

**Maintaining Full Employment:
Simulating an Employer of
Last Resort Program**

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In Employer of Last Resort Program (ELR) the government, through some institutional arrangement, offers direct employment to anyone wishing to work.¹ In particular, those unable to find jobs in the private sector are guaranteed an offer of work. This effectively turns employment into an entitlement. In a set of related papers Edward Nell and I have explored the macroeconomics and the institutional features of an ELR designed to create employment directly, while indirectly stabilizing private output and employment, and, at the same time, helping to control inflation.² Such a program, we show, could have three mutually supportive components:

- *Job Placement*, which combines our current system of unemployment insurance with an expanded career-counseling program,
- *Job Training*, which aids mid-career training through job training accounts for workers, and
- *Public Service Employment*, which directly provides full or part-time jobs.

This is not the only way an ELR can be set up, but these three are complementary and together address both demand-based unemployment and skill-mix issues for U.S. labor markets, issues that are often intertwined. In our proposal, all three components would be funded as entitlements or direct spending.

To have the macroeconomic properties that we desire, an ELR must have five effects. First, it must directly create employment for those unable to find jobs in the private sector. Second, it should indirectly help stabilize employment and output in the private sector. Third, it should help stabilize money wages by acting as a buffer stock, absorbing workers when there is underemployment and releasing them when they are needed in the private sector. Fourth, it should have a manpower effect, improving the skills of the workers involved in a way that increases labor productivity and enhances the buffer stock effect by providing workers with skills that are in short supply. Finally, the stimulus provided by the program should be reduced as the economy approaches full employment, so as to avoid overheating.

The total effect is an automatic stabilizer that does a better job of maintaining full employment and at least as good a job at maintaining price stability as current policies.

¹ This research is supported by grants from the Russell Sage Foundation and the Center for Full Employment & Price Stability. Raymond Majewski developed the simulations and drafted the paper. Cheol-soo Park assisted with the simulations. Members of the Transformational Growth and Full Employment Program including Per Berglund, Goncalo Fonseca & Leanne Ussher have provided discussions, encouragement and useful criticism. Chidem Kurdas made available her editorial skills. Our thanks to them all.

² Nell & Majewski 1999 a, b, c & Majewski & Nell 1999 a, b.

Our earlier work makes use of both history and theory.³ Historical analysis of America's experience with Public Service Employment (PSE) and Job Training aids us in the design, and inform us on the likely outcome, of our program. Theoretical models give us an idea of the impact of the ELR. But neither of these allows us to answer questions about the scale of the program, the size of its cost, the magnitude and timing of its macroeconomic effects. We need to answer the question of "How much?"

One way of answering this is to simulate our program using a macroeconometric model. The program's impact can be simulated under the most likely future conditions and backcast for known conditions of the past. Such a model also allows for experimentation. Different configurations of the program in terms of wage rates, material costs and participation will be examined, so will the program's response to various exogenous changes, notably demand and supply shocks.

Developing a macroeconometric model is a time consuming process requiring that the model be specified, estimated and tested before policy experiments can be performed. Hence, using a preexisting model is desirable, if one can be found that is sufficiently close to our theoretical specification and adaptable to our purpose.

FairModel-US

FairModel-US (FM) is a well established structural macroeconometric model that has existed in roughly its current form since 1976. It has been used for a variety of research and policy purposes, including the evaluation of a proposed PSE program (McGahey 1997).

FairModel-US breaks the economy down into six sectors: household, firm, financial, foreign, federal government, and state & local government. The model consists of 30 behavioral equations and 101 identities. Data is drawn from the US NIPA and FFA accounts.

Many of the key relationships in the April 2000 version of FairModel-US (FM) are very close to those of the Transformational Growth approach to economics developed by Edward Nell.⁴ These include investment, interest rates, money supply, private employment, private output and inflation. The treatment of consumption has many common features, though the differences are important. An identifying feature of Kaleckian work like TG is the role played by the distribution of income in determining consumption. It is assumed that profits, which are partially retained by firms, are saved to a greater extent than wages. Increasing the wage share increases consumption and ceteris paribus effective demand. Income

³ For historical analysis see Majewski & Nell 1999 a & b, for theoretical models see Nell & Majewski 1999 b & c.

distribution plays no role in FM's treatment of consumption, which is determined primarily by disposable income, wealth and the age of the population.

While these differences may matter for some purposes, FairModel-US is close enough to our theoretical framework for use in simulating the ELR program. A more detailed comparison of the two approaches is found in Appendix II.

Adding in the ELR⁵

Fairmodel provides us with an approximation of the way that the economy currently operates. But an ELR has never existed in the United States so we can't draw on data for this in the same way as for the rest of the model. Fortunately, this problem is not unique. Fairmodel has also been used to analyze proposed institutional changes, including a new economic stabilizer in the form of an indirect business tax whose rate changes with the state of the economy. (Fair 1999) Such modifications draw upon economic theory, but they must substitute judgement for missing data.

Each of the ELR's three components, Job Search, Job Training and Public Service Employment, will have to be added into the FairModel for our experiments. The number of people using Job Search and PSE services will vary with economic activity. This needs to be modeled endogenously. The effect of economic activity on the use of Job Training services will be less important and will be treated as exogenous using estimates from Majewski & Nell (1999b).

Our proposed ELR is Federally funded program but the bulk of its services are provided by State and Local government and the non profit sector. However, for purposes of simulation it will be treated as a purely Federal program. This makes modeling simpler, since it will not be necessary to match Federal transfers to State and Local spending on the program, but should have little overall impact on the simulation.⁶

In the theoretical model we assumed that all the unemployed would join the ELR. In practice there are two main reasons why some of the unemployed will remain outside the program. First, unemployed workers with a good prospect for a rapid return to work are likely to stay outside the program. Such workers traditionally are treated as frictionally unemployed, assumed here to be 4% of the labor force. Second, some will remain outside the ELR because they find the wage and/or the work and working conditions

⁴ See Nell 1998.

⁵ The model is estimated and solved using the Fair-Parke program. Definitions of new variables and a full list of modified equations introduced in this section are found in Appendix I.

⁶ The difference will come from different wages, average hours worked and deflators used for Federal and State and Local government.

unattractive. They are 'classically' unemployed. Both of these groups will be partially supported by unemployment insurance, which is assumed to remain in force on something similar to current terms.

I bring the ELR's PSE workforce into FairModel in two stages. First, I generate a new variable ELRR PSE employment as a percentage of the workforce (equation MAJ1).

$$\text{Eq. MAJ1} \quad \text{ELRR} = \text{ELR3} * (\text{UR} - .04 + \text{ABS}(\text{UR} - .04)) / 2$$

Where UR is the unemployment rate without PSE employment, ELR3 is the percentage of the non-frictionally unemployed who choose to join the PSE and ABS is the absolute value operator. When the unemployment rate is less than or equal to 4% ELRR will equal zero, otherwise it will equal $\text{ELR3}(\text{UR} - .04)$.

Second, a new variable ELR, the level of PSE employment, is generated multiplying ELRR by the civilian labor force (L1+L2+L3-JM) and ELR1 a variable that allows the program to be phased in gradually.⁷

$$\text{Eq. MAJ2} \quad \text{ELR} = \text{ELR1} * (\text{L1} + \text{L2} + \text{L3} - \text{JM}) * \text{ELRR}$$

The PSE workforce will be paid a wage rate that will be a percentage (ELR4) of the Firm sector's wage rate (WF).⁸ Supervisors, paid at the average federal wage (WG), are 5 percent of the PSE workforce. MAJ3 generates a new variable WELR, the average hourly earnings of ELR workers.

$$\text{Eq. MAJ3} \quad \text{WELR} = .95 * \text{ELR4} * \text{WF} + .05 * \text{WG}$$

PSE will require the purchase of materials. Based on CETA experience it is assumed that this will be equal to 15 percent of labor costs. It is also assumed that PSE workers will work the same average hours as Federal workers (HG) in general. In addition there will be spending on the Job Training component of the program. This is summed up in the exogenous series PCOELJST.⁹ In our program training will be purchased by individuals from third parties including, non-profits, private firms, state and local government, with Federal funds. For simplicity this is treated as a Federal purchase from the private sector. It is assumed that PCOELRST and nominal PSE material spending can be converted to real using the same deflator used

⁷ The program is phased in smoothly over 20 quarters for increased realism and to avoid shocking the model.

⁸ In more detail, this is average hourly earnings, including benefits and excluding employer's social insurance contributions.

⁹ For an full explanation of cost estimates and PCOELRST see Majewski & Nell 1999b.

for other Federal purchases (PG). MAJ 4 generates a new series COELR real ELR purchases from the private sector.

$$\text{Eq. MAJ4} \quad \text{COELR} = ((.15 * \text{WELR} * \text{ELR} * \text{HG}) + (\text{ELR1} * \text{PCOELJST})) / \text{PG}$$

While on the job PSE workers will not receive unemployment benefits. So all other things being equal, PSE will reduce unemployment benefits. Those still unemployed, in log form (LUELR), will equal the log of the difference between the number of not employed outside PSE (U) and PSE employment (ELR).

$$\text{Eq. MAJ5} \quad \text{LUELR} = \text{LOG}(U - \text{ELR})$$

In FairModel unemployment benefits are determined by a behavioral equation FM 28. The coefficients for this equation are estimated and used in eq. MAJ 6, which replaces FM 28.¹⁰

$$\text{Eq. MAJ6} \quad \text{LUB} = 0.5816729565 + 0.2491445707 * \text{LUB}(-1) + 1.1463479485 * \text{LUELR} + 0.3998202421 * \text{LWF}$$

Where LUB is the log of unemployment benefits and LWF is the log of firm sector wages.

To complete the modifications the new variables must be added into the rest of the model. This section discusses briefly how this is done. A full listing of modifications appears in Appendix I.

The variable ELR represents a special class of Federal employees. They are paid at a different wage rate but are otherwise treated in the model in the same way as other Federal employees. However, since their number depends on the non-PSE unemployment rate, ELR is left out of eq 85, which calculates total employment.¹¹ This also helps correct the Federal Reserve reaction function. The Federal Reserve in eq. 30 responds to the rate of unemployment. Increases in the number of PSE jobs represent a slack economy not a tightening one and should invoke a different response from the Fed. Leaving PSE employees out of the calculation of employment produces to such a response. Since non-PSE jobs will generally be preferred to PSE, it is assumed that PSE will not constrain private employment. Hence it is left out of eq. 95 which determines the potential output of the firm sector.¹² With these exceptions taken into account, variable ELR is added to FM's eqs. 43, 64, 76, 82, 83, 98, 104, 115, 126

¹⁰ This equation generates LUB for use in solving the model.

¹¹ E is used in eq. 86 to calculate unemployment U that is used in eq. 87 to calculate the unemployment rate UR. This in turn is used in eq. 28 to calculate unemployment benefits. We have already corrected unemployment benefits. U and UR include both the unemployed and those in PSE.

¹² In Fair 1994, and in pre April 2000 versions of Fairmodel, the Federal Reserve responds to increases in the ratio of actual to potential paid hours worked (JJS) by raising interest rates in eq. 30. Hence, the hours worked by PSE workers are removed from JJS as calculated in eq. 96.

COELR , the purchase of goods and services by the PSE and Job Training programs , will be treated in the same way as the Federal purchase of goods in general (COG). They will be added to eqs. 60, 61, 76, 104.

One additional modification will be made for at least some experiments. We have argued that Career Counseling and Job Training will reduce the economy's sensitivity to inflation by making skill shortages and bottlenecks less likely. In FM equation eq. 10 the price level responds to the rate of unemployment. Reducing the coefficient for this variable will reduce sensitivity of the model to high demand.

Experiments

To explore ELR as an entitlement and as an automatic stabilizer two types of experiments, which we can call levels and changes, are necessary.

Levels experiments are aimed at the size, cost and overall impact of the program. In the principal experiment, the program will be introduced starting near the peak of the last business cycle, 1989:1 and compared with the base forecast of FM for 1989:1 to 2004:4. This experiment will be performed under a variety of scenarios.

- With minimum changes to FM, using prevailing minimum wage rates.
- With adjustments to the price level's demand sensitivity and the frictional rate of unemployment to simulate Job Training's anti-inflation effect.
- With alternative wage rates, to simulate the AFL-CIO's proposed minimum wage rule.
- With an alternative Federal Reserve reaction function to simulate the monetary policy appropriate for an ELR. In such a policy regime interest rates are kept, in general, below the rate of growth.¹³
- With decreases in Federal purchases of goods COG, non-ELR Federal Employment JG and/or increases in the income tax rate DIG, designed to simulate the introduction of the program under Congressional PAYGO rules.

The change experiments consider the impact of a variety of shocks on an economy with an ELR. Multipliers calculated from deterministic simulations are used to evaluate the program's efficiency as an automatic stabilizer.

- Demand shocks are most easily simulated through changes in government spending and taxes as above, or by changing exports.
- Of objections to the ELR perhaps the most common involves foreign debt and the possibility of foreign exchange shocks. Changing the series PIM the import price index can simulate this.

¹³ See Nell & Majewski 1999 a & c.

- Dropping the Federal Reserve reaction function and making interest rates exogenous can simulate interest rate shocks.
- Changes in productivity growth can be introduced by changes in the series LAM amount of output capable of being produced per worker hour.
- Commodity price shocks can be simulated by changes in PFA, the farm sector price deflator.

Limitations

As a tool for evaluating an ELR policy Fairmodel-US has two types of limitations: those inherent in structural econometric models and those specific to Fairmodel itself.

The limitations of structural econometric models for policy evaluation are well known, set forth in the critique by Robert Lucas (1976). In building structural models a set of relationships representing the economy are specified and the parameters of these relationships are estimated. In these estimates the model builder must consider the stability of the relationships and of course periodically re-estimate the parameters. Put simply parameters change. Lucas's insight is that policy changes, including those evaluated in our experiments, may be a source of these changes. Since our experiments are based on the assumption that the parameters do not change, they are not a reliable guide to the policy's impact. For Lucas the decisions that the parameters are attempting to capture are a product of rational choice subject to tastes and technology. For users of institutional analysis like Transformational Growth, the last part of this is critique not especially impressive. In Transformational Growth model building starts with a conceptual analysis of the institutions of the economic system as determined in fieldwork and historical analysis. It looks for the rules governing behavior, the methods and procedures of production, the legal and property relations. Modeling how these institutions maintain and reproduce themselves is the next step. In a simplified and stylized way these are the rules that agents use in their actions. Transformational Growth looks for the theoretical underpinning of the econometrically estimated parameters in this structural analysis supplemented by a more concrete look at the behavioral options available to agents. (Nell 1989, pp. 119-131)

Even so institutions change and we are proposing a large institutional change that may affect others. We can not rule out change in the model's parameters. Moreover, institutional change is evolutionary and not generally predictable a priori. Our experiments are in this sense vulnerable to the Lucas critique.

But the macroeconometric modeling does not stand alone. Transformational Growth methodology does not privilege any one kind of argument or evidence. It recommends the interactive use of historical, institutional, theoretical and empirical analysis (Block & Majewski 1998). The FairModel simulations

strengthen the empirical part of the analysis. They will be interpreted, influence and be influenced by the other types of analysis.

It should also be noted that macroeconomic policy experiments continue to be used in public policy debate. In recent years Bartik (1999) and McGahey (1997) have used simulations with structural econometric models to estimate the impact of PSE programs. The public discussions of the federal deficit and more recent debates over 'spending' the surplus have been strongly influenced by the results of long run simulations from the CBO (1997, 1998, 1999), GAO (1997) and OMB (1999)¹⁴. Structural econometric models like this tend to be used whenever the question 'How much?' arises. This is not surprising given the modest results of the alternative. Since the Lucas critique, over 20 years of efforts aimed at estimating deep structural parameters have produced models largely confined to academic research rather than public policy.

The FM model is limited in its abilities to address the issues that interest us. This is most apparent with the Job Training component of our program. The program should enhance productivity and reduce inflationary pressure at high demand. These effects can be simulated in the model, but only in an indirect way. The treatment of the participation rate in PSE is also limited. We have set the rate exogenously but would expect it to depend upon the ELR wage as well as the eligibility and benefits of the unemployment insurance program.

A Preliminary Simulation

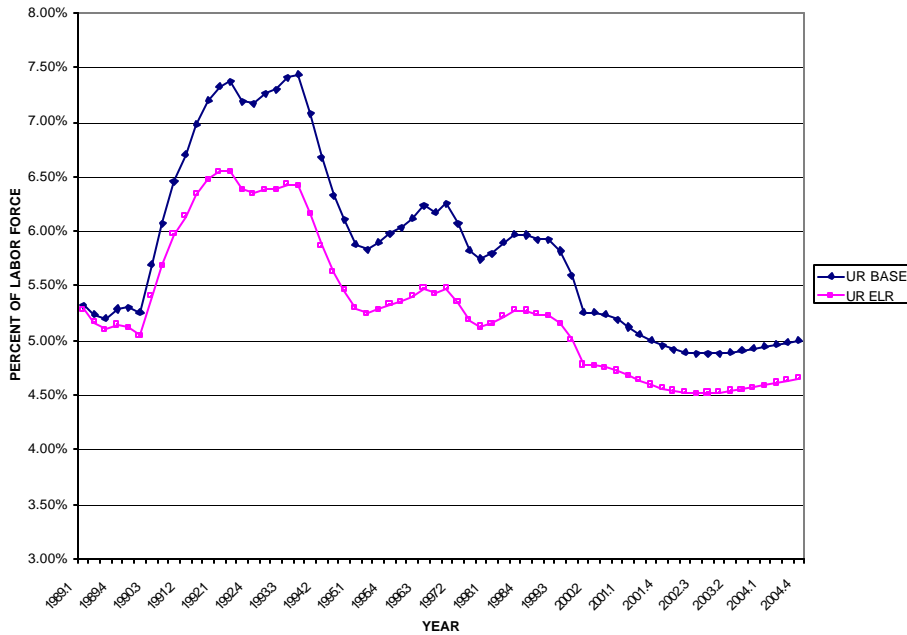
The full results of these experiments will be reported in a book, Maintaining Full Employment: Public Service Employment and Economic Stabilization. Below is the first of the level, and in the next section the first of the change experiments. In these experiments modifications to the FairModel are kept to a minimum. In this version it is assumed that half of the unemployed (above the frictional rate) join the ELR's PSE program and that their wage rate is half that of workers in the firm sector.¹⁵ For simplicity, Fairmodel's unemployment benefits equation is left in the model and equations MAJ 5 & 6 dropped.¹⁶

¹⁴ For a discussion of these models and their use in recent policy discussions see Nell & Majewski 1999a, chapter one.

¹⁵ More succinctly $ELR3=0.5$ and $ELR4=0.5$. The wage rate reflects the minimum wage proposed by the AFL-CIO.

¹⁶ This simulation may overstate unemployment benefits. Since it is likely that most participants in PSE will have exhausted their unemployment benefits, this overstatement will be small.

FIGURE ONE: UNEMPLOYMENT RATE (PSE COUNTED AS UNEMPLOYED)



It is supposed that an ELR was enacted around the peak of the last business cycle. The program starts up slowly in January 1989 and is fully operational five years later in January 1994. The simulation runs through the end of 2004. The base is an unmodified version of Fairmodel.¹⁷

In the first figure we can see the ELR's indirect effect on unemployment. Here we group the ELR's Public Service Employment (PSE) workers with the unemployed and compare this to the unemployment rate in the base (no ELR case). The ELR reduces unemployment by more than simply the number of people it puts to work. It does so by increasing private sector's employment.

¹⁷ The sharp eyed among you will note that Fairmodel did not do very well predicting the low unemployment rates of the late 1990s. These rate do not fit in with the way the economy was behaving in the late 80's and early 90s. If the backcast period was shortened, say by looking at 1997-2004 the model would do much better.

FIGURE TWO: ELR'S PUBLIC SERVICE EMPLOYMENT

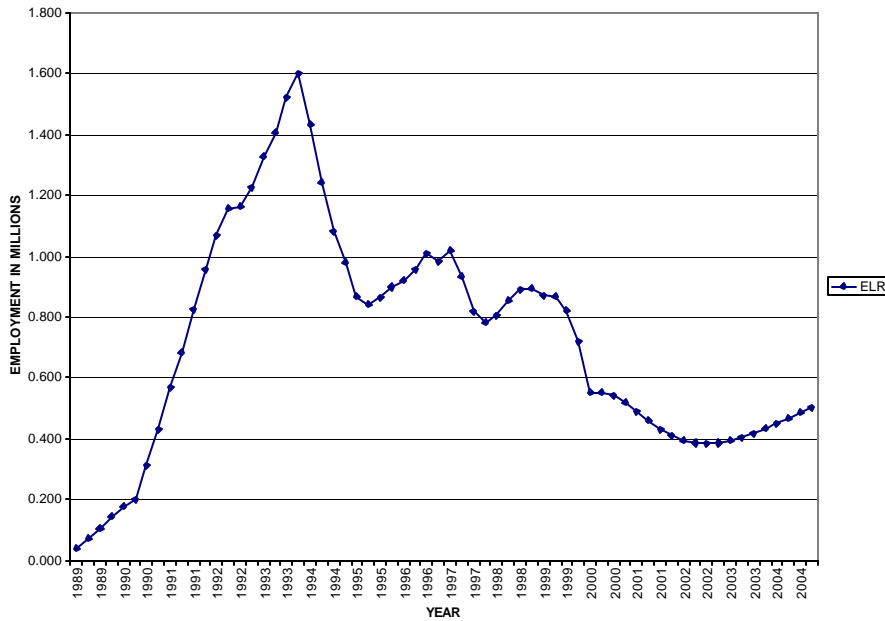
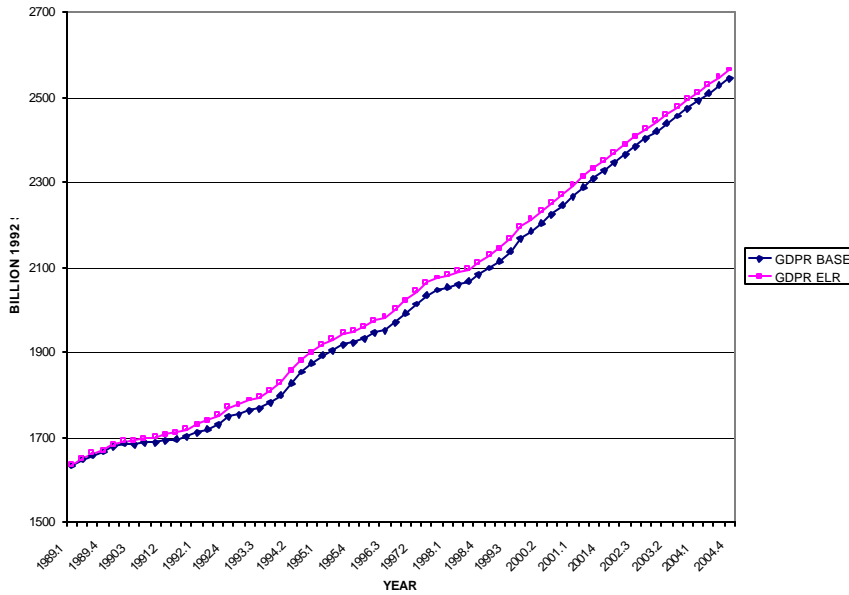


FIGURE THREE: REAL GDP

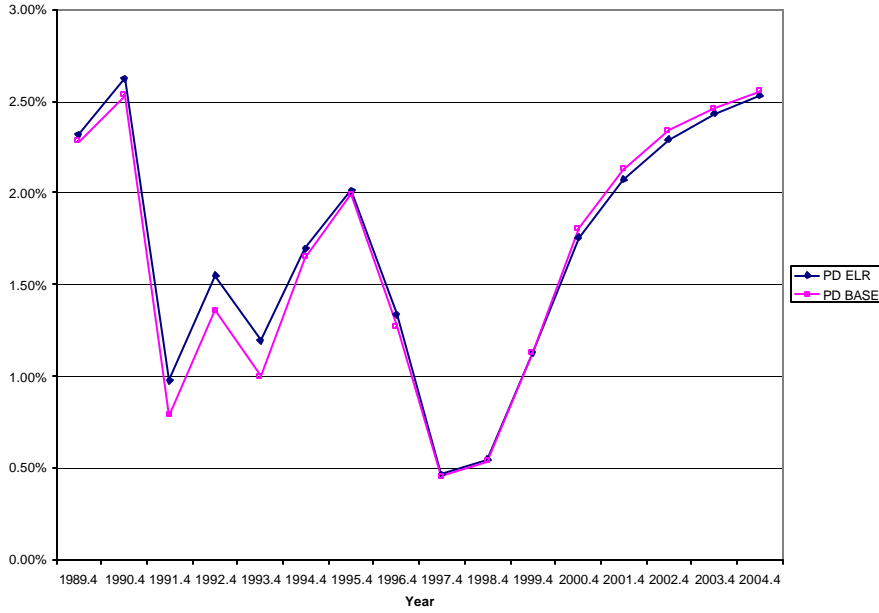


The ELR's PSE employment will vary with the rate of unemployment. In this simulation ELR employment would peak at about 1.6 million during the recession of the early 90s gradually falling to less than 400, 000 in 2002 (see Figure Two) . In this the program would be roughly twice the size of CETA during the 1970s.

The extra employment, both inside and outside the government sector means that extra output is being produced. Real GDP is higher in the ELR scenario than in the base. This is true not just in recession years.

The extra boost the ELR gives in those years also increases the economy during expansions. (see Figure Three)

FIGURE FOUR: Inflation, Annual Rate Domestic Sales Deflator



If we look at inflation we find the program had little effect during the period simulated. (see Figure Four) During the recessionary period of the early 90s the rate of inflation fell less with the ELR than without. In the rest of the period annual inflation was almost identical in the two scenarios and after 1999 slightly lower with the ELR.

Figure Five: The Net Cost of the ELR

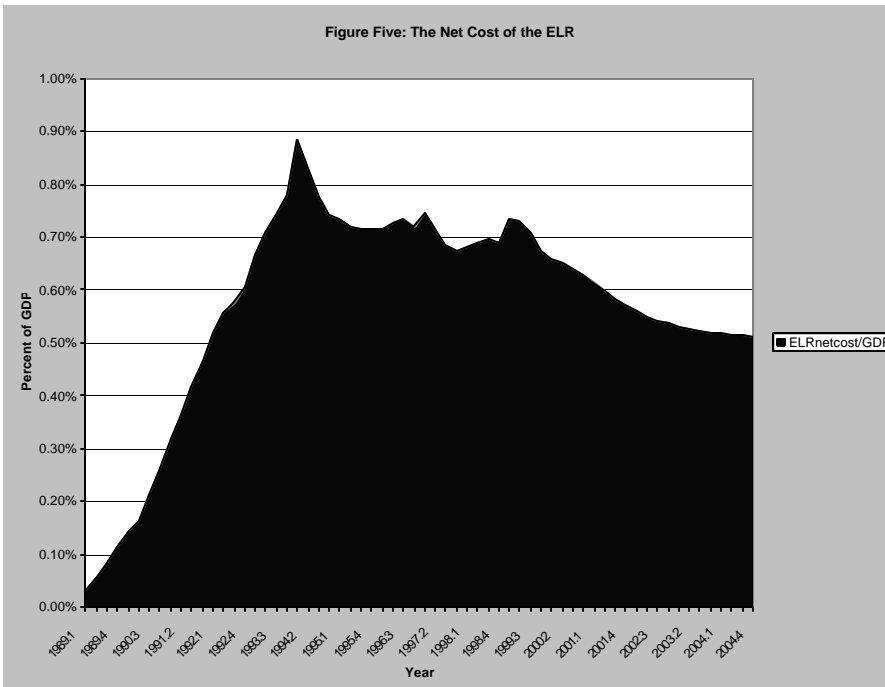
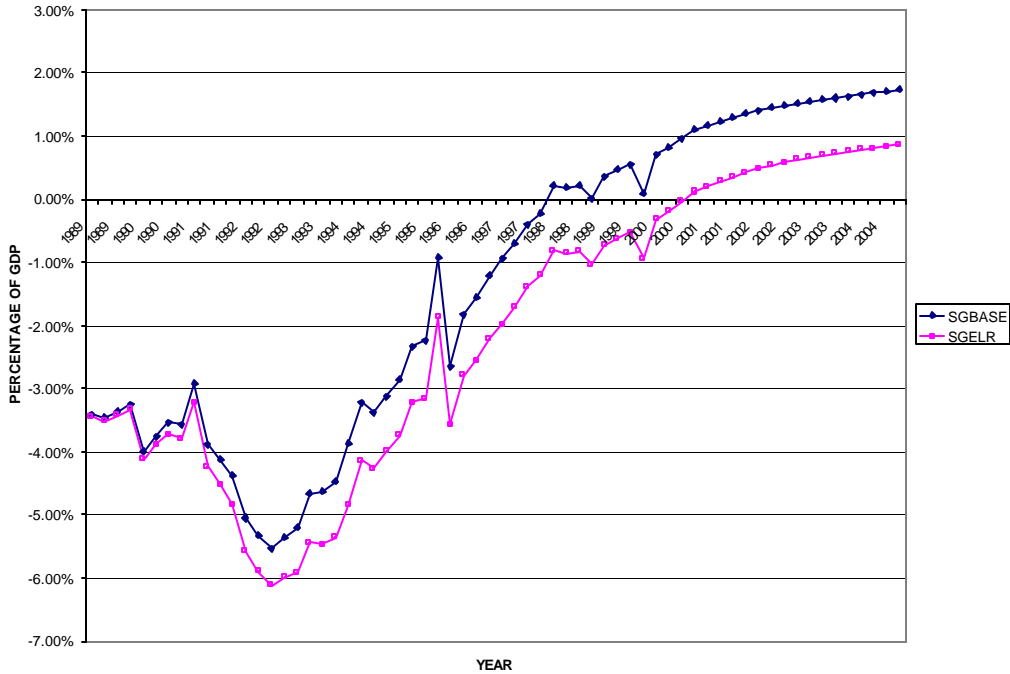


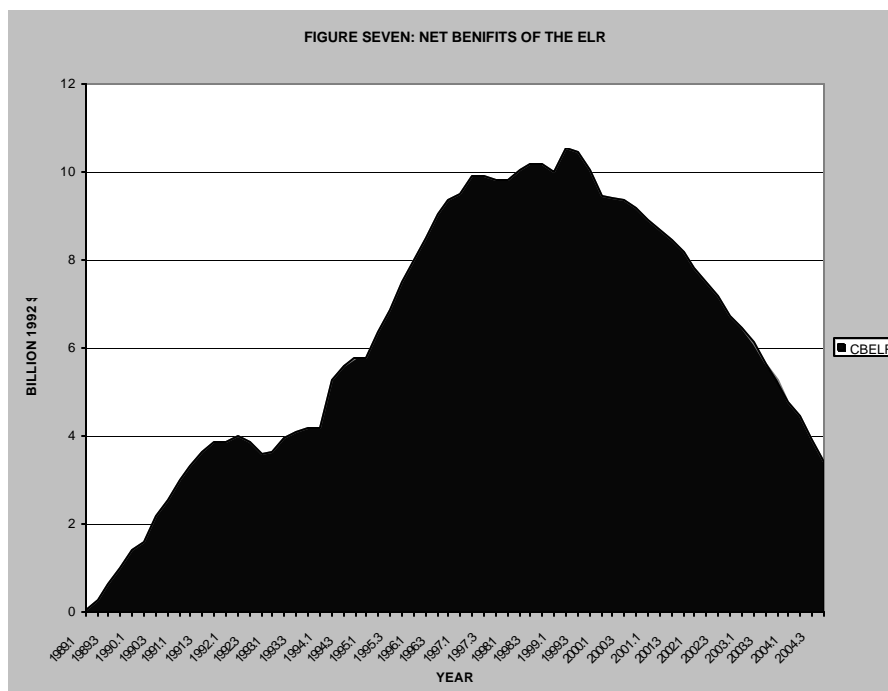
FIGURE SIX: FEDERAL DEFICIT



The program’s cost can be looked at in a number of ways. The simplest is the net cost. (Figure Five) This is the increase in federal spending due to the program. For the fully operational program spending would vary from around 0.5% to 0.9% of GDP. This is less than other entitlements such as Social Security (around 4.5% of GDP) and Medicare (1.75 % to 2.5% of GDP). But with the exception of national defense (3% to 6%), it is larger than discretionary programs such as Federal Transportation spending (0.5%) and the Justice Department (0.33%).

This doesn’t capture the whole story. Among other things the program also increases tax receipts. This increase does not quite match the programs net costs, with the result a modest increase in the Federal deficit. With the ELR the Federal Budget goes into surplus during 2001 and stays there through the end of the forecast period. (see Figure Six)

But to fully understand the policy, we need to consider its benefits as well as its costs. In terms of national income our benefits are the extra output the program directly and indirectly generate. If we subtract the net costs from the extra output we find, correcting for inflation, that we are ahead between \$4 and \$10 billion for each quarter that the program is fully operational. (see Figure Seven) For the period that we simulated the extra output would have exceeded cost by around \$400 billion. This may not capture all of the costs and it certainly does not capture all of the benefits, even so we can confidently say that this is a program that pays.



Demand and Supply Shocks

In these change experiments a shock of one quarter's duration is introduced to an exogenous variable in the unmodified FairModel and in the ELR model specified above. These are then compared to versions of FairModel and the ELR without the shock. The percentage change in various endogenous variables, such as real GNP, firm prices and the unemployment rate is then calculated. The results are deterministic multipliers that allow us to see the effects within the simulation that the shock has on an economy with and without an ELR. The experiments are run for 16 quarters from 1994:1 to 1997:4.

The variables shocked include Federal purchases, exports, import prices, exogenous labor productivity and the interest rates.¹⁸ Multipliers are calculated for real GDP, firm sector prices, firm sector jobs, the unemployment rate and interest rates. Here I will report two sets of multipliers, real GDP (GDPR) and firm sector prices (PF) for a demand shock to Federal purchases (COG), a supply shock to import prices (PIM) and an interest rate shock to the rate on 3-month T-bills (RS).

As expected an increase in Federal purchases results in an increase in GDP at least relative to the no shock scenarios. (See Figure 8) This increase fades over time eventually going negative, largely due to the Fed.'s reaction to the rapid growth. Comparing the ELR and pure FairModel or No-ELR models we find that the GDP changes are larger for the No-ELR case, that is the ELR reduces the economy's reaction to the shock.

¹⁸ Exogenous labor productivity is LAM maximum output per worker hour.

This is also as expected. When the shock hits, the economy needs more workers. In the No-ELR case these workers come from the unemployed who are producing nothing. In the ELR case a part of this workforce come from the PSE program. The services produced by the ELR are reduced while those of the firm sector are increased. For GDP (as well as firm sector employment, the unemployment rate, and the T-bill rate) an ELR is stabilizing to Federal purchases and other demand shocks.

Figure 8: Real GDP in Response to 10% increase in Federal Purchases (COG)

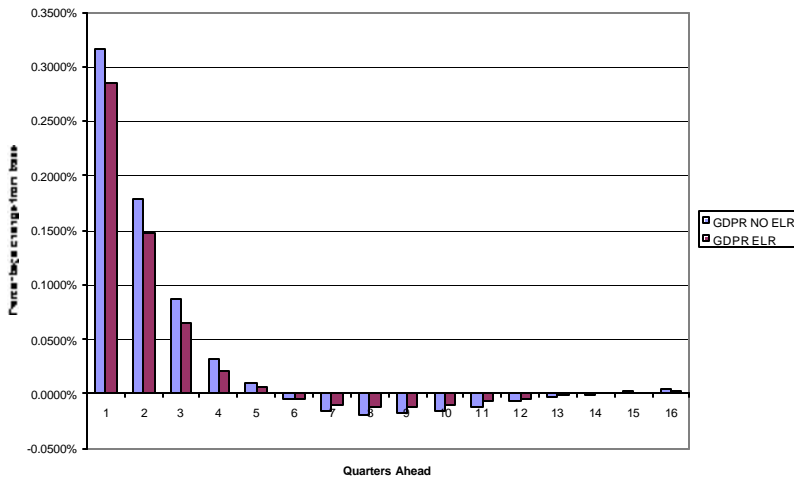
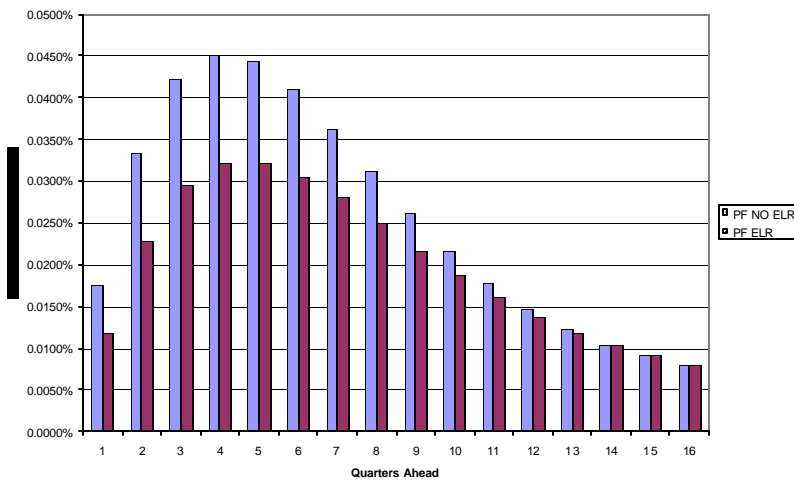
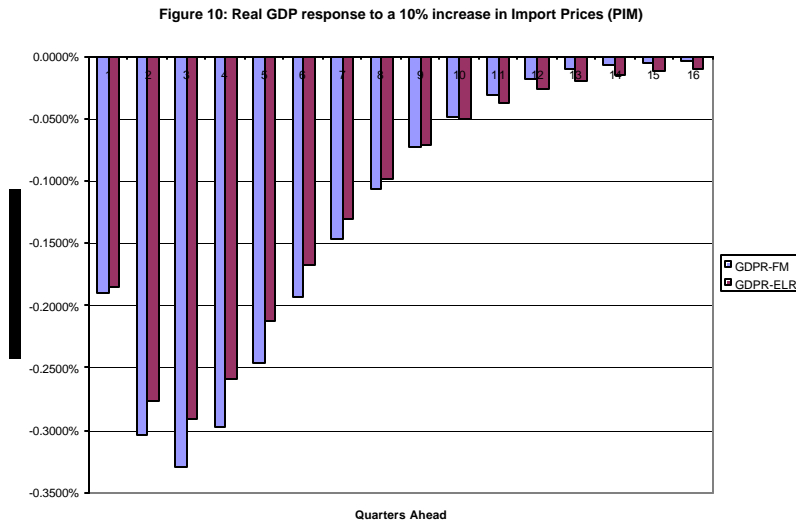


Figure 9: Firm Sector Prices response to 10% change in Federal Purchases (COG)

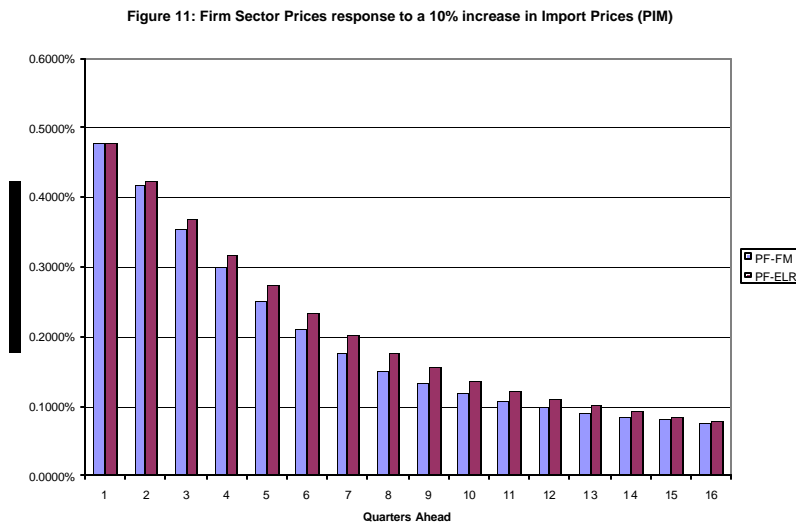


A positive shock to Federal purchases causes the price level (here for the firm sector) to increase. (Figure 9) But once again the increases is smaller (relative to the no shock scenario) with the ELR than without. This makes sense if you remember that the relative increase in output (and reduction in unemployment) is smaller with the ELR so there is less pressure on prices.

Increasing import prices causes real GDP to be lower than in the no shock scenario's. (See Figure 10)
 Here too the shock's effect is smaller with an ELR than without. This stabilizing effect is also found for the rate of unemployment and for T-bill rates.

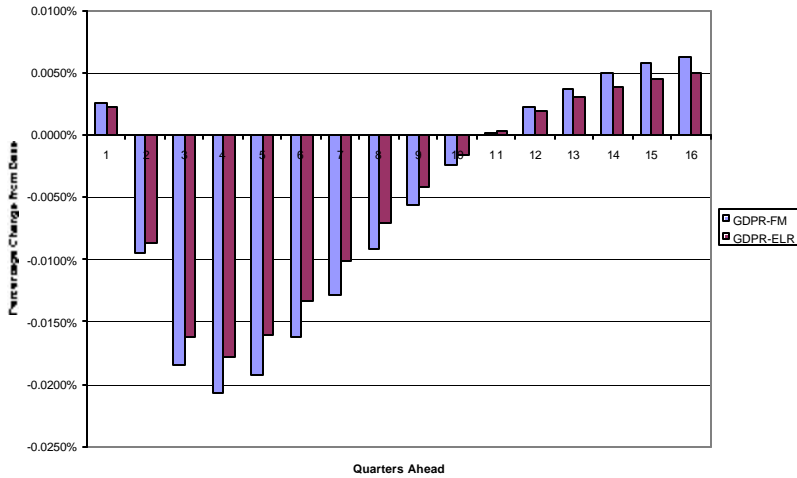


As for firms sector price, here the ELR is at a disadvantage. (Figure 11) The relative increase in prices is higher with the ELR than without. Import prices push firm sector prices upward while weaker GDP (and higher unemployment) mitigates the effect. Since the fall in output is larger without the ELR we would expect the offsetting effect to be stronger and prices to rise by less.



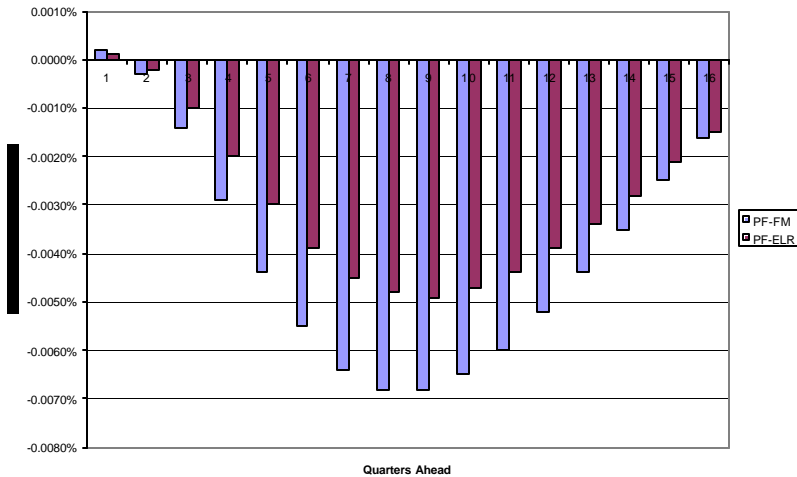
In order to simulate an interest rate shock equation 30, the Federal Reserve reaction function is dropped and interest rates on 3-month T-Bill determined exogenously using the actual rates. The interest rate for the first quarter of 1994 is raised by 10%, so that say a 5% rate becomes 5.5%. As expected the higher interest rates lower GDP relative to the base. (Figure 12) But the effect is more pronounced in the No-ELR case.

Figure 12: Real GDP response to a 10% Increase in the T-Bill Rate



After the interest rate shock firm sector prices are lower than without the shock. (Figure 13) Here too the ELR reduces the impact of the shock.

Figure 13: Firm Sector Price Response to a 10% Increase in the T-Bill Rate



Conclusion

This simulation is just a start. It represents only one configuration of the program. Even so, it is most encouraging. The program increases private employment and GDP at the cost of slightly slower disinflation during the early 1990s. The program's benefits exceed its costs. The ELR stabilizes both output and prices when there are demand or interest rate shocks and it stabilizes output in the face of supply shocks.

An ELR program is well suited for maintaining full employment and stable prices in an economy that has come close to those goals. It would fit in well with today's economy. Working with FairModel-US is a

logical step in research on ELR programs. FairModel-US is compatible, though not identical with, Transformational Growth macroeconomics. It allows for the examination of the program in a way that is both quantitative and more complex than previous theoretical work. Initial simulations support these theoretical conclusions and are an important conformation of our work. We look forward to future experiments that may offer challenges and help improve this analysis.

Appendix I: Modifications to the Fairmodel-US

Fairmodel-US, April 2000 in Fair-Parke format.

FairModel equations are numbered as in Fair 1994.

Added variables, exogenous series and constants

COELR: eq. maj 4, spending Job Training and on materials for the PSE program \$ 1992

ELR: eq. maj 2, total PSE employment

ELR1: exog. series phases in program over twenty quarters starting 1989:1

ELR3: exog. constant percentage of unemployed, above the frictional rate, who join the PSE program.

ELR4: exog. constant, PSE average hourly earnings including that of supervisors as percentage of regular Federal average earnings.

ELRR: eq. maj 1, PSE as a percentage of the labor force.

PCOELRJT: exog. series spending on job training in current dollars, source Majewski & Nell 1999b.

WELR: eq. maj 3, average hourly earnings PSE workers including supervisors.

Added equations

$$\text{Eq. MAJ1} \quad \text{ELRR} = \text{ELR3} * (\text{UR} - .04 + \text{ABS}(\text{UR} - .04)) / 2$$

$$\text{Eq. MAJ2} \quad \text{ELR} = \text{ELR1} * (\text{L1} + \text{L2} + \text{L3} - \text{JM}) * \text{ELRR}$$

$$\text{Eq. MAJ3} \quad \text{WELR} = .95 * \text{ELR4} * \text{WF} + .05 * \text{WG}$$

$$\text{Eq. MAJ4} \quad \text{COELR} = ((.15 * \text{WELR} * \text{ELR} * \text{HG}) + (\text{ELR1} * \text{PCOELRJT})) / \text{PG}$$

$$\text{Eq. MAJ5} \quad \text{LUELR} = \text{LOG}(\text{U} - \text{ELR})$$

$$\text{Eq. MAJ6} \quad \text{LUB} = 0.5816729565 * \text{CNST} + 0.2491445707 * \text{LUB}(-1) + 1.1463479485 * \text{LUELR} + 0.3998202421 * \text{LWF}$$

Modified FM equations, changes in bold

Eq. 28 Dropped when MAJ 5 & 6 are used.

$$\text{Eq. 43} \quad \text{WH} = 100 * ((\text{WF} * \text{JF} * (\text{HN} + 1.5 * \text{HO}) + \text{WG} * \text{JG} * \text{HG} + \text{WELR} * \text{ELR} * \text{HG} + \text{WM} * \text{JM} * \text{HM} + \text{WS} * \text{JS} * \text{HS} - \text{SIGG} - \text{SISS}) / (\text{JF} * (\text{HN} + 1.5 * \text{HO}) + \text{JG} * \text{HG} + \text{ELR} * \text{HG} + \text{JM} * \text{HM} + \text{JS} * \text{HS}))$$

$$\text{Eq. 60} \quad \text{X} = \text{CS} + \text{CN} + \text{CD} + \text{IHH} + \text{IKF} + \text{EX} - \text{IM} + \text{COG} + \text{COELR} + \text{COSS} + \text{IKH} + \text{IKB} + \text{IKG} + \text{IHF} + \text{IHB} - \text{PIEB} - \text{CCB}$$

$$\text{Eq. 61} \quad \text{XX} = \text{PCS} * \text{CS} + \text{PCN} * \text{CN} + \text{PCD} * \text{CD} + \text{PIH} * \text{IHH} + \text{PIK} * \text{IKF} + \text{PEX} * \text{EX} - \text{PIM} * \text{IM} + \text{PG} * \text{COG} + \text{PG} * \text{COELR} + \text{PS} * \text{COSS} + \text{PIK} * (\text{IKH} + \text{IKB} + \text{IKG}) + \text{PIH} * (\text{IHF} + \text{IHB}) - \text{PX} * (\text{PIEB} + \text{CCB}) - \text{IBTG} - \text{IBTS}$$

$$\text{Eq. 64} \quad \text{YT} = \text{WF} * \text{JF} * (\text{HN} + 1.5 * \text{HO}) + \text{WG} * \text{JG} * \text{HG} + \text{WELR} * \text{ELR} * \text{HG} + \text{WM} * \text{JM} * \text{HM} + \text{WS} * \text{JS} * \text{HS} + \text{DF} + \text{DB} - \text{DRS} + \text{INTF} + \text{INTG} + \text{INTS} + \text{INTOTH} + \text{INTROW} + \text{RNT} + \text{TRFH} - \text{SIGG} - \text{SISS}$$

$$\text{Eq. 76} \quad \text{SG} = \text{THG} + \text{IBTG} + \text{TFG} + \text{TBG} + \text{SIHG} + \text{SIFG} - \text{PG} * \text{COELR} - \text{WG} * \text{JG} * \text{HG} - \text{WELR} * \text{ELR} * \text{HG} - \text{WM} * \text{JM} * \text{HM} - \text{INTG} - \text{TRGR} - \text{TRGH} - \text{TRGS} - \text{SUBG} - \text{INS} + \text{SIGG} - \text{PIK} * \text{IKG} + \text{CCG}$$

$$\text{Eq. 82} \quad \text{GDP} = \text{XX} + \text{PIV} * (\text{V} - \text{V}(-1)) + \text{IBTG} + \text{IBTS} + \text{WG} * \text{JG} * \text{HG} + \text{WELR} * \text{ELR} * \text{HG} + \text{WM} * \text{JM} * \text{HM} + \text{WS} * \text{JS} * \text{HS} + \text{WLDG} + \text{WLDS} + \text{PX} * (\text{PIEB} + \text{CCB})$$

$$\text{Eq. 83} \quad \text{GDPR} = \text{Y} + \text{PIEB} + \text{CCB} + \text{PSI13} * (\text{JG} * \text{HG} + \text{ELR} * \text{HG} + \text{JM} * \text{HM} + \text{JS} * \text{HS}) + \text{STATP}$$

$$Eq. 85 \quad E=JF+JG+JM+JS-LM$$

$$Eq. 95 \quad JJ=(JF*HF+JG*HG+ELR*HG+JM*HM+JS*HS)/POP$$

$$Eq. 96 \quad JJS=JJ/JJP-(ELR*HG)/POP$$

$$Eq. 98 \quad YS=LAM*(JJP*POP-JG*HG-JM*HM-JS*HS)$$

$$Eq. 104 \quad PUG=PG*COG+PG*COELR+WG*JG*HG+WELR*ELR*HG+WM*JM*HM+WLDG$$

$$Eq. 115 \quad YD=WF*JF*(HN+1.5*HO)+WG*JG*HG+WELR*ELR*HG+WM*JM*HM+WS*JS*HS+RNT+DF+DB-DRS+INTF+INTG+INTS+INTOTH+INTROW+TRFH+TRGH+TRSH+UB-SIHG-SIHS-THG-THS-TRHR-SIGG-SISS$$

$$Eq. 126 \quad WA=100*((1-D1GM-D1SM-D4G)*WF*JF*(HN+1.5*HO)+(1-D1GM-D1SM)*(WG*JG*HG+WELR*ELR*HG+WM*JM*HM+WS*JS*HS-SIGG-SISS))/(JF*(HN+1.5*HO)+JG*HG+ELR*HG+JM*HM+JS*HS)$$

Appendix II: Transformational Growth and the FairModel

Many of the key relationships in the April 2000 version of FairModel-US (FM) are very close to those of Transformational Growth (TG) as found in Nell (1998) and Nell & Majewski (1999 a, b, c). These include investment, interest rates, money supply, private employment, private output and inflation. The treatment of consumption has many common features, though here there is an important difference.

To see these common features and differences let's look at some of the more interesting of FM's 131 equations (30 behavioral and 101 identities) and compare them to a TG theoretical model

In TG theoretical work, an accelerator determines planned investment. In FM the principal investment equation (non-residential fixed investment,) is a capital stock adjustment accelerator:

$$\text{EQ 12 } LKK = LKK(-1), LKK(-2), LY, LY(-1), LY(-2), LY(-3), LY(-4), LY(-5)$$

The current period's capital stock KK (L for log) depends upon its lagged values (-1,-2 etc.) and upon firm sector production Y and its lagged values. Non-residential fixed investment is current capital minus the previous period's net of depreciation.

In TG theoretical work, short run interest rates are determined by the Federal Reserve and the money supply is endogenous. In FM this step is taken further and tries to model the Fed's decision. The three-month bond rate is determined by a Federal reserve reaction function and the money supply is determined endogenously.

$$\text{Eq. 30 } RS = C, RS(-1), PCPD, UR, UR1, PCM1(-1), PCM1LA, RS1(-1), RS1(-2)$$

Where RS is the three month T-bill rate, $PCPD$ the percentage change in domestic prices, UR is the unemployment rate, $UR1$ is the first difference of the unemployment rate, $PCM1$ percentage change in $M1$, $PCM1LA$ a dummy to represent the monetarist experiments of 1979:4 - 1982:3 and $RS1$ the first difference of RS .

In TG other interest rates are determined by a variable markup on the short-term interest rates. FM determines such markups in its behavioral equations based on the trend in the T-bill rate and the trend in the markup itself (see Fair Eq. 23 & 24).

For TG private sector employment depends on effective demand and average labor productivity. FM's firm sector employment equation is written in log form. The growth rate of firm sector jobs ($LJF1$) depends, its previous value, the growth of firm sector production ($LY1$), a time trend T , the ratio of the previous period's jobs to the minimum number of worker hours necessary to produce that output ($LEXL(-1)$) and a dummy for 1977:2 ($DD772$) which is also applied to the variables other than firm production ($LEXLL1D$, $LJF1L1D$, TDD).

$$\text{Eq. 13. } \text{EQ 13 } LJF1 = C, DD772, LEXL(-1), LEXLL1D, LJF1(-1), LJF1L1D, T, TDD, LY1$$

Equilibrium private sector production depends on effective demand in TG models. There are implied inventory adjustments in the movement towards equilibrium. In FM firm sector real output (Y) depends on itself with a lag, on total sales (X), on lagged inventories (V) and on a set of autoregressive processes ($RHO=3$).

$$\text{Eq. 11 } \text{EQ 11 } Y = C, Y(-1), X, V(-1), RHO=3$$

In analyzing the price level and inflation, neither TG nor FM makes use of a Philips curve. Both see firms as price setters analyzing the price level and its changes with a price equation. For TG price level movements have many triggers, but to turn such movements into an ongoing inflation requires a sustained conflict over income distribution. The principal price equation in FM is firm sector prices (PF), here

written in log form. It depends on its own lagged value, unit labor costs (LWFD5)¹⁹, the log of import prices (LPIM), the rate of unemployment (UR) and a time trend.

$$\text{Eq. 10} \quad \text{LPF} = \text{LPF}(-1) \text{ LWFD5 } C \text{ LPIM UR } T$$

Since the extent to which wages exceed productivity (LWFQ) depends upon past prices and itself the conflict that TG specifies is captured within the FM model.

$$\text{Eq. 16} \quad \text{LWFQ} = \text{LWFQ}(-1) \text{ LPF } C \text{ T LPF}(-1)$$

TG accepts two stylized facts about productivity. First, that there is short run increasing returns to labor or Okun's law.²⁰ FM denies the existence of a stable Okun's law relationship but does have short run increasing returns to labor. Second, TG accepts Verdorn's (or Kaldor's) Law, that increasing the rate of economic growth increases the rate of growth of labor productivity. In this FM differs, treating the maximum output per worker hour (LAM) as exogenous.

Labor market participation has not been modeled with in TG. However, within our discussions of the ELR it has been assumed that it is responsive to job availability and the real wage though we are uncertain of the sign of the latter effect. FM uses four labor force equations²¹, all of a similar form. Choosing labor force men 25-54 as representative, the log of the ratio of labor force men 25-54 to population depends upon itself lagged, log of real wage (LWAZPH) and a time trend. In earlier versions including Fair 1994, it was also dependent on a labor constraint variable. This variable was dropped in the April 2000 estimation of the model.

$$\text{Eq. 5} \quad \text{LL1Z} = C, \text{ LL1Z}(-1), \text{ LWAZPH}, T$$

Consumption is one of the areas where the models differ. An identifying feature of Kaleckian work like TG is the role played by the distribution of income in determining consumption. It is assumed that profits, which are partially retained by firms, are saved to a greater extent than wages. Increasing the wage share increases consumption and ceteris paribus effective demand. FM makes use of three wage equations, services, non-durable and durable goods. (eqs. 1-3) While there are differences in each, they have a common structure and we can use the per capita consumption of non-durable goods (written in log form LCNZ) as representative. (eq.2) In all the equations consumption depends upon the age of the population, here AG1, AG2, AG3.²² Consumption also depends on itself lagged and in this equation on its lagged growth rate. (LCNZ1(-1)) It depends on net wealth (LAAZ) and on disposable income (LYDZ). An interest rate enters into all of the consumption equations, in this case it is the after tax mortgage rate (RMA).

$$\text{Eq. 2} \quad \text{LCNZ} = C, \text{ AG1}, \text{ AG2}, \text{ AG3}, \text{ LCNZ}(-1), \text{ LCNZ1}(-1), \text{ LAAZ}(-1), \text{ LYDZ}, \text{ RMA}$$

Interest rates may pick up the effect of changes in income distribution, to the extent that rising interest rates are associated with rising non-wage shares in income.

¹⁹ LWFD5, unit labor costs are the difference between the log of firm sector wages (including employer Social Security Taxes) and the log of maximum output per worker hour.

²⁰ In simple models constant average labor productivity is often assumed.

²¹ Equations 5-8, men 25-54, women 25-54, all others and moonlighters respectively.

²² AG1 is the percentage of the 16+ population 26-55 minus that 16-25, AG2 the percentage 56-65 minus that 16-25 and AG3 the percentage 65+ minus that 16-25.

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