Monetary and Fiscal Policy

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Preamble and Sources

The primary text used in this paper is *MacroEconomics: An Integrated Approach*, Auerbach & Kotlikoff, MIT, 2nd ed, 1998, supplemented by other professional literature. The working paper essentially is a summary of the Auerbach and Kotlikoff text and Macro Policy class lecture notes. The outline generally follows graduate level course offerings on Macro Policy.

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Household Decisions - The Life Cycle Model

Macro Policy is currently viewed as an aggregation of decisions occurring at the individual household level. This is quite a change from as recently as 20 years ago, when macro policy primarily involved an aggregate level debate between two conflicting sides – the Monetarists and post-Keynesians.

This paper initially develops a relatively simple, household model, and then builds complexity into the model, culminating in an aggregate model of economic behavior. Note the similarity of the household model developed in this paper and many of the concepts expressed in the general utility working paper, 2007:1. Many of the lifetime consumption equations in the investment context are very similar to concepts in Macro policy. Thus, utility models based on consumption choices under conditions of uncertainty can serve as the basis for both macro-level planning (this paper), and micro-level investment choices (2007:1).

The life cycle model was initially developed by Modigliani and Albert Ando in 1963 with an article entitled "The Life Cycle Hypothesis of Savings: Aggregate Implications and Tests", *American Economic Review* 53. It traces the supply of capital and labor to household savings and work related decisions. The focus is on the supply side behavior of the household (also called agent). The reasoning is that the HH is the ultimate owner and supplier of both labor and capital.

By way of a background, National Investment is the capital accumulated at home or abroad by a country's residents in a given period of time. In the 1980's, US savings rate declined dramatically. This had the effect of limiting growth of the capital stock and subsequent output. Also, US labor growth has been slowing as the number of females in the work force has stabilized, and the boomers have maxed into the labor markets. So, there had been a generational slowing of both labor and capital growth in the US economy.

The critical decision at the HH level is how much to save. The model involves a trade-off between consumption and savings (which is considered to be deferred consumption). What is not consumed in the first period represents the savings at the HH level, and the savings becomes assets at the HH level (and invested capital stock at the aggregate level). Generally, the deferred consumption in the 1st period is then consumed in the 2nd period.

Initial assumptions include:
- Single country model (ie a closed economy model).
- No government, initially.
- The two period life cycle model has HH living in only two time periods.
- Each period is roughly 30 years long.
- Inelastic labor supply, with everyone working 40 hours per week. Wages are set.
- Labor is constant; capital is accumulated until an optimal level.

- Other household decisions include human capital, etc.
- Assume that all HH are identical within each period.
- No population growth.
- Each generation is born with no assets or wealth, and assume no inheritance.
- There are two sets of people: the young from one generation who work from 20 to 50 years of age), and the old in another generation who are retired and/or not working (from 50 to 80 years of age).
- Savings is considered to be deferred consumption. The economy is on-going.
- Only one commodity in the model (say, corn). The commodity is both a consumption good and a capital good.
- The old hire the young to have labor generate the output
- The old give part of the output to the young for wage payment, and keep the rest as capital income.
- The old consume the capital income and the principal, and die penniless. Essentially, the old dissave in the 2nd period.
- Assume no depreciation.

The only decision to make at the HH is how much to save (or dissave for the old).

Cy_t = consumption by the young in time period t.
W_t = wages in time period t.
S = Savings.
a = Assets.

$$Wt = Cy_t - S$$
$$\text{Or, } Wt - Cy_t = S;$$
$$\text{And, } Cy_t = W_t - S$$

where S is the amount of savings in generation t. This then becomes the amount of assets, a, in time period t + 1. So, $S_t = a_{t+1}$. Then, since S from period t = a in period t+1, substituting a_{t+1} for S produces:

$$a_{t+1} = W_t - Cy_t$$

Then, N = the number of people in the model. Further assume N people in each generation and no population growth. Total population in the model is then 2N. K = capital stock; L = labor supply. K_{t+1} is the nation's total capital stock in period t+1. Then:

$$K_{t+1} = N\,(a_{t+1}) = N\,(W_t - Cy_t)$$

This is the amount of total capital aggregated from all old people that saved during their youth. K is basically the savings of all old people added together. Savings can also be expressed as wages after consumption. So, $K_{t+1} = N\,(W_t - Cy_t)$, as stated above.

Now, onto labor. All young people work. They allocate 1 unit of labor inelastically.

$$L_t = N$$

Or, the labor supply in period t is the number of people of any one working generation. Labor is measured in the number of workers, and not the number of hours. Further assume that the labor supply is the same in each period (an easy assumption, since there is no growth in population, by assumption).

Now, back to consumption when old. A decision about how much to consume when young effectively becomes a decision about how much to save when young, and then how much to consume when old. The old age consumption will be:

$$Co_{t+1} = a_{t+1} (1+ r_{t+1})$$

Where Co = consumption of the old; r = the interest rate earned on assets.

The consumption equation of the old merely states that retired people are assumed to consume both their accumulated savings from youth (that becomes their assets when old) plus interest earned on those assets. This consumption function is necessary, due to the above assumption of no inheritance. Over the 30 year retirement period, old people are assumed to dissave down to zero assets, thereby consuming both their assets accumulated and the interest earned on the assets.

This leads to a very important concept, the lifetime budget constraint. We already know that $Cy_t = W_t - S$. Savings in period t is equal to assets in period t+1, so $Cy_t = W_t - a_{t+1}$. Co in t+1 time period is known to be the assets in period t+1 plus the interest earned on those assets. Dropping out a t+1 in both equations leads to:

$$W_t = Cy_t + Co_{t+1} / (1+ r_{t+1})$$

The constraint is that, from a certain wage rate when young, a person can have a certain consumption when young plus a certain consumption when old plus what was saved when young plus what was earned on interest from that savings when old. This equation represents all combinations of consumption when young and old that an individual can have, given a certain wage rate, and interest on savings. This equation generates a sloping line with consumption when young on the x axis and consumption when old on the y axis. The slope is the negative of the savings plus interest. A slope of 1.5 for example means that each extra unit of consumption when young gives up to 1.5 units when old.

A higher interest rate will shift the vertical axis upward (and outward), expanding the available consumption when young and old. A higher wage rate also shifts the axis upward (and outward). But at the HH level, the agents only have control over the choice variables of consumption and savings. Interest rate and wages are set external to the model. The constraint establishes what is feasible to consume and/or save, with any point in the graph on or below the line drawn in the graph above being feasible, and anything beyond the line being infeasible. If consumption is 100% today, then Wt is at the x axis intercept. If 100% savings, the consumer is at the Y axis intercept of Wt plus r t+1. The interest rate determines the slope of the graph. Its trade-off between consumption and savings. The optimal decision occurs anywhere along the graph.

One unit of consumption in time t involves giving up principal and interest in the future. The quantity of consumption goods tomorrow is converted into the present value by:

$$\text{PV of } Co_{t+1} = 1 / (1 + r_{t+1})$$

This takes the future wages and savings back to PV.

The savings decision involves different economic combinations of consumption when young and consumption when old. The utility level (ie happiness) depends upon the amounts consumed when young and old and the preference parameter α, alpha. The more that is consumed, the higher the happiness and the higher the utility. Larger the α , the more important the consumption when young versus when old. Alpha is a parameter set between $0 < \alpha < 1$. Utility is u(x), or just u.

$$u\,(x) = Cy_t^{\alpha}\ Co_{t+1}^{\ 1-\alpha}$$

Thus, utility increases as either Cy_t or Co_{t+1} increases. A person would like to maximize consumption in both period t and period t+1, but this cannot be done due to the budget constraint. If alpha was zero, then the person would not care at all about current consumption. If α was 100%, then the person only cares about current consumption. α, and $1 - \alpha$ then represents that part of a person's consumption pattern in period t and period t+1. Equal weighting between Cy_t and Co would make alpha = 0.5.

Consumption when young is that fraction α of lifetime labor income W_t. Then savings in period t becomes the assets in period t+1.

Indifference curves share all the combination of two commodities having the same utility. The curves are derived from the above utility equation.

The marginal rate of substitution is that rate at which an individual is willing to consume when young and old. For example, at a MRS of –1.5, the person is giving up 1.5 units of Co for every 1 unit of Cy_t, and this would have the same utility or indifference. The person can have a utility maximization by choosing the consumption level with the highest utility with the budget constraint. The intercept between the lifetime budget constraint and the indifference curve is the utility maximization.

The intercept point is the maximum utility affordable for any given budget constraint. It also determines the 1st period savings which is the difference between the wage income and Cy_t, with $S_t = W_t - Cy_t$. Mathematically, the solution between the budget constraint and the utility function involves the following two decision rules.

$$Cy_t = \alpha\ W_t$$

$$Co_{t+1} = (1- \alpha)\,(W_t)\,(1+r_{t+1})$$

The decision to consume and save is made by optimizing the indifference curve within the budgetary constraint. These two decision rules dictate the optimal point, with savings, $S = \alpha\, W_t$ (which is also equal to $W_t - Cy_t$, of course).

An important point to consider is the concept of consumption smoothing. The agent cares equally about today and tomorrow, and the model implies that consumption will hold steady over the life of the agent. If $\alpha = 0.50$ (meaning equal weighting between the two periods), and $r = 0$, with the economy not producing anything more tomorrow than today, then the following will be true:

$$Cy = 0.5\ w \text{ and } Co = 0.5\ w$$

By implication, a person smoothes consumption into a fractional share of income between the two periods. Income is w in period t, but is zero in period t+1, while the consumption preference is equal weighting between the two periods. 100% of the income in period t is thereby taken in equal components of consumption across period t and period t+1.

At the aggregate level, national savings = national investment. The real assets of individuals is available to firms as additional capital and investment. Where Y = aggregate output, and the general consumption equation is $Y = S - C$ at the national level:

$$Sy = Y_t - N\ Cy_t - N\ Co_t$$

The equation also could be stated as: $Y = S - N\ Cy_t - N\ Co_t$.

Where K_t = the capital stock in time period t, the output equation could also be stated as:

$$Y_t = N\ w_t - r_t\ K_t$$

This equation states that aggregate output is the summation of the efforts of both capital and labor, with the wage payments to workers multiplied by the number of workers being the labor output in time period t, and the income earned from the capital stock at the applicable interest rate being the capital component.

Using the US as a case study, since the 1980's, there has been a significant decline in national savings and investment. National investment = Domestic investment plus the net foreign investment. In recent years, the net foreign investment has been negative, meaning that foreign investing in the US has been greater than US investing in foreign nations. Lower national savings may come from either lower net foreign investment or lower domestic investment. Domestic S and I may roughly move with each other, but can diverge when there is a change in foreign investment. When the net foreign

Investment is negative, foreigners are responsible for financing some of the capital stock in the US.

An interesting ratio at the national level is the capital to labor ratio, or K / L. We have assumed a ratio of 1.0 in some of the analysis. As the age of the old population increases (which it is doing currently), the K / L ratio increases because there is greater savings and accumulated assets when old. In the case study of the US, the K /L ratio has increased 30% due to demographic changes alone.

In summation of the life cycle model, in its most general form, the life cycle theory simply asserts that HH makes sequential decisions to achieve a coherent and stable goal using the available information the best they can. The framework rules out rule of thumb behavior in which the HH spends some designated fraction of their income (ala Keynes). It also rules out psychological behavioral explanations.

Key implications of the life cycle model are that 1) consumption is smoothed over the life cycle; and 2) the path of consumption expenditure should be independent of the income path within any one year. Critics of the model suggest that there are failures on consumer smoothing.

As supplements to the main text, Martin Browning and Thomas Crossley presented a defense of the life cycle theory in the *Journal of Economic Perspective*, Summer 2001, "The Life Cycle Model of Consumption and Saving".

Main points of the paper include:

1) It makes sense intuitively.
2) the model has a long tradition.
3) the general framework is acceptable to many economists.
4) The article believes that rejection based on an anomaly should not be taken so lightly. Violations of the model are small in nature, and occur when stakes are low. Where the economic stakes are high, the model is followed. One could therefore calculate the "welfare costs" of adopting a consumption plan different than the life cycle model.
5) The model provides a framework for inter-temporal allocation at all frequencies. The essay concentrates on consumption smoothing at different frequencies to determine whether there is consumption smoothing. The income could be smooth while consumption varies or the income could be variable while Consumption is smooth. The data suggests that consumption pattern is smoothed even though income is pretty bumpy.
6) The article also studies business cycle issues that are involved with the data. The data suggests that consumption and savings are synchronized to the business cycle, with consumption increasing during good times. The fact that consumption varies across a business cycle may be inconsistent with the theory. The business cycle discrepancy may be explained by the following: there may be some shock to consumption correlating to income in a business cycle, and that is to be expected to occur in the

ST. There should be no surprise due to a temporary external shock from economic conditions. The data is only picking up consumption reactions to external variables changing, and should not be interpreted otherwise. That still does not negate consumption smoothing over the entire life cycle, however.

7) The model also predicts that borrowing prior to labor market entry can and should occur, with accumulation of savings during the work life, followed by dissavings in retirement. The data however appears to have consumption fall during retirement, and this indicates some consumption correlation to a fall in income. The data from the article suggests that consumption initially increases as income increases, but then falls when income is reduced in retirement. *(KCK Note: This increase in consumption in the work years followed by a moderate fall in consumption in retirement has also been shown in the investment context by Campbell and Viceira (2002), using a general equilibrium dynamic utility model).*

A study done by Parker (1989) of SS maximum caps on taxes shows that expenditures go up in the fall of each year after more income is available on a net basis (but SSA payments are only 7% of income, nationally). The study would tend to contradict the smoothing of consumption.

Hsich (2000) examined a permanent fund in Alaska giving out annual payments. Expenditures were no higher in the fall, even though the payment was 2/3 of one-month salary. That conclusion supports the model as to consumption smoothing.

Browning and Callato studied a program in Spain with double payments in two of 12 months for some workers. The finding was that there was no effect on consumption through the year.

Firm Production – Inputs, Outputs, and Growth

Output at the firm level depends on two inputs, labor and capital, and also depends on the efficiency of their use. Capital is the accumulated factor and this is called the capital treasury. At equilibrium, the model ends up with just the right amount of capital for the labor employed.

The hallmark of the modern industrial economy is growth over time. US GDP is three times larger in 1993 as it was in 1929. The growth pattern is the dominant characteristic of a modern economy. This was not the case in pre-industrial economies, however. Economic growth was probably 0% between 1500 and 1750, according to one study done by Angus Maddison. Growth was 0.2% annualized between 1750 to 1829, and was 1.6% annualized compounded between 1820 and 2000 (which is the period of time of the industrial revolution).

The big question in macro theory is: What determines growth? The current focus is on micro activities at the firm level, the business cycle, and variations off of growth. Then, the question becomes: how can we design policies to encourage growth?

Looking at the micro firm level, we first assume perfect competition; the same products; the same technology; the existence of numerous firms; and all of which are price takers, having competitive price at both the output and input levels. The Cobb Douglas Production Function is as follows:

$$Y = A\, K^{\beta}\, L^{1-\beta}$$

Where Y = aggregate output (also referred to as national income at the aggregate level); A is the level of multi-factor productivity (which is the ability of K & L to produce Y); β is beta and is a "capital share" parameter of the production function. The labor and capital in the equation are also at the aggregate level.

Properties of the equation include the following.

- First, the capital share of national income is constant in the data. "Capital share" is that portion of output going back to the owners of capital. The capital share of US GDP has been very close to 30% over time, suggesting that the beta parameter should be set at .30 in most practical applications. Then, the share paid to labor is 1 – beta, of course.

- Second, the equation exhibits a constant return to scale – for every doubling of both inputs, the output doubles. A hot topic in the 80's and 90's was whether there was an increasing return to scale.

- Third, the equation also exhibits a diminishing return of each input. By varying one input factor constant and holding everything else constant, output exhibits a diminishing return as to the increase in output. To materially increase output then, one must adjust both K and L at the same time.

Capital can be measured by a wide variety of means. The capital stock is in real terms, and is net of depreciation.

$$K_{t+1} = K_t + I_t - D_t$$
$$\text{Net } I = \Delta K = I - D$$

Where I is the new purchase of investment in period t, and D is the depreciation of capital stock, K. (A defined pointed in time is a "stock" type of variable while quantity between time periods are "flow" types of variables).

Labor can be measured by taking the number of potential workers, N. The hours worked = population * employment / population * hours / employment.

Multifactor productivity has increased by 70% since 1950. Productivity, A, measures the efficiency of by which labor and capital generate output. As the number of units produced increases, the average cost of production falls. Small changes in productivity thus can generate a large change in the output because productivity exhibits a multiplier-like effect. Productivity has two principal types: Embodied productivity increases the quality of L and K, whereas disembodied productivity increases includes better industrial productivity processes.

With the Cobb Douglas production function, increases in Y reflect either a growth in inputs (K and L) or improvements in productivity (A), or both. Growth rates for K, L, and A can be generated from the available data or imputed. The growth rate in output is equal to the sum of the rate of productivity change, and the rate of change for K and L.

$$\Delta Y / Y = \Delta A / A + \beta \Delta K / K + (1-\beta) \Delta L / L$$

Productivity, A, reflects the various factors, and is usually imputed from the data once the other factors are known for Y, K, and L. This is known as the Solow residual, and is the rate of technological progress. What is left over after Y, K, and L are determined must be the rate of productivity. In terms of the math, Solow took the logs of the equation, and then generated the rates of growth of the variables. Subtracting the log of time period t from the log of period t – 1, produces the rate of growth. The above equation can be shortened down to the following:

$$\Delta Y_t \cong \Delta At + \beta \Delta K_t + (1 - \beta) \Delta L_t$$

Solving for the productivity rate, by implication, just involves the rearranging of the above equation, generating the following:

$$\Delta At \cong \Delta Y_t - \beta \Delta K_t - (1 - \beta) \Delta L_t$$

Today, this is considered to be "growth accounting". In the above equation, beta is the fractional share of the economy that is attributable to either capital or labor. Thus, beta lies between 0 and 1. The limits of beta are: $0 < \beta < 1$. National income increases can therefore come from either an increase in labor, capital, or productivity. An increase in National Income can result simply from an increase in population in the economy, for instance. Using the US as a case study, the average rate of growth of output has been 3%. The rate of growth in capital has been 2%. Labor growth has been 1%. We already know from prior chapters that the capital share is 30%, or .30. Solving for multifactor productivity, A, produces an estimated or implied productivity rate of 1.7%. This is very close to Angus Maddison's 1.6% annualized GDP growth using historical data over the last 180 years.

Labor productivity is the amount of Y produced for each given unit of labor that is produced.

$$Y_t / L_t = (A K^{\beta} L^{1-\beta}) / L = At (K_t / L_t)^{\beta}$$

The per capita Y = A K^{β} per capita. Output per unit of labor is therefore dependent upon the capital to labor ratio, Kt / Lt, the multifactor productivity estimate, and the capital share, beta. The K / L is the ratio of capital needed per unit of labor, which is normally expressed as worker "unit" or per worker hour. Labor will increase efficiency if it has more capital, K, to work with. So, as the K / L increases, the Y / L ratio also increases. Additionally, labor is affected much more than capital by a change in productivity, A. This is because of beta being much greater for labor than it is for capital. With a capital share of only 30%, that means that labor is impacted by (or impacts) multifactor productivity to a much greater degree (of 70%).

Labor productivity is closely related to marginal product concepts. Labor is increased one unit while K and A are held constant. The marginal product of Labor then is:

$$\text{MP of L} = (1-\beta)\, Y$$

So, workers pay should be closely related to worker productivity. The US data suggests that it is in fact related. As the Y / hr increases, the real pay per hour has also been increasing over the years.

Labor productivity slowdowns have been occurring recently. As labor productivity growth has slowed, US output growth has also slowed. The labor productivity growth slowdown has contributed to a slower growth in pay per hour since 1973. About 3 /4 of the decline in labor productivity growth can be traced to a lower capital growth per worker. This in turn may be due to the continual pattern of moving to a service economy where there is less capital used per unit of labor than in industrial areas.

The US economy has experienced a "capital deepening". The capital stock is growing but the growth rate has slowed relative to employment growth. Net investment has therefore lagged. This may be due to any or all of the following: the net investment rate of growth decreasing because of a lowering of the rate of savings; a failure of fiscal policy to encourage savings and investment; and to a lack of savings behavior in the young. Between 1969 to 1989, the US growth rate has slowed to 1.76%, while other countries (such as Japan) has had much larger growth rates (Japan has been at 4.09%). *(KCK Note: Instead of a capital deepening, perhaps we should be thinking of a "capital maturing", with some measures of convergence occurring among the larger industrial nations. It also may show a RTM on an historical basis, with the LT growth rate at maturity of an industrial economy being close to 1.7%).*

A change in the production mix has also occurred, and technological changes has dramatically increased labor productivity as compared with capital productivity, while a shift away from industry to services has had the opposite effect.

A change in the quality of inputs has also been noted. The US labor force has been changing in recent years as women have entered the work force in large numbers. The labor force has also brought in a number of inexperienced workers with a slowdown in educational levels. This all leads to a labor productivity rate slowdown.

Declining R & D may be a major cause of labor productivity growth slowdowns. Government regulations on health, safety, and the environment may have also contributed to slowdowns in the growth rate of capital or labor.

25% of the post 1973 slowdown in labor productivity may be due to a slower growth of capital relative to labor. The rest is due to multiple factors. Slower growth in the quality of capital may be 33% of the slowdown. 33% may also be attributable to the change in productivity mix resulting in a labor productivity slowdown. The rest however is not easy to explain.

As to international activity, per capita output is growing at a higher rate in almost all advanced countries than it is in the US. This may be resulting from other countries experiencing a more rapid technological change. The gap between the rich and poor is interesting. Developing countries may be able to approach high standards of living of the developed countries, but the rate of growth may be very slow in the poorest countries. 67 nations show strong evidence of convergence. Self propelled national growth is called an endogenous growth model.

<u>As a supplemental reading,</u> Parente and Prescott analyzed data without the use of statistical regression analysis in "Changes in the Wealth of Nations". The findings of the paper are:

1) A great wealth disparity exists between nations over the 25 year time period. The range of wealth distribution is wide between nations.
2) The disparity is constant over the study period, and this disparity has not increased during the study period.
3) Wealth distribution has shifted upward for all countries, both rich and poor. So, the rich got richer, and the poor got richer.

4) There have been both miracles and disasters. There has been some mobility in the rankings, indicating that there has been no poverty trap.

General Equilibrium

The economic behavior of households can be compared with firm theory to produce a general equilibrium between the two. Firms want to maximize profits while HH want to optimize the consumption-savings trade-off. We assume no uncertainty, so that we expect a certain interest rate and wage rate. The interest rate that will clear and balance all markets is the rate that is expected. Expectations are important, but are implied by the equations.

A general equilibrium is a situation in which supply = demand in all markets simultaneously. Such an equilibrium has the following characteristics:

- It has an existence. Any pricing that will clear all markets simultaneously is what is expected and built into the model.

- It is unique. There could be more than one equilibrium point with some conditions, but otherwise, there is one point of equilibrium.

- It has stability. That's why it is known as an equilibrium.

The goal is to develop a complete model of economic growth. Simplifying assumptions are made, which are:

- lots of perfectly competitive firms that are price takers.

- Input prices are also competitively arrived at, which price taking activity.

- Capital structure of the firm is that either the elderly purchase equity or the elderly provide the capital. The financing decision has no impact (instructor cites to the M&M study).

- The human capital structure is that no OTJ training is necessary, no search process or frictional unemployment, no life cycle productivity.

The firms try to maximize profit by using just the right amount of labor and capital that optimizes output at a maximum profit. Firms do so through the following marginal product equations.

$$\pi = Y - r K - w L$$

In plain language, a "pure" economic type of profit corresponds to total revenues less the total capital costs and the total labor costs. The costs of capital comes from the capital stock multiplied by the interest rate, while the labor costs are the wages in time period t multiplied by the number of workers. Remember, the assumption that actions in the markets do not affect the wage rates or interest rates. Firms have no control over these two items, so they try to maximize revenues and minimize labor costs and capital costs to maximize their profits.

Economic Profit can be defined as revenues – costs. A change in revenue = the extra output caused by a change of 1 unit of the inputs, that being either/or both labor or capital. The marginal cost of capital = r, while the margin cost of labor = w. At profit max, the marginal product of capital = marginal cost of capital = r, while the marginal product of labor = marginal cost of labor = w. This is summarized by the following, which is a first derivative of the capital production and labor production.

$$\text{Marg. Prdt of K} = \beta\, Y / K = r$$

Rearranging the variables leads to: $rt = \beta\, At\, Kt^{\beta - 1}$

$$\text{Marg. Prdt of L} = (1 - \beta)\, Y / L = w$$

Rearranging the variables leads to: $wt = (1 - \beta)\, At\, Kt^{b}$

Thus, the marginal cost of capital (i.e. the last extra amount of capital added to production) is the rate of interest on the capital stock. Marginal production of capital keeps occurring until the marginal product = the marginal cost of capital (i.e., the interest rate). On the question of hiring another worker, if the marginal product of labor is greater than the wages of the workers, then it would be profitable to go ahead and hire another worker. Conversely, no new labor production would occur if the marginal cost of labor were higher than the product. So, labor production would occur until the marginal product of labor = the Mc of labor (i.e. the wages).

Therefore, under perfect competitive conditions, pure profit = zero. *(KCK note: This is an economic profit of zero. The firm will still be making a nominal profit at this level, but just without any excess returns. The return will be equal to its costs of capital and costs of labor).* This is because of free entry and exit assumptions and perfect competitive assumptions in the model. As the capital stock increases in response to pure profits being generated, the interest rates will go down because the supply of capital increases. But, as the capital increases, wage rates and total wages will go up due to greater demand for labor. More labor is added until the Mc of labor = the MP of Labor. At this point, the markets are in equilibrium, and economic profit will be zero.

<u>The Transition Equations.</u> By taking the capital stock in period t+1, and then equating everything to it, the equations will balance at equilibrium.

$$k_{t+1} = a_{t+1}$$

This was already established from Savings of the young in the first period becomes the assets of the old in period t+1, or $S_t = a_{t+1}$. Then the assets in t+1 become the capital stock for investment purposes in period t+1. Then, $a_{t+1} = (1 - \alpha)\, w_t$, and substituting for a t+1 generates the following equation.

$$k\ t+1 = (1 - \alpha)\ w_t$$

This comes from the decision problem of the household. The equation merely states that the assets in t+1 = Savings in period t (where the savings is the part of the wages in period t that is not consumed), and that the capital stock in t+1 = the assets in t+1. Then, with regard to wt, the wages in period t = the marginal product of labor in period t (this is from the above discussion on marginal production equations), with:

$$w_t = (1 - \beta\ )\ Y / L.$$

Substituting the Cobb-Douglas production function for aggregate output Y, produces:

$$w_t = (1 - \beta)\ (A\ K^{\beta}\ L^{1-\beta}) / L.$$

Rearranging all the exponentials will result in:

$$w_t = (1 - \beta)\ A\ (K / L)^{\beta}.$$

K / L can be shortened to k, which then equals $(1 - \beta)\ A\ k^{\beta.}$ By substituting for w_t, the next equation ensues.

$$k_{t+1} = (1 - \alpha)\ (1 - \beta)\ A\ k^{\beta}$$

This comes from the profit maximization problem of the firms. Then, if the multi-factor productivity were to be set at some constant where:

$$A_t = A$$

Then, the following equation will describe the evolution of the economy, for any given capital to labor ratio, K / L. The following is known as the transition equation because it relates the K / L ratio of two successive time periods. The transition equation tells us how the K / L ratio changes from one period to the next.

$$k_{t+1} = (1 - \alpha)\ (1 - \beta)\ At\ k_t^{\beta}$$

With Lt = N, whereby every household provides one unit of labor at any one time, and the total amount of labor is equal to the population in period t. Now, if the capital to labor ratio is set at some initial level so that:

$$K / L = k_o$$

At time period o, the ko is the total assets of the elderly to total labor supply, or K / L. Once the K / L ratio is known in each time period, the absolute amount of K in the economy for each time period can be ascertained by simply multiplying (K / L) * N. Then the time paths of all variables in the equations can be determined, and the calculations on each variable can be extended until growth is at zero, and the model is at LR equilibrium. A sample calculation and table of a hypothetical variable-set is included in the main Auerbach text.

(The graph referenced in the text is not included). The 45 degree line represents $k_{t+1} = k_{t.}$ The curved line represents the change of $K_{t+1} / L_{t+1} / K_t / L_t$, and basically is the capital to labor ratio in time period t+1 and compared with the capital to labor ratio in time period t. The first couple of steps will experience the greatest rate of change, and therefore the rate of change in consecutive time periods is sketched out as a curve. The larger the beta coefficient, the less the concave of the curve, and the straight will be the line (and closer to the 45 degree angle). Each step on the graph takes 30 years (because of the two time period assumption). k bar is the steady state of the system. If the initial value of the capital stock is less than the capital stock at equilibrium (i.e. if ko < k bar), then the system moves toward the general equilibrium that exists at k bar. If the initial amount of capital is too much (i.e. if ko > k bar), then capital is gradually reduced until the system comes into equilibrium at k bar.

Wages and interest rates are critically dependent upon the capital to labor ratio. Because these two variables represent the marginal products of labor and of capital, respectively, wt can be sketched out as a concave curve of a positive slope, wt on the Y axis, and k on the X axis (the book has nice graphs of both the marginal product of labor and capital). r_t is a convex curve with a negative slope, rt on the Y axis and k again being on the X axis. As the capital to labor ratio increases, wt will increase but at a declining marginal rate, and rt will decrease at an increasing marginal rate. The converse is therefore also true – as k decreases, wages will decrease and interest rates will increase.

<u>Growth of the Economy.</u> Several examples and hypotheticals will demonstrate some of the reasons for economic growth.

One case study is for the post WWII environment, where ko < k bar. The initial level of ko would be significantly reduced from the equilibrium amount due to the capital stock being obliterated in Germany and Japan, especially as compared with the US. So, the initial K / L ratio would be lower in the two losing countries. The US GDP output would be much higher initially, and would continue to remain so throughout the post WWI period. But the US would be closer to the equilibrium point with its ko. Thus growth rates would be slow, as well as zero net savings (due to a lack of capital build-up). In losing countries, the K / L would be lower, and thus the succeeding growth rates would be much higher than in the US while they catch up to the equilibrium point. Interest rates would go down as time moves on (due to the increasing availability and supply of capital), and there would be a net savings as the net for investment and capital stock would increase.

Another case study: the black plagues of the middle ages. This would be the reverse scenario to post WWII. Capital remained constant, but labor was greatly reduced. Thus, the K / L ratio was greater at ko than the equilibrium point, k bar. On the graph, ko would be > k bar. At ko, wages would be much higher than at k bar because of the increase in demand for labor, and interest rates would be lower than at k bar because of the lowered comparative demand for capital relative to labor. Wages and interest rates would gradually return to their original levels as the capital to labor ratio ultimately returns to k bar and an equilibrium.

So, following an external shock to a nation's capital base, the economy will grow corresponding with an increase in the accumulation of capital stock. With labor assumed to be fixed, the K / L will increase. This process of capital deepening increases the marginal product of L and thereby increasing the wage rate, w. It also will lower the marginal product of K, thereby lowering the interest rates, r. So wages go up, and interest rates go down as the capital stock of the nation increases from extra savings and investment. In the model, most of the growth occurs in the first two stages, and thus the reason for the curve in the graph. The convergence to equilibrium is quick, in terms of the time periods: only two periods are required before most of the movement towards equilibrium occurs. However, with every step being 30 years in the model, movement in terms of the number of years is rather slow: two steps equates to 60 years. For a post WW II environment then, it would take until 2005 before most of the aftershocks of capital stock depletion wears out, and growth rates in the losing countries slow to that of the winning country.

The output will converge through time to a fixed value at equilibrium. The growth of the model slows and then stops. Therefore, growth itself should be considered to be a transitional and temporary aspect of the economy. By limiting both L and A (technology), most of the variables that can induce growth will have been eliminated from the model, and the only other source of output growth will come from increases in the capital stock from a ko to a k bar steady state. Once k bar occurs, even the capital stock will quit growing. Thus, the LR position of an economy is steady state zero growth, absent population growth, technological changes, and/or an external shock to the capital stock (from a war, for instance). After an initial shock to the capital (as with a war), or to the population (as with the plague), the capital and labor supplies will both adjust and the economy will grow until such time as equilibrium is achieved. At that time, no more growth of the economy will occur. In practical terms, a mature economy will typically increase by the rate of population growth rate, since over the LT, everything else nets out to an equilibrium point.

We can use the steady state k bar to calculate the steady state value of all other variables in the model. One inescapable conclusion is that at steady state, net national investment = 0 because net S = 0. The young generation's savings will be completely offset by the older generation's dis-savings. At steady state, r K = w N, and no savings occur. As the wages increase and the interest rates decrease, the lifetime budget constraint rises upward, resulting in an intercept with a higher indifference curve.

Now, let's assume an increase in the propensity to consume in subsequent time periods (each generation has a greater desire to consume versus save. This is represented by an increase in alpha, α). This has the effect of forcing or rotating the curve outward and downward. Ko will be thrown above k bar, and the K / L ratio will contract until K / L = k bar once again.

Now, let's adjust for population and technological changes. As the population increases and the assumption of no growth in N is relaxed in the model, the number of N increases, resulting in an increase in Lt. The absolute amount of savings also increases (back to assumption an unchanging propensity to consume of alpha, α) since S increases from simply from an increase in N, the population. Since S increases in period t, that will also increase the amount of assets in the next period, a t+1, and that also represents an increase in the amount of available capital stock in the next period. So K t+1 increases. Therefore, the rate of change of L and K will be the same, resulting in a constant K / L ratio. All other variables relying on the K / L ratio, such as w, r, and per person output will also remain constant, while the aggregate variables, such as Y, K, N, will all increase at the same rate of growth as the general population growth rate.

As to technological changes (and holding population constant for a moment), the multifactor productivity, A, will increase with an increase in technological levels. This produces an increase in wages since labor is more efficient in its output for any given level of L (or, since the marginal product of L = w, as the marginal product increases, w will increase too). As w increases, the absolute amount of K will increase because with higher wages (and the same rate of consumption, alpha), more absolute savings will occur in period t. That generates a higher amount of assets in t+1, and capital stock in t+1. So, the K / L ratio in t+1 will increase. If the rate of change of technology is constant, the economy will grow and converge to a steady state (?) featuring an increasing wage and growth at a constant rate. Both the aggregate variables and the per capita variables will grow at a constant rate, and the living standards will increase through time.

With both technological change and population growth occurring at the same time, the economy will reflect the combination of effects with aggregate growth occurring at the sum of the rates of growth of population and technology. *(KCK: this analysis confirms the equation in the previous comments where the $\Delta Y \simeq \Delta A + \beta \Delta K + (1 - \beta) \Delta L$).* Economists refer to this as endogenous growth, in which the LR rate of growth is determined by economic decisions made the individual HH and firm level. New research suggests that the technological change is endogenous to and is caused by and is produced by micro-economic decisions such as the R&D investment levels of a business, and the child schooling investment decisions made by a HH. Such growth studies predict a LR constant rate of technological growth. The process producing the technological change does not peter out over time. The endogenous growth provides an economic explanation for changes in technology, A.

<u>Remarks / summary.</u> The following is a general summary of the model at general equilibrium.

1. Existence. The model has a steady state at K bar, with K bar being:

$$K\ bar = [\ (1 - \alpha)\ (1 - \beta)\ A\ ]^{1 / (1 - \beta)}$$

2. Uniqueness. There is normally one point of steady state where there is enough capital stock to balance the system. The origin point in the graph at zero could be thought of another steady state, however, but then no production would occur at all. The system could also have 2 steady states. This might occur if there were poverty traps. The curved line in the graph would be pushed outward and downward so that curve would intersect the X axis at some point greater than zero. The curve would then intersect the diagonal line at two points along the way, with one being at a reduced level of capital, and the other point being at a heightened level of capital.

3. Stability. The system wants to move towards K bar and a general balance and equilibrium.

4. Growth. The system will want to grow along the transition path where Ko < K bar. Seen in this manner, growth is a transition phenomenon. The graph would also explain the varying growth rates among the different countries. The post WWII economic activity is a great example of different levels of the initial capital stock for each nation. Japan grew a lot in their rebuilding program, while Germany also grew fast, but not quite so fast. Growth in the US was much slower due to the maturity of the economy and the fact that no part of the economy or the cities had to be rebuilt. So, on the graph, Ko for the US would have been closer to K bar to begin with, while Ko for Germany was farther away from K bar, and Japan's Ko would have been very far to the left of K bar.

5. No Growth. Once the system is at equilibrium, there will be no growth since the system is in balance, and there will be no economic reasons to move away from that balance. The reason why certain economies grow is because of a transition state from one technological path to another. *(KCK Note: At equilibrium then, growth would only occur if the population was growing and/or technology would be increasing. Growth of the economy would be related more to demographics and technological shifts than anything else. If the population quits growing or technological changes flatten out, the growth rate of the economy will slow).* The higher the K / L ratio, the higher the productivity of labor, and the higher the wages. This is because the marginal unit of labor can generate more output if the K / L ratio were higher. Poorer countries will therefore tend to grow more quickly, while the richer countries will be closer to steady state and will grow more slowly (as evidenced by the US growth rate in post WWII).

<u>As a reading supplement,</u> Lant Pritchett wrote in the *Journal of Economic Perspectives*, Summer 1997, Vo. 11, #3, p.3-17, "Divergence, Big Time". Pritchett's believed that world income distribution is diverging. From 1870 to 1990, the ratio of per capita income in the poorest countries and richest countries increased by a factor of 5. This would be in contradiction to Parente and Prescott's conclusion #2 that the world's wealth distribution was roughly constant in 1960 to 1985. Pritchett critiques the convergence findings of others. He feels the basic problem is one of sample selection. Economists

will use whatever is the available data, and normally only the wealthiest countries will keep extensive economic information.

Table I of Pritchett shows is illustrative of the point. It shows the 1870-1989 period with per capita GDP growth rate of the 16 high income countries with pricing parity figured in. In 1870, the richest country, according to Pritchett was Australia (!). In 1870, the poorest was Japan. There was a 5 times difference between the poorest and richest nations in 1870. The richest countries had the slowest growth rates from 1870 to 1989. The poorest countries in 1879 had much faster growth rates. This shows that the theory is exactly right and that per capita income is converging. There is strong evidence of convergence, but the growth rates between countries are very narrow.

Pritchett then argues that using such data virtually guarantees a finding of convergence. Either a rich country today was rich in the past, or it was poor in the past, it became rich, and then had available data. So, it appears to be converging.

Pritchett says this is a case of sampling bias. We are systematically excluding countries that might violate the hypothesis. We do not have data on the poorest countries, only on the richer countries. The solution therefore calls for the creation of data for the lower boundaries for the poor countries in 1870. There are three ways to do it.

- First, take the lowest measured per capita income, in any place for any one time period. Ethiopia 1961-1965 had a price parity income of $275, or less than $1 per day. Such a low level of income may be unrealistic for the base. This type of calculation would virtually guarantee the other extreme – that of divergence.

- Second, calculate subsistence income for each time period. This is the technique that Pritchett uses.

- Third, The poor countries had high infant mortality. It was too high to support the population trends.

Pritchett's main finding is one of divergence. The rich countries, such as the USA, just kept getting richer, while the poor counties such as Chad and Ethiopia, just stayed at or near subsistence levels throughout the study period. The ratio of poor to rich in 1870 was 8.7:1, while the ratio by 1989 was 45:1. The average rich to poor ratio also increased over the study period, from 2.4:1 in 1870, to 4.2 in 1960, to 4.5 in 1989. So, large amounts of divergence exist. Further, USA's per capita income increased four times during the study period.

Pritchett notes a study done by Maddison in 1995 on the 16 industrialized countries and 28 less developed nations. The growth rates of the countries in that study showed higher growth rates in the 16 developed nations than the 28 poorer nations. Pritchett also notes that some researchers currently feel that there was almost no gap between non-developed nations and the developed countries as late as 1800.

Pritchett concludes by finding that some countries are catching up with explosive growth, while other countries have had economic meltdowns, and still other countries are continuing to have slower growth than the richest nations. He states that the 16 developed nations show convergence within a narrow range of growth. But, the growth rates between developed nations and less-developed countries show considerable divergence and with varying rates ranging between explosive expansion to implosive decline.

A caveat is appropriate at this point. This study is essentially using a one country, one observation rule. But 50% of the world's population is in only two countries – China and India. The conclusions may be different per population group rather than per country.

Welfare Costs, and The Business Cycle – Selected Articles. Two articles present important concepts and countervailing views regarding the importance of the business cycle.

Robert E. Lewis, Jr., presented a 1987 paper / lecture series entitled "Models of Business Cycles". Lucas was awarded the Nobel prize in 1995. The main finding was that the welfare costs of the business cycle are very small and the preference for growth is very strong. The question becomes the following: how do policies induce different consumption sequences for each agent in the economy? The welfare, or lifetime utility, of the people in the economy is the key concern.

HH will consume goods at date t along a utility function β U. Beta is a discount factor and is between zero and 1. So, $0 < \beta < 1$, while $\sigma > 0$, and is a constant coefficient of risk aversion. The utility equation is:

$$E [\ \Sigma\ \beta\,(1/(1 - \sigma))\,(ct^{1-\sigma} - 1)\ ]$$

Instead of a 2 period model, Lucas uses an infinite horizon model. HH will consume goods at date t along a utility function β U. Beta is a discount factor and is between zero and 1. So, $0 < \beta < 1$, while $\sigma > 0$, and is a constant coefficient of risk aversion. The utility equation is:

$$E [\ \Sigma\ \beta^{t}\ U(C\ t)\ ]$$

And

$$E [\ \Sigma\ \beta\,(1/(1 - \sigma))\,(ct^{1-\sigma} - 1)\ ]$$

Which is also

$$Et\ U(C) + Et\ \beta\ U(C1) + Et\ \beta^{2}\ U(C2) + \ldots\ldots\ldots$$

Today + period t + period t+1 …………

In plain language, the expected value operator, Et, has a randomness component. The total expected value of the consumer's preferences are the sum of all periods of time where the consumer makes preferences known in each time period with a discount of beta, B, for each future period. U is the utility function. You simply sum the consumption fro each time period, giving a heavier discount to the future periods. Each period ids time separable, and is not dependent upon each of the periods. Function U is applied to each period separately. The more the consumption, the more utility (but at a diminishing rate). The greater the concave nature of the marginal utility curve, the greater the risk aversion. The consumption is actually random and fluctuating in nature. But the consumption will have a mean value. The consumption across time periods is also referred to as a consumption stream.

If we let $U(C) = (C^{1-\sigma} / (1 - \sigma)) - 1$, sigma, σ, is the coefficient of relative risk aversion. The curve will be more concave for $\sigma > 1$, and less concave for $\sigma < 1$; and where $\sigma = 1$, then the curve is the log c. Sigma, σ, is the coefficient of relative risk aversion. In each period, c is a random draw from a distribution having a mean and a variance.

The consumption preference is the sum of all periods of time where the consumer makes preferences known in each time period with a discount of beta, B, for each future period. In the USA, the total consumption growth rate is 3%, so mu, or μ, = .03. The next equation provides for lambda, λ, providing consumption for parameters μ and σ^2.

$$C = (1 + \lambda)(1 + \mu)^t$$

Given any choice of parameters, we could calculate an indirect utility function. To evaluate changes in the growth rate, μ, the $f(\mu, \mu_o)$ is the percentage change in consumption uniform across all dates and value of shocks that are required to leave the consumer indifferent between growth rate μ and μ_o. This is done in the following equation:

$$f(\mu, \mu_o) = ((1+\mu_o) / (1 + \mu)^{\beta/(1-\beta)} - 1$$

The above equation represents the welfare costs of reduced growth. Beta is .95, and the base growth rate of $\mu_o = 0.03$. Consumers would require a 20% across the board consumption increase to accept voluntarily a reduction in the consumption growth rate from 3% to 2%. They would also surrender 42% across the board consumption to obtain an increase in the growth rate from 3% to 6%. *(KCK Note: these are huge preferences).* Thus, the welfare costs or welfare effects of growth changes are very large. The growth rate changes are meant to represent permanent changes, and not transitory changes. One of the reasons that the welfare costs of a growth rate change is so large is due to the compounding effect of the growth rate over long time frames.

The cost of economic instability can be analyzed by the same means as measuring the cost of reduced growth.

$$U(g(\sigma^2), \mu, \sigma^2) = U(0, \mu, 0)$$

And

$$g(\sigma^2) \cong 1/2\, \sigma - \sigma^2$$

σ is the risk aversion variable and σ_z^2 is the variance of the shock to the model. The variable $g(\sigma^2)$ is the percentage change in consumption uniform across the dates and value of shocks required to leave the consumer indifferent between consumption instability of σ^2 and a perfectly smooth consumption path. This is the cost of consumption instability. Eliminating consumption variability is equal to the utility of an increase in the average consumption of less than .10%. *(that is one-tenth of 1%).* This may be a very low estimate to many of the cost of economic instability. A log sigma of 1 and a variable number of .013 may be a realistic preference point, and thus the result of 1/10 of 1% may be a better estimate than the multiple of nines.

Ranking of consumer preferences are then identified as 1) growth of consumption rates; 2) distortions, such as a more efficient tax system; and 3) stabilization policy.

In the period prior to WWII, the standard deviation of consumption was about 3 times the post WWII level. With squaring, the implied costs are multiplied by nine, and thus ½ of 1% may possibly be amplified into a larger large number nine times larger. Also, fluctuations in the total consumption do not affect all HH proportionally. So, consumption risk faced by the individual HH may be very different than the risk faced at the aggregate level. *(These end up being very small numbers. The implication of the article is that stabilization policy does not matter to the consumer, only a stable growth rate of consumption matters. This paper may therefore cast doubt on an analytical concentration on the business cycle. The paper suggests that an emphasis on the business cycle is trivial, and what is really important is concentration on the consumption growth rate).*

The cost of individual income variability measures the potential or actual gain from the social insurance perspective, not from stabilization policy. A reduction in the aggregate income variability cannot be expected to eliminate more than a small part of the risk borne at the individual level.

Because of the concave function, the operator has utility, and the mean utility is half way between C+1 and C-1, at C bar. These points are equally probable along the consumption function. The fact that U(C+1) – U (C) generates less utility than U (C-1) + U (C), shows risk aversion and the concave nature of the curve If there is risk neutrality, that would be demonstrated by a straight 45 degree line. A large sigma value shows very large risk aversion.

The next equation has lambda, λ, providing consumption for parameters μ and sigma, σ^2.

$$C = (1 - \lambda)\,(1 - \mu)^t\ C\ - \tfrac{1}{2}\,\sigma_z^2$$

This equation accounts for consumption growth over time, but with fluctuation along the way. The mu is the growth rate while the σ variable represents the shock to the system. The expected mean consumption is the expected growth rate. In the USA, the consumption growth rate is 3%, so mu, or μ, = .03. The standard deviation in the US of the log of consumption is 0.013, which is 2.5% above or below the trend-line of the consumption path. So, $\sigma = 0.013$. Then, $\lambda, \mu, \sigma^2 = 0, 0.03, 0.013$, respectively.

A +- 2.5% standard deviation above or below the trend-line is a rare event. So, this shows people that "consumption is smooth", i.e. regardless of GDP shocks, consumption is within 2.5% if the trend-line of the 3% growth rate in consumption. US data is therefore suggestive of consumption smoothing of the life cycle model.

The equations rest on assumptions about preferences only and not about any particular mechanism assume to generate the business cycles. Economic instability since WWII is a minor problem relative to the historical level of inflation and certainly relative to the limits of reduced rates of economic growth.

Caveats include: 1) pre WWII consumption variability was much longer; 2) leisure; 3) post WW II business cycles were stabilized and would have been much larger had there not been counter-cyclical policy.

Another paper was done by Cynthia D. Romer, "Changes in Business Cycles: Evidence and Explanations", *J of Economic Perspectives",* Spring 1999, p.23-44.

Lucas's work is considered in Economic circles to be the radical view, while Romer is more of the conventional view on business cycles. Romer is considered to be a neo-Keynesian, but also ascribes to things that have been previously advocated by some of the Monetarist writings.

The pre WWI period was noted for a lack of government and tax activity, and a lack of monetary policy with a reliance on the gold standard instead. The post WWII period had the development of large state and federal governments, the development of a federal income tax as well as state level consumption taxes, an active monetary policy with counter-cyclical activities to the policy, and a fiat paper based currency.

Main Conclusions: 1) Business cycles have not changed much between the two eras. 2) This is because the Fed has been causing recessions in the post WWII era to fight inflation. (This is similar to beliefs of Friedman and Schwartz).

Data crumbles as you go back in time, with no GDP or national accounts existing pre WWII. So, only an approximation can be made. The existing evidence tends to emphasize volatility, but building data for industrial production (instead of GDP) shows a rough similarity between the pre WWI and post WWII volatility. The implication is that stabilization policy did not do much for the post WWII era. The period between the wars is excluded, as there was a tremendous intra-war volatility going on. Further, the similarity does not mask other fundamental changes. There has only been a small improvement in post WWII volatility, and not enough to overcome the data problems to say for sure that volatility has been reduced in the post WWII period.

Standard deviation of economic variables has declined substantially in the last 15 year period between 1985 and 2000, with less than ½ the volatility as in the post WWII era, generally. The break point seemed to occur in 1982, with volatility being sharply reduced from that point on. This is also true in other industrial countries around the world (so the US Fed may not be the reason for this recent stabilization occurring throughout the world, recently). The recent volatility reductions are significant in terms of macro policy.

Romer reclassifies the definition of recession. Instead of seeing a recession as a peak to trough as does the NBER, Romer reclassifies a recession as a peak to return to peak *(KCK note: this would have the effect of extending the lengths of recessions, since it also includes the time frame past the bottom up until a return to the previous peak. Perhaps an easier way to could classify a recession, or at least a slow period, as simply anything being below trend-line, and a boom as anything above a trend-line).*

In part II of the paper, Romer starts off by stating that macro policy has been stabilizing the economy into longer periods of expansion and a general control of panic type of problems. But Romer also believes that the Fed has introduced new shocks into the economy with destabilizing impacts in an effort to control inflation.

Romer believes that the Fed has induced recessions as part of its macro stabilization policies. Romer then goes into the 1989 Romer and Romer paper that analyzed several FOMC meeting minutes and applies certain dates to these Fed statements *(These dates have come to be known as the "Romer dates").* Romer then analyzes the effects of the Fed policy enunciated at the FOMC meeting and also analyzes what the GDP would have been had the Fed not moved to a new policy. Romer's concludes that the Fed may have lengthened the expansions, but has also introduced new impacts upon the economy in an effort to combat inflation. That would then explain the post WWII experience that volatility remains, but with longer expansions and a moderation of a recession's adverse impact. Fed policy has the effect of moderating recessions and extending the expansion period, but also has the effect of generating other recessions through mistakes and/or intentional efforts at inflation control *(this would then explain the continued volatility even with stabilization policies being present).*

The paper provides the leading evidence of an impact from monetary policy, and the analysis is really based on monetary policy arguments made by Friedman and Schwartz. Romer concludes by suggesting that perhaps the Fed has acted with more abilities since 1985, and that the period from 1985 on has seen Fed policies without policy induced inflation (and thus the volatility of the GDP growth rate goes down). The Fed has used counter-cyclical policy without generating policy induced recessions. "We have had a steadier hand on the macroeconomic tiller in recent years than in the years before", according to Romer.

Economic Fluctuations

Recessions normally have 2 consecutive quarters of decline in GNP, although there is no precise rule. The 2 quarter rule is from the NBER. NBER also dates the beginning and end of recessions. The NBER builds upon work done by Mitchell in 1913 and then by a Burns and Mitchell book on US data. A business cycle is characterized by a number of variables, and no single variable (such as GDP) is controlling on the start of a business cycle. Numerous variables will typically be used. Sometimes, even a growing economy can be considered to be in a recession. This could be the situation of a very fast moving economy, such as Japan in the 1970's, that has had a temporary slowdown in it's growth rate. This is referred to as a "growth" recession.

The data on pre-1929 is less than complete. Many people use Simon Kuznet's data for this time period. He assumed a constant relationship between output in sectors with data. Romer suggests that volatility of pre WWI data is less than what is implied in the Kuznet data. Others challenge Romer's conclusions, believing that volatility in the pre WWI era was as volatile as what Kuznet suggests.

As to the actual variables, unemployment is counter-cyclical (meaning that as Y increases, unemployment decreases). Non-farm employment is pro-cyclical, as are the hours worked per employee, labor productivity and capacity utilization. There are 11 variables in the Index of Leading Indicators, and these variables will lead the business cycle. This Index is therefore reviewed very closely, as it provides a glimpse of where the economy may be headed in the near future.

The permanent change to the industrial bases (caused by demographic shifts or tech changes) is not part of the definition of recession. Recessions are temporary but widespread. Permanent changes represent a fundamental shift in GNP. The distinction is important because LT permanent changes cannot necessarily be affected by macro policy initiatives. As an example, 50% of the population was in agriculture in 1900, and 100 years later, only 2% of the population is in the ag sector.

Since 1960, recessions have run 11 months on average, and an expansion 5 years for a total business cycle of 6 years. The pattern changes over time. Volatility of a recession will measure the magnitude of the swings in the growth rates if output. The reductions in the frequency and the severity of recessions in the post WW II era may be due to counter-cyclical policies. From the Romer article, the post WWII era is experiencing longer expansions, shorter recessions, and volatility may be slightly less than pre WWI.

National Income Accounts**.** The economic fluctuations of an economy are caused by output declines in the areas of HH consumption, investment, net export, and government purchases. This thinking pattern comes from the equation of national income:

$$Y = C + I + G + NX$$

Consumption will decreases during a recession but evidence exists of consumption smoothing, whereby consumption will decrease by less than the decrease in output.

Investment is much more volatile than consumption. A large part of the variation in output over a business cycle can be traced to fluctuations in investment. It is less than clear however what may be the cause of investment changes.

Government expenses are relatively stable during recessions, and less volatility exists with government expenditures, especially when all levels of government are considered.

International changes may have some relationship among certain nations (like the US and Western Europe, for example), but the movements of separate economies are not always in sync, and may often only roughly coincide with each other.

Seasonal adjustments. Seasonal variation in output is much larger than the normal business cycle variation – output may vary by as much as 19% over the course of a year just due to seasonal activity. To account for the huge seasonal changes that occur in the US economy over the course of a year, an attempt is made to make a seasonal adjustment. Christmas shopping causes much of the seasonal variation in retail sales, while other yearly changes occur due to weather (fruits and vegetables). It is necessary to deseasonalize the data before the economic fluctuations can be looked at more thoroughly.

Business Cycles. The traditional view is that recessions are temporary cycles revolving around a LT growth path. One of the more controversial theories is the "random walk" which suggests that permanent shocks to the growth trend line will be random in nature, with some being positive while other shocks will be negative. The shocks will affect the output in following quarters as private sector pricing points adjust to the shock, and this will then begin to develop into a business cycle. The text has a graph (p.104) showing the similarities between these two competing theories, demonstrating that the evidence suggests that the random walk cannot be easily dismissed.

The standard theory on fluctuations, also referred to as the "real business cycle theory", holds that business cycles are caused by shocks to technology and household preferences that are simply part of the equilibrium path. Technology advances will occur every day, but at a non-uniform rate. So, technological shocks can be seen as a cause for many of the features of the business cycle – the real business cycle theory is advanced by Prescott and others. Milton Friedman believed the business cycle is caused by variations in the money supply, while Prescott says the cycle is caused by "real" factors such as technology or a change in consumption and leisure preferences.

The theory will start with a model having no government at all, and then will added government expenses and government policies in to the mix. The text (at p.105) has examples for changes in oil prices and for scientific breakthroughs. The text also shows an interesting graph visually showing subsequent changes to Y, I, C, for a technological shock occurring in the economy at time period t. The resulting changes in I and C appear to look like a typical business cycle, with small C changes and large and highly volatile changes in I.

The change in the level of I versus the change in the level of Y is known as the "accelerator" since the level of I is determined by the change in output. This is contrasted by consumption smoothing, with C being far less volatile than output fluctuations. Now, for a few formulas.

$$Yt = At\ Kt^{\beta}\ Lt^{1-\beta} \text{ (this is just the Cobb-Douglas equation)}$$

Then, dividing both side by L yields: $Y / L = (At\ Kt^{\beta}\ Lt^{1-\beta)} / L$

The, defining Y / L as yt, yields $yt = At\ kt^{\beta}$, where $kt = K / L$

The yt variable is referred to as the "intensive" production function, as it is the output per worker, or the multifactor productivity of technology, A, multiplied by the capital to labor ratio K / L. Substituting yt into the capital stock equation generates:

$$Kt+1 = (1- \alpha)\ (1 - \beta)\ yt$$

Now let's suppose that At increases. That will immediately increase Y in period t, which will in turn lead to an increase in the capital stock in t+1 (from the above equation). So, as technology increases in period t, the capital stock increases in t+1. Also, the inverse of the above equation, sketched out below, must also be true.

$$Kt = (1- \alpha)\ (1 - \beta)\ yt+1$$

Then, the capital stocks in the two consecutive periods can be subtracted from each other:

$$Kt+1 - Kt = (1- \alpha)\ (1 - \beta)\ (yt - yt+1)$$

Because the change in the capital stock is tantamount to the change in investment between the two periods:

$$\Delta\ I\ t = (1- \alpha)\ (1 - \beta)\ (yt - yt+1)$$

The change in investment is accelerated by the change in the level of output, and hence the term "accelerator" when referring to investment changes. The above equation has the effect of making investment very volatile. Changes in output will generate even greater changes in Investment.

The supplemental reading is by Edward Pritchett "Theory Ahead of Business Cycle Measurements", circa 1986.

The traditional explanation of recessions is that aggregation of firm level decisions seeking profit maximization will inevitably lead to an overcapacity in plants and inventory levels, with subsequent excesses in product supply, lowering of prices, loss of profit, lay-off and plant shut downs. Pritchett's article was a radical view away from the traditional perspective. After Pritchett, the professional journals exploded with activity.

Discussion. Pritchett's view is that it is quite normal for large fluctuations in output and employment to occur in a market economy. Pritchett believes that the standard life cycle model can be made to readily display business cycle type of behavior. He states that it would be puzzling if the economy did not display large fluctuations in output and employment. Pritchett feels that technology shocks go a long way towards explaining the existence of a business cycle.

Of course, at equilibrium, firm policy and HH policy is optimal, and the model will converge to a unique resting point, or if growth is occurring, then to a balanced growth path. Also, at equilibrium markets clear and expectations are rational.

Pritchett defines a business cycle as a recurrent fluctuation of output above or below the trend-line. He uses a growth model of an indefinite time period, but he first has to remove the growth trend from the data in order to isolate the deviations from the trend data. The deviations would thus be the business cycle. *(KCK note: this is similar to deseasonalizing the data, except that Pritchett takes the growth of the data).* The author uses a "Hodrick Prescott filter" to draw a line through the data growth trend. The controversy surrounding the article involves the exact composition of trend. Why not use a best fit trendline? Or even a straight line with a slope for the rate of growth?; etc. Not only is growth detrended, but Consumption, Investment, and all the other variables are also detrended. The detrended series shows the deviation from the trend, and this deviation constitutes the business cycle.

The Model, as interpreted by Prescott. Then, the author simulates a model under conditions of uncertainty. For the HH part, Pritchett simply uses the utility function of the life cycle model, $\Sigma \beta U(Ct)$. He then introduces uncertainty into the model with the expected value operator, E, being:

$$E = [\Sigma_{t=0} \beta U(Ct, l t)]$$

Beta is the discount factor in all time periods, as each time period is summed into the expected value, E. Beta is between 0 and 1. Leisure, l t, is introduced into the model as a second argument of the utility function. HH agents value the productive time that is allocated to non-market activity, so leisure as well as consumption (and indirectly, employment) can be made to vary in the model at equilibrium. Thus, leisure (as a non-market produced good) can be combined with market-produced goods, C, to produce a composite commodity good at the HH level that can itself vary at the equilibrium. Utility is just defined in each time period as some optimal combination of leisure and consumption.

The firm production function of the standard model is also used. The general form is Y = C + I + G + NX, of course. The constant technology productivity assumption of the model can be relaxed, thereby introducing tech shocks into the model. Zt is the stochastic tech level that now may be moving around due to shocks of technology being accomplished at non-uniform rates. Z is used instead of A in order to differentiate between a constant technology assumption of A and a variable technology level of Zt. The technology shock becomes a function of capital and labor (which the author has as being n, or n = Lt). Investment is referred to as X, Consumption is still C. The general form of the national income account equation can now be written as:

$$Zt \ f(Kt, nt) = Ct + Xt$$

The author also adds in depreciation into the law of motion of capital in two successive time periods, sketched as follows:

$$K \ t+1 = (1 - \delta) Kt + Xt$$

The δ figure is delta, and represents depreciation. The above equation merely states that tomorrow's capital is today's capital minus depreciation plus investment in new capital.

HH and firms will maximize preferences subject to the budget constraints. Consumption and investment must be equal to or less than labor * the wage rate plus the interest rate times the assets in the same time period. This is expressed as:

$$Ct + Xt <= wt \ N + rt \ at$$

The remainder of the life cycle model is also applicable. We now from the standard model that today's savings is equal to tomorrow's capital. In the form of math:

$$A \ t+1 <= (1 - \delta) at + Xt$$

Tech shocks to the model display a high degree of serial correlation with output in subsequent time periods with the 1st shock being nearly uncorrelated in the initial period. This is represented as:

$$z \ t+1 = p^{z}{}_{t} + \varepsilon \ t+1$$

Where, $p^{z}{}_{t}$ is the serial correlation, and ε t+1 is some white noise. If the tech shock is positive in period t, then because of the serial correlation, the shock will tend to continue to be correlated in the subsequent period t+1.

We know at the equilibrium, several things occur. Firms will maximize their profits. HH maximize their utility. All markets will clear (labor, capital, and output). Expectations are rational, where HH and firms will make decisions today based upon what they think will happen in the future. At equilibrium, the utility function of consumers will be optimized to the amount of output being generated at the firm level. This is shown as:

$$f(Kt, nt) = zt\, kt^{\alpha}\, nt^{1-\alpha}$$

(Note to KCK: Auerbach and Kotlikoff use Beta, but most other texts use alpha in the production function's exponentials). zt is the serially correlated tech shock. Taking the above equation to its log, the following results:

$$U(Ct, l\,t) = (C^{1-\alpha}\, lt^{\phi})^{1-\gamma} / (1-\gamma) \quad \text{where } \gamma > 0 \text{ and } \neq 1$$
$$\text{And if } \gamma = 1, \text{ then } U(Ct, lt) = \text{log function, } Ln(Ct^{1-\phi}\, lt^{\phi})$$
$$\text{And this is } = (1-\phi)\ln Ct + \phi\, Ln\, lt$$

The above equations can be deciphered this way. γ is just another parameter, this time called gamma, while ϕ is a preference parameter between C and I, with ϕ pronounced "fhi". Where gamma is greater than zero, but also not equal to 1, the utility function is equal to consumption and leisure raised to gamma power after also raising C and I to 1 – alpha and to alpha, respectively. Where gamma does equal 1, then the utility function becomes the log of consumption and leisure. This is then just 1 minus the preference parameter multiplied by the log of consumption, and the preference parameter multiplied by the log of leisure. Graphs of the above equations show the 1^{st} order progressive showing diminishing marginal utility for C and l (or a positive rate of change in C and l that is slowing along a concave curve).

Conclusions. Overall, Prescott's interpretation has been considered by many Economists as a huge success since model's simulation of the economy was close to actual US data. With a technology shock, real wages will increase while capital and labor shares of output remains constant as well as the rental price of capital. A growth model can therefore generate a standard deviation of output showing the amount of variation off of a growth path that is likely to occur for any given tech shock.

The author feels there is overwhelming evidence that these tech shocks are highly persistent in subsequent periods. When US data is applied to the model, where the standard deviation of tech shocks = .71, and other variables are put into the model, the fluctuations in the model's output are as large as the US economy's fluctuations. The variability in hours is 77% as large as the variability in output, for instance.

Economic theory thus predicts fluctuations in output of 5% and more from the trend line with most of the fluctuations being accounted for by normal variations in employment and all the rest being accounted for by the technology parameter. Theory predicts that investment will be 3 or more times as volatile as output and consumption only ½ as volatile as output. The match from theory to observation is excellent, but is not perfect. The key deviation is that the empirical labor elasticity of output is less than predicted. Theory may be ahead of the business cycle measurement on this input, and now we should seek to obtain better measurements of the key economic time series data.

The overall tone of the article is that economic fluctuations will normally occur at the equilibrium, for any given change in employment or technology. Fluctuations can be seen as optimal responses to uncertainty in the rate of technological change. Macro efforts should thus not be focused so much on stabilization policy to correct the fluctuations as on the determination of the average rate of technological change. With a stochastic tech shock, the article believes that one should expect to see normal fluctuations in the economy, with HH agents having rational expectations of these fluctuations and rational reactions to them. This could be a rather radical conclusion to make given the current state of the literature, but one that is logical to draw given the article's interpretation of the standard life cycle model.

Fiscal Policy

The Government Budget Constraint. Fiscal policy consists of government purchases; taxes; transfers; and debt financing. Sources of revenue include: taxes; borrowing from the private sector; print money.

The net national debt is the sum of all past budget deficits and surpluses. The equation is:

$$B_{t+1} = B_t + D_t$$

As the net national debt increases, the interest on the debt increases. The budget is cyclical in nature, with national debt increasing during recessions. Deficits have tended to increase over time, and deficits are a chronic problem with many industrial nations.

A government could keep debt as a percentage of GDP constant, and thus the deficit could grow in absolute terms, buut at the same rate as GDP growth. Governments must eventually pay their debt, or at least pay the interest on their debts and not let their debt become an overwhelming percentage of the GDP. The Governments therefore face a budget constraint, much like HH's do.

$$D = G - Z_t + r * B_t$$

Where, D is the debt, G is the government expenses, Z_t is the net tax receipts (which is the tax receipts minus transfer payments). r is the interest rate, and B is the debt. Expanding this to successive years will yield:

$$B_{t+1} = B_t + G_t - z_t + rB_t$$

B_t is the initial debt in period t while $G - z + rB_t$ is the budget deficit in period t. The constraint basically states that tomorrow's stock of total debt is equal to the government purchases minus the net tax payments plus today's stock of debt. The government budget constraint can be restated as the present value of all future budget deficits. This is summarized as:

$$B_t + G_t / R_t + G_{t+1} / R_t R_{t+1} + \ldots = Z_t / R_t + Z_{t+1} / R_t R_{t+1} \ldots$$

Where $R_t = (1 + r_t)$. This is the discount factor used to convert future consumption and net taxes into a present value. The constraint assumes that the government pays its bills through the collection of taxes, and that taxes are large enough to cover the PV of the government expenditures plus the initial debt. Please note that there is no need for an assumption that the government will ultimately balance a budget, only that taxes are large enough to cover the PV stream of the debt.

The government constraint is like the HH constraint, except that the net tax payments, zt is used in the place of wages, and Gt is in the place of consumption. Instead of balancing consumption versus savings as component parts of the wages, the government will balance consumption, Gt, against the net tax payments. Fiscal policy this becomes a series of independent decisions made at discrete times along the way, all culminating in an overall deficit or surplus.

Fiscal Policy and HH Behavior. Assume 1st period consumption = 0, and alpha = 0. All consumption therefore occurs in the 2nd period. Then, C t+1 = wt (1 + r t+1) because the alpha parameter just drops out by assumption. Fiscal policy will then affect HH behavior through the net tax payments, zt. Zyt is the net tax payment of the young in period t; zot is the old people's net tax payments; zt is the aggregate net tax payments.

$$Zt = N\ zyt + N\ zot$$

In period t, the young's net tax payment will reduce savings dollar for dollar due to the above assumptions. The lifetime budget constraint at the HH level becomes the following. In period t+1, the same people, who are now old, will now consume:

$$Co\ t+1 = (1 + r\ t+1)\ a\ t+1 - zo\ t+1$$

The HH budget then becomes:

$$Co\ t+1 = (1+ r\ t+1)\ (wt - zyt) - zo\ t+1$$

Where z^t is the PV of an individual's lifetime net tax payment. This can be expressed as the following:

$$Z\text{^}t = zyt + zo\ t+1 / (1+r\ t+1)$$

The above equation states that the net taxes will be equal to the net tax when young plus the PV of the taxes when old. The consumption behavior of the HH does not depend upon the timing of the net tax payments made when young or old, but simply upon the combined PV of the net payments. z^t is referred to as the generational account, and it is the PV of the net tax payments made by a particular individual over his or her lifetime. The generational account determines the impact to the economy from fiscal policy.

The government budget constraint can be rewritten as:

PV of future net tax payments = zto + PVt of future generational accts

Thus, fiscal policy is a zero sum game. Reductions in the generational accounts of a generation requires that the account of other generations are raised. This assumes of course that the government continues to pay its bills.

Fiscal policy is thus considered to be the time pattern of G, the net tax payments, and the breakdown of the net tax payments in each time period by the young and old. The government must decide how much of the tax payments can satisfy its own budget constraint. And how much will be borne by the young versus the old. Fiscal policy can create a wedge on the capital to labor ratio.

On the transition path, the higher curve is the path without any fiscal policy, and is the traditional equation, $k_{t+1} = (1 - \beta) A k^{\beta}_t$, only without the alpha parameter (since it is set to zero for the young generation). The lower curve has fiscal policy factored in, and is: $k_{t+1} = (1 - \beta) A k^{\beta}_t - f_t$, where ft is the net tax payments or net bond purchases by the young. The introduction of fiscal policy shifts the capital to labor ratio curve downward. With fiscal policy, some of what each worker earns will go to the government as a net tax payment, zyt, or will be spent on government bonds by the young, b. Either way, the young will have fewer resources left over to invest with. So:

$$f_t = z_{yt} + b_{t+1}$$

Then, as stated above: $k_{t+1} = (1- \beta) A k^{\beta}_t - f_t$

All fiscal policy will therefore lead to the sum of the tax payments on the young and the bond purchases. This is described as ft, above. It is the sum of the net tax payments, zyt, and the bond purchases, b t+1, that matters as to a fiscal policy. Policies with offsetting impacts between zyt and bt will have no net effect.

The following are several examples of various fiscal policies.

Policy 1: Financing Government Consumption. We start with the Lt steady state, and with the government wanting to spend a constant G each period on consumption. The government policy is to have a consumption tax. By previous assumption, consumption is 100% with the older generation. In the US, consumption taxes fall more heavily on the elderly. With a consumption tax, the following equation applies:

$$Z_{ot} = g = G / N$$

This policy has no impact on aggregate output, since ft = zero, and young pay none of the tax. There will be no change in investments or savings. The decrease in consumption by the elderly is offset by the increase in consumption from the government. So, the aggregate consumption remains unchanged along with national savings, and investment. The increase in G will not affect S or I if G is financed in such a way to exactly offset the decline in private consumption. This is referred to as "the wisdom of a consumption tax". Such a tax does not interfere with the economy, while the government gets the revenue it needs. But, consumption of the older will be lower than it otherwise would be.

Policy 2. Tax the Young. If the young must pay the taxes for government expenditures, savings will be adversely affected. A tax on the young will raise the PV of lifetime net tax payments. Zyt = g. This is the same thing as G = N zyt, and zt = zyt. Since ft > 0, and ft = g, then the transition curve shifts downward. The young will use some of their wages to pay for the taxes instead having money fro C and S = I. Requiring the young to pay for consumption leads to a decline in I and K / L.

Also note that in the one period where a switch occurs between a consumption tax and an income tax on the young, one entire generation is not taxed, while all the other generations are taxed earlier, while they are young.

<u>Policy 3: Deficit Finance.</u> The government can borrow and deficit finance instead of taxing. The government borrows g from each young person to pay for G expense. Bonds are sold to young and then are repaid when old as interest, with the equation being: g (1 + r t+1), but the old must also pay taxes of g (1 + r t+1). The deficit policy produces the same generational accounts as with the case of taxing the young to pay for government spending. The transition equation is identical to that of taxing the young. This is because the government takes away from the young the identical same amount in either case. So, the economic outcome is exactly the same. This results in the same net flows between each generation and government. The government takes g from the young and gives nothing back when old. Ft = zyt + b t+1. With no taxes on the young, ft = 0 + bt+1 = g. the young are the ones that buy the bonds (by assumption), and thus divert assets to buy bonds instead of S or C. The timing of the tax is different, but in both cases where the young is taxed or where the government sells bonds to pay for a deficit budget, z^ = g. The savings of the young are diverted, in either case.

So, government debt alone is not an indication generational impact through deficit financing. The government has considerable leeway to report it fiscal accounting, and to figure out the verbiage of what the government is saying that it is doing, one must look at generational accounting.

<u>Policy 4: SSA payments.</u> SS is a pay as you go system. The contributions of the young are given directly to the old to consume. This reduces S and I. This is an implicit debt by the young to finance the consumption of the old. Future payments depend upon payroll taxes of future generations. Each young generation pays S when young to receive only S when old.

$$Zt = s - s / (1 + r\ t) = r\ t{+}1 * S / (1 + r\ t{+}1)$$

The payout of s when young deprives the young of interest payments on s. The transition equation now becomes:

$$k\ t{+}1 = (1- \beta)\ A\ k^{\beta}t - s$$

This could also be described as debt financing. It is a shift in the fiscal burden across generations, not the presence or absence of the national debt causing the decrease in S.

Policy 5: Government Capital. To determine capital stock, we can add government capital to private capital. The transition equation thus will be the summation of private capital and public capital, expressed as:

$$k\ t+1 = (1- \beta)\ A\ k^{\beta}t - ft + k^{g}\ t+1$$

Government capital can be invested just like at the HH level. Government investment in capital can lead to an increase in capital accumulation in the economy, and the government workers can become more productive, thereby potentially offsetting tax effects. Government transfers also redistribute among members of given generations. Transfers will increase consumption but decrease Savings. It lowers the K / L ratio and lowers the capital stock, overall. Zyt = g, but then the capital stock in the next time period can also be equal to g, or k t+1 = g. So ft = zyt may be cancelled out by k^{g} t+1, thereby leaving the original transition equation intact, with no net effect because k^{g} t+1 = zyt.

Taxes on capital income can distort and discourage HH savings behavior, however. The impact is similar to increase in alpha as to the consumption parameter, reducing the K / L ratio. A tax on labor income will decrease the marginal utility to work, while a tax on individual commodities will discourage the purchase of these items.

The supplemental reading is "Taxing Capital Income: A Bad Idea", Summer 1999, Atkinson, Chari, and Kehoe.

In 1986, Chamley established that the optimal tax rate on capital income is eventually zero. The supplemental reading relaxes the rather stringent assumptions of Chamley to determine whether the same result holds. The authors of the article conclude that the result is the same.

Without government, consumers will use a savings rate that will maximize utility. The optimal rate of tax on capital; is zero, according to Chamley. A constant tax rate on K income is equivalent to an ever increasing tax rate on consumption.

In a steady state, the optimal tax is zero over the LT, and capital taxes may be driven to zero. As per Chamley, maybe a tax on capital is appropriate during a transition, but such taxes are driven to zero at the steady state, in order to maximize utility. The authors attempt to merge both the traditions of public finance and equilibrium analysis. The first three propositions are from Chamley.

Here are a few equations from the article. Output, Y, is the sum of consumption, government expenses, and investment. This can be restated as:

$$C + G + k\ t+1 = f\ [kt, lt] + (1 - \delta)\ kt$$

At the HH level, the following is said to exist:

$$\max_{(Ct,\ lt)} \ \Sigma_{t=0} \ \beta^t U (Ct, lt)$$

The agents will attempt to maximize consumption and leisure, with the sum of each period's utility being discounted to present value by beta, which in this instance a discount factor between 0 and 1. The agents will choose the sequence of consumption and leisure that generate as a high as utility over all time frames. As to taxes, agents will have to pay taxes on labor and capital. Firms will maximize their profits and will produce up to their marginal productivity of labor and capital.

The government will use its tax receipts to fund government consumption into the future, with PV also factored into the mix. This can be reduced to the following equation:

$$\Sigma_{t=0} \ p + g = \Sigma_{t=0} \ pt \ [Tt \ wt \ Lt + \theta t \ (rt - \delta t) \ kt]$$

p is the price, and the rest of the equation is that the sum of all government purchases into the future will be valued by discounting into the present. Tao, Tt, is the taxes on labor in period t, wt Lt is the wage times the hours, theta (θ) is theta, and is the tax on capital, rt is the interest rate, δt is the depreciation rate, and kt is the capital to labor ratio in period t. With an infinite sequence the, the tax can be placed either on labor or capital production. Any reasonable firm and government production function and HH utility curve will suffice in the equations. The general goal is to max the taxes on labor and capital in accord with a maximization of utility of the representative household.

Monetary Policy

Monetary Policy effectively imposes a tax on the holders of money and government bonds. The policy creates and spends money by the government. In most of the economic models currently in vogue, there is an assumption of quick adjustments in wages and nominal prices to levels that would produce market clearing and equilibrium.

Numerous definitions of money exist. M1 is the value of all currency plus demand deposits (ie checking accounts). M2 is M1 plus savings deposits and small time deposits and MM. M3 is M2 plus large demand deposits. In all there are 13 money definitions.

There are numerous usages of money. The development of money led to an abandonment of a system of barter, wherein direct exchanges occurred for one commodity for another commodity, without the use of anything to act as a medium of exchange. Money is based upon the willingness of people to accept it as payment upon the expectation that it carries value. Money has 3 primary uses: first, it acts as an exchange medium, eliminating the need for a barter economy. Second, money is a store of value, in which people place their worth in the form of money for a time being. Third, money is liquid, acting as an immediate substitute for the commodity itself, without the necessity of having actual physical possession of the commodity. Money can be destroyed by inflationary tendencies in an economy, however. This occurs when more money is needed in consecutive time periods to purchase the same commodity. Money is referred to as being in both nominal terms, and real terms, whereby a price deflator is used to convert nominal money into real money.

The neutrality of money originated in 19^{th} century economic writings and beliefs, and represented the classical view. If an increase in the money supply of a given percentage would generate the same percentage increase in price levels with no impact on real variables, such as output, then money is said to be neutral. This can be expressed as follows:

$$\text{Nominal GNP} = P\,Y$$

$$\text{Then, } M\,v = P\,Y$$

Where M is the money supply, and v is the velocity of money. Velocity was considered to be the ratio of nominal GNP to the nominal money supply. P is the real price level (nominal Price times the inflation index), and Y is output. The quantity theory of money held that velocity of money is fixed so that changes in the money supply would have proportionate changes in nominal income. This is stated as:

$$V = P\,Y / M$$

Velocity therefore measures how many times the money supply will turn over in each year. If v is constant over time (represented as v bar), any increases in the money supply, M, would lead to equal increases in PY, the nominal GDP. So, as the money supply, M, increases, Pricing will increase as well. A one time increase in M should lead to a one time increase in P, according to the theory. The rate of growth in the money stock should dictate the rate of inflation. The evidence on this is fantastic over the LT, according to the instructor.

However, velocity has proven to be anything but constant over the years. This is partly due to technological changes, like ATM's, that has the effect of speeding up turnover of the money supply. It is also due to substitutes for money (ie credit cards), which also has the effect of increasing velocity. For velocity to be stable, there needs to be a stability of the output growth rate and the underlying economic structure. Then, there will be a direct relationship between the % change in money and the % change in pricing.

The broader classical view is that a change in real variables is not the result of a change in money supply. The authors of the book believe that as money supply increases, real variables (such as Y or w) can and will be affected, and therefore money is not always neutral.

The rest of the material adds money into the life cycle model.

Money applied to the Model. We first assume that the young will hold some wages for money and will not consume it, and we are still assuming no consumption of the young. When old, the money that was held when young will now used for consumption we still are assume that agents only consume when old. We also now have two assets, money and capital. Here is the equation:

$$A_{t+1} + M_{t+1} / P = w_t$$

Where, M_{t+1} is the nominal money balance in the second period, and p is the price level at time t. Basically, the accumulated assets of the old plus the real amount of money of the old amounts to the wages of the person while young. Adding the real value of money back into the assets and factoring interest accumulation into the equation will generate:

$$Co_{t+1} = a_{t+1} (1 + r_{t+1}) + M_{t+1} / P_{t+1}$$

For capital, firms are willing to pay interest because they need money to pay for goods. But as to money held by the agents, there is no return – only the holding of the money in the belief it carries value. Thus, real assets pay a real return, and nominal assets pay no return. Holding cash may even have an implicit by way of inflation. We can see the impact of inflation upon consumption of the old. As pricing increases, consumption has to go down. Intuitively, inflation dilutes the real value of money holdings, and inflation represents an implicit tax on the holding of money. There will be an opportunity cost for holding money where inflation exists. Many years ago, the classical economist, Irving Fisher, thought up the following equation:

$$i_t = r_t + \pi_t + r_t * \pi_t.$$

The nominal interest rate equals the real rate of return, r, and the rate of inflation, π. In practice, the rt * πt drops out of the equation, since it is such a small number. The opportunity cost for holding money depends upon the nominal interest rate, i.

Onto the <u>lifetime budget constraint.</u>

$$wt = Co\ t+1 / (1 + r\ t+1) + i\ t+1 / (1 + i\ t+1) * M\ t+1 / Pt$$

where i is the nominal interest rate and i t+1 is just r t+1 * the inflation rate (the inflation rate is referred to as Δ P / P, or also as π). The present value of consumption when old plus the price of holding real balances of money plus the real balance itself equal an agent's wages. The model so far does not explain why people hold money. In the data, people hold onto lots of money.

The utility function at the HH level still remains, with only the savings being replaced by real money balances, and with alpha replaced by theta. So, the choice is between money holding and consumption when old, instead of savings and consumption as it was before. Each individual will be indifferent between real money balances and consumption when old. The utility function is described as:

$$\mu\ t = (M\ t+1 / Pt)^{\theta}\ Co\ t+1^{\ 1-\theta}$$

Theta is a weighting parameter for the two factors of money and capital, just as alpha was the weighting factor for consumption and savings in the original utility function. The money divided by pricing part of the equation is a proxy for the fact that we have to use the money for transaction purposes. The HH chooses the extent of the real money balances. The consumption part of the utility function stays the same, except with theta acting as the preference parameter instead of alpha.

The demand for real money then depends upon the HH utility function's preference for holding money versus consumption when old. The real balance of money is the following: is then the following:

$$M\ t+1 / P = \theta\ (1 + i\ t+1) / i\ t+1 = (i\ t+1)\ wt$$

Where gamma, γ , is dependent inversely to the nominal interest rate. As the nominal interest rate increases, a smaller demand for real money balance will occur. Gamma, γ , is the agent holding money. We can simply this by making gamma at the applicable interest rate, γ (i t+1), a constant. The simplified money demand equation is now:

$$M\ t+1 / P = \gamma\ bar\ wt$$

The key transition equation now becomes:

$$K\ t+1 = (1 - \gamma\ bar)\ A\ (1 - \beta)\ k^{\ \beta}\ t - ft$$

In the above equation, the alpha and 1 – alpha drops from the transition equation since alpha is set to zero (the young do not consume at all, by assumption). Gamma is the agent holding money, so 1 – gamma becomes the percentage of wages moved to capital. The middle part of the equation, A (1 – β) k $^{\beta}$ t, is merely the marginal product of labor, and ft is the net tax payments. This version of the transition equation allows us to solve for the time paths of all the other real variables.

The demand and supply for Money. The demand for money by the young can be compared to the supply of money held by the old, as follows:

$$Pt = M \text{ bar} / (\gamma \text{ bar} * wt * N)$$

This is the key equation for money demand. γ , Gamma, is still the estimation of the money demand preference parameter. We also inserted the time path of wt into the equation so that we can solve for prices. As the real wages increase, the more the young will be willing to exchange for money held by the old. Pt is inversely related to real wages in the equation (as well as all other real variables. As the pricing increases, real variables will decrease). The price level is the total amount of money in the economy, M bar, divided by the number of people times the fraction held as money times the wages. At steady state, the pricing level is constant. *(KCK note: This is Freidman's belief, that at steady state, Pricing and the Money supply will move 1:1. In the transition however, pricing may not correlate with the money supply because the velocity of money is not constant).* In general, the pricing level will be dependent upon wages, the money stock, and the preference parameter for cash.

Shifts in money demand can occur. If the preference for holding money shifts, then the transition curve will also shift. A low gamma will lead to a high transition curve, since less money is being held, and more money is being used for capital. So, the effect of different gammas will be to rotate the transition curve downward or upward.

Is Money Neutral? This is the burning question. Does a one time increase in the money supply (with reversion to the original money supply in subsequent periods) have a real effect on any real variables?

Case 1. The Government prints money to pay for transfers to the elderly (such as SSA payments). Money is neutral, in this example. Prices will increase from the printing of money. The elderly will effectively pay the tax for this money printing through the form of higher prices, thus reducing the value of the money they held onto. However, since the old are also receiving the government transfers, the net impact upon the elderly will be zero, and the neutrality of money will therefore hold in this example. In the above transition equation, ft = zero, since there is no net taxes on the old and the savings behavior of the young will also not be affected. No impact will therefore occur to the economy's real variables. The pricing level, Pt, just increases in proportion to the increase in the money stock. The old really did not get anything because the old received both the transfer and the increase in prices in the same proportion. The implicit tax on the elderly is exactly offset by the transfer payments.

Case 2. The government prints money to finance its own consumption (such as road construction). This is not neutral because it reduces the welfare of the elderly. The net government tax payment, ft, is still set for zero, so the young's saving decision and behavior is unaffected. Prices will still increase as a result of the printing of money, and the money that is being held onto by the old will still be worth less than before. So the pricing will increase in the same proportion as the increase in the money supply. But now, the elderly will not receive any government payments in return for the increase in money. Their welfare is reduced in the process, and money cannot be said to be neutral with this government policy. The implicit tax through higher pricing will not be offset by the transfer payments. *(Dropping out the assumption of "old" and inserting "anyone holding money instruments" would lead to unexpected increase in the money supply and an inflationary impact upon anyone holding the money based instruments, such as bonds).*

Case 3. The government prints money to finance transfers to the young (like education grants). The transition path moves but then returns to its original position LT. This policy is not neutral in the ST, but is neutral in the LT at steady state.

The old have their welfare reduced in period 0, since the money supply increases leads to a proportionate pricing level increase, along with the attendant implicit tax borne by anyone holding money. No transfers are being given to the old, so the old's welfare is reduced, just as in case #2. So far, this is the same situation as case #2.

By assumption, the young consume only when old. They therefore save all the government transfers given to them. This increases savings of the young, thereby increasing assets when old in the next period. This increases capital, thus increasing the capital to labor ratio, which is sketched out in the transition path. In the transition equation, ft is no longer zero, since there is now a net transfer payment being made. fo = ΔM / Po N. So, the K / L ratio increases due to fo no longer being zero: tax of zero minus the transfer payment of ΔM / Po N would produce a net negative ft, which would then be subtracted in the transition equation (or added to the K / L ratio, as ft < 0, and the equation is … $k^{\beta}t$ - ft). The transition path increases in the first period of time, but then returns to its normal state since the education grant was for one time only.

In the short run then, money is not neutral since the entire path shifts out. Thus, the time path of the wage rate is raised, and the pricing level increase is lowered in subsequent periods of time than it would have been otherwise. This pattern of higher wage rates and lower inflation rates (compared to otherwise) gradually is eliminated by the economy eventually returning to the original transition path and k bar. (This is explained in the text at p. 190-191). As such, the economy's real variables can be manipulated in the SR, and the quantity theory of money therefore does not hold in the SR. But in the LR, a one time change in monetary policy cannot impact things much, and the transition path returns to its original trend.

Money supply changes, and the impact to the government. The government can use inflation to garner real resources. Income taxes are collected on nominal income levels, so every time inflation increases, income will increase, and the amount of taxes will also increase (both from the nominal increase in individual income and by the move to a higher tax bracket from the progressive tax structure). This results in an increase in revenues to the government. Further, the real value of the national debt is reduced by the existence of inflation. The absolute dollar value of the debt does not increase, so inflation will effectively reduce the debt level in real dollar terms (assuming no new additions to debt) *(KCK Comments: you could also say the same for private sector debt as well).*

The supplemental reading is "The Ends of Four Big Inflations", Thomas Sargent, *Journal of Economic Perspectives.* The paper is a famous article on expectations of governmental policy. The paper led to an explosion of research into expectations of government policy, and this led to interest in maintaining "credible" government policies.

Findings of Paper: The paper examines hyperinflation in 4 countries (actually 5) in the post WWI era, and concludes that the expectations of future governmental policy will impact the economic environment in current time frames. The hyperinflation examined presented extreme examples, but they provide possible lessons to be used in a low inflation environment.

As a background on the paper, when the paper was written in 1980 (question on exact date), two schools of thought existed on the high inflation that was then existing in the US economy. The "gradualist" school felt that it was best for government to leave inflation alone. This school of thought cited to numerous articles indicating that government policies designed to force a 1% decline in inflation would cost about a 10% reduction to the GDP. The other school of thought was the "rationale expectations view", whereby the private sector comes to expect high inflation in the future. While it is true that inflation is slow to respond to isolated actions perceived to be temporary in nature, expectations as to inflation could change very rapidly if government policy changes. This article provided large theoretical support for an activist governmental policy towards inflation.

The implications of the paper's main conclusion are large: inflation can be stopped in rapid order because there is no inherent momentum to inflation (citing to the examples in the article). The effort at inflation reduction is not easy however, as there needs to be a credible commitment to new policy. The effectiveness of government policy today depends in large part upon the expectations of future policy.

Discussion of paper. After WWI, Austria and Hungary separated as nations, and Germany was defeated. Poland was also decimated. Each of these nations experienced rapid hyperinflation. *(hyperinflation has been a common ingredient of post war and revolution environments. Example: Russia in the post Soviet era of 1990 had hyperinflation).* Each of these countries after WWI were in dire straits. They had trouble paying their bills and collecting taxes. So they simply printed money, and that led to a sudden hyperinflation in each of their economies. In each case however, inflation stopped abruptly when certain actions were implemented. The hyperinflation ended even before money was no longer being printed in large amounts. The inflation stopped upon the expectations that changes were imminent.

The common economic features of each of the countries examined included: 1) large budget deficits; 2) huge amounts of printing of money was occurring to finance government spending; and then 3) deliberate and drastic measures were taken to counteract inflation. 4) the runaway inflationary price levels then immediately stabilized; 5) inflation ended eventually.

The nations being examined had lots of unbacked currency floating in their economies (i.e., unbacked by gold or silver). Fiat currency was the norm. The hyperinflation ended when there were credible promises and commitments made to a new policy.

In Austria, there were 6 ½ million people that survived the war. There were large deficits: 50% of total government expenditures were being covered by the printing of money. People tried to get away from their local currency. The government immediately restricted this activity. The League of Nations intervened. In August, 1922, it was announced that serious discussions were occurring with the League, and that the Austrian government had agreed to change their policy regarding the money supply. By September, 1992, hyperinflation had ended abruptly. The stabilization occurred before any of the reforms were implemented or even signed, as the protocols were signed only in October, 1992. Money was still being printed at a rapid rate. *(As per Friedman, however, prices still should have been hyper-inflating).* No currency reforms were actually engaged upon until later. The protocols included the government establishing a new independent central bank; the promise was made by the government to cease running large deficits; and the League monitored compliance with the protocols. The budget was balanced within 2 years.

With the gradualist view, such a drastic plan would generate huge unemployment. Sargent wrote that inflation came down 10,000% with only very small increases in unemployment.

In Hungary, 8 million people survived the war, and this figure was down from 21 million pre war. Following the end of the war, political revolutions occurred. Not only was Hungary separated from Austria, but the Red Bolsheviks attained power briefly, then Romania invaded but quickly withdrew, and this was followed by a military admiral dubbed the "white terror" taking over for a time. Tax collection was impossible to achieve, and the government (or what there was of a government) ended up printing money. The government ran substantial budget deficits between 1919 and 1924. Hyper-inflation resulted. People attempted to hold other currencies. The state restricted the activity. The League of Nations intervened, and protocols were signed with the Hungarian government. A central bank was developed. The budget was to be balanced. The League monitored the activity. A reconstruction loan to the government was floated in 1924. The central bank was created in June, 1924, and hyperinflation abruptly ended in the same month, before anything could really be accomplished. Unemployment was no higher after the stabilization than one or two years later.

Poland became a new nation after WWI. It remained at war with Russia, however, until 1920. Large deficits existed until 1924, and currency was rapidly expanded to finance the debt. Inflation shot up by 2,400% over the course of a few years. Poles tried to hold foreign currency, but this was outlawed by the government. There was no foreign intervention, but in January, 1924, a central bank was created having the power of currency reform. The government made a dramatic move to a balanced budget and a central bank was prohibited from making any further unsecured loans to the govt. The bank's notes had to be secured by private bills of exchange and silver. At this point, the government moved swiftly to balance its budget. Unemployment rose somewhat, but not by an order of magnitude as that would have been predicted by the same analysis as used for an estimate of unemployment in the contemporary US of massive reductions in GDP needed to ease inflation. Once stabilization occurred, inflation ended.

Germany was defeated, and after WWI, Germany owed staggering amounts of reparations to the Allied countries. Germany experienced political revolution at the end of the war. Germany's hyperinflation was the most spectacular of the four studied. Note circulation increased dramatically from 1921 to 1923. Flight from the local currency occurred. Citizens held large amounts of foreign currencies. In November 1923, prices suddenly stopped rising. Additional government borrowing from the central bank stopped; the budget was swung into balance; and inflation then stopped abruptly in October, 1923 with binding limits occurring on the total volume of notes that could be issued. Bank notes increased even after the reforms were announced. Unemployment actually decreased after the reforms were put into place. There was an absence of a Philips curve trade-off between inflation and employment. There is also evidence that the German inflation was far from neutral and had real variable impacts.

In Czechoslovakia, after WWI a minister of finance adopted conservative fiscal and monetary policies. The nation avoided the hyperinflation experienced by its neighbors. The Czecks moved quickly to limit the total government note circulation and prevented inflationary pressures.

Conclusions. Expectations play a huge role in the inflationary environment, even in the more typical cases. He cited the Volcker era in 1980 when inflation was running at 10%. When it was evident that Volcker was going to finally make a change in monetary policy, inflation was suddenly and drastically reduced to 3%.

All future government policies may have an impact on people's expectations and on current interest rates. The expectations of future prices at all levels have a major impact upon current economic conditions.

The author's beliefs are summed up at the end of the article. The last few paragraphs of the article states that "the essential measures that ended hyperinflation in each … were first, the creation of an independent central bank that was legally committed to refuse the government's demand for additional unsecured credit and, second, a simultaneous reduction in the fiscal policy regime. These measures were interrelated and coordinated." Sargent goes on to state that "In each case that we have studied, once it became widely understood that the government would not rely on the central bank for its finances, the inflation terminated and the exchanges stabilized. … in each case the note circulation continued to grow rapidly after the exchange rate and the price level had been stabilized. Rather, it was the growth of fiat currency which was unbacked… which there never was a prospect to retire through taxation."

"… earlier attempts to stabilize (prices) …. Failed precisely because they did not change the rules of the game under which fiscal policy had to be conducted."

"…the four incidents we have studied are akin to laboratory experiments in which the elemental forces that cause and can be used to stop inflation are easiest to stop."

The Keynesian Model of Fiscal and Monetary Policy

The Keynesian model comes from Keynes' famous 1936 book, *The General Theory of Employment.* To make Keynes more understandable, Hicks wrote a summary of Keynes' beliefs entitled *Mr. Keynes and the Classics*, and the LM and IS verbiage actually originated with Hicks's reviews of Keynes' theories.

Nominal rigidities form the basis of the Keynesian model of business cycle fluctuations. Many models follow a fully flexible process, but in less competitive markets, price adjustments may be weaker and slower. Keynes viewed recessions as manifestations of weaker demand, and his model focuses on the downward nominal rigidity such as was the case in the US labor market. Keynes assumed SR unemployment coupled with LR adjustment to market clearing prices.

Rewriting the HH lifecycle model in terms of output will lead to the LM curve showing all combinations of current output and next period interest rate at which the quantity of money demand = supply of money. Time periods become more undefined than in the lifecycle model. So, instead of period t+1, it just is written as +1. The price equation is based upon money supply and demand. Pricing points can be summarized as:

$$P = M\ bar / (\gamma\ (r + 1)\ N\ w)$$

Gamma is a function of the interest rate, r, in period + 1 times the population times the wages per population. The expected inflation component is zero, so the nominal interest rate will the real interest rate. Pricing can be rewritten as:

$$P = M\ bar / (\gamma\ (r + 1)\ N\ (1 - \beta)\ Y)$$

The transition equation becomes:

$$\begin{aligned} K + 1 &= (1 - \gamma\ (r + 1)(1 - \beta)\ A\ k^{\beta} - F \\ &= (1 - \gamma\ (r + 1)(1 - \beta)\ Y - F \end{aligned}$$

Now, rearranging the equations further to output and interest rate solutions, we assume for the moment that expected inflation is zero, and solving for Y generates the LM side of the curves, and represents the liquidity preferences.

$$Y = M\ bar / (1 - \beta)\ P\ \gamma\ (r + 1)$$

With the above LM equation, Y becomes related to r, because everything else is being held constant. The resulting LM curve can be relatively flat (with little positive slope) which then would be rather insensitive to interest rates, or the curve could have a greater positive slope, with correspondingly greater sensitivity to interest rates.

The IS curve represents the IS part of the curves, and represents the money demand. It shows all combinations of output and the next period interest rate consistent with the transition equation, and is described as:

$$R + 1 = \beta \; A[\,((1-\beta)\,(1-\gamma\,(r+1)\,Y - F)\,/\,N\,]^{\,\beta - 1}$$

When f = f N, or the total government receipts, Investment will be equal to savings.

Full or potential employment occurs when all available inputs are fully utilized, and the LM and IS curves intersect. Keynes believed that the economy could stick at certain points below equilibrium output levels. With rigid prices, the pricing structure will be too high, producing less output and higher interest rates. This is a lack of aggregate demand for output. So, unemployment will be less than full, as a result. The LM curve will be higher than normal, resulting in lower levels of output and higher interest rates. In such instance, either monetary or fiscal policy could be undertaken to tackle the problem and return the economy to an equilibrium.

<u>The role of monetary policy.</u> An increase in the money supply shifts the LM curve outward to the right, increasing Y and lowering r. Money will not be neutral, as real variables such as Y will be affected. A multiplier will increase the output by more than the policy variable input. Monetary policy accelerated aggregate demand through LM curve shifts. This is the classic case of monetary policy being used to expand output.

With Monetary policy, and with sticky wages or prices, the LM curve will shift out from expansionary monetary policy. But as Y increases, price levels also increase, and this reduces the real money stock, causing a partial shift back in the LM curve.

<u>The role of fiscal policy.</u> Output can be increased by increasing the net transfer payments, f. The IS curve will shift out, resulting in higher output and higher interest rates. The f variable in the life cycle model will be increased by the fiscal policy, so Y increases, and r increases. Increases in fiscal spending will increase the r variable, crowding out investment. But investment will fall by less than the government spending increase, resulting in a net gain in Y. If flexible pricing existed, this crowding out effect would not be so good, since the increase in government spending would be less than investment. Thus, the model must be done in the context of output being below the LR potential level with sticky wages or prices being in existence.

With expansionary fiscal policy, the IS curve shifts out. But as Y increases, so does the prices of course. The LM curve will then shift partially back resulting in a smaller overall shift in Y.

<u>Summary</u>**.** Either an expansionary fiscal or monetary policy will shift the AD curve outwards, resulting in both an increase in Y, but for different reasons. With monetary policy, Y will increase and r will decrease. With fiscal policy, Y increases as well as r increasing.

The effectiveness of monetary and fiscal policy. A critical question is which policy to use? Which is more effective in stimulating output when stocky prices or wages exist, monetary or fiscal policy? Ultimately, the answer depends upon the slope of the LM and IS curves, and whether the pricing and wage rates are sticky.

The monetarist view is that the LM curve is vertical, so Money demand will be very insensitive to interest rates. Thus shifting the LM curve with monetary policy will lead to output increases and with interest rate reductions. Fiscal policy shifts the IS curve outward, leading to output not increasing beyond original levels, but now with higher interest rates. So, fiscal policy would be ineffective compared with monetary policy.

With the opposite argument, money demand is very sensitive to interest rates, so the LM curve is very flat. In this case, a shifting of the LM curve with expansionary monetary policy would generate very little output increases even with a major reduction in interest rates. Expansionary fiscal policy would cause the IS curve to shift out, greatly increasing output with only a slight increase in r. Thus, fiscal policy is more effective.

In the context of the long run equilibrium, both camps agree that economic forces will align into an equilibrium. In the SR however, prices or wages may not adjust quickly.

International Policy

The Life-Cycle Model of a closed economy. So far, we have been developing a one nation model. Now, we will add a second country. The export to GDP ratio of the US was 10% in 1993, and the current export to GDP ratio in Europe (when taken as a whole) is 10%. Both cases are examples of a fairly closed economy. Japan also has a low ratio, since they are very protectionistic.

The trade surplus (ore deficit), or net exports, is the following:

$$X - M = NX$$

Where X is the exports, M is the imports, and NX is the next exports or trade surplus. Then, the following must be true for investment levels:

$$S - I = I^f = (X - M) + E$$

Where, S is the domestic savings, I is the domestic investment, and I^f is the foreign investment. E is the net foreign income. If savings exceeds investment at home, then the remainder must be in investment abroad. As the above equation demonstrates, net foreign investment also is equal to net exports plus the net foreign income.

Initially, the model has been set for a one country situation, called "Autarky". A second nation is now added to the model, where the two nations are not identical in economic variables. If they were identical, then the two nation model would be boring, since it would merely be a scaled up version of the one nation model. We assume that the foreign nation has a higher propensity to save then the domestic nation. So, alpha, the consumption preference parameter, is once again turned on. Alpha is therefore higher in the home country than in the foreign nation.

A higher consumption pattern at home, alpha, result sin a lower rate of savings, lowered investment, lowered assets in period t+1, and thus a lowered capital stock in t+1. This will lower the K / L ratio at home, generating a lowered equilibrium k ratio, with a lowered wage rate and a higher interest rate. The equilibrium k t+1 is still equal to: $(1 - \alpha)(1 - \beta) At\, kt^{\beta}$.

The Life-Cycle Model applied to an open economy. Now, let's open the two nations to international trade. We will make a key assumption that international capital is mobile between countries. If this assumption is not complete, then the final two nation model will certainly be affected (primarily in the persistence of differences in the variables of each nation at equilibrium). This assumption has some historical connotations, with four eras of capital mobility. In pre WWI, there was free flow of capital, especially between the nations of Europe. Between the two wars however, there was a complete shut-down on capital mobility. In post WW II from 1945 to 1973 and Breton Woods, mobility increased, but was still fairly low. After Breton Woods in 1973, to the present, there has been a gradual restoring of capital mobility.

Assuming mobility of capital, the Ja investors will want to obtain the higher interest rate in the US, so they will have foreign investment in the US. Over time, the interest rates of the two nations will equalize over time, and it happens fairly rapidly (assuming mobility of capital, again). This called factor price equilibrium. Once one factor goes into equilibrium, other factors also equalize, such as wage rates. You do not need mobility of wages to get equality of wages. It is sufficient that one factor mobility of capital exists. The process works likes this: interest rates initial differ, but then investment flows between the two nations. Interest rates will equalize. The k ratio equalizes, resulting in an equalized wage rate. The cross border investment not only serves to equalize interest rates, it will also equalize real wage rates and the k ratio.

Empirically, the purchasing power parity moves around along with the exchange rates, so this creates less certainty in the wage comparisons. As such, the differences in the wages do not necessarily mean that equilibrium does not exist.

The world capital to labor ratio is still the same k t+1 equation, just now with the world's savings (and investment) and consumption pattern interspersed into the equation. First, the assets saved into t+1 also is tantamount to the capital invested in t+1. Weighting the two nation's asset base (or capital to labor ratio) by the population of each nation will generate a combined capital to labor ratio applicable for the world at equilibrium. This is done by:

$$k\ t{+}1 = (N\ a\ t{+}1 \;+\; N^*\ a\ t{+}1^*\ ) / (N + N^*)$$

Second, the world's consumption preference is the weighted average of the two speared nation's consumption preferences, again weighted by population. Thus:

$$\alpha\ \text{bar} = (N\ \alpha\ + N^*\ \alpha^*) / (N + N^*)$$

Since wages are equalized by way of equalization of the interest rates, then $wt = (1 - \beta)\ A\ kt^{\beta}$, where kt is the world's capital to labor ratio. The model so far assumes the same technology base in both countries because the flow of information should spread rapidly throughout the world. The world's transition equation becomes:

$$k\ t{+}1 = (1 - \alpha\ \text{bar})\ (1 - \beta)\ A\ kt^{\beta}$$

Asset accumulation along a transition path is the following:

$$a\ t{+}1 = (1 - \alpha)\ (1 - \beta)\ At\ kt^{\beta}$$

$$a^*\ t{+}1 = (1 - \alpha^*)\ (1 - \beta)\ At\ kt^{\beta}$$

The above asset accumulation equations are the curves without international trade. The world capital to labor ratio will always be between the curves for each separate country in a two nation model, with capital mobility. The domestic net foreign investment during any two periods is the change in US net foreign assets between the two periods.

We can see how international trade impacts asset accumulation by noting that in a closed economy, a t+1 may be less than k t+1. This will be the case where r* < r. US savings will fall short of US capital. But then Ja capital will flow into the US because of the higher interest rates. The US net foreign asset position will be:

$$kt^f = N\,at - N\,kt = N(\alpha - kt)$$

$$kt^{f*} = N^*\,at^* - N^*\,kt = N^*(\alpha^* - kt)$$

The capital to labor ratio for the world will be between that of the two countries, since arbitrage of they two nation's asset positions will occur immediately. It will take a while between the two nations k ratio to become the world's k ratio, due to step by step movements along the transition path from the separate nation's k ratio to a merged world's k ratio. The decline in the propensity to save of the nation with the higher k ratio will lead initially to a trade deficit but ultimately to a trade surplus.

The textbook has several examples of the transition path of two nations moving towards an equilibrium with trade.

The Impact from International Trade. When the nations open themselves to trade, the standard of living in the nation with the lower K / L ratio will rise, while the standard of living of the nation with the higher k ratio will be reduced. There will be clear winners and losers between the nations, but there will be more output in total with open trade than there will be with closed economies. The wage loss in the nation with a higher initial k ratio should be able to be compensated by the increase in total output. In order to get both nations to go along with international trade, a side payment (out of the increase in total output) must be made back to the nation with the higher k ratio, and higher wages, in order to compensate for a relative lowering of the wage rate and relative increasing to the interest rate. There has been some evidence of these side payments being made through international trade treaties where compensation flows between the two signatory nations to the agreement.

Trade will have the effect of expanding the "social pie". While the workers of the nation with the higher k ratio will have to be compensated for a lowering of their wages, the investors of that nation will eventually see their rate of return increase (and/or their total profit) from the increase in total world output.

The textbook has a good point concerning the impact from trade. First, domestic fiscal policy can have an impact internationally. The nation's relative size is critical in determining whether the fiscal policy will have much impact on anything other than its own asset accumulation, however. The larger the population (and output), the greater the international impact from a purely domestic fiscal or monetary policy. This can work against the various nations, especially if a smaller nation will have policies that are in opposition to that of the bigger nation. An example would be where a smaller nation is trying to contract its money supply in order to slow down inflation while at eth same time a much bigger nation is engaging in fiscal and monetary expansion in order to come out of a recession. The smaller nation's inflation might actually increase, especially if there is lots of trade between the two nations and there is a great mobility of capital. So, the nations will attempt coordination of fiscal and monetary policies (examples include the IMF bank and the G6 summits).

The supplemental reading is entitled "The Global Capital Market: Benefactor or Menace", Maurice Obstfeld, Journal of Economic Perspectives, Fall, 1998.

Background. With the Mexico crisis in 1994, the Thailand bhat devaluation in1997, and the Russia loan default in 1998, other countries became embroiled in the situations. The question is whether the impact being felt at home is really connected to these problems. There became a concern about money movement across borders. There have been 2 views: The impact will occur on US exports, adversely affecting the national GDP. The counter view is that the export to GDP ratio is small in the US. With each financial crisis, LT interest rates were pushed down globally, and this is a good thing for US exports. The second view was not the leading view in 1998, but that is what has actually occurred in the US. We have benefited by lower interest rates abroad that have been generated by the numerous financial problems.

Integration of Global Markets. Over the last 25 years, regional financial crisis seem to be more frequent and dramatic, as the global financial arenas have grown.

The economic theory behind the global markets is that greater diversification results from international activity than with purely domestic models. The emerging economies can more easily finance their activities and increase the savings rate, with international investment in their countries. The welfare gains can be enormous at the firm and the HH level. Domestic policy of an unsure nature would be curbed as well, due to the fear of rapid capital outflow and higher domestic interest rates in response to the dubious policies. In general, market integration can channel resources to the most productive use. Smaller countries are especially likely to benefit from international trade. The advantages of market integration are hard to quantify however.

The historical nature of the capital markets is reviewed in the article. Pre-WWI saw full mobility of capital; WWI and post WWI experienced a complete halt of capital across borders. Post WWII saw a fragmented international equity situation, but the foreign capital flows began to increase. The 1970's to the present have seen a return to the mobility of capital.

Mobility of capital results in equalization of interest rates across international borders.

Trade-offs. The exchange rate is a key instrument of monetary policy. An open market will deprive a government of the ability to target the exchange rate and simultaneously use monetary policy in the pursuit of other policies.

Another paper on exchange rate shows no correlation between exchange rates and various economic variables, implying that it makes no sense to attempt to control exchange rates, because the volatility of the exchange rates is unpredictable and uncontrollable. Thus, it may be a bad thing to attempt to constrain monetary policy. US policy normally does not make exchange rate policy to be a priority. This is contrasted with the European policies where exchange rates are a key factor (due to the greater amount of trade between EU nations). With the Euro, Europe can be viewed as a closed economy, with little trade outside of its collective borders. So, it will be an open question in the future whether individual nations of Europe will continue to be so critically concerned with exchange rate policies.

The gold standard pre-WWI implied fixed rates with capital mobility, sometimes with adverse domestic monetary effects. The Depression discredited the gold standard orthodoxy and made the financial markets unpopular. The IMF formed in 1944 for hard currency loans to governments to prevent recessions. Floating exchange rates had allowed an increase in the international financial markets. The nations were then able to open their capital markets while also deploying monetary policy in pursuit of national objectives.

Main Discussion and Findings, as to Monetary Policy. A nation could maintain capital mobility and then allow the currency to float. This would give the government the ability to move interest rates and other monetary policies. This is referred to as "inconsistent trilogy", or the "open economy trilemma". A nation cannot simultaneously engage in 1) fixed exchange rates; 2) open capital market while 3) pursuing monetary policy oriented to domestic goods. Governments can choose only two of the three above goals. Governments can do any two, but not all three policies simultaneously. In reality, the degree of exchange rate flexibility lies within a continuum. The greater the attention given to the exchange rate, the more the constrained the monetary policy can be for other objectives.

With free capital mobility, capital is free to flee from nations of heavy taxation of capital. Countries will thus lose some autonomy of capital taxation. This results in competition between nations and lowering of capital taxation rates, internationally. As a result, there will be a tendency for equality of capital income taxes and interest rates across borders. So, a smaller country (such as Austria) becomes linked to the interest rate policy of a larger neighboring country (such as Germany). The equalization of interest rates across borders can be cut by prohibiting cross border transactions, thereby cutting off the arbitrager's ability to take advantage of unequal interest rates. For a long time, this is what happened according to the instructor. It has become increasingly difficult to do however, in the face of increasingly open international capital transactions.

The more current option is to forgo a fixed exchange rate policy, thereby allowing monetary policy to be used domestically. This is what occurred in the US in 1973 when the Breton Woods agreement was abandoned. The US has an advantage in that a floating rate will not impact a closed economy very much. In Europe and elsewhere, where there has been an insistence on fixed exchange rate policies, the nations end up with financial crisis. There is a pressure to fight recession in the face of rising unemployment, for instance. In order to defend the fixed exchange rate, the policy makers will have to increase interest rates, which is not what is called for in recessions. Policy makers end up floating the exchange rate so that they can deal with recessions at home by generating aggregate demand. For example, in Sweden in 1992, that country refused to give up the fixed exchange rates, but ended up doing so after arbitrage activity resulted. The article notes the London Bank example as another situation of the same thing occurring.

For a long time, nations had a managed exchange rate. A peg existed, and then the nations would adjust it every once in a while. There are too many pressures in an open capital market to do this currently, however. A bi-polar choice results. Either a nation can have a completely free float, or it can develop a currency union (like with the Euro) that then floats outside of the union. The idea of a small open economy is not tenable with all three options.

There is a basic argument on efficiency grounds: that taxes on capital should be low to encourage long-term investment and higher living standards. Empirically, we do not see equal capital tax rates or equal social services across nations, however. It is difficult to say how far the tax competition might go in the LT. Already there is a trend to tax consumption heavier.

Discussion as to Fiscal Policy. Many observers fear that the constraint of financial openness poses a dilemma for fiscal policy. Either cost of social services and of government generally must be shifted to labor, or governmental services must be scaled back. Evidence exists for that with greater openness of capital, nations have lowered taxes on capital and raised taxes on labor. This can (and has) produced a populist backlash to international trade.

As to Income Distribution. Increased trade depresses wages in the higher income nations and raises wages in the nations with lower wage rates. Import restrictions cannot prevent factor price convergence when the capital markets are free and open.

As to Market Failures. International trade can produce greater benefits but it also constrains national choices over monetary and fiscal policy and may facilitate excessive borrowing. The opportunity to diversify portfolios seems to not have been utilized. The majority of investors remain at home with their wealth. As of the 1980's, US investors had 94% of their wealth at home, and the Japanese had 48% of their wealth in Japan. Germany, France, and Canadians, hold only 1% of their wealth in the US or Japan. No one knows why people do not take full advantage of such obvious opportunity. It could be that the profit stream associated with domestic firms came from production abroad. So, investment in domestic businesses may be sufficient to obtain international diversification. Foreign direct investment is substantial, as well. There may just be unfamiliarity with international information.

Crisis in Capital Markets. By the 1990's foreign exchange crisis have occurred (examples: Mexico 1994; Russia 1998; Thailand and Asia 1997). Some people blame greedy market operators. The opposing view is that global markets are simply performing a needed role in discipline imprudent government policies. Then there is the grey area, where neither view is correct. With the grey area, the feeling is that a need exists for more effective monitoring and regulation of assets and liability structure of financial institutions. (This is referred to by the author as the 1st best case). The 2nd best case is for limiting foreign capital inflows through taxes on capital imports, with greater exchange rate flexibility.

One should not conclude that capital mobility is stabilizing in the absence of underlying vulnerabilities. There needs to be a disclosure of key economic data (The IMF proposes this).

The IMF as Leader. The IMF came into the picture in 1994 with Mexico, and in 1997 with Argentina and Thailand. The IMF has embraced its role as a leader of last resort. The IMF seeks to have progressive integration into world capital markets. International Finance can be an engine to growth but there needs to be adequate safeguards. Capital markets must be competitive and free of government favoritism. Investors and capital recipients must avoid excessive risks.

The IMF lending role can generate a negative wedge in the capital markets. Because investors generally believe that the IMF will come to the rescue in nations with a financial crisis, the speculators will not worry so much regarding international risk. They then will invest in unsound foreign areas, knowing that the IMF will engage in a bail-out if things get too rough in foreign nations.

Conclusion. The post WWII environment had been characterized with growing acceptance of economic openness. But their needs to be economic stability and social safety nets that may at times conflict with capital openness. Financial integration holds significant benefits despite the periodic crisis, and in any event, may be impossible to stop. The challenge is to maintain economic and political environments in which to continue the trend of international integration. Integration can yield greater benefits but integration can also lead to constraints of monetary systems internationally.

The Model and the Political Economy

The HH model has heterogeneous agents within it having different interests. The model divides between young and old, and to a certain extent, the rich and poor. The poor are impliedly the young who have no savings, and the old who are rich in accumulated savings.

Assume that the two assets of the model are money and capital (instead of consumption and savings), and that equal rates of return exist between the two asset classes. The agents are indifferent to holding money or capital.

Now, let's run through the model, changing the various factors around to account for a political economy. The following applies:

$$Rt = Pt / Pt+1$$

Where Rt is the rate of return in period t for both assets, Pt is the pricing in period t, and then Pt / P t+1 is the inverse of the inflation rate.

Money growth in the economy will be:

$$H\ t+1 = \mu\ A\ (r)$$

Where H is the money growth, mu, μ, is >= 1. In the standard model, the growth of the money supply is considered exogenous to the model. But, in a political economy, the agents can and will decide the question, since the money supply can be adjusted through political action. Thus, the policy question becomes: what is the appropriate rate of growth for the money supply?

Assume that HH lives for 3 periods, with the youngest period not working, not saving, but participating in the system. The middle group would be the young of the model, who save, consume, work, and participate. The old as the same as before, with consumption, no savings, no working. They do not participate since they really do not care of the next period activities. The youngest group are the most forward looking in that they are mostly concerned with what they will be earning in the next period. There will be intergenerational conflict between those looking for a high wage and those wanting a high interest rate. A trade-off occurs between these two desires because wages are inversely proportional to interest rates.

Further assume population growth. Thus, more people are in the young group than in the middle and than in the old group. The labor force is:

$$N\ t+1 = \eta\ Nt, \text{ with } \eta > 1$$

Where ada, η, is the growth rate of the population. The households will maximize the log of their middle age consumption plus the present value of their future consumption. The equation is:

$$V = \text{Ln } C + \beta \text{ Ln } C, \text{ with } 0 < \beta < 1$$

Beta is the present discount factor for future consumption. Aggregate savings is:

$$A\ t{+}1 = (Nt{+}1\ (\beta)\ wt{+}1) / (1 - \beta)$$

This is merely the middle age population times some fraction of their wages.

The production function is stated as:

$$Yt = Kt^{\alpha}\ Nt^{1-\alpha}$$

The multifactor productivity factor, A, drops out of the production function, for purposes of simplicity. The marginal products of labor and capital are still wt and rt.

The money demand is:

$$Ht / Pt = At - Kt{+}1$$

HH really want to hold onto the model, since the above equation states that money holding adjusted for the pricing level is the total assets held by the HH minus the next period capital. One can either hold assets as money or as capital.

A general equation can now be seen as a second order differential with three time periods are in it (t, t+1, and t-1). At steady state, Rt is constant, so Rt simply becomes R with 2 solutions at the steady state. Since Rt, Rt+1, and Rt-1 are all the same rates of return at steady state, the equilibrium equation just simplifies down to ada / mu, expressed as:

$$R^* = \eta / \mu.$$

Money demand is positive at the steady state, so agents will want to hold money. This is called the monetary steady state. The second stated state will be at a money demand of zero, with the following equation:

$$R\ \text{bar} = (\alpha / 1 - \alpha)(\beta / 1 - \beta)\ \eta$$

This is a steady state where people do not want to hold onto money, with asset holdings minus capital being equal to zero. So, people will quit holding money altogether. If inflation becomes high enough, people will quit holding money, and will revert to a barter economy (or will convert to other currencies, as was the case of the 4 post WWI economies noted in one of the supplemental readings).

Both of the steady states can exist, and are plausible scenarios to contemplate.

<u>Implications of the Model.</u> First, if $\mu = 1$, then $R^* = \eta$, with η being the population growth rate. The interest rate then becomes the growth rate of the economy, at a steady state equilibrium. Second, this is also the social optimum desired by the HH. Third, we would have a constant level of deflation at this interest rate level where $R^* = \eta$. This is known as the Friedman rule. Fourth, if the money growth rate equals the population growth rate, then constant prices result. This occurs if $\eta = \mu$. Fifth, if we assume that the economy will always coordinate on the monetary steady state, then there will always be two equally consistent results. Sixth, as we move towards money growth rate decreases, the R* keeps falling down to R bar, and away from the social optimum at $R^* = \eta / \mu$.

So, a high money growth rate generates a high inflation rate, and the equilibrium is driven to R bar where the people do not want to hold money at all.

The lifetime utility is defined as consumption over the general equilibrium, as follows:

$$V = C + (\alpha (1 + \beta) / \alpha) - 1 \text{ Ln } Rt + P \text{ Ln } Rt{+}1$$

Where $0 < \alpha < 1$. In the above equation, V is the lifetime utility, C is a constant representing the 1st period youth (?). The Alpha part of the equation minus the log of Rt is a negative number representing the 2nd period of an agent's life. As wages increase, interest rates decrease. Higher interest rates lowers the utility because wages would then be depressed. The last part of the equation with P log Rt+1 is a positive number representing old age. Higher interest rates will give more utility.

The central question thus becomes: What would an individual like to do with the money growth rate?

The young and middle groups would like to lower interest rates to stimulate aggregate demand and produce a higher wage rate. The old would like to have higher interest rates flowing from their investments. Please remember that the interest rate is also the marginal product of capital, and with the old holding all the assets and capital, they would like to have higher levels of return on their capital. The old would therefore like to see high interest rates, low wages, and low amounts of inflation. The generational conflict now becomes clear – the young and middle want high wages and low interest rates, while the old want higher interest rates and low wages.

If we then were able to choose the values of the money growth rate, mu or μ, what would happen? We assume that $1 < \mu < \mu$ bar. A value of 1 for the money growth rate allows for R*, while a u bar allows for R* to go to R bar.

<u>Political Cultures.</u> The central policy question of the appropriate money growth rate can be traced through three different political institutions.

With Majority Voting, the young and the middle will enjoy all the power, since there are so many more of them then the old *(this assumes everyone votes, which they don't. Typically, the old will vote more often, if for no other reason, to protect their asset base. The young do not vote as often because they have no assets, and possibly only have an interest in a future job. The middle will vote and participate in order to protect their wages).* If the young and middle control the process, low interest rates will produce higher wages but with higher inflation, so the money growth rate, μ, goes all the way to μ bar. This is a bad outcome and is not the social outcome.

With the second institution being a Policy Board, a representative from each generation will sit on the board and will have bargaining abilities. They will end up, through bargaining, with an intermediate interest rate of μ, with something between $1 < \mu < \mu$ bar. Thus, we improve upon the majority vote option, but still do not arrive at the social optimum.

With a third institution being a Constitutional Rule requiring a super majority vote, it becomes difficult to change the status quo. The young will have to offer to the middle age group some things in order to secure the super majority. Then the young are also secure in the knowledge that they know that they will be protected by a status quo in the next period by the super majority rule. This leads to R^* where $\mu = 1$, and the social optimum results. *(There will usually be a gridlock problem occurring in a super majority system, however. Any economic optimum may be subsumed within a political climate of "no action", leading to stalemate and no social optimum being acheived).*

Concluding Remarks / Executive Styled Summary

Macro Economic policy is currently viewed as an aggregation of individual household economic decisions on consumption and saving. The life cycle theory asserts that agents make decisions involving combinations of either consuming when young or consuming when old. The model involves a trade-off between consumption and savings (which is considered to be deferred consumption). From a certain wage rate when young, a person can have a certain consumption when young plus a certain consumption when old plus what was saved when young plus what was earned on interest from that savings when old. This represents all combinations of consumption when young and old that an individual can have, given a certain wage rate, and interest on savings. The ultimate decision to consume or save is made by optimizing indifference curves within a budgetary constraint.

Key implications of the life cycle model are that 1) consumption is smoothed over the life cycle; and 2) the path of consumption expenditure should be independent of the income path within any one year. The data suggests however that consumption and savings are synchronized to the business cycle, with consumption increasing during good times. There may be some ST shock to consumption correlating to income in a business cycle, but that may not negate consumption smoothing over the entire life cycle.

The model also predicts that borrowing prior to labor market entry can and should occur, with accumulation of savings during the work life, followed by dissavings in retirement. The data however appears to have consumption fall during retirement, and this would indicate some consumption correlation to a fall in income.

Output at the firm level depends on two inputs, labor and capital, and also depends on the efficiency of their use. Capital is the accumulated factor, and at equilibrium, the model ends up with just the right amount of capital for the labor employed. Wages should be closely related to worker productivity. The US data suggests that it is in fact related. As labor productivity increases, the real pay per hour has also been increasing over the years.

The US economy has experienced a "capital deepening", with the capital stock growing but at a slower rate relative to employment growth. A change in the production mix has also occurred, and technological changes have dramatically increased labor productivity as compared with capital productivity, while a shift away from industry to services has had the opposite effect. A change in the nature of labor inputs has also been noted. The US labor force has been changing over the last thirty or more years as women have entered the work force in large numbers. The labor force has also brought in a number of inexperienced workers with a slowdown in educational levels. The economic behavior of households can be compared with firm theory to produce a general equilibrium between the two. Firms want to maximize profits while household agents want to optimize the consumption-savings trade-off.

On economic growth, a mature economy will typically increase by the rate of population growth rate, since over the LT, everything else nets out to an equilibrium point. Aggregate variables, such as output, capital, and labor, will all increase at the same rate of growth as that of the general population. With both technological change and population growth occurring at the same time, aggregate growth will be the sum of the rates of growth of population and technology.

Technological change may be endogenous to and produced by micro-economic decisions (such as the R&D investment levels of a business, and the child schooling investment decisions made by a HH). Growth studies predict a LR constant rate of technological growth. The process of technological change continues over time. The endogenous growth provides an economic explanation for changes in technology.

On a steady state level of the economy, there is normally one point of steady state where there is enough capital stock to balance the system. After an exogenous shock occurs to the economy, growth will occur along a transition path until equilibrium is reestablished, and there will then be no economic reasons to move away from that balance. At equilibrium, growth would only occur if the population was growing and/or technology would be increasing. Growth of a mature economy would be related more to demographics and technological shifts than anything else.

As to business cycles and recessions, the traditional view is that recessions are temporary cycles revolving around a LT growth path. Aggregation of firm level decisions seeking profit maximization will inevitably lead to an overcapacity in plants and inventory levels, with subsequent excesses in product supply, lowering of prices, loss of profit, lay-off and plant shut downs.

Some theories suggest that business cycles are caused by shocks in technology and household preferences that are simply part of the equilibrium path. Technology advances will continuously occur but at a non-uniform rate, and thus technological shocks can be seen as a cause for many of the features of the business cycle. Other researchers believe that the business cycle is caused by variations in the money supply.

Still other evidence suggests that permanent shocks to the growth trend line might be random in nature, with some shocks being positive while other shocks are negative. The shocks will affect the output in following quarters as private sector pricing points adjust to the shock, developing in a business cycle and / or recession. The standard life cycle model can even be made to readily display business cycle type of behavior, with technology shocks explaining much of a business cycle.

With any of the above scenarios, changes in investment will be accelerated by the change in the level of output, thus making investment very volatile. Changes in output will generate even greater changes in Investment, as a new equilibrium occurs.

On stabilization policy, some research suggests that an emphasis on the business cycle is unnecessary, and the concentration should instead be on the consumption growth rate and on technological changes. For example, if technological and other exogenous shocks are causing business cycle fluctuations, macro efforts should not be focused so much on stabilization policy to correct the fluctuations as on the development of an average rate of technological change.

Other more commonly accepted research indicates that stabilization policy has been effective in changing the length and intensity of recessions and business cycles, although such policy has also generated recessions at times to combat inflation. Reductions in the frequency and the severity of recessions in the post WW II era may be due to counter-cyclical policies, as the post WWII era has experienced longer expansions, shorter recessions, and slightly lees volatility than pre WWII.

<u>On fiscal policy,</u> the government constraint is similar to the household budget constraint. Instead of balancing consumption versus savings as component parts of individual wages, the government balances expenditures against the net tax payments. Fiscal policy this becomes a series of independent decisions made at discrete times along the way, all culminating in an overall deficit or surplus. Fiscal policy may be a zero sum game, with reductions in the generational accounts of one generation requiring that the generational accounts of other generations be raised.

<u>Monetary policy</u> effectively imposes a tax on the holders of money and government bonds, with the policy creating and / or spending money by the government. In most of the current economic models, there is an assumption of quick adjustments in wages and nominal prices to levels that would produce market clearing and equilibrium. In older Keynesian theories, clearing mechanisms might be slow or "sticky", thus causing lengthy economic positions at less than optimal levels and general equilibrium being re-established only in the LT.

A broad view of monetarist policy suggests that LT changes in real variables are not the result of changes in money supply. As money supply increases in the short-term, real variables (such as aggregate output or wages) can and will be affected. In a transition period, pricing may not correlate with the money supply because the velocity of money is not constant, and pricing level will be dependent upon wages, the money stock, and the preference parameter for cash. The economy's real variables can thus be manipulated in the SR by monetary policy. But over the LT, the economy will eventually return to its original transition path. Thus, many believe that pricing and the money supply will move in accord with each other in long-term time frames.

<u>As to inflation,</u> some research concludes that the expectations of future governmental policy will impact the economic environment in current time frames. Inflation may therefore be able to be controlled by a credible commitment to anti-inflationary policies. The effectiveness of government policy today depends in large part upon the expectations of future policy. If pricing and the money supply are correlated over the long run, then stability in the money supply would be an important objective of macro policy. In the short run however, money supply changes may affect real variables, and thus monetary policy could be used to temporarily modify adverse macro economic conditions.

On international activity, cross border investment may serve to equalize interest rates, real wage rates and worker productivity, all assuming mobility of capital. The equalization would be a gradual process however, as it would occur in a step-by-step fashion along a transition path of moving multiple economies towards a merged world's economy at equilibrium. Assuming open international trade, the standard of living in nations with lower capital to labor ratios will gradually rise, while the standard of living in nations with higher ratios will be reduced. There will therefore be clear winners and losers between the nations until an international equilibrium is established between all nations. There will be more output in total with open trade than there will be with closed economies, however. With higher total output, investors in nations with higher initial productivity will eventually see their rate of return increase (and/or their total profit) from the increase in total world output. Thus, in nations with higher labor or capital productivity, wage earners would tend to resist trade openness while investors would tend to favor open policies.

In order to induce nations to enter into an open international trade, it therefore may be necessary to have a side payment back to the nation with the higher productivity ratios, in order to compensate for a relative lowering of the wage rate and relative increasing in interest rates. There has been some evidence of side payments being made through international trade treaties where compensation flows between the two signatory nations to the agreement.

Further, domestic fiscal policy can have an impact internationally. The nation's relative size is critical in determining whether domestic fiscal policy will have an impact on anything other than its own asset accumulation. The larger the population (and output), the greater the international impact from a purely domestic fiscal or monetary policy. The effects from policies of much larger trading partners may even swamp the domestic fiscal and monetary policies of smaller nations.

An open market policy will deprive a government of the ability to target the exchange rate and simultaneously use monetary policy in the pursuit of other policies. A nation cannot simultaneously engage in 1) fixed exchange rates; 2) open capital markets; and 3) pursuing monetary policy oriented to domestic goods. Governments can choose only two of these three goals simultaneously. Since the degree of exchange rate flexibility normally lies within a continuum, the greater the attention given to the exchange rate, the more constrained the monetary policy will be for other objectives. Many nations have found that fixed exchange rates cannot be successfully maintained if the goal is to encourage open international trade, and have thus moved towards greater flexibility in their currency exchange rates.

The post-WWII environment had been characterized with growing acceptance of economic openness. Financial integration holds significant benefits despite the periodic crisis, and in any event, may be impossible to stop. Evidence exists however, that with greater openness of capital, nations have lowered taxes on capital and raised taxes on labor. Along with a lowering in wage rates in nations with higher productivity levels, open trade policies can (and has) produced at times a populist backlash. Import restrictions have been attempted, but such restrictions cannot prevent factor price convergence when the international capital markets are otherwise free and open to trade (restrictions may only serve to slow down the convergence). International trade can produce greater benefits but it also constrains national choices over monetary and fiscal policy and may facilitate excessive borrowing. Arguably then, there should be economic and social safety nets that may conflict with capital openness. The challenge is to maintain economic and political environments in which to continue the trend of international integration.

<u>As to a political economy,</u> the model suggests that individual agents will have differing interests. The model divides between young and old, and to a certain extent, the rich and poor (with differing interests occurring along the lines of wage-income earners versus capital-income earners). Wage earners will desire macro policies favoring higher wages, greater economic growth, lower interest rates and a general indifference to modest forms of inflation, while capital income earners will favor policies generating low inflation and higher interest rates, with a general preference towards lower wages. There may be intergenerational conflict between those looking for a high wage and those wanting a high interest rate. In a well-functioning political economy, a political trade-off ultimately occurs between these two desires to satisfy all groups.

In a steady state economy, the interest rate becomes the growth rate of the economy, and if the money growth rate equals the population growth rate, then constant prices result. A money growth rate higher than the population growth rate may generate a high inflation rate over the LT. So the central policy question of the appropriate money growth will involve the trade-off between wages and interest rates, and more specifically, resolution of the intergenerational conflict (or the resolution of the conflict between wage earners and capital income earners).

The conflict resolution can occur through a variety of political institutions. With a majority rule process, the applicable monetary policy will be dependent upon whatever demographic group momentarily holds the popular vote. That may or may not result in the social outcome, as the resulting monetary policy may generate higher inflation or higher wages than optimal. A Policy Board (similar to the Fed), can improve upon such a result, if representatives from each generation are part of the Board. Negotiations between parties on the Board will result, but this may still not achieve a social optimum. With a super majority vote system (some super majority rules exist in the US Senate), a social optimal could occur if the various interest groups negotiate in order to secure a super majority. Gridlock could result however if no groups are able to achieve a super majority. This could generate a status quo environment with a sub-optimal macro policy.