A POST KEYNESIAN MODEL OF MACROECONOMIC GROWTH, INSTABILITY, AND INCOME DISTRIBUTION[1]

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"the element of Time is the centre of the chief difficulty of almost every economic problem"

Alfred Marshall [1920, Preface]

ABSTRACT

The purpose of this paper is to show that a well-known group of economists known as "Post Keynesians" or "Post Keynesian Institutionalists," engage in macroeconomic modeling in a way that is strikingly similar to the system dynamics method. It will be argued, therefore, that system dynamics can be used to improve Post Keynesian macroeconomic analysis. In addition, this paper will present an original system dynamics model of macroeconomic growth, instability, and income distribution, that can clearly be classified as Post Keynesian. Of interest is that the model generates, among other behaviors, an economic long wave.

A CONTINUING CONTROVERSY

One of the continuing controversies in macroeconomics involves the issue of what John Maynard Keynes "really" said in the General Theory of Employment, Interest, and Money [Keynes 1936]. The view held by many economists is that the essence of Keynes' message can be found in John Hicks' IS-LM model [Hicks 1937],[2] and the standard presentation of "Keynesian economics" that appears in virtually every introductory and intermediate macroeconomics text in the United States.[3] The standard presentation of Keynesian economics, known as the "neoclassical synthesis," was first formulated and popularized by Paul Samuelson in his famous principles of economics text.[4] Essentially, the neoclassical synthesis postulates that, although market forces will ensure full employment in an economy in the long run, Keynesian demand management policies are necessary to ensure it in the short run.

Post Keynesian economists, on the other hand, argue forcefully that the neoclassical synthesis does not represent what Keynes was "really" saying in the General Theory. Indeed, they often refer to the neoclassical synthesis as "Vulgar Keynesianism," or "Bastardized Keynesianism" -- i.e., a type of Marshallian equilibrium economics disguised in Keynesian clothing [Davidson 1991]. In its place, the Post Keynesians offer a body of theory that purports to capture the true spirit of Keynes. The intellectual origins of Post Keynesian theory can also be traced to the work of Michal Kalecki [1939, 1954, 1966, 1971], a Polish economist that independently discovered "Keynesian" economics three years before Keynes did [See Klein 1947; Robinson 1973; Feiwel 1976; and Sawyer 1985].[5]

POST KEYNESIAN MACROECONOMICS

Central to Post Keynesian macroeconomic theory is the belief that the distribution of income both determines, and is determined by, the behavior of the economy. In Kalecki's original work, for example, there are two classes of economic agents: capitalists and workers. The capitalists decide how much to invest via their expectations of demand, adjust their prices to acquire the necessary revenue and, after a lag, reap the results of their investment -- profits. Workers, on the other hand, receive nothing but a subsistence wage. Indeed, Kalecki's most frequently quoted statement is that: "Workers spend what they get and capitalists get what they spend."

In terms of methodology, Post Keynesian economists adhere to a form of macroeconomic analyses that is strikingly similar to the system dynamics method. Indeed, they believe in modeling reality as it actually is, in utilizing a systems approach and a disequilibrium framework, and in analyzing a model economy via "comparative dynamics" -- i.e., over time with one set of assumptions and then with another.

A POST KEYNESIAN MACROECONOMICS MODEL

The model created for this paper can clearly be classified as belonging to the Post Keynesian school of macroeconomics. It represents a one sector, two factor, economy and incorporates three important macroeconomic processes: economic growth, capital ownership and wage determination. The feedback structure driving each of these processes is explained below.

Economic Growth. The economic growth processes are represented by a modified version of the multiplier and accelerator model originally proposed by Samuelson [1939] and Hicks [1950]. The modifications made decouple production and sales through a backlog accumulation while also allowing the consumption to vary according to worker income, instead of being determined by the past sales and the marginal propensity to consume. Figure 1 shows the feedback loops driving economic growth.

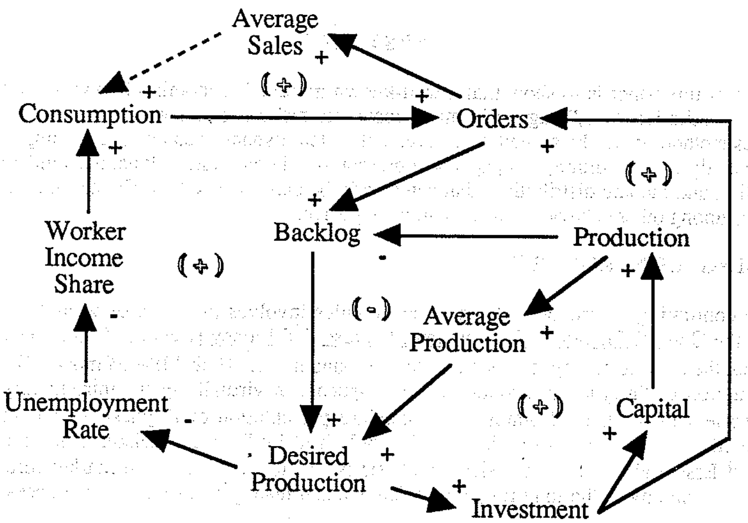

Figure 1: Feedback loops creating economic growth.

Multiplier effects manifest in the induced growth processes. Thus, an autonomous increase in sales will increase desired production by increasing backlog. This reduces unemployment, expanding worker income and consumption, which further expands sales. Note, the traditional multiplier mechanisms represented by the feedback loop with the broken link is only an abstraction of expansion in consumption from expansion in the wage payments. The accelerator effects come from the feedback loops formed by the sale induced from capital investments for the expanding desired production. Finally, the backlog condition influences desired production, creating a negative feedback loop that clears the market.

Capital Ownership. Capital ownership is not collective or infinitely widely distributed as is implicitly assumed in the neoclassical system, nor completely separated from the workers as in the Marxist system. Worker investment and capital accumulation mechanisms account both for informal production and ownership of equity by workers in the formal sector. Figure 2 shows the feedback loops affecting investment and capital ownership by the workers.

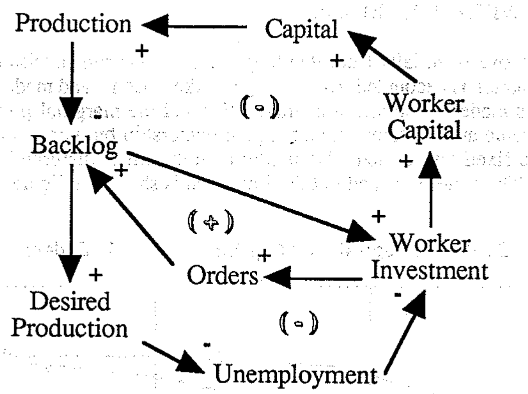

Figure 2: Feedback loops affecting investment and capital ownership by workers.

The accelerator effect is enhanced when an increase in sales due to worker investment leads to an increase in desired production. The worker investment, in turn, is also influenced by the backlog, which represents a proxy for profitability. This creates a control mechanism that also keeps worker investment in line with the demand for production. Finally, the backlog condition influence on desired production, and in turn on the unemployment rate, creates another control process that helps to clear the market.

Wage Determination. The wage rate is determined, both on the basis of labor market conditions, and the existing average income level of workers. The later represents the opportunity cost to the workforce of moving a worker from a household to formal employment, and depends both on the wages and rents received by the workers. Figure 3 shows the feedback loops affecting wage rate determination.

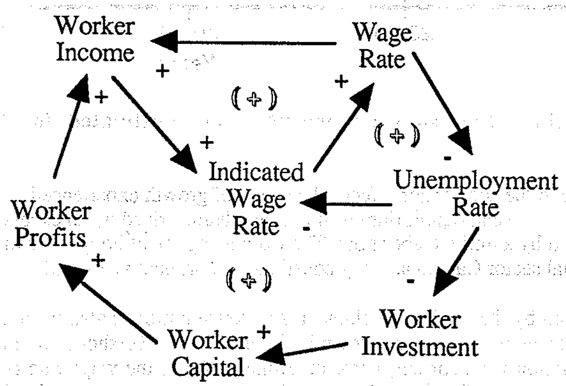

Figure 3: Feedback loops influencing wage determination.

Both the current level of wages, and capital ownership by the workers, add to worker income which, together with unemployment rate, determines the wage demanded. This creates the three positive feedback loops shown in Figure 3 that tend to escalate any trends existing in the wage rate and capital ownership by the workers.

The mathematical structure of the model is given in the Appendix. The initial conditions of the model are automatically computed to bring it to an equilibrium for any specified value of sales. Reasonable values are selected for the other parameters. These are also given in the Appendix. It should be recognized that the parameters selected attempt to maintain the initial equilibrium and many sets would be able to accomplish this, while the dynamic pattern generated by the model when disturbed from equilibrium would be largely independent of its parameters.

EXPERIMENTATION WITH THE MODEL

The model described above is initially truncated to generate a base run consistent with the neoclassical growth theory. Thus, wage determination is decoupled from average worker income and made dependent only on labor market conditions. Consumption is made a function of average sales and the marginal propensity to consume, instead of being linked to worker income and investment, and capital ownership by workers is eliminated. Additionally, the economy is assumed to be fixed and closed. The model equilibrium is disturbed by stepping up the fraction of government balance spent. The pattern created in this simulation is shown in Figure 4.

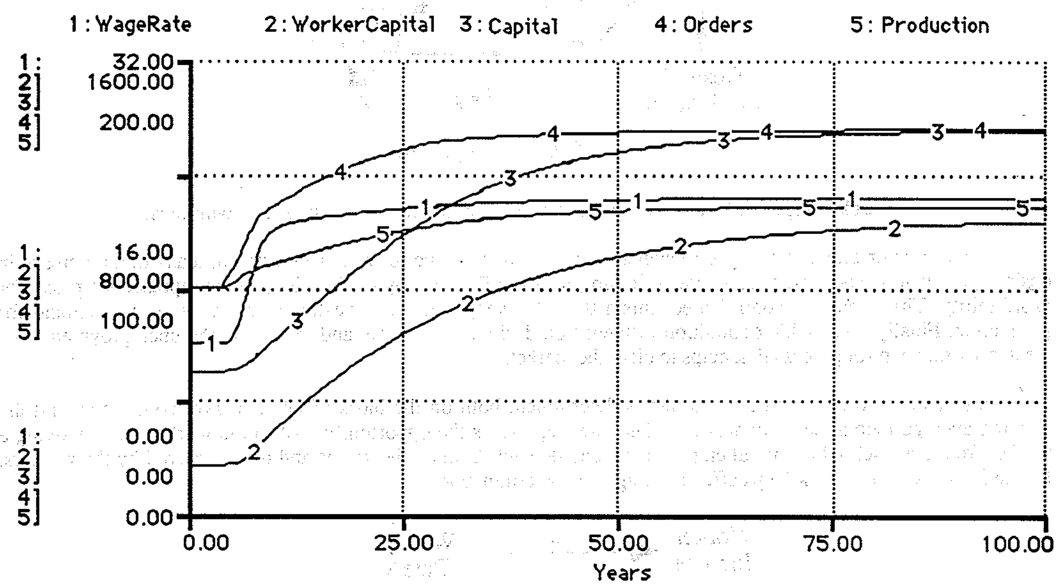

Figure 4: Base run simulation showing growth mode postulated in the neoclassical growth model.

Due to the multiplier and the accelerator effects, the extent of growth experienced far exceeds the initial increase in the government spending. The end equilibrium is, however, characterized by an excess of demand over production and a high wage rate created by a limited labor pool. The worker capital, although shown in the graph, does not enter computations and the formal sector Capital actually constitutes all productive capital.

When capital ownership by the workers is allowed, and consumption is also made dependent on wage income, the system develops an overshoot tendency as shown in Figure 5. This overshoot occurs in the formal sector capital and the demand for production from formal sector investment. When the wage rate is also allowed to depend on worker opportunity costs, instead of only on labor market conditions, the scenario changes further as shown in Figure 6. The wage rate as well as demand equilibrate at a much higher level, the decline in formal capital is sightly reduced as compared to the case of Figure 5, while the shortfall in production is increased.

Open economy scenarios are more or less similar, although opening the economy limits both growth and overshoot. The degree of "openness" in these scenarios determines the extent of the limiting effects. Population growth with neoclassical assumptions creates a golden age, although it leads to a stagnation when the consumption and wage determination assumptions are introduced.

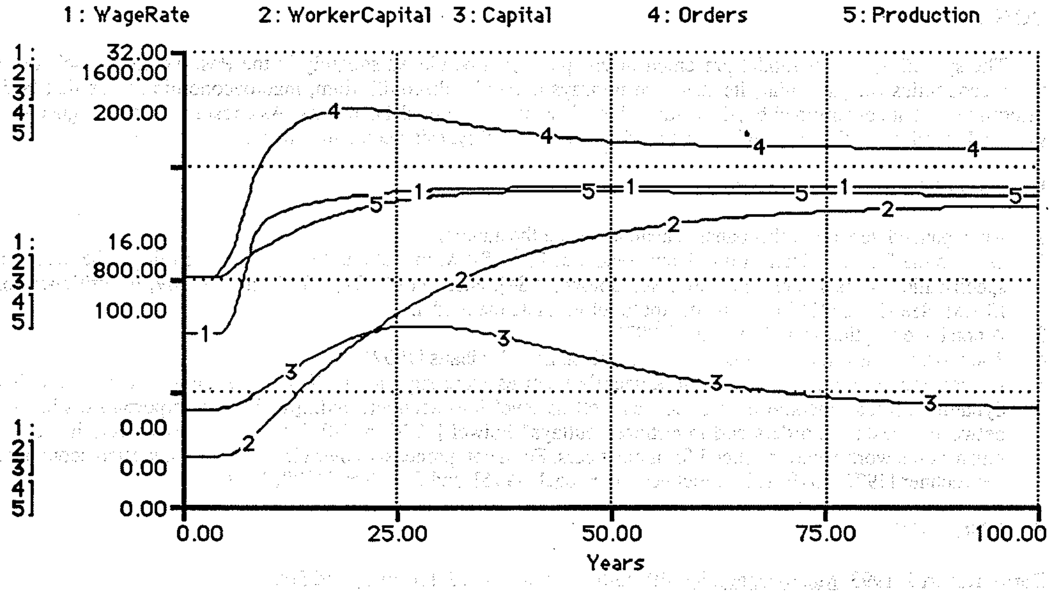

Figure 5: Simulation of the model when worker ownership of capital is allowed and consumption is made dependent on worker income.

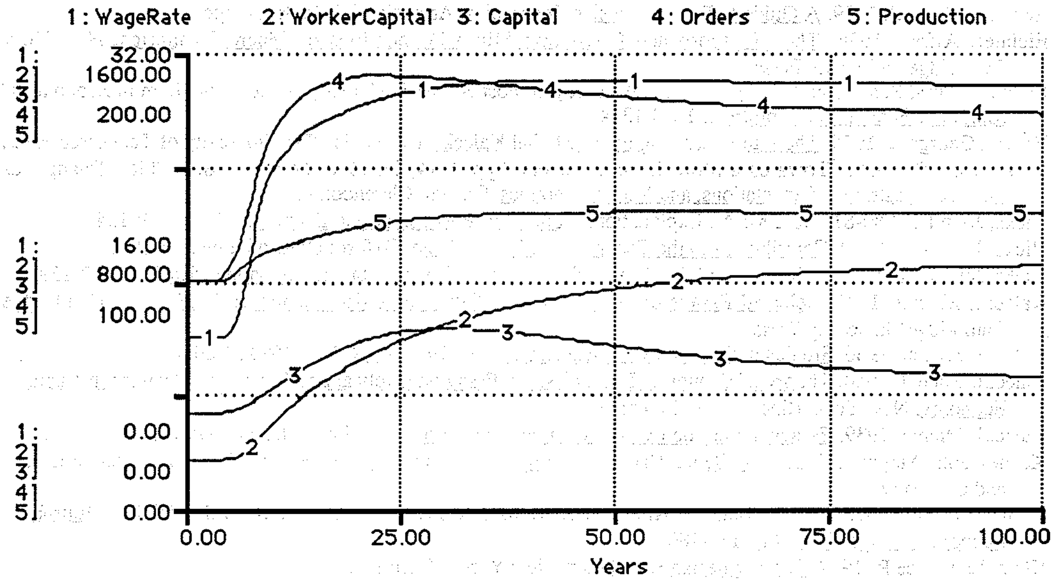

Figure 6: Simulation of the complete model with Post Keynesian assumption regarding wage determination and consumption.

CONCLUSIONS

The system dynamics model presented in this paper can be placed squarely in the Post Keynesian school of macroeconomics. In particular, its structure portrays dynamic, disequilibrium, macroeconomic forces that both determine, and are determined by, the distribution of income in the model economy. As a result, it can be argued that system dynamics has the potential to be a useful tool in Post Keynesian economic analysis.

ENDNOTES

1. An expanded version of this paper is available from the authors.
2. Despite the fact that, later in life, Hicks renounced the IS-LM model due to, among other things, the incorrect specification of its stocks and flows. See Solow [1984], Hicks [1980-81], and Klamer [1989] for criticisms of IS-LM. See Hicks [1988] for an attempt to reformulate the model.
3. A notable exception would be Barro [1993].
4. The most recent version of this text is Samuelson and Nordhaus [1992].
5. In fact, many economists feel that Kalecki's theories were superior to Keynes' as they "[were] explicitly dynamic;...[took] income distribution as well as level into account; and...[made] the important distinction between investment orders and investment outlays" Feiwel [1976, p. 28]. Because Kalecki wrote in Polish, much of his work went unnoticed for many years. For a comprehensive overview of Post Keynesian economics see Eichner [1976, 1979, 1987], Eichner and Kregel [1975], and Davidson [1978, 1991].

REFERENCES

Barro, Robert J. 1993. Macroeconomics. 4th edition. New York: John Wiley and Sons.

Davidson, Paul. 1991. Controversies in Post Keynesian Economics. Brookfield, VT: Edward Elgar.

Davidson, Paul. 1981. "Post Keynesian Economics: Solving the Crisis in Economic Theory." pp. 151-173, In: David Bell and Irving Kristol, eds., The Crisis in Economic Theory. New York: Basic Books.

Davidson, Paul. 1978. Money and the Real World. 2nd edition. London: Macmillan.

Eichner, Alfred S. 1987. The Macrodynamics of Advanced Market Economies. Armonk, NY: M. E. Sharpe.

Eichner, Alfred S. 1979. A Guide to Post-Keynesian Economics. Armonk, NY: M. E. Sharpe.

Eichner, Alfred. 1976. The Megacorp and Oligopoly: Micro Foundations of Macro Dynamics. New York: Cambridge University Press.

Eichner, Alfred S. and Jan A. Kregel. 1975. "An Essay on Post-Keynesian Theory: A New Paradigm in Economics." Journal of Economic Literature 8: 1293-1314.

Feiwel, George R. 1975. The Intellectual Capital of Michal Kalecki. Knoxville, TN: University of Tennessee Press.

Hicks, John R. 1988. "Towards a More General Theory." pp. 6-14, In: Meir Kohn and Sho-Chieh Tsiang, eds. Finance Constraints, Expectations, and Macroeconomics. Oxford: Clarendon Press.

Hicks, John R. 1980-81. "IS-LM: An Explanation." Journal of Post Keynesian Economics 3(2): 139-154.

Hicks, John R. 1950. A Contribution to the Theory of the Trade Cycle. Oxford: Oxford University Press.

Hicks, John R. 1937. "Mr. Keynes and the 'Classics'; A Suggested Interpretation." Econometrica 5(2): 147-159.

Kalecki, Michal. 1971. Selected Essays on the Dynamics of the Capitalist Economy: 1933-1970. Cambridge: Cambridge University Press.

Kalecki, Michal. 1966. Studies in the Theory of Business Cycles: 1933-1939. New York: Kelley.

Kalecki, Michal. 1954. Theory of Economic Dynamics: An Essay on Cyclical and Long-Run Changes in Capitalist Economy. New York: Rinehart and Company.

Kalecki, Michal. 1939. Essays in the Theory of Economic Fluctuations. London: Allen and Unwin.

Keynes, John Maynard. 1936. The General Theory of Employment, Interest and Money. New York: Harcourt, Brace and Company.

Klamer, Arjo. 1989. "An Accountant Among Economists: Conversations with Sir John Hicks." Journal of Economic Perspectives 3(4): 167-180.

Klein, Lawrence R. 1947. The Keynesian Revolution. New York: Macmillan.

Marshall, Alfred. 1920 (1890). Principles of Economics. 8th edition. London: Macmillan.

Robinson, Joan. 1973. "Michal Kalecki." pp. 87-91, In: Joan Robinson, ed. Collected Economic Papers: Volume IV. New York: Humanities Press.

Samuelson, Paul A. 1939. "Interactions Between the Multiplier Analysis and the Principle of Acceleration." Review of Economics and Statistics 21: 75-78.

Samuelson. Paul A. and William D. Nordhaus. 1992. Economics. 14th edition. New York: McGraw-Hill.
Sawyer, M. 1985. The Economics of Michal Kalecki. London: Macmillan.
Solow, Robert M. 1984. "Mr. Hicks and the Classics." Oxford Economic Papers 36: 13-25.

APPENDIX

AverageProduction(t) = AverageProduction(t - dt) + (ChgAveProduction) * dt
INIT AverageProduction = 100 {Dollars/Year}
ChgAveProduction = (Production - AverageProduction) / TimeToAveProduction
Backlog(t) = Backlog(t - dt) + (Orders - Production) * dt
INIT Backlog = DesiredBacklog {Dollars}
Orders = Consumption + (CorporateInvestment + SwitchForWorkerIncome * WorkerInvestment) + GovernmentSpending + NetExports {Dollars/Year}
Production = IndicatedProduction {Dollars/Year}
Consumption = (Worker'sPermanentIncome * (1 - FractionWorkerIncomeSaved)) * SwitchForWorkerIncome + AverageProduction * MPC * (1 - SwitchForWorkerIncome) - TaxRevenue {Dollars/Year}
FractionWorkerIncomeSaved = NrmFracWorkerIncomeSaved * EffUnemplFracWorkerIncSaved * EffBacklogRatioDesiredProduction {Dollars/Dollar/Year}
IndicatedProduction = TechnologyCoefficient * (EXP(ElasticityOfLabor*LOGN(Labor)) * EXP(ElasticityOfCapital * LOGN(TotalCapital))) {Dollars/Year}
MPC = .75 {Dollars/Dollar/Year}
NrmFracWorkerIncomeSaved = .1 {Dollars/Dollar/Year}
TechnologyCoefficient = 100 / (EXP(ElasticityOfLabor*LOGN(ElasticityOfLabor*100/NominalNormalWage)) * EXP(ElasticityOfCapital*LOGN(ElasticityOfCapital*100/InterestRate))) {Dimensionless}
TimeToAveProduction = 2 {Years}
TotalCapital = CorporateOwnedCapital + SwitchForWorkerIncome * WorkerOwnedCapital {Dollars}
CorporateOwnedCapital(t) = CorporateOwnedCapital(t - dt) + (CorporateInvestment - CorporateDepreciation) * dt
INIT CorporateOwnedCapital = DesiredCorporateOwnedCapital {Dollars}
CorporateInvestment = CorporateDepreciation * EffectCapitalRatioInvestment {Dollars/Year}
CorporateDepreciation = CorporateOwnedCapital / AveLifeOfCapital {Dollars/Year}
WorkerOwnedCapital(t) = WorkerOwnedCapital(t - dt) + (WorkerInvestment - WorkerCapitalDepreciation) * dt
INIT WorkerOwnedCapital = (ElasticityOfLabor * AveLifeOfCapital * FractionWorkerIncomeSaved * AverageProduction) / (1-FractionWorkerIncomeSaved) {Dollars}
WorkerInvestment = GrossWorkerIncome * FractionWorkerIncomeSaved {Dollars/Year}
WorkerCapitalDepreciation = WorkerOwnedCapital / AveLifeOfCapital {Dollars/Year}
AveLifeOfCapital = 20 {Years}
CorporateCapitalRatio = DesiredCorporateOwnedCapital / CorporateOwnedCapital {Dimensionless}
DesiredCorporateOwnedCapital = (ElasticityOfCapital * DesiredProduction/InterestRate) - SwitchForWorkerIncome * WorkerOwnedCapital {Dollars}
ElasticityOfCapital = .25 {Dimensionless}
InterestRate = 1 / AveLifeOfCapital {1/Years}
SwitchForWorkerIncome = 1 {Dimensionless}
EffectCapitalRatioInvestment = GRAPH(CorporateCapitalRatio)
(0.00, 0.00), (0.2, 0.05), (0.4, 0.15), (0.6, 0.3), (0.8, 0.58), (1, 1.00), (1.20, 1.36), (1.40, 1.59), (1.60, 1.77), (1.80, 1.91), (2.00, 2.00)
Labor(t) = Labor(t - dt) + (LaborHiringRate - LaborAttritionRate) * dt
INIT Labor = DesiredLabor {People}
LaborHiringRate = LaborAttritionRate * EffectOfLaborRatioOnHiring * EffectOfUnemployment_RateOnHiring {People/Year}
LaborAttritionRate = Labor / AveDurationEmployment {People/Year}
UnemployedLabor(t) = UnemployedLabor(t - dt) + (LaborAttritionRate + LaborGrowthRate - LaborHiringRate) * dt
INIT UnemployedLabor = DesiredLabor * (NormalUnemploymentRate / (1 - NormalUnemploymentRate)) {People}
LaborAttritionRate = Labor / AveDurationEmployment {People/Year}
LaborGrowthRate = LaborForce * FractionalGrowthRateLabor {People/Year}
LaborHiringRate = LaborAttritionRate * EffectOfLaborRatioOnHiring * EffectOfUnemployment_RateOnHiring {People/Year}
AveDurationEmployment = 5 {Years}

DesiredLabor = ElasticityOfLabor * (DesiredProduction/WageRate) {People}
ElasticityOfLabor = 1 - ElasticityOfCapital {Dimensionless}
FractionalGrowthRateLabor = 0 {People/Person/Year}
LaborForce = Labor + UnemployedLabor {People}
LaborRatio = DesiredLabor / Labor {Dimensionless}
NormalUnemploymentRate = .1 {Percent}
UnemploymentRate = UnemployedLabor / LaborForce {Percent}
UnemploymentRatio = UnemploymentRate / NormalUnemploymentRate {Dimensionless}
EffectOfLaborRatioOnHiring = GRAPH(LaborRatio)
(0.00, 0.00), (0.2, 0.06), (0.4, 0.16), (0.6, 0.35), (0.8, 0.64), (1, 1.00), (1.20, 1.42), (1.40, 1.69), (1.60, 1.85), (1.80, 1.95), (2.00, 2.00)
EffectOfUnemployment_RateOnHiring = GRAPH(UnemploymentRatio)
(0.00, 0.00), (0.1, 0.26), (0.2, 0.475), (0.3, 0.635), (0.4, 0.755), (0.5, 0.84), (0.6, 0.9), (0.7, 0.945), (0.8, 0.975), (0.9, 0.99), (1, 1.00)
EffUnemplFracWorkerIncSaved = GRAPH(UnemploymentRatio)
(0.00, 2.00), (0.2, 1.92), (0.4, 1.81), (0.6, 1.62), (0.8, 1.36), (1, 1.00), (1.20, 0.58), (1.40, 0.29), (1.60, 0.13), (1.80, 0.05), (2.00, 0.00)
GovernmentPaymentBalance(t) = GovernmentPaymentBalance(t - dt) + (TaxRevenue - GovernmentSpending) * dt
INIT GovernmentPaymentBalance = (AverageProduction * FractionIncomeTaxed + TotalCapital * CapitalTaxRate) / FractionGovernmentBalanceSpent {Dollars}
TaxRevenue = AverageProduction * FractionIncomeTaxed + TotalCapital * CapitalTaxRate {Dollars/Year}
GovernmentSpending = GovernmentPaymentBalance * FractionGovernmentBalanceSpent {Dollars/Year}
CapitalTaxRate = .04 {Dollars/Dollar/Year}
FractionGovernmentBalanceSpent = 1 * (1 + Step(.1,4)) {Dollars/Dollar/Year}
FractionIncomeTaxed = .1 {Dollars/Dollar/Year}
BacklogRatio = Backlog/DesiredBacklog {Dimensionless}
DesiredBacklog = AverageProduction * DesiredDeliveryDelay {Dollars}
DesiredDeliveryDelay = .5 {Years}
DesiredProduction = AverageProduction * EffBacklogRatioDesiredProduction {Dollars/Year}
NetExports = ((DesiredBacklog - Backlog) / TimeToAdjNetExports) * NetExportSwitch {Dollars/Year}
NetExportSwitch = 0 {Dimensionless}
TimeToAdjNetExports = 4 {Years}
EffBacklogRatioDesiredProduction = GRAPH(BacklogRatio)
(0.00, 0.00), (0.2, 0.06), (0.4, 0.18), (0.6, 0.39), (0.8, 0.68), (1, 1.00), (1.20, 1.33), (1.40, 1.62), (1.60, 1.81), (1.80, 1.94), (2.00, 2.00)
OpportunityCostOfWorkers(t) = OpportunityCostOfWorkers(t - dt) + (ChgOpportunityCostWorkers) * dt
INIT OpportunityCostOfWorkers = NominalNormalWage {Dollars/Person/Year}
ChgOpportunityCostWorkers = (AveWorkerIncome - OpportunityCostOfWorkers) / TimeToAdjOpportunityCost {Dollars/Worker/Year}
WageRate(t) = WageRate(t - dt) + (ChgWageRate) * dt
INIT WageRate = OpportunityCostOfWorkers {Dollars/Worker/Year}
ChgWageRate = (IndicatedWageRate - WageRate) / TimeToAdjWageRate
Worker'sPermanentIncome(t) = Worker'sPermanentIncome(t - dt) + (ChgWorker'sPermIncome) * dt
INIT Worker'sPermanentIncome = GrossWorkerIncome {Dollars/Year}
ChgWorker'sPermIncome = (GrossWorkerIncome-Worker'sPermanentIncome) / TimeToChgWorker'sPermInc
AveWorkerIncome = GrossWorkerIncome / LaborForce {Dollars/Person/Year}
GrossCorporateProfits = GrossProfits - GrossProfitsOfWorkers {Dollars/Year}
GrossProfits = AverageProduction - WagePayments {Dollars/Year}
GrossProfitsOfWorkers = GrossProfits * (WorkerOwnedCapital / TotalCapital) {Dollars/Year}
GrossWorkerIncome = WagePayments + GrossProfitsOfWorkers {Dollars/Year}
IndicatedWageRate = NormalWage * EffUnemployRatioWageRate {Dollars/Worker/Year}
NominalNormalWage = 12 {Dollars/Year/Person}
NormalWage = NominalNormalWage * (EffOpportCostOnNormalWage * SwitchForWageRate + (1 - SwitchForWageRate)) {Dollars/Person/Year}
SwitchForWageRate = 1 {Dimensionless}
TimeToAdjOpportunityCost = 2 {Years}
TimeToAdjWageRate = 2 {Years}
TimeToChgWorker'sPermInc = 2 {Years}

WagePayments = Labor * WageRate {Dollars/Year}
EffOpportCostOnNormalWage = GRAPH(OpportunityCostOfWorkers/NominalNormalWage)
(0.00, 0.6), (0.5, 0.725), (1.00, 1.00), (1.50, 1.52), (2.00, 2.33), (2.50, 3.27), (3.00, 4.05), (3.50, 4.55), (4.00, 4.83), (4.50, 4.95), (5.00, 5.00)
EffUnemployRatioWageRate = GRAPH(UnemploymentRatio)
(0.00, 2.50), (0.2, 2.01), (0.4, 1.66), (0.6, 1.38), (0.8, 1.18), (1, 1.00), (1.20, 0.875), (1.40, 0.8), (1.60, 0.75), (1.80, 0.713), (2.00, 0.7)