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by

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The employer of last resort (ELR) policy proposal, also referred to as the job guarantee or public sector employment, is promoted by its supporters as an alternative to unemployment as the primary means of currency stability (see Forstater 1998; Mitchell 1998; Wray 1998, 2000; Mitchell and Wray 2004; Tcherneva and Wray 2005; and numerous publications available at the Center for Full Employment and Price Stability and the Centre of Full Employment and Equity). The core of the ELR proposal is that a job would be provided to all who wanted one at a decent, fixed wage; the quantity of workers employed in the program would be allowed to rise and fall counter to the economy's cycles as some of the workers moved from public to private sector work or vice versa depending upon the state of the economy. Supporters have played an important advisory role in Argentina's *Jefes de Hogar* (hereafter, *Jefes*) jobs program that has provided jobs to over two million citizens—or five percent of the population; though there are some important differences, the *Jefes* program has many similarities with the ELR proposal (Tcherneva and Wray 2005).

While ELR proponents argue the program would not necessarily generate budget deficits (Mitchell and Wray 2004), the program is based upon Abba Lerner's (1943) concept of functional finance in which it is the results of the government's spending and taxing policies in terms of their effects upon employment, inflation, and macroeconomic stability that matter (Nell and Forstater 2003). This is in contrast to the more widely promoted concept of "sound" finance, in which the presence of a fiscal deficit is itself considered undesirable. Rather than not being able to "afford" an ELR program, ELR proponents argue that societies would do better to consider whether they can "afford" involuntary unemployment.[1] The proposed ELR's approach of hiring "off the bottom" is argued to be a more direct means for eliminating excess, unused labor capacity than traditional "military Keynesianism" or primarily "pump-priming" fiscal policies, particularly given how the U.S. economy struggles to create jobs for the poor even during economic expansions (Pigeon and Wray 1998, 1999; Bell and Wray 2004). As Wray (2000) notes, "How many missiles would the government have to order before a job trickles down to Harlem?" (5). More traditional forms of fiscal stimulus or stabilization are still useful and complementary to an ELR program, though proponents argue that only the latter could ensure that enough jobs would be available at all times such that every person desiring a job would be offered one while also potentially adding to the national output.

Regarding macroeconomic stability, it is the fluctuating buffer stock of ELR workers and the fixed wage that are argued by proponents to be the key features that ensure the program's impact would be stabilizing. With an effectively functioning buffer stock, the argument goes, as the economy expands

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ELR spending will stop growing or even decline—countering the inflation pressures normally induced by expansion—as some ELR workers take jobs in the private sector. Regarding the fixed wage, traditional government expenditures effectively set a quantity and allow markets to set a price (as in contracting for weapons); in contrast, the ELR program allows markets to set the quantity as the government provides an infinitely elastic demand for labor, while the price (the ELR base wage) is set exogenously and is unaffected by market pressures. Together, proponents argue, the buffer stock of ELR workers and the fixed wage thereby encourage loose labor markets even at full employment. Aside from an initial increase as the program is being implemented (the size of which will depend upon the wage offered compared to the existing lowest wage and whether the program is made available to all workers), proponents suggest the program would not generate inflationary pressures and thus would promote both full employment and price stability.

The purpose of this paper is to model quantitatively the potential macroeconomic stabilization properties of an ELR program utilizing the Fairmodel (Fair 1994, 2004). The paper builds upon the earlier Fairmodel simulations of the ELR in Majewski and Nell (2000) and Fullwiler (2003, 2005). Here, a rather simple version of the ELR program is incorporated into the Fairmodel and simulated. The quantitative effects of the ELR program within the Fairmodel are measured via simulation within historical business cycles and in comparison to other policy rules for both fiscal and monetary policies through stochastic simulation.

The Fairmodel and Macroeconometric Simulation

The Fairmodel is a well-known, large macroeconometric model of the U.S. economy developed in the 1970s by Ray Fair. The model is dynamic, nonlinear, and simultaneous and it incorporates household, firm, financial, federal government, state and local government, and foreign sectors of the economy. The model combines 30 stochastic equations that are estimated using the two stage least squares method with another 100 identity equations. National Income and Product Account (NIPA) and Flow of Funds data are completely integrated into the model within the identity equations; balance sheet and flow of funds constraints are thus fully accounted for. There are 130 endogenous variables and over 100 exogenous variables.

The overarching intellectual tradition of the Fairmodel is the Cowles Commission approach to econometric modeling, which is strongly empirical but nonetheless relies heavily on theory—and in the case of the Fairmodel, particularly on an acceptance of the possibility of market disequilibrium—in specifying the stochastic equations that are the model's core (see Fair 1994, chapter 1, for further discussion).

As a structural econometric model, the Fairmodel is admittedly subject to Robert Lucas's (1976) critique, which suggests that estimated coefficients from structural models may not be consistent across policy regimes. Fair (1994) answers that "the logic of the Lucas critique is certainly correct, but the key question for empirical work is the quantitative importance of this critique" (13). Alan Blinder notes similarly that

> while Lucas's conceptual point is valuable and indubitably correct, so are the well-known points that heteroskedastic or serially correlated disturbances lead to inefficient estimates and that simultaneity leads to inconsistent estimates. But we also understand that small amounts of serial correlation lead to small inefficiencies and that minor simultaneity leads to only minor inconsistencies; so suspected violations of the Gauss-Markov theorem do not stop applied econometrics in its tracks. In the same spirit, the realization is now dawning that the Lucas critique need not be a show stopper. Indeed, evidence that it is typically important in applied work is lacking. (1989, 107)

Fair and others have further pointed out that attempts to generate tests and reliable predictions from models based upon the "deep structural parameters"—such as in real business cycle models or models employing rational expectations—Lucas prefers have not been overly successful:

> When deep structural parameters have been estimated from the first order conditions, the results have not always been good even when judged by themselves. The results in Mankiw, Rotemberg, and Summers (1985) for the utility parameters are not supportive of the approach. In a completely different literature—the estimation of production smoothing equations—Krane and Braun (1989), whose study uses quite good data, report that their attempts to estimate first order conditions were unsuccessful. It may simply not be sensible to use aggregate data to estimate utility function parameters and the like. (Fair 1994, 15)

On the other hand, Fair (1994, 2004) argues that the economic significance of the Lucas critique can be tested, and thus models that suffer in important ways from the critique can be "weeded out."

For its part, the design of the Fairmodel's stochastic equations—following the Cowles Commission approach—is more driven by data and statistical testing than so-called "modern" macroeconomic models that are based upon rational expectations and calibration. For each of the model's stochastic equations, Fair has performed statistical tests of dynamic specification, spurious correlation, serial correlation of errors, rational expectations, structural stability where the date of potential structural change is not known *a priori*, end-of-sample structural stability, and over-identifying restrictions. Consequently—and importantly—the Fairmodel's basic structure has changed surprisingly little over time and according to statistical tests demonstrates structural stability across several business cycles and policy regime changes. Indeed, 29 of the 30 stochastic equations passed structural stability tests even in the face of the so-called "new economy boom" during the mid-to-late 1990s; since stability was rejected only for the stock valuation equation, these results led Fair to predict early on that the so-called "new economy" was driven primarily by a stock market bubble as none of the other equations provided rationale for the increased equity values (see Fair 2000b, 2004 (chapter 6)). His related estimates of accelerations in trend and cyclical productivity during the 1990s from the model (reported in Fair 2004, chapter 6) were nearly identical to those reported in the influential study by Robert Gordon (2003). Furthermore, Fair (2004) shows that wealth effects (chapter 5) and interest rate effects of monetary policy (chapter 11) in the model are consistent with generally accepted empirical evidence; his research also suggests that assumed asymptotic distributions of the model's dynamics (as in modeling multiplier effects of policy actions, for example) are reasonable and not biased according to bootstrapping and stochastic simulation procedures (chapter 9). Finally, Fair (1994 (chapters 8 and 9), 2004 (chapter 14)) demonstrates that the Fairmodel's predictive abilities "dominate" vector autoregressive (VAR) models (using the same variables that Sims (1980) uses, which are also similar to those in the Atlanta Fed's VAR forecasting model (Robertson and Tallman (1999)) and autoregressive components models in terms of root mean squared errors (RMSE) and other standard tests of competing models.

Due to the statistical rigor of Fair's methodology, the Fairmodel has found support among many orthodox economists even as its theoretical approach is counter to much of the modern macroeconomic research program. Indeed, going back only to the mid-1990s, Fair has published numerous articles incorporating the Fairmodel or econometric issues closely related to the Fairmodel's structure in many of the highly-ranked orthodox journals; as a representative though not exhaustive list, see Fair (2005, 2001, 2000a, 1999a, 1999b, 1996, 1993) and Fair and Howrey (1996). Laurence Klein's (1991) frequently-cited, standard text on comparative macroeconometric models presents Fairmodel simulations alongside models used by the Federal Reserve, the University of Michigan, the Bureau of Economic Analysis, DRI, and WEFA. More recently, Seidman and Lewis (2002) and Seidman (2003) make extensive use of the Fairmodel for simulations of alternative macroeconomic policies. Both also show that the Fairmodel's structural approach to modeling consumer behavior is more consistent with generally accepted empirical evidence than the intertemporal consumption smoothing approach prevalent in modern macroeconomic theory.

Nevertheless, all models are mere representations of the economy and thus all of them have various shortcomings. The Fairmodel is no exception in this regard, but the fact that it differs from the dominant research program of orthodox macroeconomics during the past few decades perhaps says more about the shortcomings of a research program driven by a desire to found modern macroeconomics strictly on neoclassical microeconomic theory than it says about problems inherent to the Fairmodel. Fair, given his unapologetic support of the Cowles Commission approach, has argued that both the New Classical and New Keynesian literatures do not sufficiently test their models against either actual time series or competing models:

> The currently popular approach in [New Classical] macroeconomics of working with calibrated models does not focus on either single-equation tests or complete model tests, which leaves the field somewhat in limbo. . . . If in the long run the aim is to explain how the macroeconomy works, these models will need to become empirical enough to be tested, both equation by equation and against time-series models and structural models like the [Fair] model. (2004, 176)

> As is also true in the RBC [i.e., real business cycle] literature, one does not see, say, predictions of real GDP from some New Keynesian model compared to predictions of real GDP from an autoregressive equation using a criterion like the RMSE criterion. (1994, 15)

> The RBC literature should entertain the possibility of testing models based on estimating deep structural parameters against models based on estimating approximations of decision equations. Also, the tests should be more than just observing whether a computed path mimics the actual path in a few ways. The New Keynesian literature should entertain the possibility of putting its various ideas together to specify, estimate, and test structural macroeconometric models. (1994, 16)

From a heterodox perspective, being out of step with the modern counter-revolution in orthodox macroeconomics is not in itself a shortcoming; indeed, several characteristics of the Fairmodel are consistent with heterodox macroeconomic approaches. These include the following, some of which were noted by Majewski and Nell:

- Expectations are important in the Fairmodel, but they are generally adaptive in nature. Fair (2004) writes that "there is . . . no strong evidence in favor of the [rational expectations] assumption (and some against it)"; thus, in the Fairmodel, "Agents are assumed to be forward looking in that they form expectations of future values that in turn affect their current decisions, but these expectations are not assumed to be rational (model consistent). Agents are not assumed to know the complete model" (4).
- Equations for household spending on non-durable goods, services, durable goods, and residential investment are each affected by a nominal interest rate rather than a real interest rate (see Fair 2004, chapter 3). Household durable and non-durable consumption spending are also influenced by current disposable income and a wealth effect.
- Production—which here refers to "output" of both industrial and services sectors—depends upon lagged production, current sales, and the lagged change in inventories, all of which essentially generate an expected level of production consistent with sales and desired inventories. As Fair put it, in the production equation "production is smoothed relative to sales." Private sector employment and hours worked are then heavily influenced by changes in firms' production. Like production, productivity is not purely determined on the "supply side," but is rather a result of the interaction between aggregate demand and aggregate supply. Fair's own empirical research has found significant support for this "production-smoothing" approach (e.g., Fair 1989).
- The main capital investment equation—non-residential fixed investment—is a capital stock adjustment accelerator in which the current capital stock is set largely by an estimate of excess capital on-hand and expected production to meet sales demand. Costs of debt and equity capital are statistically significant determinants of investment spending. In the Fairmodel, saving equals investment due to national income accounting identity; saving does not "fund" investment.

- The monetary policy tool is a short-term interest rate, the 3-month T-bill, while the money supply is endogenously determined. (While the Fed actually sets the federal funds rate, the two are closely related through arbitrage; Fair (2004, 2005) notes that it makes virtually no difference econometrically which rate is used.) The short-term rate responds, similar to Taylor's rule, positively to higher inflation and lower unemployment. The policy responses are fitted to the actual historical interest rate strategy of the Federal Reserve, which is different from the Taylor's Rule approach of modeling an "optimal" monetary policy feedback rule (Fair 2001). Nevertheless, the comparison tests by Fair (2004, chapter 11; 2005) show that the Fairmodel's estimated rule performs as well as an optimal control procedure. Fair's estimated feedback rule for the short-term interest rate is discussed more completely in a later section of this paper.

- Fair's tests of unemployment and inflation data reject the NAIRU dynamics in which inflation spirals out of control if unemployment falls below a certain level (Fair 1999b, 2000, 2004 (chapter 4)). He found that there are no low rates of unemployment associated with high and spiraling inflation over the model's estimation period. Rather, his research suggests that the U.S. economy has normally operated below full capacity utilization. According to his results from econometric testing, a NAIRU or a natural rate of unemployment can only be assumed and imposed on a large macroeconometric model, as is done in the Federal Reserve's FRB/US model (see Fair 2004, chapter 7). As discussed below, the inflation dynamics in the Fairmodel have much in common with recent Post Keynesian critiques of the orthodox "New Consensus" view (which Fair refers to as the "modern view" or modern macroeconomics; the three terms are used interchangeably in this paper).

- Long-term interest rates in the Fairmodel are determined as a markup over short-term rates based upon the trend in short-term rates and the trend in the markup. Interest rates in the Fairmodel, like the capital stock above, are *not* determined in a loanable funds market. Contrary to current orthodox thinking (particularly that related to the "generational accounting" literature) or the FRB/US model, expectations of future federal deficits do not lead to higher long-term interest rates today in the Fairmodel. Orthodox researchers have had little success in empirical studies finding consistent, economically significant effects of rising deficits or debt on interest rates (Engen and Hubbard 2004, Galbraith 2005), which is consistent with the endogenous money/horizontalist view of many Post Keynesians.

- As mentioned, the Fairmodel integrates complete consistency with NIPA and Flow of Funds identities, which is also emphasized in the related "stock-flow consistent" modeling and "social accounting matrices" literatures currently popular among heterodox economists (e.g., Dos Santos 2002, Taylor 2004, Godley and Lavoie 2005). Not surprisingly, the Fairmodel is frequently referenced in this literature. Indeed, Godley and Lavoie have labeled Fair's research one of the "outstanding individual contributions to the stock-flow consistent approach" (2).

An understanding of the tools being used in empirical analysis reduces the likelihood that the evidence gathered will be misused or misinterpreted. Accordingly, what the simulations reported here demonstrate is the *logic* of an ELR program *given* historical relationships among macroeconomic variables implied by coefficients of the Fairmodel's stochastic equations and *given* constraints provided by NIPA and Flow of Funds accounting identities. It is certainly possible that a policy such as the ELR would alter some of the historical relationships—though it would not alter NIPA and Flow of Funds account identities—but it is essentially impossible to know how much (in quantitative terms) the relationships would be altered. As is shown below, the simulated ELR program is not an expensive program and thus structural changes in coefficients that could occur arguably might not be of tremendous economic significance; the fixed wage/hiring off the bottom nature of ELR and the stability of the Fairmodel's structural equations through time and across alternative policy regimes would both seem to support this to some degree. Most importantly, economists desiring to provide advice to policymakers recognize that some estimate regarding the impacts of a policy proposal in terms of predicted outlays, benefits, and impacts upon the broader economy is absolutely essential. The simulations here are one possible source of such information regarding an ELR policy.

ELR in the Fairmodel

For simplicity the ELR program is modeled as a purely federal program, though it is computationally similar in terms of costs to a federally funded but state or locally administered program. It could also provide funding for targeted job creation in the private sector, particularly at not-for-profit businesses, if desired (Wray 2000). Both state/local administering and not-for-profit sector job creation have been common in Argentina's *Jefes* program (Tcherneva and Wray 2005). The program is simulated from the first quarter of 1985 through the third quarter of 2005, which enables simulation of roughly two complete business cycles following the initial implementation period (discussed below). The rest of this section discusses the equations added to or changed in the Fairmodel in order to simulate the ELR program. The simulations are carried out using the Fair-Parke program (Fair 2003).

ELR Wage and Jobs Equations

The basic wage for ELR workers (hereafter, WELR) is set to reach $6.25 in 2005, which had been proposed as a "starting point" for discussion in some of the ELR literature. There is no particular WELR necessarily most consistent with the ELR proposal; there are obviously more generous versions of an ELR program that one could envision and that proponents have in fact proposed. For instance, Wray (2000) suggests the program could offer "a package of benefits [including] healthcare, child care, sick leave, vacations, and contributions to Social Security so that years spent in ELR would count toward retirement" (4). More recently, Tcherneva and Wray (2005) propose that ELR workers be paid a "living" wage. As Wray (2000) confirms, "On one level, it does not matter where the [ELR] wage is set" (4). However, WELR becomes the effective minimum wage in society, and in that sense the level at which it is set *does* matter. "Setting [WELR] well below current market or minimum wages would require massive deflation of the price level in order to generate a pool of workers willing to work for that wage. On the other hand, setting [WELR] well above the going wage would generate a large increase of wage and price levels as firms would have to compete with [WELR]" (Wray 2000, 4). The choice of WELR for the simulation is based on the criterion of consistency with the lower end of the wage structure for the actual time period being simulated, which a WELR of $6.25 in 2005 achieves.

Since there is modest inflation during 1985-2005, the WELR should be adjusted periodically. For purposes of price stability, however, indexing the WELR to the inflation rate may not be desirable. Again, there are countless possibilities consistent with the ELR proposal (e.g., indexing to growth in the calculated living-wage level, to trend productivity growth, and so forth). The approach here, consistent with modest average wage and inflation growth during the simulation period, is simply to index WELR to an inflation target of, say, 2.5 percent. This ensures that WELR is consistent with the inflation target and that the effect of the WELR on private sector wages is consistent with the target. In other words, if the economy were in an expansion, indexing WELR in this manner would not contribute to additional cost-push inflation or to the sort of wage-price spirals hypothesized in the natural rate of unemployment or NAIRU theories; if the economy were in recession, such indexation would reduce the threat of deflation. WELR is set at $3.81 in 1985 and grows at 2.5 percent annually, rising to $6.25 in 2005. Indexation is assumed to be fully implemented in the first quarter of a new year, as is done for government transfer programs such as Social Security; there is no change in WELR during the 2^{nd}, 3^{rd}, and 4^{th} quarters of a year.

In the Fairmodel, let $WELR_{-1}$ refer to the value of WELR in the previous year; the current WELR is then set by the following equation:

(1) $WELR = 1.025 \cdot WELR_{-1}$

Regarding the number of ELR employees, all unemployed workers are included in order to avoid understating the costs of the program, though the feedback from larger assumed ELR expenditures to private sector hiring will offset some of this. It is obvious that not everyone counted as unemployed will take an ELR job since the WELR will be below the reservation wage of some; at the same time, it is expected that many from outside the labor force will join the ELR workforce.[2] While it is difficult to know how many of the unemployed will not take ELR jobs versus how many from outside the labor force will, this treatment assumes that the magnitude of both roughly offset one another; more importantly, it generates a rather large ELR program. The point here is to examine "what if" several million people were to take ELR jobs, not to provide a micro-theoretic model explaining why they would do so. This also is perhaps the most "theoretically pure" version of the ELR buffer stock, since changes in non-ELR employment are matched one-for-one by changes in the ELR workforce and because the policy accepts all those looking for work.

While the simulated ELR program begins in 1985, it is assumed to be phased in during 1985-1987, employing 8.33 percent of the total unemployed to begin and then adding another 8.33 percent each quarter until fully implemented in the last quarter of 1987.

In the Fairmodel, let U be the number of unemployed according to the Bureau of Labor Services survey and let PHASE be the variable that phases in the program (set to 0.0833 to begin, and then rising by 0.0833 each quarter until reaching 1.0 in the last quarter of 1987 and remaining at 1.0 thereafter); the number of ELR jobs (JELR) is given by

(2) $JELR = U \cdot PHASE$

ELR Spending Equations

According to the NIPA and Flow of Funds data used by the Fairmodel, average hours worked in the private sector fluctuates cyclically between 32.5 and 34 hours per week during 1985-2005; in the government sector average hours worked ranged from 34 to 37 hours per week, with little discernable pattern. In this paper, ELR workers are assumed to work an average of 34 hours each week, which is an average of hours worked in the two sectors and also avoids cyclical fluctuations.

In the Fairmodel, let HELR denote average hours worked per quarter per ELR employee and be exogenously set to 442 (34 hours per week times 13 weeks). Given (1) and (2) above, the aggregate income earned by ELR workers (YELR) is given by

(3) $YELR = WELR \cdot JELR \cdot HELR$

Following Majewski and Nell, whose treatment is consistent with earlier CETA experience, it is assumed that there will be additional costs to the ELR program for production supplies totaling 15 percent of the income paid to ELR workers. The treatment here, again, errs on the side of overstating the costs of the program, given that it would not necessarily be the case that significant additional costs would be incurred if, for instance, ELR workers were employed at qualifying non-profit organizations and the organizations were simply given a subsidy equal to the WELR. Such additional costs are frequently absent in Argentina's *Jefes* program (Tcherneva and Wray 2005).

In the Fairmodel, the total non-labor costs of the ELR program (COSTELR) are determined by the following equation:

(4) $COSTELR = 0.15 \cdot YELR$

Given (1), (2), (3), and (4) above, the total spending on the ELR program (ELRSPEND) within the Fairmodel is given by

(5) ELRSPEND = YELR + COSTELR

Lastly, it is useful to also discuss the impacts of the ELR program on unemployment benefits. Unemployment benefits are estimated in equation 28—a stochastic equation—of the Fairmodel, which takes the following form:

(Fair 28) $\log(UB)=a+b_1\log(UB_{-1})+b_2\log(U)+b_3\log(WF)+e$

where,

- UB is the nominal dollar value of unemployment benefits paid
- a is a constant term
- b_i are coefficients from two-stage least squares estimation
- WF is the average wage in the firm sector and accounts for the fact that unemployment benefits are frequently increased through legislation as average wages rise
- e is an error term.

The response of log(UB) to a decrease in the number of unemployed workers is through the coefficient b_2. The estimated value of b_2 is not large in the economic sense; decreasing U by 500,000 or even 1,000,000 workers does not reduce UB by more than, say, $5 billion annually while total UB itself was in the $60 billion range during the most recent recession. There is no other cyclical variable in the equation such as jobs or real GDP in the equation. In the simulations here, then, effects on UB are limited to the rather minor direct effects of falling U since any other treatment would be rather *ad hoc*.

While one could envision policy regimes in which ELR employment directly replaced some unemployment benefits, any level of unemployment benefits would be consistent with the ELR proposal. Wray (2000) confirms that "no matter what social safety net exists, ELR can be added to allow people to choose to work over whatever package of benefits might be made available to those who choose not to work" (4). By the same token, since well over half of those unemployed are not eligible for unemployment benefits, and since many others employed by ELR would likely come from outside the labor force altogether, it is not necessarily the case that those eligible for unemployment benefits would be the same people accepting ELR jobs particularly since WELR is set at a fairly low value. The approach here is to leave Fair's equation 28 above intact, which likewise suggests that some receiving unemployment benefits will take ELR jobs while other ELR jobs will be taken by those receiving no benefits or coming from outside the labor force.

Changes to Fairmodel Identity Equations

In order to simulate the ELR policy, equations (1) through (5) above, and parts of these equations in some cases, are incorporated into the following NIPA and Flow of Funds identity equations within the Fairmodel:

- Equation 43: Average nominal hourly earnings excluding overtime of all workers
- Equation 53: Employee social insurance contributions to the federal government
- Equation 60: Total real sales of the firm sector
- Equation 61: Total nominal sales of the firm sector
- Equation 65: Total nominal saving of the household sector
- Equation 76: Nominal saving by the federal government

- Equation 82: Nominal GDP
- Equation 83: Real GDP
- Equation 95: Total worker hours paid divided by population over 16
- Equation 104: Nominal purchases of goods and services by the federal government
- Equation 115: Nominal disposable income in the household sector

Changes made to the above equations are shown in Appendix A. One point of note is that ELR wages earned are applied to the workers' portion of payroll taxes but not to regular income taxes. The ELR proposal is not necessarily more consistent with any particular method of taxation of ELR earnings, though proponents appear to prefer that ELR income be subject to as little tax as possible (since the program hires "off the bottom"). The treatment here is simply in order to be consistent with actual tax treatment of lower-end wages during 1985-2005. While much of that income would not rise above standard deductions for income taxes, the treatment here will tend to slightly overstate the net outlays of the program since it is likely that *some* portion of ELR earnings would be subject to income taxes (for instance, in the case of a second family income). Another noteworthy point is that the changes made to real GDP in equation 83 assume that ELR workers are *unproductive*; that is, they receive an income but do nothing to add to the national output directly (this assumption is relaxed, however, for some of the stochastic simulations reported later in the paper).

These identities themselves—except for equations 43 and 95, which simply track average wages and hours worked, respectively, but do not impact any other equations in the model—affect directly and indirectly the determination of variables in many other stochastic equations and NIPA/Flow of Funds identities during simulation. For instance, ELR workers receive an income that is subject to payroll taxation, so this must be added to government spending/receipts/saving equations and to household income/saving/taxation equations in order to actually simulate the program.

Supply-Side Effects

On the supply side, two important variables are the price level and the wage rate. As is standard practice in Fair's research using the Fairmodel (e.g., Fair 2001, 2004, 2005), PF—the price level in the firm sector which measured the average price of finished goods—is the measure of the price level used here. The inflation rate as measured by the growth in PF moves closely with the PCE Deflator. The two are shown on a year-to-year basis in Figure 1 during 1985:1-2005:3, for which time their correlation was 0.87.

As Fair (2004) explains,

> The price level [PF] is a function of the lagged price level, the wage rate inclusive of the employer social security tax rate, the price of imports, the unemployment rate, and the time trend. The unemployment rate is taken as a measure of demand pressure. The lagged price level is meant to pick up expectational effects, and the wage rate and import price variables are meant to pick up cost effects. The log of the real wage rate has subtracted from it LAM, where LAM is a measure of potential labor productivity.[3] (32)

Fair has tested the unemployment rate against other output gap variables for the equation and has found that the unemployment rate dominates the others statistically (2004, 32). Another way of stating Fair's PF equation is that prices of finished goods are set as a markup on wages and import prices—such as the price of oil and of other primary commodities—and also has a pro-cyclical component to account for labor market and/or bottleneck effects. Also, note that the unemployment *rate* affects the *level* of prices, which means that a fall in the unemployment rate creates a one-time increase in inflation, rather than spiraling inflation as in the NAIRU view of modern macroeconomics. Overall, the approach has much in common with recent theory and empirical evidence published by Post Keynesians (e.g., Arestis and Sawyer 2005, Bloch et al 2004, Kreisler and Lavoie (forthcoming)).

The average wage in the firm sector, WF, is also determined in a stochastic equation.

> The wage rate is simply taken to be a function of the constant term, the time trend, the current value of the price level, the lagged value of the price level, and the lagged value of the wage rate. Labor market tightness variables like the unemployment rate were not significant in the equation. The time trend variable is added to account for trend changes in the wage rate relative to the price level. The [dependent variable is the] potential productivity variable, LAM, . . . subtracted from the wage rate. (2004, 39)

In the Fairmodel, therefore, when unemployment is reduced, higher prices and wages can result as in any macroeconomic model.[4] As a result, when ELR-related spending automatically rises and falls countercyclically, the potential for demand-pull inflation or, as the case may be, greater price stability as a result of the program can be simulated.

Regarding cost-push effects of the ELR program, if WELR is set above the minimum wage—as is the case here—then it would be reasonable to expect that there would be some pass-through effect to average wages and prices given that WELR becomes the effective minimum wage. At the same time, the actual effect on the overall wage structure could be far less than the rise in the effective minimum wage since WELR affects primarily the low end of the wage structure. While there is no mechanism within the Fairmodel to account for such a pass-through effect, the Federal Reserve's FRB/US model does incorporate such an effect in its dynamic wage-adjustment equation.[5] According to the approach of the FRB/US model as described in Appendix B, an increase in the current minimum wage from $5.15 to $6.25 raises WF by around 12 cents. The effect on WF from Appendix B is increased in the simulations (in order to err on the side of a *less* stabilizing ELR program) such that at least one-third of an increase in WELR (or, to begin the simulation, the increase from the minimum wage in 1984 to the beginning level of WELR in 1985) is passed through to WF—that is, the rise from $5.15 to $6.25 would raise WF by around 38 cents in these simulations—by adding this amount to the constant term in the WF equation during simulation (but following estimation of coefficients).

Also, because ELR will generate *de facto* full employment and permanently reduced "slack" in the economy, the trend variable in the WF equation was replaced with the lagged natural logarithm of real GDP and re-estimated (some first-stage regressors were replaced or added, as well). The other coefficients for variables in the equation were not altered to a statistically or economically significant degree; there was also a slight increase in the equation's R-squared value. Without this change, an ELR induced, permanent increase in real GDP would not affect WF except to the degree that increased aggregate demand affected the general price level of output (that is, the effect would be indirect only). This change enables the ELR program to directly influence wages as aggregate spending raises capacity utilization.

There are two potentially stabilizing effects of the ELR program in the Fairmodel worth discussing. The first effect is related to another important supply-side variable, the labor force. Labor force participation in the Fairmodel is determined by stochastic equations; according to these equations, labor supply responds negatively to the unemployment rate, positively to aggregate wages and salaries, and (modestly) negatively to aggregate household wealth. These effects are unchanged in the simulations. There is thus the possibility of a modest stabilizing effect if increased employment and wages raise labor supply, since they would encourage greater labor force participation and thereby soften a decline in the unemployment rate and then also soften a rise in PF. The effect upon PF would then feed into the determination of WF, softening its rise, as well. In other words, according to the Fairmodel's stochastic equations—and like most any macroeconomic model—an increase in labor supply can suppress wage demands by slowing the fall in the unemployment rate. Likewise, the simulated ELR program may raise labor force participation (as has been the case in Argentina's *Jefes* program; see note 2) as average wages rise—since WELR is set above the minimum wage—and as "slack" in the economy is permanently reduced, which will soften somewhat potential increases in PF and in WF. A related, more traditional, impact of the ELR program in the Fairmodel results from the countercyclical nature of ELR-related spending. As the economy expands, the concurrent reduction in ELR-related spending will offset to some degree a falling unemployment rate. Since, again, the unemployment rate has a direct negative effect on PF, the former's slowed or muted reduction during an expansion will modestly offset the procyclical behavior of PF. The addition of real GDP to the WF equation discussed above will also have a similar, albeit smaller, effect *if* the ELR buffer stock's fluctuations soften swings in the level of real GDP.

ELR proponents have long argued that the pool of ELR workers will suppress excessive wage demands, even during economic expansions[6] (e.g., Wray 1998, 2000). Using the Fairmodel, the simulated impact on PF of both increased labor supply and countercyclical ELR spending during an expansion provide at least some quantitative estimate of the anticipated (by ELR proponents) ability of the fluctuating buffer stock of ELR workers—who are employed at a fixed wage that does not respond to market pressures—to promote price stability. Nevertheless, the total quantitative impact in these simulations is probably smaller than ELR proponents expect would occur in reality; for instance, throughout the simulations the labor supply increase has a total effect of only 0.1 to 0.3 percentage points on the measured unemployment rate.

To conclude this section, even with the potential stabilizing effects described here, the stabilizing properties of the ELR policy are possibly *understated* in the simulations. As mentioned, ELR workers are assumed to contribute nothing directly to the national output (except in some of the stochastic simulations reported later). Also, potential productivity-enhancing externalities from ELR employment such as education, training, and reduced skills depreciation from unemployment—not to mention employers' reduced search time when looking for available workers—are omitted here, even as they are common within the ELR literature and are reported to be important aspects of Argentina's *Jefes* program (Tcherneva and Wray 2005). Given the structure of the Fairmodel, these other benefits could only be incorporated in a rather *ad hoc* manner and would, in a similar *ad hoc* manner, bias the simulations toward greater macroeconomic stability. On the other hand, the primary labor demand influence on prices, the demand-pull effect on production due to increased aggregate income, is already present in the Fairmodel's supply-side equations that are statistically robust across several business cycles and policy regime changes. And less favorable—to the ELR's ability to stabilize the economy—impacts upon the supply side, namely the pass-through effect of an increased effective minimum wage and a direct influence of reduced "slack" in the economy upon labor costs, are added here as well.

ELR Simulations within Historical Business Cycles

As mentioned, the above ELR program is simulated for the period 1985:1-2005:3. Error terms (residuals) from stochastic equations were used in the simulations in order to generate business cycles. This also generates a perfect tracking solution for the period, as the "base" data are the actual data for the period and are shown in Table 1. In order to isolate the stabilization potential of ELR, the short-term interest rate is set to be exogenous and remain at the "base" or actual levels for the period; there is thus no feedback from the effects of ELR as an influence upon monetary policy in the simulation in this section.

There are various "shocks" coming into contact with the ELR program here. From Table 1, the economy is in an expansion through the first half of 1990, though unemployment rates are high according to recent standards. A recession ensues driven largely by oil price increases and falling consumption. While the recession ends in 1991, unemployment does not peak until late 1992. Unemployment drops thereafter and there is economic expansion throughout the decade; the period 1996-2000 is notable for both low unemployment and low inflation; it is also notable for the exceptional stock market "bubble" and federal budget surpluses. Another recession occurs in 2001 due to falling investment spending and a stock market correction; another sluggish recovery until late 2003 follows. In 2004-5, oil prices rise significantly and economic recovery appears to be in full swing to the degree that the Fed raises interest rates at a "measured" pace.

Macroeconomic Effects of the Simulated ELR Program

Figure 2 shows the workers employed in the simulated ELR program (JELR). Aside from the phase in period during 1985-1987, JELR moves with the unemployment rates in Table 1 since JELR is assumed to be the same size as the number of measured unemployed. From the business cycle trough in 1992 to business cycle peak in 2000, there is a reduction in JELR of around 3.5 million; from the two business cycle peaks (1990 and 2000) to the respective troughs, the increase is a bit over 2.5 million. These results are consistent with Mitchell and Wray's (2004) contention that a minority of total ELR workers moving between ELR and other jobs would suffice for the buffer stock effect of the ELR program to be effective.[7]

Figure 3 shows the annualized level of real GDP during the period compared to the simulated value. From this graph, the ELR program moves the economy to a permanently higher level of real GDP, while the swings in the level of real GDP due to exogenous shocks are less pronounced. Figure 4 shows the non-annualized differences between the simulated and base levels of real GDP. Again, the ELR program both permanently raises the level of real GDP while this increase is greater when the economy slows in the early 1990s and 2000s and is reduced significantly as the economy expands during the mid-to-late 1990s. The reason for the permanent rise in real GDP within the simulation is straightforward: individuals previously unemployed are now earning incomes in the ELR program; as they spend their incomes, this in turn begets more aggregate income as firms raise production levels, hire more workers, and so forth, to meet increased sales.

Figure 5 shows the unemployment rate in the simulation less the base rate. Note from the previous section that JELR is assumed equal to all those in the labor force but not employed in non-ELR jobs. Thus, the measured unemployment rate is identical to JELR divided by the labor force. By itself, then, the unemployment rate in the ELR simulation is uninteresting, since the measured unemployment rate is simply the measured ELR employment rate. Compared with the base rate of unemployment, however, Figure 5 shows what additional percentage of the labor force was able to find non-ELR jobs in the ELR simulation. As the program is implemented during the relatively high unemployment of the late 1980s and continuing into the recession of 1990-91, the stimulus from the program and thus the reduction in the unemployment rate (i.e., increase in non-ELR employment) is the largest. During the expansion of the 1990s, simulated unemployment moves closer to the base value as the economic stimulus it provided by the ELR policy is reduced. As the economy moves to recession again in 2001, simulated unemployment is again reduced further below the base level (i.e., non-ELR employment rises). Again, the unemployment rate—like real GDP—is altered as ELR employees receive incomes, spend these incomes, and the resulting increased production leads to greater private sector hiring; when the economy expands, workers leave ELR for newly created, higher paying jobs and the stimulus provided by the program is thus reduced.

The goal of many ELR workers would be higher paying, private sector employment rather than ELR work. Whereas Figure 5 showed the percentage of the labor force leaving the unemployed ranks (i.e., leaving ELR employment in the simulation) and taking non-ELR jobs, Figure 6 shows the actual number of non-ELR jobs created in the private sector. As the spending of ELR workers encourages greater production and hiring (and, during recessions, reduced layoffs) by firms, around 1,300,000-2,100,000 additional private sector jobs are *permanently* created (or not lost during downturns) beyond the base level of jobs (which itself increases through time except during recessionary periods). As above, this effect is stronger during recessionary periods and weaker during expansions.

As noted in the introduction, those promoting ELR argue that it would not create significant inflationary pressures, aside from modest initial impacts. The year-to-year inflation rates in the simulation are shown in Figure 7. As they predicted, a modest increase in inflation occurs at first, peaking at 0.44 percentage points greater than the base inflation rate; this initial effect evaporates over time even as the economy expands in the late 1980s. During the recessions of the early 1990s and early 2000s, there are increases in inflation generally peaking at 0.10 and 0.13 percentage points above the base value, respectively, due to the additional ELR spending. Note that the simulated inflationary effects of the ELR program during 1990-1991 were slight even as the economy was experiencing an oil price shock. Most interesting, however, is that during the expansion of the 1990s simulated inflation rates are actually slightly *below* base values as ELR workers take private sector jobs and thereby reduce ELR-related government spending; likewise, after the slowdown and sluggishness of the early 2000s, inflation in the ELR simulation falls slightly below the base level by 2005 as the economy recovers and expands (and yet another oil price shock is in force). Regarding stabilization properties, therefore, the simulated ELR program provides modest countercyclical stabilization to inflation rates, raising them slightly as ELR payrolls rise during recessions when deflation could otherwise threaten, and actually reducing inflation pressures slightly during expansion as workers leave the ELR program. Consistent with what ELR proponents have long argued, the ELR program simulated here is not inflationary.

Note that during the early stages of the simulation that a permanent increase in the price *level* did occur due to a permanent reduction in economic "slack" and a higher effective minimum wage in the economy. But, again, the effect upon the *growth rate* of the price level (i.e., inflation) was temporary. In other words, during the implementation period the simulated ELR program raises aggregate demand and thereby raises production (compared to without the ELR program). Thereafter, the simulated program *does not* raise production any further beyond the non-ELR level. Rather, the buffer stock of ELR workers—and thus the macroeconomic effects of the program—adjusts counter to the business cycle to *sustain* and *stabilize* this raised level of production (compared to without the ELR) while also countering modestly the business cycle's influence upon inflation.

The effect of the simulated ELR program upon inflation is consistent with recent heterodox research suggesting that a Phillips curve relating actual inflation and unemployment rates can in fact be essentially horizontal across a wide range of capacity utilization. According to these views, changes in employment lead to significant accelerations or decelerations in inflation only when capacity utilization moves significantly outside these ranges (Bloch et al 2004, Kreisler and Lavoie (forthcoming), Palacio-Vera 2005). An empirically-based Phillips curve estimated by Kansas City Fed Economist Andrew Filardo (1998) was also supportive of these views. All of these authors, and Fair's research as well, have suggested that the U.S. economy has historically operated well within this theorized horizontal range and below full utilization of capacity. Furthermore, in the simulations it need not be the case that productive capacity has not increased with sales and production; in the Fairmodel and consistent with most heterodox analyses, rising sales demand can encourage greater capital accumulation (see the discussion and literature reviews in Palacio-Vera (2005, especially 754-758) and in Fontana and Palacio-Vera (2005)).

Budgetary Impacts of the Simulated ELR Program

The simulated ELR program has modest budgetary impacts. Figure 8 shows that the total ELR-related spending (ELRSPEND) in the simulation is generally between 0.6 and 1.25 percent of GDP. The percentage is smallest toward the late 1990s after economic expansion had continued for several years and the quantity of ELR workers is at its lowest level for the simulated period. Figure 9 shows the federal budget (calendar year) as a percent of GDP for both base and simulation. As with Figure 8, the budgetary effects are modest and a bit smaller than in Figure 10 due to greater tax revenues as a result of the higher level of real GDP. Figure 9 also demonstrates, as Mitchell and Wray (2004) argue, that ELR does not necessitate government deficits; in the simulation, there are federal surpluses in both 1999 and 2000. In

Figure 10, simulated state and local budgets are improved by the ELR program due to the economy's enhanced stability and raised level of real GDP; notably, the fiscal crises encountered by states in the early 2000s is significantly less severe in the simulation, which itself would have countercyclical benefits as fewer spending cuts and tax increases would be necessary where balanced budgets are mandated by law or constitutional amendment.

Comparison of Macroeconomic Policy Rules with ELR

This section utilizes stochastic simulation to compare the stabilization properties of the ELR policy with three other macroeconomic policy rules that have appeared in Fairmodel-related literature: an estimated interest rate rule, a sales tax rate rule, and a transfer payment rule. Each of the three alternative rules are discussed in turn, followed by explanation of the stochastic simulation procedure, and then discussion of simulation results and implications.

The Fed's Interest Rate Reaction Function in the Fairmodel

The short-term interest rate reaction function in the Fairmodel is thoroughly discussed in Fair (2001, 2004, 2005). The structure of the rule is the following:

$$r_t = \alpha_0 + \alpha_1 r_{t-1} + \alpha_2 \pi_t + \alpha_3 u_t + \alpha_4 \Delta u_t + \alpha_5 \Delta r_{t-1} + \alpha_6 \Delta r_{t-2} + \alpha_7 \left(\%\Delta M1_{t-1}\right) + \alpha_8 \delta_{79-82} \left(\%\Delta M1_{t-1}\right) + \varepsilon_t$$

Where

- *t-i* indicates the lag of *i* quarters
- Δ is the level change from the previous quarter
- $\%\Delta$ is the percentage change from the previous quarter
- π is the inflation rate
- u is the unemployment rate
- M1 is the M1 measure of the money supply
- δ_{79-82} is 1 during the period of 1979:4-1982:3 and 0 otherwise

Fair's goal was to model actual Fed behavior, rather than "optimal" behavior often modeled in the modern macroeconomics literature. Fair has thus fit the equation to data for the period 1952:1-2005:3, estimating the coefficients via two-stage least squares regression. The R-square is 0.973.

Aside from the effects of lagged interest rates—which aid the equation's fit to the dynamic, "gradualist" nature of the Fed's interest rate target changes—according to the Fairmodel's estimated interest rate reaction function is a "leaning against the wind" rule that is most influenced by a negative response to a rise in the unemployment rate (that is, coefficients α_3 and α_4 are less than zero) and a positive response to the inflation rate (α_5 is greater than zero). Fair found the lagged growth rate of the money supply to be statistically significant (and positive)—though economically less important than other terms in the equation—in explaining actual Fed behavior for the entire estimation period. The δ_{79-82} term is a dummy variable for the monetary targeting experiment during the early Volcker years.

Fair (2001) finds that once δ_{79-82} is added, coefficients for the other variables are structurally stable for the entire post-1952 period. This is significant, since the widely held view among orthodox economists is that the post-1979 Federal Reserve—and especially the Greesnpan-era Fed—has carried out a much more "optimal" strategy than the pre-1979 Fed, namely by responding more strongly to inflation than previously (e.g., Clarida, Gali, and Gertler 2000, 177-8). To the contrary, Fair has found little difference between the two periods aside from the 1979-1982 period. Interestingly, Gordon's (2005) recent study of postwar Fed strategy and its effects is supportive of Fair's findings:[8]

> Perhaps the most surprising finding of this paper is that there has been *no* change in monetary policy after 1990 compared to the policies pursued before 1979, taking a narrow view of policy as the response coefficients in a Taylor Rule monetary policy reaction function. . . . We show that previous estimates of Taylor Rule reaction functions are plagued by serial correlation. Once an autoregressive correction is applied to the Taylor Rule equation, the post-1990 "Greenspan" policy turns out to look much the same as the pre 1979 "Burns" policy . . . . (8)

Fair (2005) explains that the total response of the interest rate target to inflation in the "long run" is roughly 1.0, as given by $(\alpha_2 + \alpha_7) / (1 - \alpha_1)$ and based upon the assumption that growth in the money supply eventually converges to the inflation rate. For the period 1952:4-2005:3, the response is estimated to be 1.0375 [= (0.072 + 0.011) / (1 – 0.92)]. According to modern-view (or New Consensus) models based upon neo-Wicksellian notions of a "neutral" rate of interest, a coefficient of 1.0 would be insufficient for macroeconomic stability; rather, the coefficient on inflation must be greater than 1.0 such that the real interest rate rises more than inflation or else the interest rate target remains "accommodative" (e.g., Taylor 2000; Clarida, Gali, and Gertler 2000). Both Fair (2004 (chapters 7 and 11), 2005) and Giordani (2003)—using the Fairmodel and a VAR model, respectively—suggest that empirically this is not the case and that the coefficient on inflation need not be greater than 1.0. Fair (2004, 107-8) argues that modern-view models require larger coefficients on inflation simply because they impose significant real interest rate effects on aggregate expenditures; numerous econometric studies by Fair (e.g., Fair 2004, chapter 3) have found scant empirical evidence of such real interest rate effects (and tests in Giordani (2003) support Fair's results).

Following Fair (2005), in the simulations below three versions of Fair's estimated interest rate reaction function are analyzed:

- The estimated rule as shown above.
- A modified version of the estimated rule in which the coefficient on inflation (α_2) is increased from 0.072 to 0.109, yielding a "long-run" coefficient on inflation of 1.5 [= (0.109 + 0.011) / (1 – 0.92)].
- A modified version of the estimated rule in which the coefficient on inflation (α_2) is increased from 0.072 to 0.189, yielding a "long-run" coefficient on inflation of 2.5 [= (0.189 + 0.011) / (1 – 0.92)].

Fair's Indirect Business Tax Rate Rule

Fair (2004, chapter 11; 2005) analyzes the stabilization effects of a tax rate rule to see whether it aids monetary policy.

> The idea is that a particular tax rate or set of rates would be automatically adjusted for each quarter as a function of the state of the economy. Congress would vote on the parameters of the tax rate rule as it was voting on the general budget plan, and the tax rate or set of rates would then become an added automatic stabilizer.
>
> Consider, for example, the federal gasoline tax. If the short run demand for gasoline is fairly price inelastic, a change in the after-tax price at the pump will have only a small effect on the number of gallons purchased. In this case, a change in the gasoline tax rate is like a change in after-tax income. Another possibility would be a national sales tax if such a tax existed. If the sales tax were broad enough, a change in the sales tax rate would also be like a change in after-tax income. (Fair 2005, 655)

Within the Fairmodel, let τ^* be the base indirect business tax rate. Fair then set a new rate each quarter, τ, according to previous quarters' levels of real GDP and inflation rates versus targeted values of each in the same quarters. The adjustment, intended as an example of a tax rate rule rather than an "estimate," is as follows:

$$\tau_t = \tau_t^* + 0.125\left[.5\left(\frac{y_{t-1} - y_{t-1}^*}{y_{t-1}^*}\right) + .5\left(\frac{y_{t-2} - y_{t-2}^*}{y_{t-2}^*}\right)\right] + 0.125[.5(\pi_{t-1} - \pi_{t-1}^*) + .5(\pi_{t-2} - \pi_{t-2}^*)]$$

where,

- *t-i* indicates the lag of *i* quarters
- * indicates a variable's targeted value (by policymakers)
- *y* is real GDP
- π is the inflation rate

According to the rule, the existing indirect business tax rate is thus raised (lowered) 12.5 percentage points for every 1 percent excess (deficiency) of real GDP from the target (i.e., full employment or "potential") level of real GDP averaged across the past two quarters, and another 12.5 percentage points for every 1 percentage point excess (deficiency) in the inflation rate from the targeted rate averaged across the past two quarters. (Presumably a more broad-based national sales tax would enable percentage point changes to the tax rate that were smaller in size.)

In the simulations below, the suggested tax rate rule is analyzed both with and without Fair's estimated interest rate rule.

Seidman and Lewis's Asymmetric Transfer Payment Rule

Seidman and Lewis (2002) propose an asymmetric fiscal policy rule which triggers transfer payments "in response to a decline in the output of the economy of particular magnitude" (262). The policy rule is asymmetric because it "does not attempt to restrain demand when demand is excessive. That task is left to monetary policy because we suspect that Congress may be more willing to pre-enact fiscal stimulus than to pre-enact fiscal restraint" (262). The basic rule, which determines an aggregate transfer payment, *tr*, is the following:

$$tr_t = \alpha\left[\left(\frac{y_{t-1}^* - y_{t-1}}{y_{t-1}^*}\right) - \chi\right] \times y_{t-1}^*$$

where,

- *t-i* indicates the lag of *i* quarters
- * indicates a variable's targeted value (by policymakers)
- *y* is real GDP
- α is a *power* coefficient
- χ is a threshold that must be cleared before transfer payments are triggered.

Thus, once real GDP is reduced below the target (i.e., full employment or "potential") level, if the percentage point deficiency is larger than χ, then aggregate transfer payments are triggered as a percent of target real GDP and according to the power coefficient, α. If the deficiency does not exceed χ then no transfer is triggered. Seidman and Lewis's proposal requires that Congress pre-enact the values of α and χ. They considered three different pairs that were labeled policies F1, F2, and F3; these were illustrated by assuming a deep recession in which the previous quarter's real GDP was 4 percent below its target or full employment level.

- For policy F1, α = 0.5 and χ = 2%; *tr* = 0.5 (4% – 2%) = 1% of the previous quarter's level of y*.
- For policy F2, α = 1.5 and χ = 2%; *tr* = 1.5 (4% – 2%) = 3% of the previous quarter's level of y*.
- For policy F3, α = 1.5 and χ = 0%; *tr* = 1.5 (4% – 0%) = 6% of the previous quarter's level of y*.

Obviously, with policies F2 and—especially—F3, transfer payments triggered by the rule can be very large. Recognizing this, Seidman and Lewis also proposed a possible modification in which the transfer, *tr*, is reduced if the inflation rate is above the targeted level:

$$tr_t = \alpha\left[\left(\frac{y^*_{t-1} - y_{t-1}}{y^*_{t-1}}\right) - \chi\right] \times \left[1 - \beta\left(\pi_{t-1} - \pi^*_{t-1}\right)\right] \times y^*_{t-1}$$

Here, the reduction in the *tr* is enacted *only* if actual inflation in the previous quarter was larger than the targeted rate. As an example, they proposed β = 0.8; if inflation in the previous quarter was 5 percent higher than its targeted rate, then *tr* is reduced by 60 percent (since 0.6 = 1 – 0.8 x 5%).

The calculated value of *tr*, whether with the modification for inflation or without it, is multiplied by a price deflator (*ph*, which is the deflator for the household sector in the Fairmodel) and this amount is added to the level of transfer payments that would have occurred without the rule. In the Fairmodel, *trgh* denotes transfer payments from the federal government to households. If *trgh** is used to denote the level of transfers absent the transfer rule, the new level of transfers, *trgh*, is given by:

$$trgh_t = trgh^*_t + tr_t \times ph_t$$

Since *trgh* is untaxed, the additional transfer payment adds directly to disposable income and impacts all household spending and sales equations.

Seidman and Lewis simulated the transfer rules (F1, F2, and F3) using the Fairmodel and found all three rules to be helpful in mitigating the effects of deep recessions. In the simulations below, the three proposed transfer rules are analyzed, both with and without Fair's estimated interest rate rule. Also, each transfer rule is modified as above for deviations in inflation from its targeted rate (assuming β = 0.8) and analyzed both with and without Fair's estimated interest rate rule. In sum, twelve total versions—four versions of each of the three proposed transfer rules—are simulated and analyzed.

The Stochastic Simulation Procedure

The stochastic simulation procedure (Fair 2004, 2005) is carried out here using 1993-1997 as the base period, though the choice of base period is actually unimportant. The procedure involves (1) adding historical residuals to the stochastic equations during 1994-1997 to create a base path that is the identical to the historical path, (2) drawing residuals randomly for one quarter from a selected set of past quarters (in the manner discussed below) and adding these to existing residuals for the given quarter, (3) solving the model's 130 equations for the given quarter, and (4) as steps 1-3 makeup one trial, these steps are repeated this procedure many times. In this case, 100 trials are simulated for 1993-1997; since each trial is 20 quarters long, this means a total of 2000 quarters are simulated. The period for historical error draws is 1954:1 to 2005:3, or 207 quarters in length, which means there are 207 vectors of 30 residuals from which to draw.

For each quarter, an integer between 1 and 207 is randomly drawn with probability 1/207; this draw determines which of the 207 vectors of residuals is used for that quarter as discussed in (2) and (3) above. The solved model is an estimate of how the economy might have performed had the particular “shocks” as represented by the draw of residuals actually occurred. The advantage of using historical error terms is that no distributional assumption has to be made and no zero restrictions have to be imposed; further, the “shocks” simulated are realistic since they actually have occurred in the past.

As mentioned earlier, Fair’s estimated short-term interest rate reaction function is incorporated into some of the simulations. As in Fair (2004, chapter 11; 2005), estimated residuals are added to the interest-rate equation, but no errors are drawn. As with other variables, the base case for the Fed’s rule is a perfect tracking solution for the actual short-term rate. Not drawing errors, however, ensures that the Fed does not behave randomly but rather simply follows the rule in response to shocks to the other stochastic equations. Following Fair (2004, 161), let $Y_{i,t}^{j}$ be the simulated value of an endogenous variable *i* (e.g., real GDP, inflation, unemployment) in quarter *t* on trial *j*, and let $Y_{i,t}^{*}$ be the historical or base value of variable *i* for quarter *t*. One could simply compute the standard deviation for the variable after several trials, but the problem is that there are 20 quarterly values simulated here per variable, which makes comparison across quarters difficult. Instead, Fair suggested calculating a value, L_i, for each variable, *i*, using the following two-step procedure:

First, allowing *T* to denote the length of the simulation period (T=20 quarters here), let L_i^j be

$$L_i^j = \frac{1}{T}\sum_{t=1}^{T}(Y_{i,t}^{j} - Y_{i,t}^{*})^2 \ .$$

L_i^j is the average value of the squared quarterly deviations of the 20 simulated values of variable *i* for a given trial *j* from the 20 quarterly base values. Second, recalling that *J*=100 here, let L_i be

$$L_i = \sqrt{\frac{1}{J}\sum_{j=1}^{J}L_i^j} \ .$$

L_i is then a measure of the average *within* quarter deviation of variable *i* from quarterly base values in a simulation of length *T* quarters and averaged across all *J* trials. In essence, the lower L_i is, the more effective a given policy was at offsetting or neutralizing the shock by returning the economy back toward its base values. In other words, $L_i = 0$ implies that the policy was able to completely offset all shocks and return the economy to the base value of variable *i* (i.e., the real GDP or inflation “gap” was zero).

As mentioned already, stochastic simulation was carried out for the three previously discussed policy rules (interest rate rule, tax rate rule, and transfer rule), including some variations of each. A significant concern for policy implementation would be how real GDP and inflation targets were determined in the tax rate and transfer rules, but for stochastic simulation this concern is easily sidestepped since it simply considers how well the policy rules offset deviations from base values brought on by the randomly drawn “shocks.” Thus, for the tax rate and transfer rules, the actual base values of real GDP and inflation serve as proxies for y^* and π^*, respectively, and L_i measures how well these policies offset shocks to keep the economy at or close to these base values. This explains why it is unimportant which time period is selected to be used as base values for the stochastic simulation (Fair 2004, 2005).

Each of the three policy rules targets an inflation *rate* and a *level* of real GDP. Note that a policy could significantly raise $L_{price\ level}$ if a one-time jump in the price level occurred even if the price level remained very stable thereafter. As such, it is $L_{inflation}$ that is more important than $L_{price\ level}$. Similarly, each of the policy rules theoretically targets full employment real GDP (i.e., no real GDP “gap”) rather than a growth rate of real GDP; indeed, a policy with a low value for $L_{real\ GDP}$ could have a high value for $L_{real\ GDP\ growth}$, particularly if alternating positive/negative shocks are occurring. As such, it is $L_{real\ GDP}$ that is more important than $L_{real\ GDP\ growth}$. However, if two policies are fairly equally successful at reducing

$L_{real\ GDP}$, if one also is more successful at reducing $L_{real\ GDP\ growth}$ (that is reducing real GDP variability *across* quarters) then this would seem to be preferable to a greater degree than if the same were true regarding reducing both $L_{price\ level}$ and $L_{inflation}$.

Discussion of Stochastic Simulation Results

Table 2 presents results for the stochastic simulations. In order to generate simulations in which the implementation effects of the ELR program are not present (as in the 1985-1989 period in the previous section), stochastic simulations were run for the periods 1988-1997 though only the results for the 1994-1998 appear in Table 2. Simulations with the short-term interest rate equation in effect are labeled "Fed" and those without are labeled "No Fed." Also, for simulations incorporating the interest rate reaction function, Fair's (2005) adjustment to export and import equations are incorporated, which enable the latter to be affected by changes to the interest rate target in an attempt to emulate estimated effects of interest rate changes on currency values in an open economy.

Each row reports results from 2000 simulated quarters. Values of L_i for the price level and for real GDP are deviations from quarterly base values reported as a percent of the mean of the base values; values of L_i for the remaining variables are percentage point deviations from quarterly base values. Each scenario has been exposed to the same pattern of historical error draws enabling comparisons of stochastic simulation results; no tests of statistical significance are necessary, therefore, since a larger (smaller) value of L_i is in fact larger (smaller).

There are several rows of results reported in Table 2, but they are relatively easy to summarize, even if not quickly. The most significant results are in the "inflation" and "real GDP" columns, since those are the targeted variables. The results for the price level, real GDP growth are also reported, as are results for the unemployment rate and interest rate target since they provide some insight into the workings of different policy approaches.

Row 1 reports L_i for the "base" simulation, which is the basic Fairmodel with the interest rate left exogenous. This row is the basic "starting point," since it represents the economy's performance without monetary policy or any of the fiscal policy rules (including the ELR policy).

Rows 3, 4, and 5 report L_i for Fair's estimated interest rate rule and modified rules with larger coefficients on inflation. The values of L_i are lower in each row than in row 1 (aside from real GDP growth for row 5, which is the same as row 1), implying that each policy rule stabilizes the economy within the Fairmodel. As Fair found, according to the Fairmodel, a "long-run" coefficient on inflation of 1.0—which is the case for row 3—is stabilizing, not destabilizing as New Consensus literature argues. Also, "long-run" coefficients of 1.5 and 2.5 add very slightly to inflation stability and to slightly reduce real GDP stability. The reported results in these two columns for rows 3-5 are nearly identical—relative to each other—as those reported in Fair (2005, 651), even though Fair used the larger, multicountry version of the Fairmodel and a narrower time period for drawing residuals. The main result of adding to the coefficient on inflation appears to be raised interest rate variability ($L_{short\text{-}term\ interest\ rate}$) with little to no benefit in terms of macroeconomic stabilization. This result is consistent with Gordon (2005), which finds that greater emphasis on stabilizing inflation by the Fed has not led to greater macroeconomic stability. It is also consistent with Post Keynesians who consider inflation to be caused by factors other than monetary policy—even in the "long run"—and also believe the interest rate is a "blunt" instrument by itself for macroeconomic stabilization.

In row 2, all automatic stabilizers—unemployment benefits, transfer payments to households and firms, indirect business taxes, social insurance taxes, and income taxes—have been held exogenous and thus do not respond to the macroeconomic shocks in the simulation. Comparing row 1 with row 2 thereby shows to some degree the impact of current automatic stabilizers. It also speaks to the potential for fiscal policy to stabilize the economy, even as it is generally out of favor among orthodoxy when compared to monetary policy.

Rows 6 and 7 present results for the tax rate rule. In row 6, the tax rate rule raises price level variability largely because it shifts the price level—this is a common theme for all of the fiscal policy rules tested here. From row 7, the tax rate rule combined with the estimated interest rate rule in row 3 reduces variability for real GDP while also reducing variability in the interest rate. In other words, the tax rate rule contributes by stabilizing real GDP while also enabling monetary policy to "lean against the wind" less than without the rule. Further, the tax rate rule combined with the estimated interest rate rule produces less variability in all columns than the modified interest rate rules in rows 4 and 5. As with all the fiscal policy rules discussed here, the monetary policy rules in rows 3-5 are far more effective in reducing variability in the unemployment rate; this is not surprising given that the unemployment rate is explicitly included in the reaction function.

Rows 8-11 report results for Seidman and Lewis' (denoted with "SL" in Table 2) transfer rule policy, version F1. The results are nearly identical to those for the tax rate rule. There are two notable points here. First, the Seidman and Lewis rule is not as asymmetric as might be thought even though there is no response once the size of the output gap is less than χ. After a transfer payment, if the economy grows the reduction—or elimination, depending upon the size of χ—in the size of the transfer in the following quarter will have a constraining effect. This effect becomes stronger as α is increased in F2 and F3. Second, there is very little effect when $\beta = 0.8$; this makes sense given that it implies that even an inflation rate one percentage point above the base rate reduces the size of the transfer by only eight percent. Future research may want to see how different values of β affect the stabilization properties of the transfer rules.

Rows 12-15 present results for Seidman and Lewis's proposal, version F2. With α increased from 0.5 to 1.5 here, there is another reduction in variability in the level of real GDP compared to the tax rate rule or to F1. There is also a slight reduction in interest rate variability, implying that greater intervention by fiscal policy enables monetary policy to "lean against the wind" less still. Interestingly, there is no loss in inflation stability as variability in real GDP lessens.

Rows 16-19 present results for Seidman and Lewis's proposal, version F3. With $\chi = 0$ here, the stabilizing effect of the rule upon real GDP is larger than with F2. This is not surprising given the large size and more frequent transfer payments in this example. There is another reduction in variability in the short-term interest rate, which is, again, not surprising. Inflation variability fell again slightly, as it did in comparing F2 to F1. This reported reduced inflation variability might be overly optimistic, however, because—unlike the ELR simulations reported in this paper—there has been no account made for the potential effects of such large transfers on reservation wages of the public; it could be the case that such large transfers invoke economically significant increases in private sector wages and thus also raise final goods prices (beyond the effects of reduced unemployment rates that are already incorporated into the PF equation). Nonetheless, the results are consistent with previous rows that support a greater role for fiscal policy in macroeconomic stabilization. In rows 18 and 19, F3 generates large enough transfers that the addition of $\beta = 0.8$ creates rather visible effects. Notably, having fiscal policy respond to inflation here *raises* variability in real GDP and in real GDP growth, indicating that greater emphasis on inflation stabilization raises variability in real GDP (as was also the case in rows 4 and 5 when compared to row 3).

The ELR program is simulated in rows 20-33; rows 1-19 enable some comparison of the stabilization effects of the program with other policy rules.[9] Rows 20 and 21 report results for the ELR program simulated in the previous section. The results here are nearly identical with those for F2 above, except that variability in real GDP growth is reduced more than for the latter policy. ELR is thus the only policy simulated here to reduce variability in both real GDP *and* real GDP growth; thus, the ELR program stabilizes real GDP both within and across quarters. Also, the variability of the short-term interest rate is reduced by more than in F2.

Rows 22-25 simulate the ELR program except the ELR buffer stock is assumed to be less responsive to changes in the number of unemployed. In rows 22 and 23, JELR = 0.75 • U; in rows 24 and 25, JELR = 0.50 • U. For rows 22 and 23, the results lie somewhere between F1 and F2; for rows 24 and 25, the results are similar to F1 and the tax rate rule. These indicate that a less efficient buffer stock still has stabilization effects on real GDP.[10] Again in these cases, the ELR policy reduces real GDP growth variability by more than the other fiscal policy rules.

The version of ELR simulated heretofore has assumed ELR workers add nothing to national output and are thus unproductive. Rows 26-29 assume that ELR workers are *half* as productive as the average public sector employee, which is itself about 65 percent as productive as the average private sector employee during 1993-1997, according to the Fairmodel data. Thus, these rows assume the average ELR employee contributes to the national output at a rate of about one-third that of the average private sector worker. Rows 26 and 27 simulate this with an efficiently functioning buffer stock of ELR workers; the results are somewhere between those for F2 and F3, and real GDP growth is again reduced. Rows 28 and 29 simulate with JELR = 0.50 • U, and the results are similar to those for F2, aside from the larger reduction in variability of real GDP growth for the ELR policy.

Rows 30-33 assume ELR workers contribute the same on average to the national output as government workers (and, again, about 65 percent as much as the average private sector worker). Row 30 approaches the results for F3; real GDP growth is again significantly less variable and—for the first time in the simulations—there is very little reduction in volatility once the interest rate reaction function is added. In other words, monetary policy contributes little here except to stabilize the unemployment rate. It is notable that as the responsiveness of the buffer stock and the productivity of ELR workers are increased the contribution of the interest rate rule to reduced variability falls in kind; this is not the case with the Seidman and Lewis rule as the interest rate rule still has a significant impact on GDP variability even in the F3 simulation.

Taken together, the simulations suggest that an ELR policy can have stabilization properties similar to other fiscal policy stabilization rules—particularly regarding stabilization of the level of real GDP—even if the buffer stock is less than optimally responsive and even if ELR workers are not as productive as private sector workers. Rather intuitively, they also suggest that the greater the responsiveness of the buffer stock and the greater the productivity of ELR workers the larger the stabilization effects of the program on real GDP *and* real GDP growth. None of the other rules tested or variations thereof demonstrated an ability to improve upon the base simulation in smoothing real GDP *across* quarters. While the Fed's interest rate reaction function attempts to stabilize the *unemployment rate* to achieve macroeconomic stabilization, the ELR policy instead raises *and* stabilizes *total employment* (inclusive of ELR employment). In other words, the ELR policy enables fluidity between public and private sector employment via the buffer stock of ELR workers, and thus variability in the unemployment rate remains even when the responsiveness of the buffer stock and ELR worker productivity are increased. By contrast, the Fed's rule and the other fiscal policy rules tend to reduce unemployment rate variability as the countercyclical responses are increased. Finally, the effects of the ELR program on inflation variability were similar to the other fiscal policy rules; adding an interest rate rule that "leans against the wind" less than without the fiscal policy rule achieved inflation variability roughly equal to that of all three interest rate rules.

Concluding Remarks

In the simulations in this paper, a fairly "vanilla" ELR program was added to normal federal spending and private incomes, and then it was allowed to interact with exogenous shocks, stochastic equations, and accounting identities within the Fairmodel. The simulations *did not* alter the stochastic equations of the Fairmodel that are the model's core, aside from changes made to WF, which are biased toward *de*stabilization at any rate. The results reported here provide some quantitative estimates of a fluctuating ELR buffer stock's macroeconomic effects *given* historical correlations of macroeconomic variables as organized within the Fairmodel and the "shocks" the ELR policy was exposed to in the simulations (as opposed to demonstrating how the ELR program would necessarily function in reality). The reported results tend to be consistent with previous publications by ELR proponents and also compare favorably to the other macroeconomic policy rules tested here. If the Fairmodel is a decent representation of the macroeconomy, then these results are significant. Those who doubt an ELR buffer stock would have the stabilization properties shown in this paper are encouraged to provide their own detailed simulations using their own preferred model(s).

Admittedly, even if one agrees that an ELR policy would have a stabilizing effect on the economy, there are still significant difficulties to be overcome regarding logistical and administrative complexities. In particular, according to the simulations here, an ELR effective at offsetting business cycles and providing price stability does so via a buffer stock of ELR employees that rises and falls countercyclically, though fluctuations in the buffer stock need only comprise—in the U.S. case simulated here—a minority of existing ELR jobs. Also, the ability to employ ELR workers in useful activities that generate productive output further determines the extent of the stabilization effects of the program, at least according to the simulations here. Neither of these would be easy to implement or sustain on administrative, logistical, or political levels. On the other hand, these complexities and difficulties are related to one of the program's potential strengths *vis a vis* the other policy rules: namely, *if* effectively implemented and sustained, the simulations here suggest an ELR program's stabilization effects could be *automatic* in the sense that they would not be dependent upon any policymaker's forecasts, targets, or conceptual understanding of the economy's functioning—which can clearly have an ideological bent. On the other hand, the effectiveness of an interest rate rule, tax rate rule, or transfer rule *would* be (or in the case of interest rates, already *is*) dependent upon the abilities of policymakers to correctly estimate and forecast current versus "potential" or "target" variables, as well as upon their (potentially ideological) perspectives regarding the relationship of policy instruments to ultimate policy objectives. This is so even where a small, somewhat politically-independent decision-making committee can avoid the "decision lags" that plague a larger body such as the U. S. Congress, as already demonstrated by the FOMC.

Appendix A

Changes to Fairmodel Identity Equations

EQUATION 43: Average nominal hourly earnings excluding overtime of all workers
WH =100*((WF * JF * (HN + 1.5*HO)+ WG * JG * HG **+ YELR** + WM * JM * HM + WS * JS * HS – SIGG - SISS) / (JF* (HN + 1.5 * HO) + JG * HG **+ JELR * HELR** + JM * HM + JS * HS))

EQUATION 53: Employee social insurance contributions to federal government
SIHG =D4G * [WF * JF * (HN + 1.5 * HO) **+YELR**]

EQUATION 60: Real sales of the firm sector
X =CS + CN + CD + IHH + IKF + EX – IM + COG **+ COSTELR / PG** + COS + IKH + IKB + IKG + IHF + IHB – PIEB - CCB

EQUATION 61: Total nominal sales of the firm sector
XX =PCS * CS + PCN * CN + PCD * CD + PIH * IHH + PIK * IKF + PEX * EX – PIM * IM + PG * COG **+ COSTELR** + PS * COS + PIK * (IKH + IKB + IKG) + PIH *(IHF + IHB) – PX *(PIEB + CCB) – IBTG - IBTS

EQUATION 65: Aggregate nominal saving of the household sector
SH =YT **+ YELR** + CCH – PCS * CS – PCN * CN – PCD * CD – PIH * IHH – PIK * IKH – TRHR – THG – SIHG + TRGH – THS – SIHS + TRSH + UB + INS - WLDF

EQUATION 76: Nominal saving of the federal government sector
SG =THG + IBTG + TFG + TBG + SIHG + SIFG **– ELRSPEND** – PG * COG – WG * JG * HG – WM * JM * HM – INTG – TRGR – TRGH – TRGS – SUBG – INS – PIK * IKG + SIGG + CCG

EQUATION 82: Nominal GDP
GDP =XX + PIV * (V - V(-1)) + IBTG + IBTS + WG * JG * HG **+ YELR** + WM * JM * HM + WS * JS * HS + WLDG + WLDS + PX *(PIEB + CCB)

EQUATION 83: Real GDP
GDPR =Y + PIEB + CCB + PSI13 * (JG * HG + JM * HM + JS * HS) **+ YELR / GDPD** + STATP

EQUATION 95: Total worker hours paid divided by population over 16
JJ =(JF * HF +JG * HG **+ JELR * HELR** + JM * HM + JS * HS) / POP

EQUATION 104: Nominal purchases of goods and services by the federal government
PUG =PG * COG + **ELRSPEND** + WG * JG * HG + WM * JM * HM + WLDG

EQUATION 115: Nominal disposable income in the household sector
YD =WF * JF * (HN + 1.5 * HO) + WG * JG * HG **+ YELR** + WM * JM * HM + WS * JS * HS + RNT + DF + DB – DRS + INTF + INTG + INTS + INTOTH + INTROW + TRFH + TRGH + TRSH + UB – SIHG – SIHS – THG – THS – TRHR – SIGG - SISS

Appendix B

Pass-Through of Changes to the Minimum Wage to Average Wages

The Federal Reserve's FRB/US model imposes conditions consistent with a vertical long-run Phillips curve. For the price level and average wages—and for several other variables—there are equations determining both long-run "equilibrium" levels and dynamic adjustment to the equilibrium level. The minimum wage affects the dynamic adjustment wage equation in the model.

According to Brayton, et al (1997, 239), the direct effect of a change in the minimum wage in the FRB/US upon the average wage in the firm sector (WF in the Fairmodel), *ceteris paribus* (that is, there are other variables in the equation that are ignored here to isolate the effect of the minimum wage), is given by the following:

(1b) $\Delta \log WF_t = 0.023\ \Delta \log (W_{MIN,\,t} / WF_{L,\,t})$

where

- WF_t is the average wage in the firm sector in period *t*,
- $W_{MIN,\,t}$ is the minimum wage in period *t,* and
- $WF_{L,}$ t is the average firm sector wage when the labor market is in equilibrium in period *t*.

Equation (1b) can be rewritten as the following:

(2b) $\Delta \log WF_t = 0.023\ [\ \log (W_{MIN,\,t} / WF_{L,\,t}) - \log (W_{MIN,\,t\text{-}1} / WF_{L,\,t\text{-}1})\ ]$

In contrast to the FRB/US model, there is no "equilibrium" firm-sector wage in the Fairmodel separate from a short-run, dynamically adjusting firm-sector wage; in the Fairmodel there is only the average firm-sector wage. Thus, simply inserting (2b) into the Fairmodel's WF equation is not possible.

Alternatively, historical data might be substituted into (2b) for $WF_{L,t}$ and $WF_{L,\,t\text{-}1}$. This may be sensible since the simulations here are concerned with ELR-induced deviations from given, historical values of WF. (Though, admittedly, WF in the Fairmodel is not necessarily an "equilibrium" value.) In this case, WF_t and $WF_{t\text{-}1}$ could be substituted for $WF_{L,\,t}$ and $WF_{L,\,t\text{-}1}$ in (2b), respectively, which would yield the following:

(3b) $\Delta \log WF_t = 0.023\ [\ \log (W_{MIN,\,t} / WF_t) - \log (W_{MIN,\,t\text{-}1} / WF_{t\text{-}1})\ ]$

Given that $\Delta \log WF_t = \log WF_t - \log WF_{t\text{-}1}$ and that, in general, log (A / B) = log A – log B, solving for $\Delta \log WF_t$ yields

(4b) $\Delta \log WF_t = (0.023/1.023) \log (W_{MIN,\,t} / W_{MIN,\,t\text{-}1})$

From the historical data in the Fairmodel, WF in the second quarter of 2005 is 0.02732, or approximately \$27.32 per hour. (WF is a broad measure of labor costs and includes some salaries and benefits that are not included in the better known average wage data reported by the Bureau of Labor Statistics.) Given $W_{MIN,\,2005:2} = 0.00515$ and assuming for the moment that ELR is implemented in the fourth quarter of 2003 such that $W_{MIN,\,2005:3} = 0.00625$, according to equation (4b) $WF_{2005:3}$ has increased by 0.0001192—or 11.92 cents per hour—as a result of the increase in W_{MIN}. For a change from \$5.15 to \$6.25, the general increase in WF is not actually constant due to non-linearities in the equation, but is a change of 0.435 percent. In sum, according to the dynamic adjustment equation for average firm wages in the FRB/US model—assuming the changes made in (3b) are reasonable—this particular increase in the minimum wage raises WF by slightly below \$0.12 per hour in 2005.

Notes

1. ELR proponents suggest there could be a variety of additional, socially beneficial effects from the program. These include moderation of the distributional effects of economic downturns—as some researchers have found that macroeconomic stability has a significant effect on income inequality (e.g., Galbraith 1998, Galbraith and Berner 2001)—and promotion of flexibility in the midst of technological and structural change, particularly if the policy were expanded to provide education and (re)training (e.g., Forstater 1998, 2001).
2. Tcherneva and Wray (2005) report that Argentina's *Jefes* program employs many who had been previously outside the labor force.
3. LAM is computed from a business cycle peak-to-peak interpolation of the log of firm sector output divided by the log of the product of firm sector jobs times average quarterly hours worked per worker.
4. Fair (2004) notes that "the price equation . . . is identified because the wage rate equation includes the lagged wage rate, which the price equation does not. The wage rate equation is identified because the price equation includes the price of imports and the unemployment rate, which the wage rate equation does not" (40). Coefficients in the wage equation are constrained to ensure that the real wage implied by the two equations is sensible, by which Fair means that the current real wage is not a function of either the current wage rate or the current price level separately (40).
5. For a discussion of the FRB/US model, see Brayton and Tinsley (1996).
6. As Wray (2000) puts it, "just as workers have the alternative of ELR jobs, so do employers have the opportunity of hiring from the ELR jobs pool. Thus, if the wage demands of workers in the private sector exceed by too great a margin the employer's calculations of their productivity, the alternative is to obtain ELR jobs workers at a mark-up over the ELR wage" (7).
7. In experimental simulations not reported here, this latter point is sensitive to how closely the earnings of ELR workers are to the non-ELR jobs people are leaving/entering. Thus, the size of ELR buffer stock necessary for a given degree of macroeconomic stabilization can vary. If earnings at those jobs within the ELR program and comparable non-ELR jobs (i.e., similar skill levels required) are roughly equal, then there is a closer offset between increases/reductions in government spending on the ELR program and reductions/increases in private expenditures as the size of the buffer stock rises and falls. Note that this could accommodate several different levels of ELR compensation at one time as long as the latter is similar to compensation at comparable non-ELR jobs. This could also be consistent with those eligible for unemployment benefits also taking ELR jobs while searching for higher earning, non-ELR jobs. While it is not necessary that ELR and non-ELR earnings be so closely related, the point is that the farther apart the two are then the greater the asymmetry between changes in private spending and offsetting changes in ELR spending. If ELR compensation is far smaller than that in comparable non-ELR jobs, then greater fluctuations in JELR are necessary to achieve a given degree of macroeconomic stimulus or restraint.
8. Gordon's results actually differ a bit from Fair's in that they suggest that the Fed's reaction function was unique during the entire 1979-1990 period, rather than just the 1979-1982 period as Fair (2001) suggests. Consistent with Fair (2001), however, Gordon's study finds that the reaction function during the pre-1979 and post 1990 periods are very similar. Both studies thus generally find that the Volcker Fed is the exception historically.
9. For each of the ELR stochastic simulations (rows 20-33), new base values were generated via simulation of the 1988-1997 period.
10. Recall that note 7 discusses how the relative earnings of ELR workers compared to non-ELR workers affects the stabilization properties of the program.

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Table 1: Base Data for 1985:1-2005:3

Year	*Real GDP Growth*	*Unemployment Rate*	*Inflation Rate*
1985	4.13%	7.21%	2.97%
1986	3.47%	7.01%	2.33%
1987	3.38%	6.20%	2.39%
1988	4.13%	5.51%	4.56%
1989	3.54%	5.28%	3.36%
1990	1.88%	5.61%	3.92%
1991	-0.17%	6.84%	2.17%
1992	3.33%	7.50%	2.42%
1993	2.67%	6.91%	2.03%
1994	4.02%	6.09%	2.32%
1995	2.50%	5.60%	2.17%
1996	3.70%	5.40%	1.98%
1997	4.50%	4.93%	1.76%
1998	4.18%	4.50%	1.28%
1999	4.45%	4.21%	1.74%
2000	3.66%	3.99%	2.17%
2001	0.75%	4.75%	2.22%
2002	1.60%	5.79%	1.39%
2003	2.70%	5.99%	1.29%
2004	4.21%	5.52%	2.87%
2005	3.15%	5.13%	3.07%

Table 2: Variability Estimates from Stochastic Simulation: Values of *L*

	Price Level	*Inflation*	*Real GDP*	*Real GDP Growth*	*Unemployment Rate*	*Short-Term Interest Rate*
1. Base (No Fed Rule)	2.17	1.70	2.08	2.75	1.43	0.00
2. Base (No Fed or FP)	2.81	1.80	2.87	2.96	1.84	0.00
3. Estimated Fed Rule	1.72	1.58	1.67	2.73	1.13	1.48
4. Modified Rule (1.5)	1.70	1.57	1.70	2.73	1.13	1.69
5. Modified Rule (2.5)	1.69	1.57	1.75	2.75	1.12	2.38
6. Tax Rule (No Fed Rule)	2.10	1.62	1.94	2.74	1.38	0.00
7. Tax Rule w/ Fed Rule	1.69	1.57	1.61	2.73	1.11	1.41
8. SL (F1, β=0, No Fed)	2.11	1.62	1.92	2.74	1.38	0.00
9. SL (F1, β=0, Fed)	1.70	1.57	1.60	2.73	1.11	1.42
10. SL (F1, β=.8, No Fed)	2.11	1.63	1.94	2.75	1.38	0.00
11. SL (F1, β=.8, Fed)	1.70	1.57	1.61	2.73	1.12	1.42
12. SL (F2, β=0, No Fed)	2.07	1.61	1.81	2.76	1.34	0.00
13. SL (F2, β=0, Fed)	1.68	1.56	1.53	2.74	1.10	1.40
14. SL (F2, β=.8, No Fed)	2.07	1.61	1.83	2.76	1.34	0.00
15. SL (F2, β=.8, Fed)	1.68	1.56	1.54	2.75	1.10	1.40
16. SL (F3, β=0, No Fed)	1.94	1.57	1.45	2.76	1.21	0.00
17. SL (F3, β=0, Fed)	1.62	1.53	1.21	2.75	1.02	1.33
18. SL (F3, β=0.8, No Fed)	1.94	1.57	1.51	2.85	1.14	0.00
19. SL (F3, β=0.8, Fed)	1.62	1.54	1.27	2.85	1.03	1.33
20. ELR (U, No Fed)	2.08	1.63	1.80	2.61	1.33	0.00
21. ELR (U, Fed)	1.64	1.57	1.53	2.60	1.07	1.36
22. ELR (¾U, No Fed)	2.12	1.64	1.87	2.64	1.36	0.00
23. ELR (¾U, Fed)	1.66	1.57	1.56	2.63	1.09	1.38
24. ELR (½U, No Fed)	2.17	1.65	1.96	2.68	1.40	0.00
25. ELR (½U, Fed)	1.69	1.57	1.60	2.66	1.11	1.41
26. ELR (U, ½Prod, No Fed)	2.06	1.62	1.62	2.49	1.33	0.00
27. ELR (U, ½Prod, Fed)	1.63	1.57	1.44	2.48	1.07	1.36
28. ELR (½U, ½Prod, No Fed)	2.16	1.64	1.84	2.60	1.40	0.00
29. ELR (½U, ½Prod, Fed)	1.68	1.57	1.54	2.59	1.11	1.41
30. ELR (U, Prod, No Fed)	2.04	1.62	1.41	2.39	1.32	0.00
31. ELR (U, Prod, Fed)	1.62	1.58	1.39	2.38	1.07	1.36
32. ELR (½U, Prod, No Fed)	2.15	1.64	1.66	2.49	1.39	0.00
33. ELR (½U, Prod, Fed)	1.68	1.58	1.46	2.49	1.11	1.41

Figure 1: Year-to-Year Inflation in the PCE Deflator vs. the Fairmodel's PF

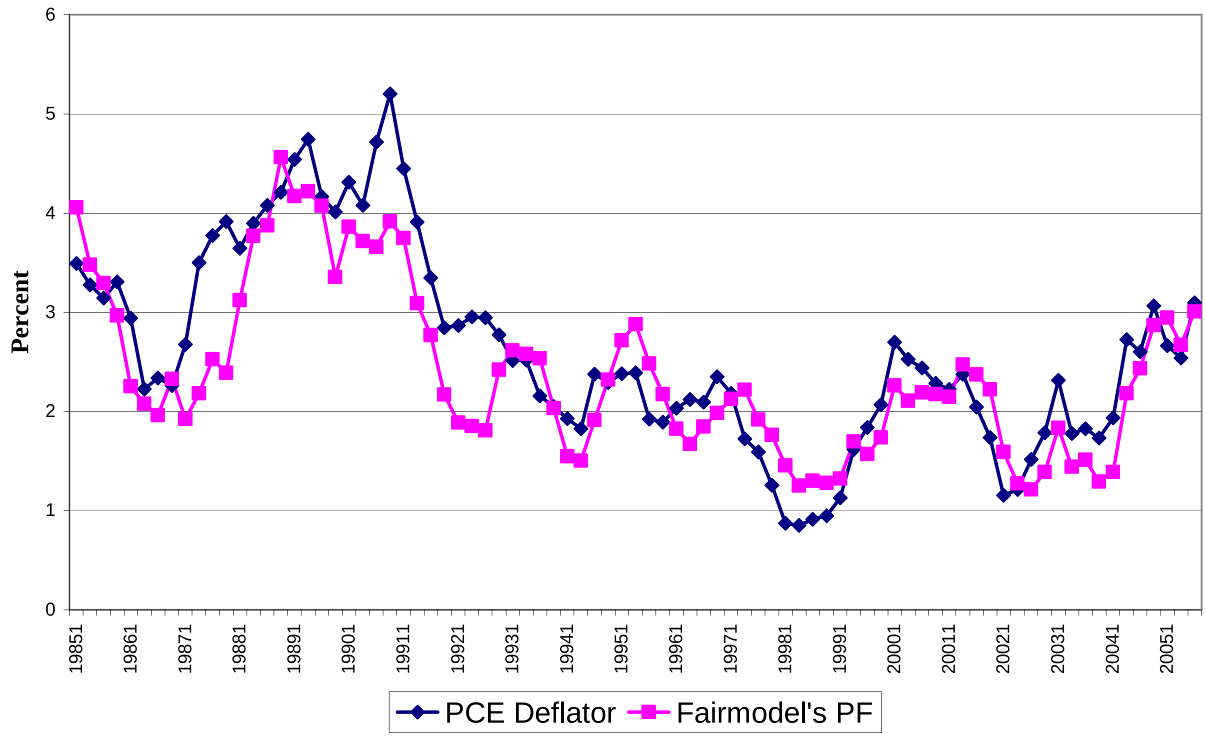

Figure 2: Simulated ELR Employees

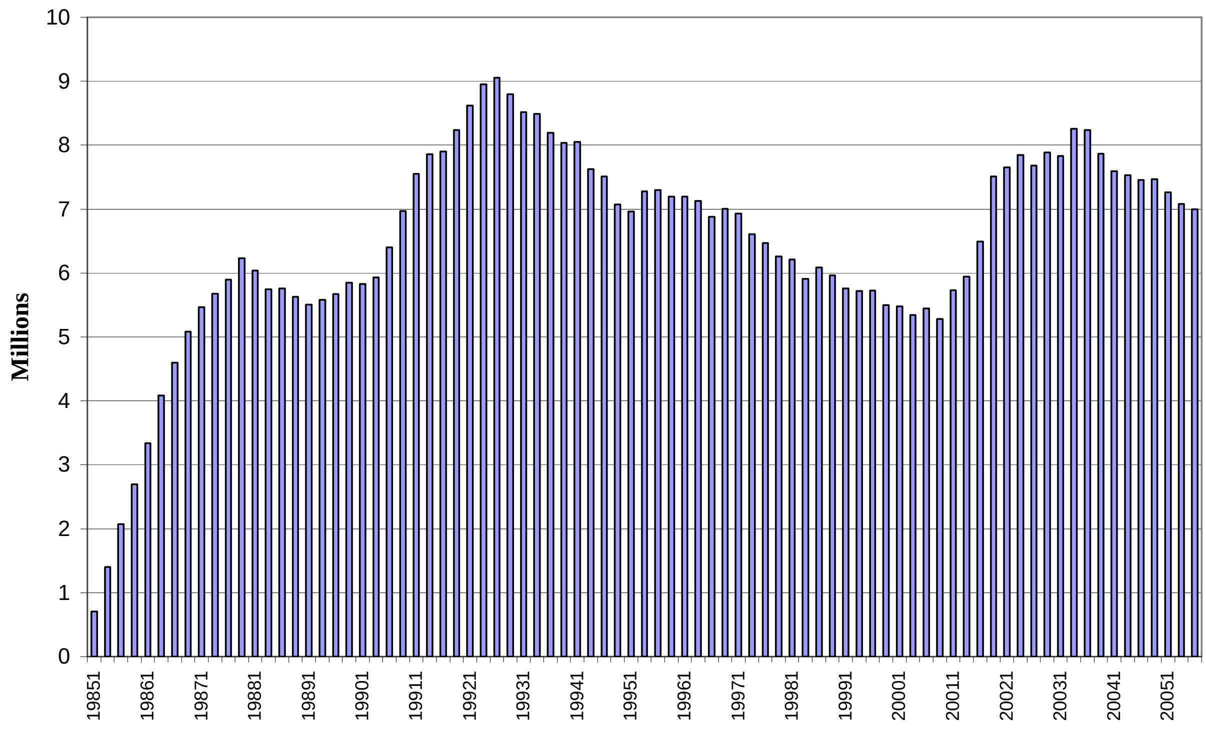

Figure 3: Base Real GDP (squares) and Real GDP from ELR Simulation (diamonds)

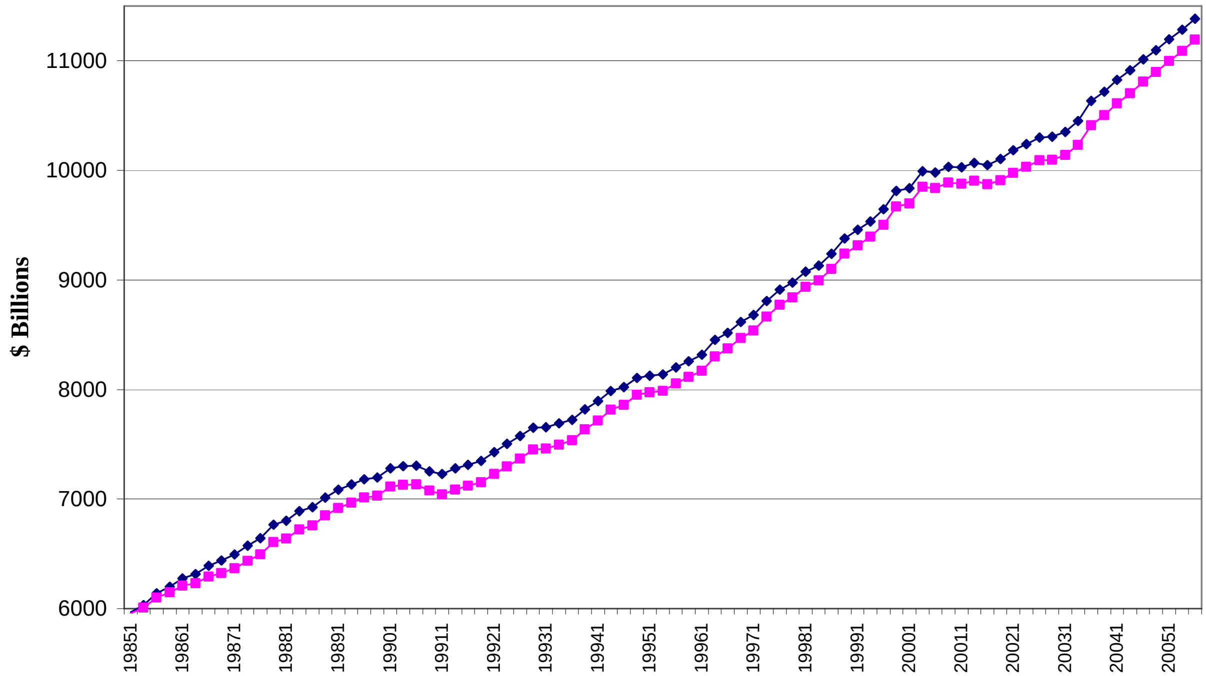

Figure 4: Real GDP in ELR Simulation Less Base Value

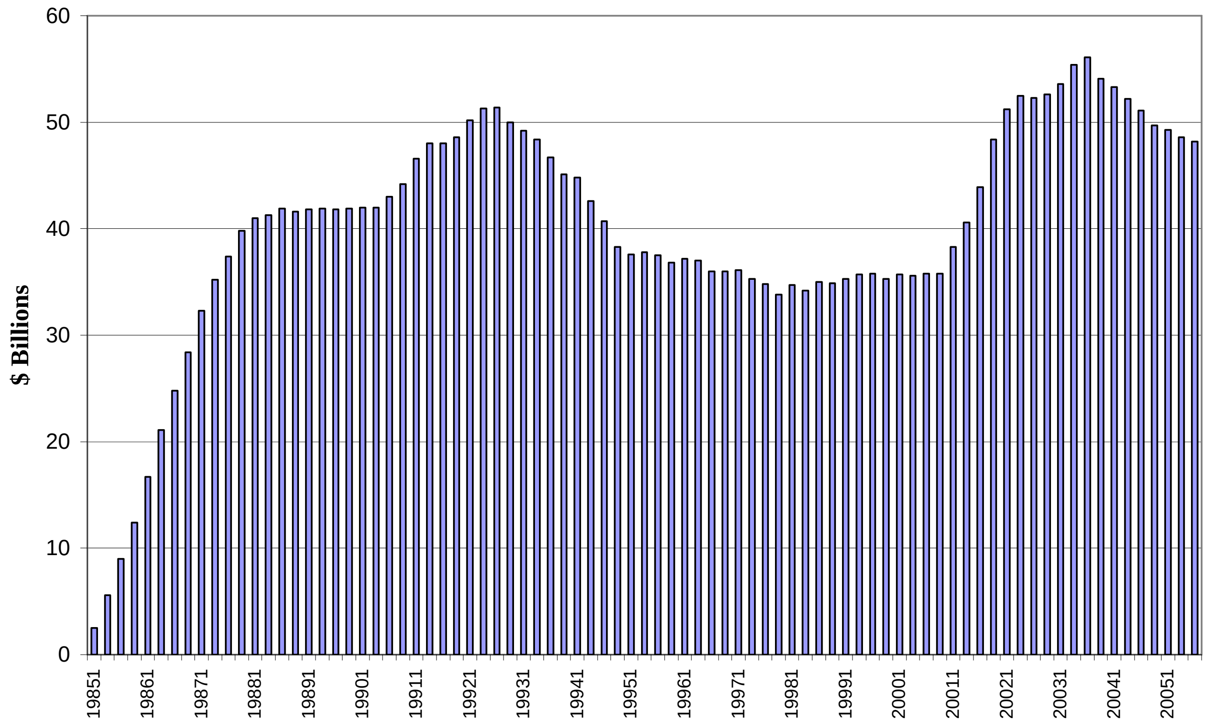

Figure 5: Unemployment Rate in ELR Simulation Less Base Value

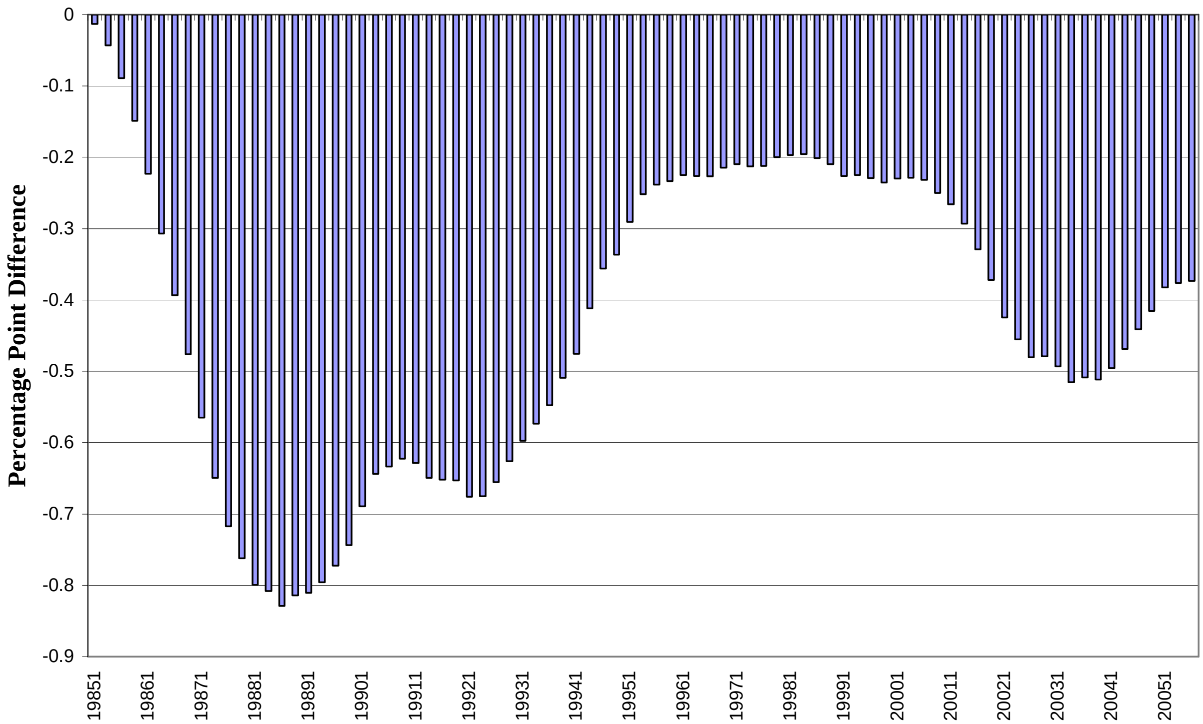

Figure 6: Private Sector Jobs in ELR Simulation Less Base Value

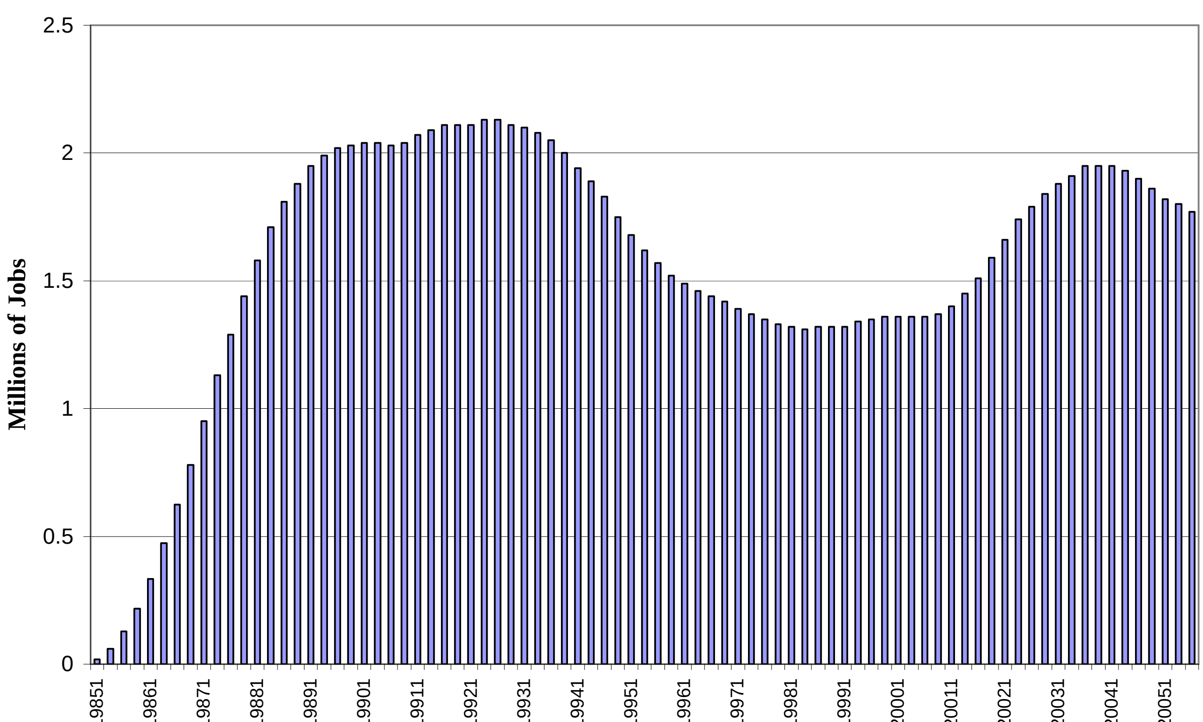

Figure 7: Year-to-Year Inflation in ELR Simulation Less Base Value

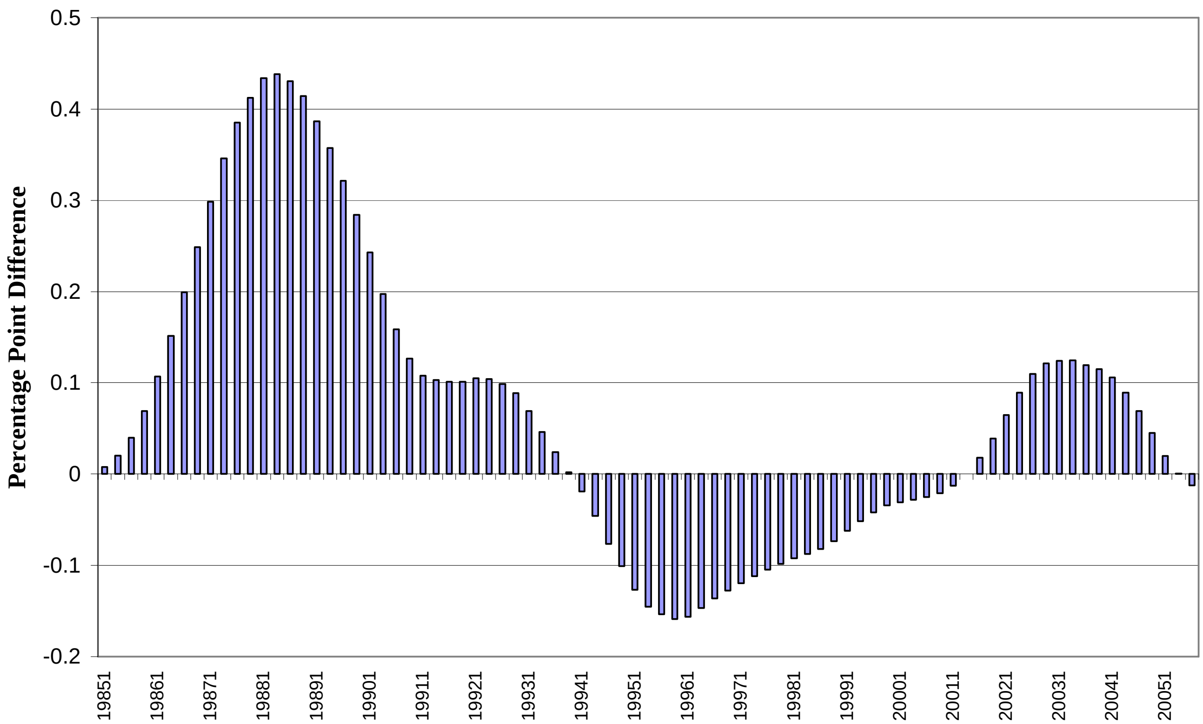

Figure 8: Total ELR Program Spending as a Percent of GDP

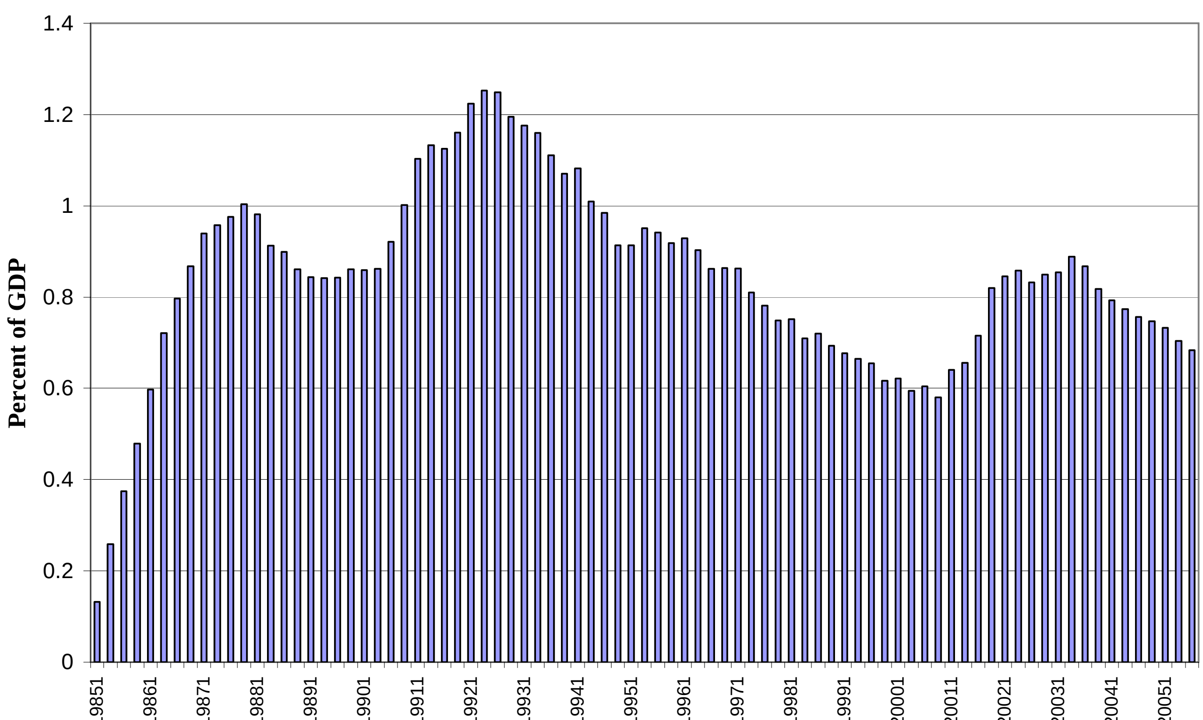

Figure 9: Federal Deficit (NIPA) as a Percent of GDP

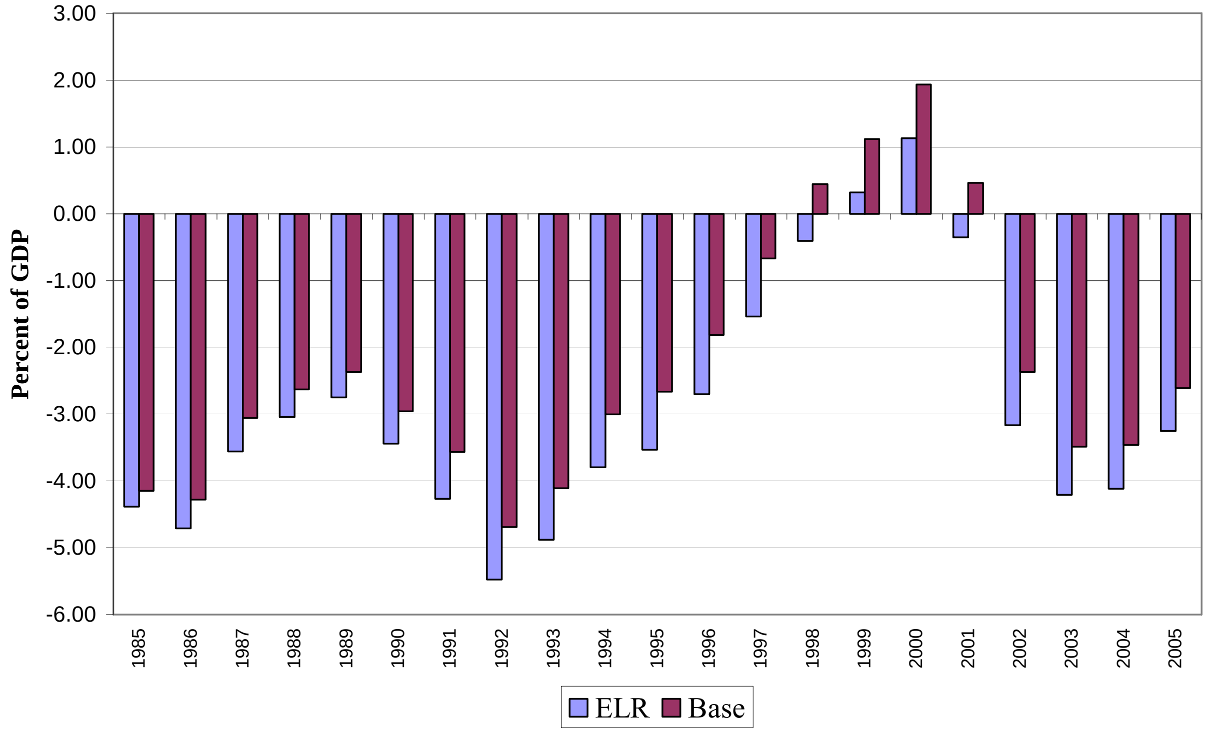

Figure 10: State and Local Budgets as a Percent of GDP