not simultaneously switch to raising taxes to stabilize debt. Although the economy experiences a boom, it does so by generating chronically higher inflation and a growing ratio of government debt to GDP.

This scenario vividly illuminates the alchemy underlying pronouncements of "unsustainable policies." Doubly active policies can and do happen periodically. The early 1980s in the United States is a graphic case: Chairman Volcker was aggressively fighting inflation while

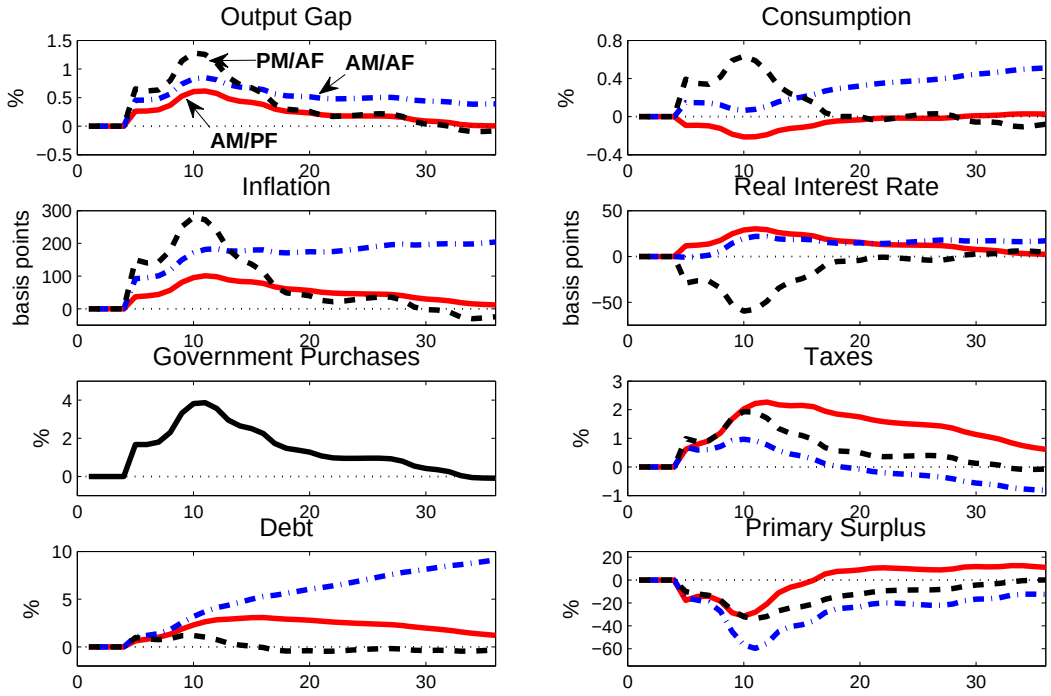

Figure 6: Impacts of the government spending path implied by the American Recovery and Reinvestment Act of 2009 in a new Keynesian model with fluctuating monetary and fiscal policy rules. Figure conditions on active monetary/passive fiscal (AM/PF) policy (solid lines), passive monetary/active fiscal (PM/AF) policy regimes (dashed lines), and active monetary/active fiscal (AM/AF) regime (dotted-dashed lines). In deviations from steady state. Time units in quarters. Source: Davig and Leeper (2010b).

President Reagan was running large deficits and steadfastly refusing to raise taxes or cut defense spending. Pundits declared policy unsustainable, yet investors at home and abroad continued to buy U.S. treasuries. Evidently, despite the dire predictions of commentators, investors believed—correctly as it turned out—that fiscal adjustments would be forthcoming. Conventional analyses that do not allow expectations formation to change over time with policy regime cannot even address the consequences of a policy mix that has occurred and may recur in times of fiscal stress.

This section has illustrated a variety of reasons why the impacts of changes in even a narrowly defined fiscal instrument—unproductive government spending in the examples—can be wildly different over time. It is little wonder that research that treats these considerations as secondary winds up in the fiscal multiplier morass. As research progressively explores these considerations, fiscal analysis will be able to leave alchemy behind.

V The Coming Era of Fiscal Stress and Its Consequences

Figure 7 neatly encapsulates why the United States is entering an era of fiscal stress, an era that many other countries are also entering. Promised federal government transfers—Social Security, Medicare, and Medicaid—are projected to grow exponentially. The federal government's share in GDP almost doubles over the projection period: from an average of about 18 in 1962 to between 31 and 35 percent in 2083, excluding interest payments on outstanding debt. Baseline revenues track baseline non-interest spending reasonably well, which is why in figure 2 the baseline 2010 debt projection shows moderate growth in debt, but the spread between revenues and total spending widens in the out years.[19]

The fiscal problem implied by the figure is sometimes called "the unfunded liabilities problem" because promised transfer payments are a future "liability" of the government and, with no plans on the books to finance them, they are "unfunded." "Unfunded liabilities" is an offspring of "unsustainable policies." Either the government will keep its promises, which means they are funded in some fashion or the government will not deliver on the promises, so they are not liabilities. Taken literally, unfunded liabilities are inconsistent with the notion of equilibrium because if the spending promises are kept and revenues cannot keep pace, then investors will anticipate that the government will not be able to service its debt. Unserviced debt is worthless or at least worth less.

Many researchers have studied this looming problem, notably Kotlikoff (1992), Auerbach et al. (1994, 1995), Kotlikoff and Gokhale (1994), and Kotlikoff and Burns (2004). Kotlikoff (2006) has even argued that the demographic shifts underlying the CBO's projections in figure 7 imply that the United States is "bankrupt." And many policy-oriented pieces have been written that point to projections like these and warn of possible fiscal crises [Rubin et al. (2004) and publications by the Committee for a Responsible Federal Budget and Peter G. Peterson Foundation]. Central bankers have also expressed concerns about the "unsustainability" of fiscal policy in the United States and elsewhere [Bernanke (2010a), Hoenig (2010), and González-Páramo (2010)].

If the CBO projections are the fiscal iceberg, then there are some fiscal ice floes out there that may add to the iceberg's mass. Many U.S. cities and states currently face dire fiscal situations and it seems reasonable to put some probability on the federal government stepping in to help. American state pensions for public employees is a bigger, long-run issue. Novy-Marx and Rauh (2009) estimate that state public pensions are underfunded

[19]The CBO attributes rapid growth in revenues to no relief from the Alternative Minimum Tax and to enforcement of the sunset provisions in the 2001 and 2003 tax cuts. Taken together, these factors account for the bulk of the difference between the two revenue projections in figure 7 [see Congressional Budget Office (2010c, chapter 4)].

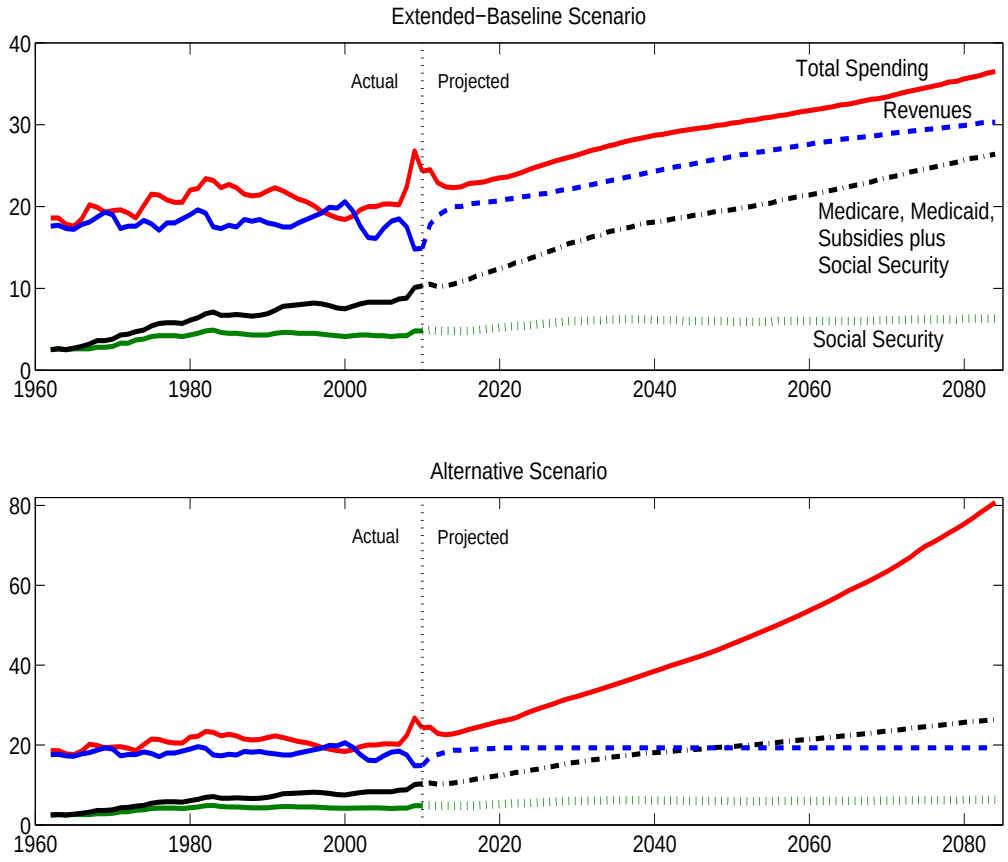

Figure 7: Congressional Budget Office long-term projections of Social Security, Medicare plus Medicaid and other medical spending, total non-interest spending, and revenues as a percentage of GDP. Solid lines to left of vertical line are actual data; extended baseline projection in dashed lines; alternative scenario projection in dotted-dashed lines. Source: Congressional Budget Office (2010c).

by $3.23 trillion, which compares to a total state debt in 2008 of under $1 trillion. Rauh (2010) projects that Illinois may run out of pension funds as early as 2018, followed by Connecticut, Indiana, and New Jersey in 2019. Some states—Florida and New York—that are now facing severe short-run budget shortfalls are projected never to run out. Rauh observes that constitutional protections may prevent states from reneging on these claims, raising the likelihood of a federal government bailout of defaulting states.

Greece's recent experience may foreshadow American events. Politics and arguments about "systemic risk" made Greece too big to fail. What might have been an isolated instance of a single member of the European Monetary Union defaulting on its debt became a Europe-wide problem. But precisely the same arguments could be made about a single American

state that is having solvency problems. If Illinois defaults, is New Jersey next? Speculation by political leaders could produce a domino theory of debt default that rationalizes federal intervention.[20] Novy-Marx and Rauh's (2009) $3.23 trillion shortfall in pension funding could make the CBO iceberg grow.

Coming fiscal stress is by no means limited to the United States. It may even be worse in other countries, according to an International Monetary Fund study that computes fiscal costs associated with aging populations [International Monetary Fund (2009b)]. Table 3 reports the net present value of the impacts on fiscal deficits of aging-related spending as a percentage of GDP. In these terms, the U.S. situation is bad, but not the worst; both Canada and Korea face larger future policy adjustments.

Country	Aging-Related Spending
Australia	482
Canada	726
France	276
Germany	280
Italy	169
Japan	158
Korea	683
Spain	652
United Kingdom	335
United States	495
Advanced G-20 Countries	409

Table 3: Net present value of impact on fiscal deficit of aging-related spending, in percent of GDP. Source: International Monetary Fund (2009b).

It is important to recognize that statements about "unsustainable" policies are always conditional on the assumption that current policies will remain in effect. Because investors are happily buying federal government bonds, they must believe that in the long run, policies *are* sustainable because current policies will *not* remain in effect. To understand how these fiscal issues are affecting the economy and interpret any tracks they might be leaving in data, it is essential to go beyond statements of unsustainability to grasp what kinds of expectations of future policies are consistent both with policies being sustainable and with the equilibrium we observe. To do this, we need to consider the notion of a "fiscal limit" and its consequences.

[20]This is not a claim that such an argument is valid; merely that it may be invoked.

V.A Fiscal Limits For both political and economic reasons, at any point in time every economy faces an upper limit on how much tax revenue it can raise and a lower limit on the level of government spending. Taken together, these limits imply a maximum level of the fiscal surplus net of interest payments. Of course, these are not constant numbers and they are not immutable. Limits will fluctuate over time, both with the state of the economy and with the political leanings of the populace.

Tax rates vary tremendously across countries, based on evidence that Trabandt and Uhlig (2009) supply for the United States and 14 European countries. In 2007, the highest labor income tax rate was in Sweden (54.6 percent) and the lowest was in the United States (28.4 percent); for capital tax rates, the highest was in Denmark (59.3 percent) and the lowest was in Greece (14.5 percent); the United States had the lowest consumption tax rate by far (4.2 percent), while Denmark had the highest (34.3 percent). Some countries are well below the peaks of their Laffer curves, while others may have high enough tax rates to put them on the wrong side of the curve, according to Trabandt and Uhlig. Similarly wide ranges exist for the overall size of governments. In a study of 28 industrial countries, Afonso and Furceri (2008) report that South Korea had the smallest ratio of general government expenditures to GDP in 2005 (29.1 percent) and Sweden had the largest (56.3 percent).

Greece's recent multi-year fiscal reforms underscore that fiscal limits are not immutable: through a variety of tax hikes and cuts in government wages and pensions, and renewed vigilance in tax collections, Greece is reducing last year's 13.6 percent of GDP deficit to a forecasted 3 percent by 2014 [International Monetary Fund European Department (2010)].

Understanding fiscal limits is essential for thinking about monetary and fiscal interactions in the coming era of fiscal stress. If a country is approaching its fiscal limit, then it no longer has the fiscal flexibility to adjust surpluses to stabilize debt. But Regime M, in which monetary policy targets inflation and fiscal policy targets real debt, requires fiscal flexibility, so fiscal limits can undermine the efforts of inflation targeting central banks to accomplish their prime objective.

In practice, the problem is more subtle. A country's fiscal limit is not observable because it depends on *expected* future surpluses far more than on the current state of fiscal policy. But those expectations, in turn, depend on the policies people think the government will adopt in the future. If policy institutions leave those expectations unanchored, then it is impossible for policy authorities to ensure that people believe that the economy will remain well below its fiscal limit. The more likely people believe it is that the limit will be reached, the harder it will be for central banks to retain control of inflation.

V.B Computing Fiscal Limits One way to quantify the economic limit to taxation is through the Laffer curve, which reports how tax revenues vary with tax rates. Figure 8 comes from Trabandt and Uhlig's (2009) study and reports one measure of Laffer curves for labor income taxes for the United States and the average of 14 European countries.[21] Trabandt and Uhlig calibrate neo-classical growth models to data for each of the 15 countries and compute steady state Laffer curves for labor, capital, and consumption tax rates. In terms of labor taxes, the United States has always been well below the peak, suggesting that there is plenty of room for raising rates and generating additional revenues. Europe, on the other hand, is much closer to its peak and, because the slope of the Laffer curve between the EU-14 average rate and the peak is relatively flat, there is little latitude to raise substantially more revenues through labor taxes. Strictly in terms of labor taxes, then, the United States is well below its fiscal limit, while, on average, Europe is much closer.[22]

Steady state Laffer curves are useful for getting a sense of fiscal limits for various tax rates, but fiscal limits are best thought of as *distributions*, rather than as fixed objects. Policy and non-policy shocks will shift the fiscal limit around: higher productivity, for example, raises factor incomes and allows the same tax rates to generate more revenues and support a higher level of government debt. Institutional features of economies—the structure of labor markets, the degree of cross-border factor mobility, and the nature of policy rules—can also have important consequences for the distributions of fiscal limits, as Bi (2009) and Bi and Leeper (2010) show. Those papers also demonstrate that shocks that deteriorate a country's fiscal position and push it closer to its fiscal limit can cause risk premia on government bonds to rise rapidly.

I know of no ministry of finance or treasury department that routinely estimates where on the relevant Laffer curves current or proposed policies place the economy. Implicitly, revenue scoring exercises employ Laffer curve concepts, but because the precise shape and location of the curve can shift over time, relying on steady-state measures or linear approximations will be fraught with pitfalls. Laffer curves and revenue scores are intrinsically dynamic, stochastic, non-linear objects produced by general equilibrium behavior.

Although there is an economic basis for thinking about limits to taxation, there is no straightforward economic argument for determining the minimum level of government expenditures. Before the current recession, federal spending on goods and services as a share of GDP in the United States was about as low as it has ever been since World War II. This suggests that this component of federal spending probably cannot fall much before it hits

[21] I thank Mathias Trabandt and Harald Uhlig for providing me with their code.

[22] As Trabandt and Uhlig (2009) report, for capital taxes the United States has far less room to maneuver, while both the United States and Europe are far from their fiscal limits for consumption taxes.

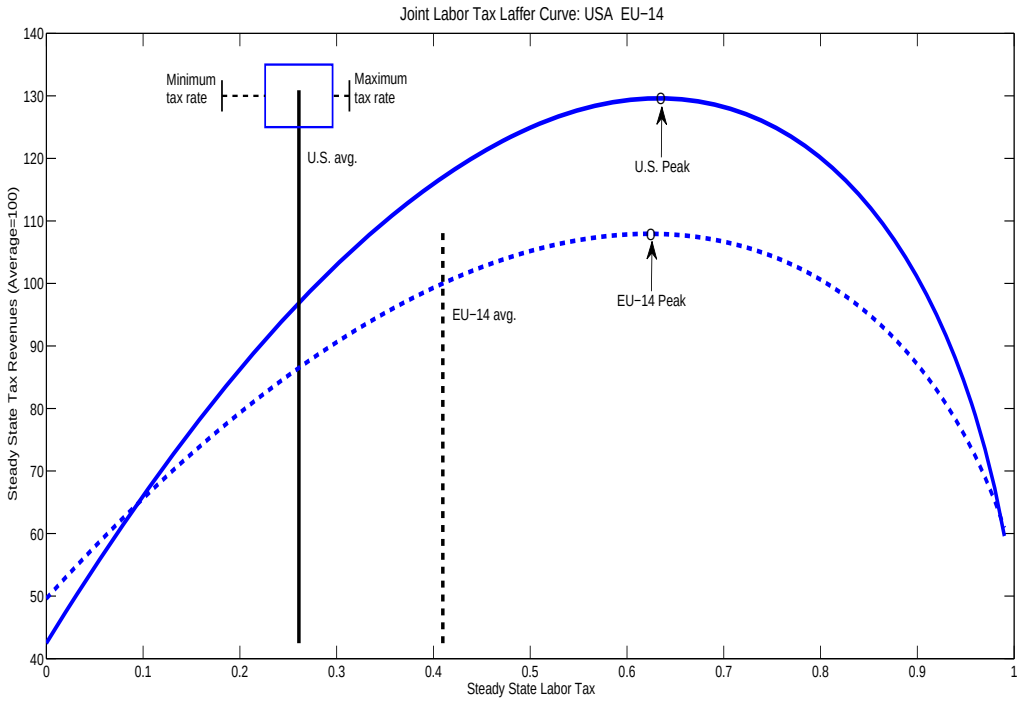

Figure 8: Laffer curves for labor tax rates for the United States (solid line) and the EU-14 (dashed line), along with historical average marginal labor tax rates (vertical lines). Circles mark the peaks of the Laffer curves. The box surrounding the average U.S. labor tax rate represents the 25th and 75th percentile of the historical rates between 1947 and 2003. Source: Trabandt and Uhlig (2009) and author's calculations using updated marginal tax rate series from Joines (1981).

its lower bound. Transfers spending, on the other hand, has grown steadily compared to the size of the economy and is expected to grow even more rapidly in coming decades. But now the political aspects of fiscal limits come into play. Older segments of the populations, who will be receiving the bulk of these projected transfers, also have unusually high voter participation rates. Significant entitlements reform is likely to be a difficult political battle whose outcome is far from predetermined.

Estimates of countries' fiscal limits may be a valuable input to policy decisions during fiscal stress because fiscal limits can change monetary and fiscal effects in unexpected ways. Just as a country need not be in default for financial markets to assess risk premia to its debt, a country need not be at its fiscal limit to feel the effects of the limit.

V.C Surprising Implications of Fiscal Limits Assets derive their value from their expected discounted cash flows. In the case of government debt, primary surpluses plus seigniorage revenues are the "cash flows" [see Cochrane (2005) for a clear statement of this

perspective]. Limits to the levels of tax revenues and spending imply limits to the primary fiscal surplus and directly impose a ceiling on the value of government debt the economy can support. With limits on surpluses, the economy lands in Regime F because fiscal policy no longer has the latitude to adjust surpluses as needed to stabilize debt.

But fiscal policy need not literally be at the limit for the economic mechanisms in Regime F to operate. If agents know the economy will hit the limit in the future or even if they just believe a limit is possible, then the equilibrium today will take on the flavor of a Regime F equilibrium. Fiscal policy will have the same kinds of wealth effects and monetary policy will be unable to control inflation. Davig et al. (2010b) derive analytical results in a setting like that in section III but where agents know that at some future period, T, taxes will remain fixed at $\tau^{\max}$ and monetary policy will shift to peg the nominal interest rate rather than target inflation; that is, in periods $t = 0, 1, \ldots, T-1$ the economy is in Regime M and for periods $t \geq T$, Regime F prevails. Because expectations of policy in the long run determine the nature of equilibrium, even before hitting the fiscal limit the equilibrium exhibits Regime F-like traits.[23] These results generalize to environments where the policy regime adopted at period T is uncertain, period T is random, or there is even some chance the fiscal limit will never be hit [see Davig et al. (2010b) and Leeper (2010) for more details].

Because most of us live in economies where fiscal expectations are not anchored well away from the fiscal limit, it is valuable for policymakers to understand inflation and aggregate demand determination at the fiscal limit.

To explore the implications of fiscal limits, we modify the intertemporal condition, expression (IEC–2), in three ways. First, we allow the real interest rate to be endogenous and respond to policy and non-policy disturbances. Second, we explicitly include high-powered money, which shows up in the new version of (IEC–2) in two ways: it adds to the total quantity of nominal government liabilities outstanding and it provides a source of revenues—seigniorage—that supports the value of those liabilities. Third, instead of assuming that all government bonds mature in one period, we assume that all government bonds are consols, which are perpetuities that we assume pay \$1 each period. The nominal price of consols sold in period t is p_t^B. By introducing long-term nominal bonds, we obtain the more plausible result that news about future net surpluses plus seigniorage will generally feed into both current inflation, as it does with only one-period debt, and the price of bonds. When long bond prices change, expected inflation rates over the maturity of the bond also change, spreading adjustments in the price level over time. Cochrane (2001) explains the general

[23]The logic follows in two steps. Because surpluses are exogenous from T on, their expected present value determines the value of debt at $T-1$, B_{T-1}/P_{T-1}. That value of debt becomes a terminal condition for the solution in periods before the fiscal limit, which has the effect of bringing policy effects at T and later forward into the equilibrium in $t < T$.

findings from adding longer term bonds and Cochrane (2010) presents some nice examples of inflation paths generated by lower expected surpluses.

With money and long bonds, the government's flow budget constraint is

$$\frac{p_t^B B_{L,t} + M_t}{P_t} + S_t = \frac{(1 + p_t^B) B_{L,t-1} + M_{t-1}}{P_t} \tag{7}$$

where S_t is the net-of-interest surplus, M_t is the amount of high-powered money, and $B_{L,t}$ is the dollar value of nominal consols outstanding.[24] Combining the analog to the intertemporal equilibrium condition in (IEC–2) with the period t flow budget constraint in (7) yields the nominal government liability valuation equation

$$\frac{p_t^B B_{L,t-1} + M_{t-1}}{P_t} = \text{expected present value of primary surpluses \& seigniorage from } t \text{ onward} \tag{IEC–3}$$

Several authors have proposed thinking about the concept of "aggregate demand" in terms of demand for government liabilities [for example, Sims (2010) and Cochrane (2010)]. An increase in the desire to hold liabilities coincides with a decrease in the desire to consume and, therefore, a decline in aggregate demand. Equilibrium expression (IEC–3) is compatible with that interpretation. The "flight to quality" that occurred over the past two years can be understood as investors substituting out of private assets and into government bonds, reducing discount rates. Lower discount rates raise the present value of any given expected path of surpluses, raising the value of government debt. Some of that reduction may occur through a contemporaneous decline in the price level, P_t, and some through higher bond prices. Lower long-term nominal interest rates imply lower expected inflation. In a model with sticky price adjustment, some the lower expected inflation will manifest in declines in output and employment.

At the fiscal limit, equilibrium condition (IEC–3) is a convenient device for evaluating the macroeconomic consequences of plausible pieces of news about the present value of surpluses. I offer a handful of examples from the United States that could arise in the coming years:

- CBO's alternative scenario projections build in the likelihood that Congress and the White House will extend in some form the 2001 and 2003 tax cuts, which are now scheduled to end in the next few years. An extension will substantially shift down expected revenue streams, according to the CBO's (2010c) analysis, and reduce the market value of government liabilities. This would trigger higher current and future

[24] Although there is no short-term interest rate in (7), we can nonetheless pose the monetary authority as setting such a rate and apply something like the expectations theory of the term structure to link the long-term rate to current and expected short rates.

inflation and stimulate the real economy.

- The non-partisan National Commission on Fiscal Responsibility and Reform, tasked with making proposals to significantly reduce deficits, may reach an agreement that Congress approves and lowers deficits in the short run. By raising the present value of surpluses, this news would have a contractionary effect on economic activity.

- State governments unable to meet pension obligations for public employees may turn to the federal government for assistance, as Rauh (2010) warns. Fears that if one state defaults others may follow could inspire lawmakers in Washington to grant assistance, reducing expected surpluses and raising the expected paths of inflation and aggregate demand.

- After the U.S. government took over control of Fannie Mae and Freddie Mac in 2008, the CBO began to include budgetary costs of the two institutions in its baseline projections [Congressional Budget Office (2010a)]. CBO puts the potential costs at $389 billion, but Bloomberg reports that the worst-case scenario may be close to $1 trillion [Woellert and Gittelsohn (2010)]. News that house foreclosures continue to rise could lower expected surpluses, requiring higher inflation to reduce the value of debt.

- As confidence recovers and investors are willing to take on more risk, the flight to quality that reduced discount rates will be reversed, reducing demand for treasuries and raising discount rates. This is equivalent to "bad news" about the present value of surpluses, raising inflation and economic activity.

- The tea party has already shown surprising political strength in primary elections and Congressional Republicans now have a tea party caucus. By the midterm elections later this year, we will have a better sense of the party's political viability and potential influence in coming years. If the party turns out to have a large constituency, this could lead to sizeable revisions downward in expected tax revenues and the value of government liabilities.

These examples are intended to be suggestive of the types of news that could cause significant revaluations of government debt, with resulting impacts on inflation rates and real activity. Most of these examples would not even generate a flutter in inflation during normal times when other fiscal adjustments can be made to offset their impacts on the value of debt. But in times of fiscal stress, when people's expectations of fiscal policies are unanchored and susceptible to wide swings, they could cause important shifts in aggregate demand to which central banks may be tempted to respond. Because the fluctuations in

demand are induced by changes in the expected present value of surpluses, their root causes will be difficult to sort out. To determine whether a monetary policy response is appropriate, central banks need to have a firm understanding of all the potential sources of the demand fluctuations.

Of course, these short-run events pale by comparison to the looming "unfunded liabilities" to which we now turn.

VI Some Possible Resolutions to Fiscal Stress

A great many accounting solutions to fiscal stress have been offered, but there is surprisingly little modeling of the macroeconomic consequences of potential resolutions. In keeping with this paper's theme, those consequences will depend importantly on people's beliefs about how monetary and fiscal policies may adjust in the future.

It is difficult to model the era of fiscal stress that confronts economies because in many ways the era is unprecedented. The problem with unprecedented things is that they don't happen a lot. Sargent (2006) characterizes the probability laws governing U.S. monetary and fiscal policies with question marks, arguing that our level of understanding what drives macro policies is best described by ambiguity or Knightian uncertainty. But if you want to model the coming fiscal situation in the conventional rational expectations paradigm, you must take some stand on those probability laws.

Davig et al. (2010b,a) take stands on how policies might adjust in the face of the relentless rise in promised transfers as a share of GDP, which figure 7 depicts. They consider three possible adjustment scenarios:

1. Tax rates rise with debt, promised transfers are fully honored, and monetary policy actively targets inflation.

2. Tax rates hit a politically determined maximum and remain fixed at that rate, the government delivers less-than-promised transfers, and monetary policy actively targets inflation.

3. Tax rates hit the fiscal limit, promised transfers are fully honored, and monetary policy switches from targeting inflation to pegging the short-term nominal interest rate.[25]

[25]The authors take off the table two other possibilities: that monetary policy will print money to buy government bonds dollar-for-dollar and that the government will default outright on its debt. Monetizing deficits is itself subject to a Laffer curve, so it cannot raise arbitrarily high levels of revenues and outright default is surely a highly unlikely outcome for the United States, which has no history of defaulting at the national level. The authors do not consider cuts in non-transfers government spending because at the federal level they are already quite low in the United States and, in any case, cannot fall at the rate that transfers are projected to grow.

There is precedent in the United States for each of the three scenarios. Scenario 1 is the normal state of affairs with tax policy behaving passively and transfers and monetary policies behaving actively, as in Regime M of section III. Scenario 2 is a variant on the first set of adjustments, with transfers taking on the passive role and taxes being active. Changes in government promises are commonplace in practice: retirement ages for old-age pensions are increased, eligibility requirements for medical benefits are tightened, payments to doctors and hospitals are reduced, and so forth. Various forms of entitlements reform allow delivered transfers to be below promised levels. A recent survey reports that 60 percent of American non-retirees believe Social Security may not fully honor its promises [Page (2010)].

Scenario 3 is similar to wartime finance. Tax increases no longer keep pace with expenditures and monetary policy supports bond prices to reduce the costs of government borrowing [see discussions in Friedman and Schwartz (1963, chapter 10), Stein (1969, chapter 9), and Meltzer (2003, chapter 7)]. The era of fiscal stress does resemble World War II with two important exceptions: based on CBO projections, this is like the Hundred Years' War, 20 years in, and now the government has the option of effectively scaling back spending by reducing future transfers. Of course, scenario 3 relies on government debt being denominated in dollars—rather than indexed to the price level—so that increases in the price level reduce the government's real liabilities, as in Regime F of section III.

To lay out these scenarios, Davig, Leeper, and Walker can draw on actual policy experiences, but there is no obvious source of information on the probabilities that economic agents place on the scenarios. The authors specify some initial probabilities and then show how equilibrium outcomes change with the probabilities.

Figure 9 sketches how uncertainty about policy unfolds in the models. The economy starts in "normal times," with transfers following a stationary process and the mix of active monetary, passive tax, and active transfers policy. With probability p_Z each period, transfers switch to a fiscal-stress process in which the promised transfers-GDP ratio grows at 1 percent per year, close to the average growth rate in figure 7; otherwise, policies remain unchanged. As transfers grow, debt and taxes rise. Higher tax rates raise the probability, $p_{L,t}$, of hitting the fiscal limit where the tax rate is fixed permanently at $\tau^{\max}$. If the economy hits the limit, it does so well below the peak of the Laffer curve, reflecting the view that, at least in the United States, political intolerance of high taxes is the most likely reason that taxes will not continue to rise to finance transfers. Whether the economy hits the limit and when it hits the limit are uncertain in the model, as they are in reality.

If taxes reach the limit and rates are fixed at $\tau^{\max}$, some other policy adjustments must occur because promised transfers continue to grow. At the fiscal limit, Regime M occurs with probability q, so transfers policy adjusts, otherwise Regime F occurs and monetary

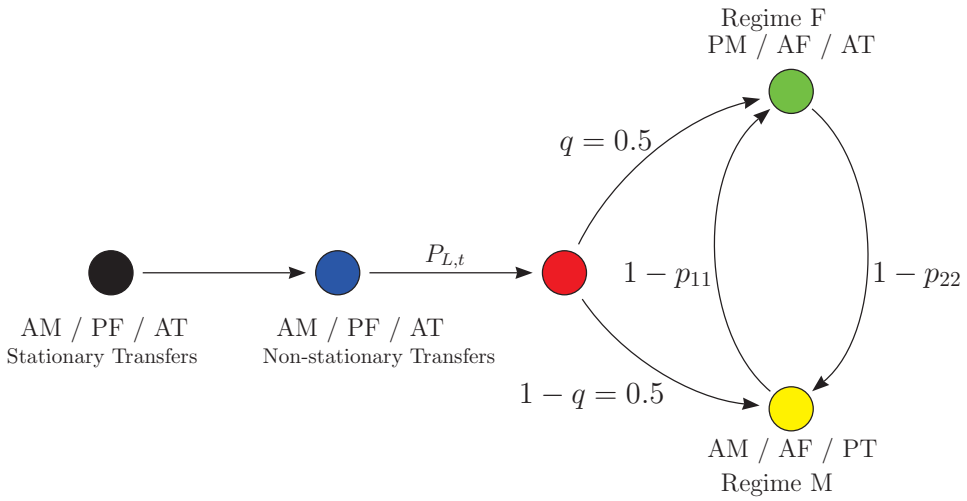

Figure 9: The unfolding of uncertainty about policy regimes. AM: active monetary policy; PM: passive monetary policy; AF: active fiscal policy; PF: passive fiscal policy; AT: active transfers policy; PT: passive transfers policy. Source: Davig et al. (2010b).

policy adjusts. For the rest of time policies fluctuate between these two regimes, scenarios 2 and 3 above, according to the transition probabilities p_{11} and p_{22}.

Davig, Leeper, and Walker embed this policy setup in an otherwise conventional dynamic model.[26] To understand how this setup plays out, it is useful to consider two limiting cases in which the sources of uncertainty are random shocks to transfers and the realizations of policy regimes. First, suppose the economy were to remain forever in the regime with stationary transfers, inflation targeting monetary policy, and debt stabilizing tax policy. This case exactly mimics Regime M in section III: both actual and expected inflation always equal the inflation target and there are no fluctuations in real variables. Second, suppose the economy switches to the non-stationary transfers regime, so debt, taxes, and the probability of hitting the fiscal limit all rise smoothly. Now set $q = 0$ so that at the limit policies switch to passive transfers—actual transfers less than promised—and imagine that the economy were to stay in that regime forever ($p_{11} = 1$). In the period leading up to the fiscal limit, distorting taxes rise, so there are now some real effects from growing transfers, but the active monetary policy behavior keeps inflation fluctuating around its target. Neither of the two cases really captures the fiscal stress arising from growing transfer payments, but they show situations in which monetary policy can succeed in controlling inflation.

Returning to the Davig, Leeper, and Walker papers, we now turn on all the uncertainty

[26]Key features of the model include: elastic labor supply, physical capital accumulation, monopolistic competition, distorting taxes levied against labor and capital income, sticky price adjustment, one-period nominal government bonds, and fiat currency. The probability of the fiscal limit, $p_{L,t}$, evolves according to a logistic function. See the papers for more complete descriptions.

about future policies that figure 9 reflects, but instead of random fluctuations in transfers, we allow promised transfers as a share of GDP to grow deterministically at 1 percent annually. Because the timing and nature of policy regime changes is random, it is instructive to simulate the model many times and examine the distribution of macro variables from the model. A wide range of outcomes is possible, as the cross-sectional distributions in figure 10 report. Dashed lines are 25th and 75th percentile bands; solid lines are 10th and 90th percentile bands.

There are realizations of regimes in which the economy hits the fiscal limit soon—within this decade—and others where it does not reach the limit over the 50-year horizon considered, so tax rates continue to drift above $\tau^{\max}$. Many realizations have the government fully honor its transfers promises, though in 10 percent of the draws the government delivers only 70 percent or less of the promised levels. In no realizations does the government debt-GDP ratio begin to approach the stratosphere, as in the CBO projections. Ninety percent of the draws keep inflation within one-and-a-half percentage points of target. Higher taxes have real effects in the model: 10 percent of the draws result in output more than six percentage points below its level in 2009. In the out years, the capital stock could be higher or lower than where it started because in the period before the fiscal limit is reached, if the current tax rate exceeds the maximum rate at the limit, economic agents anticipate lower future tax rates, which encourage investment.

Despite the wide range of outcomes possible, none of the outcomes seems as dire as some commentators suggest [for example, Kotlikoff and Burns (2004) and Kotlikoff (2006)]. The results also do not seem to confirm Kotlikoff's (2006) provocative assertion that the United States "appears to be running the same type of fiscal policies that engendered hyperinflations in 20 countries over the last century." To see what the model says about this assertion, figure 11 reports actual and 10-year-ahead expected inflation paths, averaging both across all simulations and across only those in the upper 0.5 percent tail of the distribution. Evidently, the overall average (left scale) masks realizations with high inflation but low probability (right scale). These high-inflation outcomes are likely to be most worrisome to policymakers, but eliminating them is not a simple task. In the model, the possibility of these outcomes is critical for an equilibrium to hang together.

One reason these outcomes are not nearly as gloomy as some economists predict is that in the model expectations are anchored on monetary-fiscal policy mixes that are sustainable. That is, model agents expect policies to adjust and they do adjust in the expected ways. All policy outcomes are ones that the model's rational agents have factored into their decision-making calculus. Policies that behave in an orderly fashion produce orderly average outcomes.

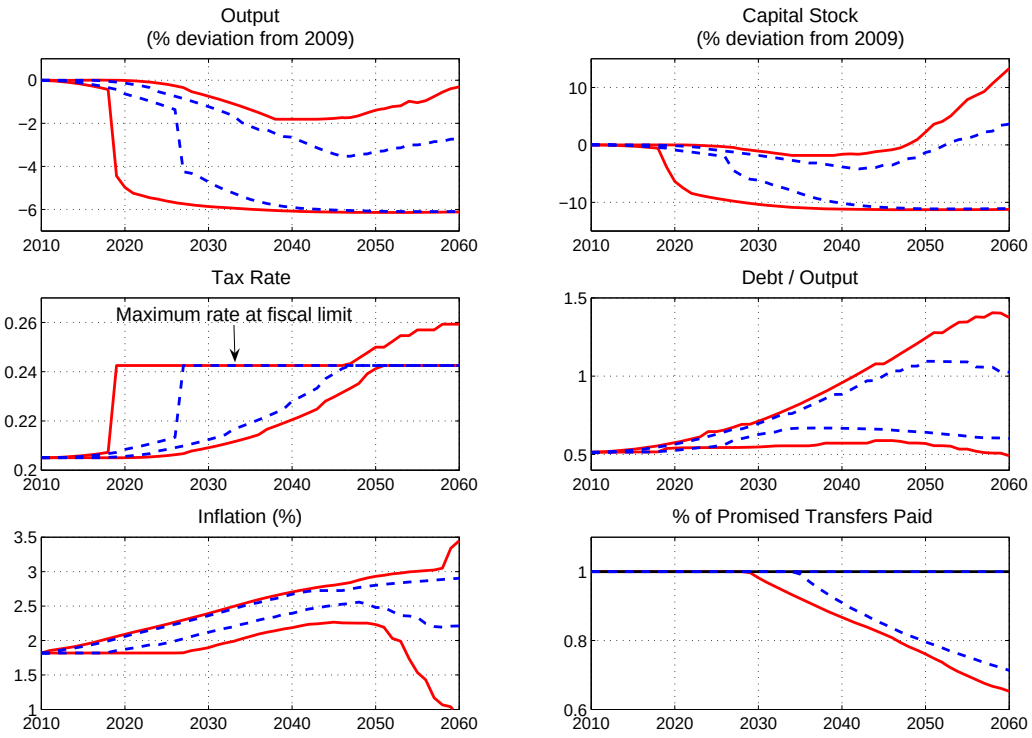

Figure 10: Range of possible outcomes for macro variables when uncertainty about future policy is as described in figure 9. Dashed lines are 25th and 75th percentile bands; solid lines are 10th and 90th percentile bands. Based on 10,000 draws of sequences of policy regimes. Source: Davig et al. (2010b).

Hidden by all the orderliness is a key policy message: the reason that high inflation is a low-probability event is because people believe that some entitlements reform is quite likely in the future. Policymakers who use the low probability of high inflation as a justification for inaction will change people's beliefs about future policies and convert high inflation into a far more likely outcome.

It's not hard to imagine disorderly resolutions that would be far more disruptive to the economy. The government could levy a surprise tax on capital (or savings), as Italy did in 1992 [Bassetto (2006)]. A large dollar depreciation would inflict capital losses on foreign owners of U.S. government bonds. Monetary and fiscal policies could both be active for several years, as in figure 6 and in the analysis of Davig and Leeper (2010a). Fears of these kinds of outcomes may grow as governments postpone implementing orderly resolutions.

Orderly resolutions, however, can be insidious for central banks. Figure 11 depicts only very gradual rises in expected long-term inflation rates. These increases could easily be mistakenly identified as the types of inflation scares that, for example, Goodfriend (1993)

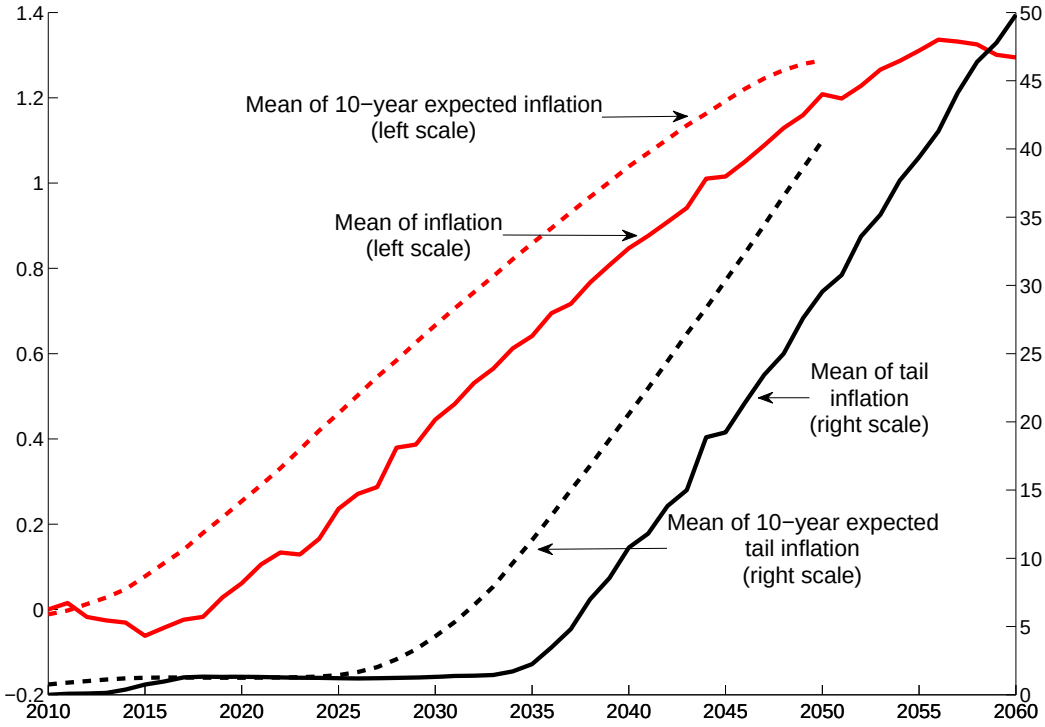

Figure 11: Simulated average paths of inflation—solid line—and 10-year-ahead expected inflation—dashed line (left scale); average paths of inflation—solid line—and 10-year-ahead expected inflation from 0.5 percent tail of distribution—dashed line (right scale). Based on 10,000 draws.

has examined. But in this case, the inflation scare is rooted in fiscal behavior that is unable or unwilling to stabilize debt. Central banks might reasonably react to the scare by preemptively tightening policy, which may slow the economy but will do little to combat the incipient inflation, which is driven by fiscal factors outside the central bank's control.

It will be important for central bankers who wish to keep inflation low and stable to understand the subtle ways that fiscal stress can affect the macro economy. That understanding will come only through fresh approaches to modeling fiscal policy.

VII A Role for Central Bankers?

Although major changes to fiscal institutions that would contribute to anchoring fiscal expectations and to making fiscal policy scientific are obviously beyond the purview of central banks, there is much that central banks and their leaders can do to move fiscal policy closer to the science that it could be.

Central banks devote substantial resources to the study of monetary policy. Those resources have played a key role in advancing the science of monetary policy. Central banks employ large staffs of Ph.D. economists who are given the time, the facilities, and the incentives to create policy relevant basic research. Central bank economists have been in the vanguard of researchers who have helped make monetary policy more scientific.

Monetary authorities advance research in other ways also. Extensive ties with academic economists through seminars, conferences (like Jackson Hole), and visiting scholar programs keep bank economists current at the same time that they inform academics about pressing policy concerns. Regular interactions of these kinds raise both the quality of policy analysis at central banks and the usefulness of research conducted outside central banks.

Central bankers have also learned—often through trial and error—effective ways to communicate with the public about complex and subtle aspects of monetary policy. Although economists have never had the physicists' penchant for bringing science down to earth for the layperson, central bankers have been largely successful in this endeavor.

Finally, there is a long tradition of econometric modeling at central banks, dating back to the FRB-MIT-PENN venture in the 1960s and 1970s. Much of the progress over the past decade in connecting dynamic optimizing models to data has occurred in central banks. Recent extensions of these models to include labor and financial market details were fostered by their relevance for monetary policy.

None of these things occur with fiscal policy. Fiscal authorities and their agencies conduct essentially no basic research and they have minimal contact with economists who do. Obtaining answers to the question, "What do fiscal policies do to the macro economy?" does not seem to be among the priorities of fiscal authorities.

Governments everywhere invest shockingly few resources into understanding fiscal policy's impacts. Consequently, the current recession caught policymakers—and academic researchers—embarrassingly ill-prepared to address fundamental questions. Is fiscal expansion more or less efficacious during a financial crisis? How should the central bank respond to a sovereign debt crisis in a monetary union? What are the impacts of unusually large fiscal stimuli and what is the desirable composition of such stimuli? Do fiscal effects vary systematically over the business cycle? How quickly should fiscal stimulus be withdrawn from the economy and by what means? How do the effects of fiscal policy change when monetary policy is operating near the zero interest rate bound? There is no shortage of opinions on these questions—only a dearth of applicable research.

But what can central banks do about this research void? Well, as they have with other voids that impede making good policy, central banks can step in and fill the void with good basic research. There are some promising signs that this is beginning to happen. This

year and next several central banks are sponsoring conferences on the topic of monetary-fiscal policy interactions. And the next round of extensions to models at central banks will build in fiscal details and government debt dynamics; the European Central Bank, Sveriges Riksbank, and several other central banks are already moving in that direction. Models that integrate monetary and fiscal policies can be used to develop consensus on rules describing fiscal behavior. Which rules fit data best? What class of implementable fiscal rules would allow the central bank to fulfill its policy mandates?

To address the kinds of issues associated with the coming era of fiscal stress, though, central bank models need to move beyond the linearized local dynamics, certainty equivalence, and Gaussian error processes that are important to the models' solution and estimation. This is what the models underlying figures 10 and 11 do. For good reasons, central bank models focus on fitting data at business cycle frequencies—monetary policy's real effects are thought to be relatively ephemeral. But fiscal effects, particularly those driven by slow-moving demographics, can also operate at very low frequencies. Whether standard central bank models adequately capture low-frequency dynamics is an open question. In an environment where promised government transfers are growing faster than the economy and the possibility of significant changes in possibly distant future policy regimes is surely influencing expectations formation, a new class of models needs to be developed and understood.[27] Central bank researchers could lead the way in this development. Because many countries will experience fiscal stress simultaneously, a group of central banks could launch a joint effort to develop the necessary analytical tools to understand these issues. Econometric modeling and inflation dynamics groups at central banks already do this. Fiscal implications of a suite of policy institution models have been examined in a recent IMF-sponsored venture. Channeling such resources into understanding the economic implications of prolonged periods of fiscal stress could significantly advance fiscal science.

Central banks gather and track survey measures of expected long-term inflation and consumer confidence. To my knowledge, no systematic surveys of expected fiscal policies exist, although some periodic ones do [for example, Page (2010)]. Because the "stance of fiscal policy" is so inadequately captured by current and past fiscal variables, measures of fiscal expectations may help central banks get a better handle on how fiscal policy is affecting the economy.

Central bank leaders also have a role to play. First, they can break away from the taboo against saying anything substantive about fiscal policy. I am *not* proposing that central

[27]This should not be taken as a rejection of efforts to construct and estimate optimizing models, as the "agent-based" modelers advocate [The Economist (2010)]. Instead, we need to handle the non-linearities, time variation, and stochastic volatility that could be built into optimizing models and appear to be important for understanding economic phenomena in non-normal times.

bankers get into the business of prescribing solutions by recommending detailed tax and spending changes. Every country has an army of policy advisors, in and out of government, ready to do that. But there is a lot that central bankers could say that falls between the two extremes of prescribing solutions and reciting platitudes about "unsustainable fiscal policy."

It would be useful to articulate why fiscal stress is a central concern for monetary policy. How does it make the central bank's primary objectives more difficult or impossible to attain? How does the enhanced macroeconomic uncertainty stemming from fiscal stress and unanchored fiscal expectations create economy-wide problems?[28] What are the alternative scenarios for how the "unfunded liabilities" problem will play out? How will monetary policy react in those scenarios? Do some scenarios imply better macroeconomic performance than others? To arrive at precise and cogent answers to these questions, central banks will need to have the new class of models at their disposal.

Central bankers occupy unique positions. They are among the very few credible spokesmen for sound economic policies. There seems to be no constituency for subtlety and complexity in fiscal thinking. Even academic economists tend to be shrill and extreme: for one prominent economist no finite amount of fiscal stimulus is sufficient, while for another any amount of stimulus is too much. But central bankers have created and educated a sophisticated audience for monetary policy. Central bankers already have the gravitas and objectivity needed to be effective communicators about fiscal stress. They just need to couple those characteristics with a deep understanding of the possible consequences of that stress.

Monetary policy institutions have good reasons to want fiscal policy research and practice to get on a path to science.

VIII Toward Fiscal Science

This paper has argued that, just as monetary policy benefitted from moving toward science, fiscal policy would also improve by becoming more scientific. This point applies equally to fiscal research and fiscal practice. Although I have argued that from a macroeconomic perspective there are striking parallels between the two macro policies, their political economy aspects differ markedly: the macro policy dimensions of monetary policy—output and inflation stabilization—have been largely depoliticized; virtually no aspect of fiscal policy is insulated from politics.[29]

[28] Eusepi and Preston (2010) emphasize that when individuals must learn about monetary and fiscal policy regime, there are instances in which the nature of the central bank's communications with the public can help to restore the ability of monetary policy to control inflation. Even with that communication, however, unanchored fiscal expectations can undermine the ability of "normal" monetary policy rules to stabilize the economy.

[29] A conversation with Jon Faust stimulated my thinking on these matters.

VIII.A Can Parts of Fiscal Policy Be Depoliticized? For some of the same reasons that fiscal policy is complex, it is also inherently political. With finely detailed tax codes and myriad spending and transfers programs, fiscal tools directly affect income distribution and can benefit some citizens and groups over others. There is no question that micro decisions like these are and should be taken by the political process. These micro decisions are an important distinction between fiscal policy and aggregate monetary policy.

Monetary policy's primary tool—the short-term interest rate—typically has far more subtle and less obvious distributional implications. As Faust and Henderson (2004) point out, some consensus on monetary policy was possible because it is widely accepted that in the long run there is no tradeoff between inflation and real activity. This consensus led naturally to the view that average inflation should be low and stable, providing a long-run anchor for the setting of the policy instrument. Of course, there is still plenty of room for debate about short-run tradeoffs—when inflation should be permitted to drift from target and how rapidly inflation should be brought back to target—but the high-frequency disputes do not diminish the import of reaching agreement on the long-run objective of monetary policy.

Consensus on fiscal policy presently begins and ends with imprecise ruminations on sustainability. Every treasury or ministry of finance web page lists this as job one. This sets the bar for fiscal policy rather low. A CEO who announced to shareholders that the company's goal for the year is to avoid bankruptcy would not be long in the job.

Perhaps there is a way to separate the various objectives of fiscal policy into two groups: micro fiscal decisions that are ground out by the give and take of politics and macro fiscal issues that can be treated as primarily scientific matters. The overarching macro issues, once settled, would serve to constrain the politically determined micro questions.

Sustainability per se does not impose enough restrictions on policy choices to help anchor fiscal expectations and move the practice of fiscal policy closer to science. But sustainability might provide a pivot point from which consensus on other macro fiscal matters may grow. Answers to questions about achieving and maintaining sustainability—if economists themselves can reach agreement—may go some way toward helping people form fiscal expectations. These questions include:

1. Should there be a long-run target for the debt-GDP ratio? What should it be?

2. Are there circumstances under which deficits (surpluses) should be permitted to permanently raise (lower) the debt-GDP ratio or should debt always be retired back to some long-run target?

3. Should government spending, taxes, and monetary policy be adjusted to stabilize debt?

4. How rapidly should the debt ratio be retired back to the target ratio?

5. What are the macroeconomic effects of certain government spending and tax changes in well-specified thought experiments?

6. What are a country's fiscal limits and how much government debt can it support before markets deem the debt to be risky?

7. What happens as the economy approaches its fiscal limit?

8. What policies can keep the economy well away from its limit?

9. What are the macroeconomic consequences of alternative policy responses to the era of fiscal stress?

10. Should monetary and fiscal policy behave in fundamentally different ways in an era of fiscal stress than they do in normal times?

Some countries are thinking along these lines. A number of countries that lived through fiscal crises in recent decades simultaneously reformed fiscal policy when they adopted an inflation targeting regime. Chile and Sweden, for example, established surplus targets for fiscal policy. Sweden also has a nominal spending ceiling. New Zealand aims to maintain government debt at about 20 percent of GDP.[30] Europe's Stability and Growth Pact, although largely ineffectual, is the best-known example of setting bounds on debt-GDP and deficit-GDP ratios. These reforms are intended primarily to keep their economies well away from their fiscal limits, but it is unclear what role, if any, fiscal science played in their design.

Some readers might argue that the optimal policy literature delivers answers to these questions, pointing to the work of Barro (1979), Lucas and Stokey (1983), Lucas (1986), Chari et al. (1994, 1995), Aiyagari and McGrattan (1998), Aiyagari et al. (2002), Benigno and Woodford (2003), Schmitt-Grohé and Uribe (2007), and Kirsanova et al. (2009). All that work presumes the economy is operating in normal times. Some general principles can be gleaned from that work, but other implications may not hold up in an era of fiscal stress. That stress is being driven by factors not usually considered in optimal policy exercises—slowly evolving demographics and their associated promised old-age benefits and appropriate strategies for recovery from worldwide financial crisis. And the demographic source carries with it powerful political constraints that could force the economy toward its fiscal limit,

[30]Sweden and Hungary have independent fiscal policy councils that scrutinize the government's plans. Holland's Central Planning Bureau (or Bureau for Economic Policy Analysis), though government run, has sufficient credibility as an independent evaluator that political parties feel compelled to have their fiscal plans vetted by the Bureau.

another consideration that optimal policy does not examine. A fresh reexamination of questions like these in light of the coming fiscal stress may provide a scientific foundation for monetary and fiscal policy behavior in the decades ahead.

VIII.B Two Additional Steps Toward Science There is a stunning and distressing lack of serious fiscal research conducted by fiscal authorities around the world. Fiscal authorities need to get a grasp on the answers to the questions that section VIII.A raises. To answer those questions, fiscal authorities need to invest in research, just as central banks have for decades. Non-governmental organizations like the Committee for a Responsible Federal Budget and others have been playing an important role by developing policy scenarios that resolve the U.S. long-term budget imbalance from an accounting perspective. The next step is to examine those scenarios in forward-looking economic models to obtain the macroeconomic implications of the policies.

Truly independent scrutiny of fiscal decisions (or indecisions) is another important step toward bringing systematic analysis to fiscal issues. One approach, which works well in Sweden, is the creation of an independent fiscal policy council that is given a public forum: the chair of the council testifies before Parliament. That council has succeeded in generating productive public debate about the tradeoff between sustainability and fiscal stimulus, which the Swedish government and most others have been facing.

The United States has a non-partisan fiscal agency, the Congressional Budget Office, that in principle, could provide the kinds of analyses and scrutiny that lead to better policy choices and more secure anchoring of fiscal expectations. In practice, though, the CBO conducts tightly circumscribed studies with little direct criticism of Congressional decisions.[31] Congress could direct the CBO to do the fiscal science that this paper advocates, even if the questions posed and the answers delivered are not to the politicians' liking. Such a modification to the CBO's mission constitutes a sea change in Congress' thinking about fiscal analysis.

VIII.C Fears of Deflation I conclude by mentioning a practical policy issue whose solution may call for a combination of monetary and fiscal science. Some members of the Federal Open Market Committee have voiced new concerns about the possibility of deflation in the United States [Chan (2010) and Bullard (2010)]. Chairman Bernanke has suggested that if those worries intensify, the Fed is prepared to take further policy actions [Bernanke (2010b) and Board of Governors of the Federal Reserve System (2010)]. Where is fiscal policy

[31] CBO's mandate explicitly prevents the agency from making policy recommendations. It is not clear that this precludes producing studies that contain a variety of policy scenarios for resolving the "unfunded liabilities" problem and reporting the likely macroeconomic consequences of each scenario.

in this conversation? This paper has detailed ways in which fiscal policy can contribute to combatting deflation, particularly when the central bank's interest rate instrument has fallen as far as it can. Those ways entail current fiscal expansion that is unassociated with credible promises of higher future surpluses or news that surpluses will be lower in the future. But fiscal news in the United States lately is all about tentative and unsystematic plans to *raise* future surpluses. U.S. fiscal policy, like its European counterparts, is too politically confused and paralyzed to be a player.[32]

I am neither forecasting deflation nor prescribing a cure. I am simply citing another example of how our understanding of monetary and fiscal policies and their interactions must accelerate just to keep pace with the world around us.

VIII.D A Final Word There are those who assert that I overestimate the possibilities of science in fiscal policy. To be sure, there are serious hurdles to overcome. But we are witnessing what the alternative to science delivers: fiscal policy as a source of stress and instability. Let's give science a try.

A Appendix: A Formal Model

To streamline the algebra, I assume that there are no real effects from monetary and fiscal actions and abstract from any monetary frictions by assuming that real money balances are a negligible share of GDP.[33] These assumptions make the model a constant endowment economy that is at the cashless limit.

The economy consists of a representative household, a monetary authority, and a fiscal authority. The household pays lump-sum taxes, τ_t, receives lump-sum transfers, z_t, and holds one-period nominal bonds paying gross risk-free nominal interest R_t. Consumption and bonds, $\{c_t, B_t\}$, are chosen to maximize $E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$ subject to the budget constraint $c_t + B_t/P_t + \tau_t = y_t + z_t + R_{t-1}B_{t-1}/P_t$, with $R_{-1}B_{-1} > 0$ given. Government purchases are zero in each period so that goods market clearing implies $c_t = y_t = y$. In equilibrium the household's consumption/saving decision produces the simple Fisher relation that links the nominal interest rate to the (constant) real interest rate, $1/\beta$, and the expected inflation

[32]Some might point to Japan's lost decade as evidence that expansionary fiscal policies are ineffective against deflation. But this is where expectations come in. Japanese fiscal policy went in fits and starts, with expansions followed by retrenchments [Ihori et al. (2003)], so expectations were almost certainly not anchored on a policy in which future surpluses are unresponsive to the state of government indebtedness. Fiscal flip-flops of that kind undermine the ability of fiscal policy to stimulate aggregate demand and inflation.

[33]More realistic environments have been studied elsewhere [Woodford (1998), Davig and Leeper (2006, 2010b), Sims (2010)].

rate, P_t/P_{t+1}

$$\frac{1}{R_t} = \beta E_t \left(\frac{P_t}{P_{t+1}} \right) \tag{A.1}$$

where $\beta \in (0, 1)$ is the household's discount factor.

Monetary policy adjusts the short-term nominal interest rate to target inflation at π^*

$$R_t^{-1} = R^{*-1} + \alpha \left(\frac{P_{t-1}}{P_t} - \frac{1}{\pi^*} \right) \tag{A.2}$$

Fiscal policy attempts to target the real value of government debt at b^* by adjusting taxes in response to the state of government debt

$$\tau_t = \tau^* + \gamma \left(\frac{B_{t-1}}{P_{t-1}} - b^* \right) \tag{A.3}$$

Government transfer payments to the household are the sole source of uncertainty in the model. Additional sources of uncertainty could be introduced, but they would not alter the basic story of inflation determination. We imagine that transfers evolve exogenously according to a known stochastic process. The growth rate of transfers is permitted to be positive, but it must be bounded to ensure that transfers do not grow faster than the real interest rate.

The government's flow budget constraint is

$$\frac{B_t}{P_t} + \tau_t = z_t + \frac{R_{t-1} B_{t-1}}{P_t} \tag{A.4}$$

The household behaves rationally and takes account of the actual policy behavior—rules (A.2) and (A.3)—and of the evolution of transfers to form rational expectations over future prices, transfers, and taxes.

A.A Regime M The first policy mix is familiar to most macroeconomists and accords well with how many central bankers perceive their behavior. I label this "Regime M." Regime M emerges when the central bank aggressively targets inflation by raising the nominal interest rate sharply in response to incipient inflation ($\alpha > 1$) and fiscal policy reacts to higher debt by raising taxes enough to achieve the debt target ($\gamma > r = 1/\beta - 1$). This combination is "active" monetary policy and "passive" fiscal policy.

The equilibrium in this regime is obtained by solving the difference equation in inflation produced by combining the Fisher equation, (A.1), with the monetary policy rule, (A.2), to

yield

$$\frac{\beta}{\alpha}E_t\left(\frac{P_t}{P_{t+1}}-\frac{1}{\pi^*}\right)=\frac{P_{t-1}}{P_t}-\frac{1}{\pi^*} \tag{A.5}$$

The solution is that inflation always equals its target, as does expected inflation.[34]

$$\pi_t=\pi^* \tag{A.6}$$

The stabilization of debt by tax policy can be seen from combining the tax rule, (A.3), with the government's budget constraint, (A.4), and taking expectations to obtain

$$E_{t-1}\left(\frac{B_t}{P_t}-b^*\right)=E_{t-1}(z_t-z^*)+(\beta^{-1}-\gamma)\left(\frac{B_{t-1}}{P_{t-1}}-b^*\right) \tag{A.7}$$

Because $\beta^{-1}-\gamma<1$, higher debt brings forth the expectation of higher taxes, so (A.7) describes how debt is expected to return to its target, b^*, following a shock to transfers, z_t.

A.B Regime F Regime F combines active tax policy, $0\le\gamma<1/\beta-1$, with passive monetary policy, $0\le\alpha<1/\beta$.

We focus on a particular policy mix that yields clean economic interpretations: the nominal interest rate is set independently of inflation, $\alpha=0$ and $R_t^{-1}=R^{*-1}\ge 1$, and taxes are set independently of debt, $\gamma=0$ and $\tau_t=\tau^*>0$. These policy specifications might seem extreme and special, but the qualitative points that emerge generalize to other specifications of passive monetary/active tax policies.

One result pops out immediately. Applying the pegged nominal interest rate policy to the Fisher relation, (A.1), yields

$$E_t\left(\frac{P_t}{P_{t+1}}\right)=\frac{1}{\beta R^*}=\frac{1}{\pi^*} \tag{A.8}$$

so expected inflation is anchored on the inflation target, an outcome that is perfectly consistent with one aim of inflation-targeting central banks. It turns out, however, that another aim of inflation targeters—stabilization of actual inflation—which can be achieved by active monetary/passive fiscal policy, is no longer attainable.

Impose the active tax rule on the intertemporal equilibrium condition, (IEC–2),

$$\frac{B_t}{P_t}=\left(\frac{\beta}{1-\beta}\right)\tau^*-E_t\sum_{j=1}^{\infty}\beta^j z_{t+j} \tag{IEC–2}$$

[34]Technically, there are many solutions to (A.5), but all but the solution in (A.6) have inflation diverging from target without bound [see Obstfeld and Rogoff (1983) and Cochrane (2007) for further discussion].

and use the government's flow constraint, (A.4), to solve for the price level

$$\frac{R^* B_{t-1}}{P_t} = \left(\frac{1}{1-\beta}\right)\tau^* - E_t \sum_{j=0}^{\infty} \beta^j z_{t+j} \tag{A.9}$$

At time t, the numerator of this expression is predetermined, representing the nominal value of household wealth carried into period t. The right side is the expected present value of primary fiscal surpluses from date t on, which is exogenous. So long as $R^* B_{t-1} > 0$ and the present value of revenues exceeds the present value of transfers, a condition that must hold if government debt has positive value, expression (A.9) delivers a unique $P_t > 0$.[35]

Using the solution for the price level in (A.9) to compute expected inflation, it is straightforward to show that $\beta E_t(P_t/P_{t+1}) = 1/R^*$, as required by the Fisher relation and monetary policy behavior. This observation leads to a sharp dichotomy between the roles of monetary and fiscal policy in price-level determination: monetary policy alone appears to determine *expected* inflation by choosing the level at which to peg the nominal interest rate, R^{*-1}, while conditional on that choice, fiscal variables appear to determine *realized* inflation.

[35] We have done nothing mystical here, despite what some critics claim [for example, Buiter (2002) or McCallum (2001)]. In particular, the government is not assumed to behave in a manner that violates its budget constraint. Unlike competitive households, the government is not required to choose sequences of control variables that are consistent with its budget constraint for all possible price sequences. Indeed, for a central bank to target inflation, it *cannot* be choosing its policy instrument to be consistent with any sequence of the price level; doing so would produce an indeterminate equilibrium. Identical reasoning applies to the fiscal authority: the value of a dollar of debt—$1/P_t$—depends on expectations about fiscal decisions in the future; expectations, in turn, are determined by the tax rule the fiscal authority announces. The fiscal authority credibly commits to its tax rule and, given the process for transfers, this determines the backing of government debt and, therefore, its market value.

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