Three Essays on Economics

by

Henry Willmore

B.A., Economics and Mathematics
Oberlin College, 1984

Submitted to the Department of Economics in partial fulfillment of the requirements for the Degrees of

Doctor of Philosophy in Economics

at the

Massachusetts Institute of Technology

February 1994

©1994 Massachusetts Institute of Technology

All Rights Reserved

Signature of Author

Department of Economics
December 13, 1993

Certified by

Oxfam Bénabou, Associate Professor
Department of Economics
Thesis Advisor

Certified by

Julio Rotemberg, Professor of Economics
Sloan School of Management
Thesis Advisor

Accepted by

Richard S. Eckaus
Chairman, Departmental Graduate Committee
Three Essays on Economics
by Henry Willmore

Submitted to the Department of Economics on January 11, 1994 in partial fulfillment of the requirement for the Degree of Doctor of Philosophy in Economics.

ABSTRACT

Chapter 1 contains an analysis of the behavior of the yield curve over the course of the four-year Presidential cycle in the U.S. It shows that the yield curve steepens before elections and flattens after them. Such behavior is consistent with attempts to use either fiscal or monetary policy to generate faster growth ahead of elections.

Chapter 2 presents evidence that inflation and the growth rate of the work force are positively correlated in the U.S. It is shown that such a relationship is consistent with attempts by policymakers to reduce unemployment in the face of demographic changes which would tend to drive unemployment up.

Chapter 3 analyzes capital accumulation and welfare in an overlapping generations model with different-sized cohorts.

Thesis Advisors:

Roland Bénabou
Associate Professor of Economics

Julio Rotemberg
Professor of Economics, Sloan School of Management
ACKNOWLEDGEMENTS

I would like to thank the following:

Roland Bénabou, my thesis supervisor, for his patient help in seeing me through the process. The final version of this thesis was greatly improved by his suggestions.

Julio Rotemberg, my second reader, also made several suggestions which resulted in a better final product.

The National Science Foundation for financial support in the form a Graduate Fellowship.

My wife, Aileen, for her constant encouragement.

Needless to say, responsibility for any errors in this thesis is exclusively mine.

Finally, I would like to dedicate this thesis to my mother, Lys.
# TABLE OF CONTENTS

## Chapter 1
Interest Rates and Political Cycles 9 - 27

## Chapter 2
Population Growth and Inflation 28 - 44

## Chapter 3
Demographic Cycles in an Overlapping Generations Model 45 - 69
CHAPTER 1

Interest Rates and Political Cycles

Over the past 20 years, the interaction among voters, politician and the economy has been extensively studied by economists and political scientists. These studies have included formal modelling of political choices regarding the economy, as well as empirical analysis of the relationship between politics and economic outcomes and policy decisions. This paper contains an analysis of the relationship between interest rates and the electoral cycle in the U.S.. Surprisingly, most studies of political manipulation of the economy have focused on measures of fiscal policy and monetary growth rather than interest rates.

Section 1 reviews some relevant models and empirical work regarding political cycles and the economy. Section 2 contains a discussion of what certain interest rates and interest rate spreads indicate about the stance of economic policy. In section 3, some empirical results on the movements of interest rates over the course of electoral cycles are presented. These results are discussed in the context of competing theories regarding political manipulation of the economy.

1. Political Cycles and the Economy: An Overview

In analyzing different models of political cycles, Alesina and Roubini (1990) distinguish between "opportunistic"
models and "partisan" models. In opportunistic models, elected officials seek to manipulate the economy in such a way as to maximize their chances of reelection. Partisan models emphasize difference in "tastes" between different parties. Typically, such models examine a system in which there is a left-wing party whose main goal is to reduce unemployment and a right-wing party which places more emphasis on maintaining price stability.

As first developed by Nordhaus (1975), the opportunistic model was based on the following assumptions: output was determined by an expectational Phillips Curve, inflation expectations were adaptive, politicians only cared about winning elections, voters judged incumbents' performances on the basis of inflation and growth during their terms of office, and the timing of elections was exogenously fixed. With these assumptions, Nordhaus showed that incumbents would stimulate the economy before election time, and inflation would accelerate shortly before or after the election as a result.

A more recent version of the opportunistic model due to Persson and Tabellini (1990) has replaced the assumption of adaptive inflationary expectations with the assumption of rational expectations. In addition, rather than voting on the basis of past outcomes, voters are assumed to choose the candidate which they rationally expect to maximize their utility. This version of the model has the same implications as the Nordhaus model with respect to opportunistic cycles on
monetary and fiscal policy instruments, as well as inflation. However, it contains no implications with respect to output or unemployment.

While opportunist models assume that politicians seek to maximize their chances for election, partisan models assume that they seek to maximize utility based on outcomes for inflation and unemployment. In Alesina's (1987) version of the partisan model, there is a right-wing party which places greater emphasis on controlling inflation and a left-wing party which places more emphasis on reducing unemployment. Alesina assumes that wages are fixed for a certain period and electoral outcomes are uncertain. As a result, once a party comes to power, it can exploit nominal wage rigidities for the first part of its term.

In the U.S., this would imply slower growth in the first year or two of Republican administrations and faster growth during the first year or two of Democratic administrations. Growth performances should not differ in the later years for governments of different parties as wage contracts are reset based on rational expectations of inflation. However, inflation should be higher throughout a Democratic administration. More expansionary fiscal policies and monetary policies should characterize Democratic administrations.

The empirical evidence tends to support the partisan model for growth, and both models for inflation. In addition, the evidence on policy instruments such as deficits and money
growth provide some modest support for the opportunistic model.

Empirical studies of Nordhaus' opportunistic model with respect to output or employment have been carried out by McCallum (1978), Golden and Poterba (1980), and Alesina and Roubini (1990). These studies find little or no evidence supporting the model. For example, McCallum tests whether various dummy variables indicating proximity to elections are correlated with the residuals derived from an ARMA model of unemployment. He finds that the t-statistics for such tests indicate no statistically significant effects due to the dummy variables.

In contrast, Alesina and Sachs (1988) find strong support for the partisan model's implications for output. Growth in the first two years of Democratic administrations tends to be much stronger than during the first two years of Republican administrations. During the last two years before elections, growth in the two types of administrations tends to converge.

With regards to inflation, most of the empirical work supports both the partisan and opportunistic models. For example, Alesina, Cohen and Roubini (1991) find significant increase in inflation shortly after elections for a sample of OECD countries as the opportunistic model would suggest. Alesina and Roubini (1990) find that left-wing governments as associated with higher inflation as the partisan model would suggest.

A number of studies have been carried out of political
manipulation of monetary and fiscal policy instruments. In general, these studies find only weak evidence supporting either the partisan or the opportunistic model. Typically, the coefficients being tested are of the right sign but not statistically significant. Moreover, the results tend to be quite sensitive to the time period covered by the data.

For example, Grier (1987) found that dummy variable designed to represent the opportunistic model were statistically significant when added to an autoregressive model of money growth. His data consisted of quarterly M1 growth in the U.S. from 1960 to 1980. However, subsequently, Alesina, Cohen, and Roubini (1991) showed that Grier's results did not hold when data for the 1980s was added. In another study, Meiselman (1986) concludes that some but not all administrations manipulate money growth prior to elections.

As for fiscal policy, Nordhaus (1989) finds that the estimated coefficients of variables embodying the opportunistic and partisan models have the expected sign for equations explaining transfers and taxes. However, they tend not to be statistically significant. Nordhaus also finds that his results are sensitive to the sample period used, and cites examples which suggest that only some administrations manipulate fiscal policy.

2. **Interest Rates and Policy**

In this section, it will be argued that certain interest rates and interest rate spreads contain useful information
about the stance of both monetary and fiscal policy. Moreover, movements of interest rates are more likely to accurately reflect political attempts to manipulate the economy than money growth, taxes or transfers.

In a recent paper, Bernanke and Blinder (1990) argue forcefully that: (1) the federal funds rate is a better measure of monetary policy than money growth, and (2) changes in the federal funds rate have a significant effect on real macroeconomic variables. To prove their first point, they argue that for the fed funds rate to be a good indicator of monetary policy, it must be unresponsive to changes in reserve demand. Once the Federal Reserve sets a target for the fed funds rate, it must be willing to supply reserves to the banking system in a completely elastic way at the target rate. Bernanke and Blinder show that (with the exception of a three year period from 1979 to 1982 when the Fed placed more emphasis on targeting money growth) the Fed reacted to innovations in money demand by increasing the supply of reserves rather than letting the fed funds rate fluctuate.

To argue their second point, Bernanke and Blinder developed a model in which increases in the fed funds rate lead banks to reduce the amounts of loans made. Under certain conditions of asymmetric information, they show that some borrowers can only obtain loans from banks, or at least face higher rates when borrowing from alternative lenders. As a result, the economy is depressed when credit is curtailed to these borrowers. Bernanke and Blinder then go on to show that
the fed funds rate outperforms a variety of other indicators of monetary policy in forecasting several real macroeconomic variables.

Their results are consistent with the findings of Stock and Watson (1989) in their work on experimental indices of leading indicators. They find that the spread between the 10-year T-note and 3-month T-bill has significant marginal predictive power for an index of coincident indicators. Since the fed funds rate and 3-month T-bill are highly correlated, their results broadly support Bernanke and Blinder's argument.

The use of the yield curve as an indicator of monetary and fiscal policy is also supported by Blanchard's (1981) IS-LM model. In his model, demand is a function of stock prices (q), income (y) and an index of fiscal policy (g):

\[ \dot{d} = aq + \beta y + g \]

Output adjusts to spending gradually:

\[ \dot{y} = \sigma(d - y) = \sigma(aq + g - by); \quad b = 1 - \beta > 0 \]

The three nonmoney assets in the model (stocks, and short- and long-term bonds) are assumed to be perfect substitutes so that they each have the same expected short-term rate of return. Blanchard initially assumes that prices are fixed so that nominal and real rates are the same.

Profits are assumed to an increasing function of output:

\[ \dot{\pi} = \delta + \alpha y; \quad \alpha > 0 \]

Arbitrage between the three assets requires that:

\[ r = R - \dot{R^*}/R \]

\[ r = \dot{q^*}/q + (\delta - \alpha y)/q \]
where \( r \) is the short-term real rate, and \( R \) is the long-term real rate. Asterisks denote expectations. Portfolio balance is denoted by a conventional LM relation:

\[
6) r = c_y - h(m - p)
\]

Substituting (6) into (5) gives:

\[
7) c_y - h(m - p) = \dot{q}^*/q + (\delta - \alpha y)/q
\]

The dynamic system described by (2) and (7) is illustrated in Figure 1. Figure 2, 3 and 4 (taken from Blanchard (1981) describe what happens in the cases of an unanticipated monetary expansion, an anticipated monetary expansion, an anticipated fiscal expansion. Since fiscal expansions take time to enact, the case of an unanticipated fiscal expansion was not examined.

Blanchard distinguishes between the "good-news" case (in which an increase in output leads to higher stock prices and the \( \dot{q}=0 \) curve is upward sloping) and the "bad news" case (in which higher output decreases stock prices via higher interest rates and \( \dot{q}=0 \) slopes downward).

In an unanticipated monetary expansion, an increase in \( m \) lowers \( r \) immediately, leading to higher output over time. In turn, higher output over time will cause \( r \) to rise. Therefore, \( R \) falls, but not as much as \( r \). The yield curve is at its steepest at the time of and shortly after the monetary expansion.
Figure 1

A. Bad News

B. Good News

Figure 2. The Effects of an Unanticipated Monetary Expansion
Figure 3. The Effects of an Anticipated Monetary Expansion

Figure 4. The Effects of an Anticipated Fiscal Expansion
In an anticipated monetary expansion, stock prices rise and long-term interest rates fall (at the time the expansion is announced or becomes embedded in expectations) in anticipation of a fall in short-term rates (once the expansion occurs). Initially, the yield curve flattens during the period between the announcement and expansion. However, the yield curve is at its steepest at the time of and shortly after the monetary expansion occurs, presumably during the second half of an administration's term.

The effects of a fiscal expansion vary somewhat in the "good news" and "bad news" cases. In the bad news case, the expansion causes stock prices and hence short rates to fall once it is announced. However, since short rates will rise once the expansion takes place, long rates rise immediately. The yield curve starts to steepen at the time of the announcement and reaches maximum steepness at the time of implementation.

In the "good news" case, stock prices rise as a result of the expansion. Therefore, short rates also rise. Long rates rise even more in anticipation of further increases in the short-rate.

Blanchard's analysis shows that the yield curve reaches maximum steepness at the time either a fiscal or monetary expansion is implemented. Presumably in the second term of a politically motivated administration. The results described above apply to the real yield curve. It is likely that they apply even more strongly to the nominal yield curve. The
reason for this is that fiscal and monetary expansions increase expected inflation. This will have little or no effect on an overnight rate, such as the fed funds rate, but a larger effect on longer-dated bond yields.

Laurent (1989) provides a similar argument for why the 10-year T-note to fed fund spread (henceforth referred to as the spread) is a good indicator of whether monetary policy is too loose or too tight. He points out that yield curve should steepen if the monetary authorities are keeping the fed funds rate too low. The main reason for this is that an excessively low fed funds rate will eventually lead to an acceleration of inflation, which in turn will cause a tightening of monetary policy.

Before moving on to the empirical results in the next section, one more point should be made about why a variable such as the spread is likely to be the most appropriate indicator of attempts to manipulate the economy. This has to do with the fact that politicians are opportunistic in a different sense than the one Nordhaus uses. A president seeking reelection can seek to work either through Congress (fiscal policy) or the Federal Reserve (monetary policy). His choice will depend on which institution is most malleable at the moment. As a result, both fiscal and monetary policy will be manipulated only some of the time. As a result, statistical tests of budget deficits and money growth may fail to provide evidence of a political cycle. But a variable such the spread, which reflects the manipulation of either, will more
consistently capture the effects of either the partisan or opportunistic model.

3. **Empirical Results on Interest Rates**

In this section, evidence will be presented on interest rate movements over the course of the political cycle. The formal tests presented will make use of quarterly data from 1955 to 1990. In some ways, the most striking evidence regarding interest rate movements over the political cycle can be summarized in the table below:

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spread</td>
<td>0.05</td>
<td>0.29</td>
<td>1.06</td>
</tr>
</tbody>
</table>

**Table 1**

Standard Deviation: 1.43

As can be seen, the spread between 10-year Treasuries and the fed funds rate tends to be much higher during the last two years of a presidency than the first two years, suggesting more expansionary policy in the last two years. Also noteworthy is the fact that the largest changes tend to occur between the second and third years, and fourth and first years. Given the lags between changes in monetary and fiscal policy and growth, it is to be expected that more stimulative policies would be put in place in the third year. In addition, a sharp change to more contractionary policies can be expected shortly after the election. However, since the standard
deviation of the spread variable is quite large, formal statistical tests of its movements over the electoral cycle are needed.

The formal tests of political effects on interest rates are similar to those introduced by McCallum (1978) and adopted by others subsequently. First, an autoregressive model of the variable, spread, is estimated. It was found that only two lagged periods were significant. Then various dummy variables representing the effects of the opportunistic and partisan models were introduced.

To test the opportunistic mode, two dummy variable were constructed. The first, DOM1, takes on the value 1 in the first 4 quarters of an administration and zero otherwise. The results for this variable are presented in the table below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>.21</td>
<td>2.4</td>
</tr>
<tr>
<td>Spread (-1)</td>
<td>.97</td>
<td>11.7</td>
</tr>
<tr>
<td>Spread (-2)</td>
<td>-.16</td>
<td>1.9</td>
</tr>
<tr>
<td>DOM1</td>
<td>-.32</td>
<td>2.1</td>
</tr>
</tbody>
</table>

\[ R^2 = .7286 \quad DW = 1.99 \]

As can be seen, the spread is significantly lower during the first four quarters of a new administration. Regressions using an alternative dummy, DOM2, taking a value of 1 in the
eight quarters up to and including the election quarter, were also performed. The estimated coefficient for DOM2 was positive with a t-statistic of 1.8. For a one-sided t-test, this is significant at the 95% level. These results provide support for the opportunistic model.

To test the partisan model, a dummy variable, DPM1 was created. DPM1 takes on the value 1 during Democratic administrations and zero during Republican ones. The theory here is that Democrats are more tolerant of higher inflation in their efforts to generate stronger growth. Accordingly, the yield curve should steepen during Democratic administrations. Surprisingly, the coefficient for DPM1 is negative and shows some statistical significance, as can be seen below.

Table 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>.30</td>
<td>3.0</td>
</tr>
<tr>
<td>Spread (-1)</td>
<td>.96</td>
<td>11.7</td>
</tr>
<tr>
<td>Spread (-2)</td>
<td>-.15</td>
<td>1.9</td>
</tr>
<tr>
<td>DOM1</td>
<td>-.32</td>
<td>2.1</td>
</tr>
<tr>
<td>DPM2</td>
<td>-.25</td>
<td>1.7</td>
</tr>
</tbody>
</table>

R2 = .7340  DW = 2.00

A possible explanation for the results in Table 3 can be found from a similar regression having the fed funds rate as the dependent variable.
The above results suggest that the Federal Reserve tends to tighten monetary policy after elections (DOM1 > 0), and to keep interest rates higher during Democratic administrations (DPM1 > 0). The central bank seems to seek to counteract the more inflationary policies of Democratic administrations. This could be related to the fact that the Democratic Party has controlled the Congress almost throughout the sample period. As a result, Democratic presidents probably have found it easier to pursue their macroeconomic objectives through fiscal policy. The results in Tables 3 and 4 also suggest that the Federal Reserve does sometimes act independently of the executive branch.

4. **Conclusions**

In section 3, it was argued that interest rates or interest rate spreads would provide a more comprehensive gauge
of political attempts to manipulate the economy that other measures of monetary and fiscal policy. The results in section 4 indicate that movements in the variable, Spread, are indeed strongly correlated with variables that reflect the effects predicted by the opportunistic model. Spread appears to better capture these effects than the money growth measures of Grier (1987) or the tax and transfer variable of Nordhaus (1989).

While the empirical results seem to reject the partisan models, they also suggest that the reason for this may be due to Federal Reserve independence. As such they provide some support for models such as those in Alesina and Tabellini (1987) which emphasize the interaction of policymakers with control of different policy instruments.
References


CHAPTER 2

Population Growth and Inflation

The role of changing expectations is often invoked in explaining shifts in the Phillips Curve relationship. The basic argument is that changing expectations of inflation affects the tradeoff between inflation and unemployment. Many models now emphasize that only \textit{unexpected} inflation can lead to a decline in unemployment. This sharply restricts the ability of monetary authorities to affect employment levels by pursuing inflationary policies.

Nevertheless, the economic history of recent decades suggests that monetary authorities have pursued or at least tacitly accepted a very wide variety of outcomes regarding inflation. This can be given any number of interpretations. It may be that monetary authorities are constantly seeking ways to surprise wage setting agents. Another interpretation is that the policymakers have set policy in reaction to a series of shocks. Since the nature and magnitude of these shocks can vary over time, the outcomes for inflation would also exhibit a time-variant pattern.

In this paper, the reaction of monetary policymakers to a certain category of shocks, demographic changes, is analyzed. First, statistical evidence linking changes in population growth and variations in inflation rates is presented. Subsequently a theoretical model consistent with the empirical evidence is developed. The model is a variant of Alesina's partisan model of economic policy. It makes use of
an expectations-augmented Phillips Curve as well as a simple objective function for policymakers.

**Inflation and Population Growth**

The history of post World War II inflation can be broken down into roughly three periods. In the first period, lasting through the late 1960s, inflation was typically below 3% and showed no pattern of acceleration or deceleration. The second period, from the late 60s to early 80s, was generally characterized by rising inflation. Since 1983, inflation has dropped to a level somewhat above 4% and remained steady.

This history as measured by the consumer price index is summarized in figure 1. Figure 1 also contains, in addition to the graph of consumer inflation, a graph of the growth rate of the working age population, defined as those between the ages of 20 and 64. Both graphs display similar movements, in the case of working age population caused by the baby boom which resulted in rapid growth from the late 60s to early 80s.

It is the thesis of this paper that the apparent coincidence in the movements of these two variables is more than a case of "chartism." In the remaining sections of the paper, statistical analysis of these comovements and a theoretical explanation for them is presented.

Table 1 shows the partial correlations between inflation, as measure by the CPI, and the growth rate of the working age population. The data suggest the possibility of a temporal relationship, with accelerations in the growth rate of the
working age population preceding and coinciding with acceleration in inflation. Table 2 gives regression results relating population growth to inflation, with a correction for the first order serial correlation of the error terms. The variable measuring demographic change is called MIX, which is the proportion of the population between ages 20 and 64 that is between 20 and 29. This table also suggests a positive relationship between demographic pressures and inflation as measured by the consumer price index.

Similar regressions were attempted with alternative measures of inflation, such as the fixed-weight GNP deflator, and the CPI excluding food and energy. In some ways, this last measure of inflation is a more attractive candidate for analyzing possible long-run relationships between demographics and inflation, since it is less influenced by short-term phenomena such as oil shock and droughts. However, data for this component of the CPI is only available since 1960, and there is therefore some loss of degrees from freedom. Nevertheless, the results are broadly similar to the regressions using the overall CPI.

In addition, the robustness of the results in table 2 as tested by including a quadratic time trend, and a measure of the effects of oil shocks, denoted GAS, is the rate of change for the gasoline and oil component of the CPI. As can be seen in table 3, MIX remains statistically significant in explaining inflation.
Finally, some corroborating evidence for the above results can be found in international comparisons of inflation rates and demographic trends. The data for 22 OECD countries indicate that there exists a positive correlation between the MIX variable and inflation. While the results are consistent for each of the last three decades, the level of statistical significance usually falls only between the 80 and 90% levels. Figures 1 to 3 show scatterplots and a regression line for the 22 countries during the 1960s, 1970s and 1980s. The MIX variable is measured at mid-decade and inflation is the average for the following three years.

The remainder of this paper consists of a theoretical explanation for the results presented above.

The Model

Following Alesina's model, it is assumed that two types of policymakers or parties exist. These parties are denote by the superscripts R and D, respectively. They are assumed to have objective functions, expressed here in the form of loss functions, based upon their preferences regarding the inflation and unemployment rates. Party R's objective function is written as:

1) \[ L^R = \frac{a}{2}\pi^2 + \frac{1}{2}(u-u^R)^2 \]

where \( \pi \) is the inflation rate, \( u \) is the unemployment rate, and \( u^R \) is the part R's ideal unemployment rate. For simplicity, it will be assumed that both parties' ideal inflation rate is zero. Similarly, party D's objective
function is written as:

2) \[ L^D = \frac{c}{2} \pi^2 + \frac{1}{4} (u-u^D)^2 \]

where \( u^D \) is party D's ideal unemployment rate.

Here, both parties' objective functions take the form of quadratic loss functions based upon deviations from policy ideals. In his work on partisan models of the political business cycle, Alesina used these objective functions to show how economic fluctuations can arise from uncertainty about which party will win upcoming elections. The parties are allowed to have differing ideal unemployment rates, denoted here by \( u^D \) and \( u^R \), as well as different views on the relative importance of achieving their inflation and unemployment targets, captured here by the coefficients \( a \) and \( c \).

It is assumed that party D attaches greater importance to meeting its unemployment target \( (a>c) \), and would like to achieve a lower unemployment rate \( (u^D>u^R) \). In political terms, party D can be thought of as left-wing party associated with labor unions, and party R can be thought of as a conservative party representing the interest of business.

The final component of the model is an expectations-augmented Phillips Curve expressed as follows:

3) \[ u = u^* - \theta (\pi - \pi^e) \]

where \( u^* \) is the natural rate of unemployment and \( \pi^e \) is the expected rate of inflation. In the following section, the parties' objective functions are combined with the Phillips Curve to derive equilibrium inflation and unemployment rates.
Equilibrium inflation and unemployment

Equation (3) can be substituted into equations (1) and (2) to rewrite the objective functions as follows:

4) \[ L^R = \left(\frac{a}{2}\right)\pi^2 + \left[\left(u^*-u^b\right) - \theta(\pi - \pi^e)\right]^2 \]

5) \[ L^D = \left(\frac{c}{2}\right)\pi^2 + \frac{1}{2}\left[\left(u^*-u^D\right) - \theta(\pi - \pi^e)\right]^2 \]

The parties's optimal choice of inflation can be derived through analysis of the first-order conditions of equations (4) and(5). In the case of party R the result would be:

6) \[ \frac{\delta L^R}{\delta \pi} = a\pi - \left[\left(u^*-u^b\right) - \theta(\pi - \pi^e)\right] = 0 \]

implying an optimal inflation rate for party R (denoted \( \Pi^R \)) of:

7) \[ \pi^R = \frac{\theta(u^*-u^b) + \theta^2\pi^e}{a + \theta^2} \]

Similarly, party D's optimal inflation rate is:

8) \[ \pi^D = \frac{\theta(u^*-u^D) + \theta^2\pi^e}{c + \theta^2} \]

Since \( \pi^R \) and \( \pi^D \) are both in terms of \( \pi^e \), the expected rate of inflation needs to be solved for.

For the purpose of this paper, this can be done through the simple expedient of assuming that party D will be elected with probability \( p \) and party R with probability \( 1-p \). As a result,

9) \[ \pi^e = p\pi^D + (1-p)\pi^R \]

or substituting equations (7) and (8) into equation (9) and solving:

10) \[ \pi^e = \left[\left(a + \theta^2\right)p\theta(u^*-u^D) + (c + \theta^2)(1-p)\theta(u^*-u^b)\right]/\left[ac + a(1-p)\theta^2 + cp\theta^2\right] \]

In turn, equation (10) can be substituted into equations (7) and (8) subsequently into equation (3) to determine the
inflation rates and unemployment rates which would be observed when one party or the other was in power.

These results were focus of Alesina's work. They show that electoral uncertainty can lead to economic fluctuations even when all decision-making agents have rational expectations.

The role of demographics

The effects of changing workforce composition can be incorporated very simply into the above framework. One way to start is by assuming two classes of workers: young workers and mature ones. Young workers, for a variety of reasons, typically suffer from a higher rate of unemployment. At any given time, the overall unemployment rate is a weighted average of the unemployment rates for the two groups.

Similarly, the natural rate of unemployment at any given time is a weighted average of the two groups's natural rates of unemployment. The task undertaken here is to analyze the policy implications of changes in the relative weights of the two groups. For starters, the natural of unemployment can be written as:

11) \( u^* = \alpha u^y + (1-\alpha) u^m \)

where \( u^y \) and \( u^m \) are the natural rates of unemployment of young and mature workers, respectively, and \( \alpha \) is the proportion of young workers in the total labor force.

It is a simple matter to proceed next to analyze the effects of changes in the proportion of young workers on the
equilibrium inflation and unemployment rates. Referring back to equations (7), (8) and (10), it is easy to verify that: \( \delta \pi^*/\delta u^* > 0 \), \( \delta \pi^0/\delta u^* > 0 \), and \( \delta \pi^e/\delta u^* > 0 \). An increase in the natural rate of unemployment will generate more inflation. In turn, equation (11) shows that an increase in the proportion of young workers in the labor force will tend to increase the natural rate of unemployment.

The results developed above rest upon the implicit assumption that policymakers' preferences are best defined in terms of inflation and the overall unemployment rate. An alternative formulation would be to allow policymakers to distinguish between the unemployment rates for different groups. It could be assumed that policymakers and the public electing them are sophisticated enough to understand that demographic changes can alter the tradeoff between unemployment and inflation.

Such an understanding could potentially remove any relationship between inflation and the demographic composition of the workforce. There are a number of reasons why this may not be the case, however. One possible reason is that most public discussion does not include nuances about the unemployment rate amongst different groups of the workforce. This puts pressure on policymakers to focus on the overall unemployment rate. A second possible reason is that faster growth in the numbers of young worker may increase unemployment amongst older workers. If political pressure arise from unemployment amongst older workers, policymakers
may not be completely free to discount demographic effects. In any case, political pressures probably also emanate from youth unemployment.

The considerations discussed above imply that faster inflation may be a policy option in responding to demographic pressures. Correspondingly, it is easier for policymakers to adopt strict anti-inflation policies during periods of low labor force growth. During such periods, the unemployment rate is likely to rise more slowly in response to tight monetary policy.

Most other explanations of inflation have linked it to real shocks such as higher oil prices or endogenous variable such as money supply growth. For example, Zigra (1989) has constructed a model in which such shocks set of persistent inflation. Ball (1991) has raised the possibility of persistent inflation resulting rom such temporary shocks as a result of adaptive expectations. Since the two major oil shocks of the post-war period occurred when the growth rate of the working age population was very rapid, some ambiguity remains about which factor played the more important role in the acceleration of inflation. In this regard, further research using data from other nations which did not experience a post-war baby boom may be useful. The future course of inflation may also shed some light on the validity of the arguments presented here. Since the growth rate of the working age population will slow further in the 1990s, a further decline in inflation would provide support for these
arguments.

The results presented here can also be viewed in the context of the Phillips Curve literature. Following the apparent breakdown to the inflation-unemployment relationship in the 1970s, this model was modified through the addition of inflationary expectations. However, as Lucas (1973) and others have pointed out, it is not possible to continually surprise the public with unexpectedly high inflation.

The results presented here suggest circumstances under which shocks which are known to all parties long in advance, such as changes in the growth rate of the working age population, will lead policymakers to adopt high inflation policies. This result depends crucially on the existence of some sort of uncertainty about the objective functions of policymakers. In democracies, uncertainty about electoral outcomes provides one such mechanism, but other sources of uncertainty may produce the same result.
### Table 1
Cross correlations between inflation (INFL) and the growth rate of the working age population (FCAPOP). Sample range: 1948 to 1990.

<table>
<thead>
<tr>
<th>i</th>
<th>COR {INFL,PCAPPOP (-i)}</th>
<th>COR {INFL,PCAPPOP (+i)}</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.674</td>
<td>0.674</td>
</tr>
<tr>
<td>1</td>
<td>0.725</td>
<td>0.631</td>
</tr>
<tr>
<td>2</td>
<td>0.693</td>
<td>0.596</td>
</tr>
<tr>
<td>3</td>
<td>0.639</td>
<td>0.510</td>
</tr>
<tr>
<td>4</td>
<td>0.562</td>
<td>0.434</td>
</tr>
<tr>
<td>5</td>
<td>0.503</td>
<td>0.299</td>
</tr>
<tr>
<td>6</td>
<td>0.517</td>
<td>0.156</td>
</tr>
<tr>
<td>7</td>
<td>0.510</td>
<td>0.040</td>
</tr>
<tr>
<td>8</td>
<td>0.395</td>
<td>-0.076</td>
</tr>
<tr>
<td>9</td>
<td>0.275</td>
<td>-0.122</td>
</tr>
<tr>
<td>10</td>
<td>0.235</td>
<td>-0.132</td>
</tr>
</tbody>
</table>

### Table 2
Dependent Var.: Inflation (CPI)  
Simple Range: 1949-1990

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>15.3</td>
<td>5.7</td>
</tr>
<tr>
<td>MIX (-1)</td>
<td>0.70</td>
<td>7.3</td>
</tr>
</tbody>
</table>

R2 = .7151  
DW = 1.89  
F-stat = 48.9
**Table 3**

**Dependent Var.**: Inflation (CPI)  **Range**: 1950-1990

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-13.0</td>
<td>3.9</td>
</tr>
<tr>
<td>GAS</td>
<td>0.14</td>
<td>6.1</td>
</tr>
<tr>
<td>GAS (-1)</td>
<td>0.08</td>
<td>3.4</td>
</tr>
<tr>
<td>MIX (-1)</td>
<td>0.54</td>
<td>4.1</td>
</tr>
<tr>
<td>T</td>
<td>0.13</td>
<td>1.2</td>
</tr>
<tr>
<td>T2</td>
<td>.003</td>
<td>1.2</td>
</tr>
</tbody>
</table>

**R2** = .8639  
**DW** = 1.98  
**R2** = .8391  
**F-stat** = 34.9
References


CHAPTER 3

Demographic Cycles in an Overlapping Generations Model

Introduction

In recent years there has been substantial public and professional discussion of the economic effects of demographic cycles. It has often been asserted that members of the "baby boom" face an economic fate different than that of other cohorts. Most analyses of such demographic phenomena indicate that baby boomers have suffered because of their numbers.

In this paper a modified version of the overlapping generations model is used to analyze the effects of demographic cycles on the pattern of wages in an economy. While such a model leaves out important factors which can affect labor markets and wages, it can be used to shed some light on the effects of demographics. Specifically, it will be used to show that members of large cohorts need not necessarily suffer from lower wages during their early years in the labor market.

The results presented below indicate that the economic difficulties facing baby boomers may not be due to a demographic cycle of alternating large and small cohorts. Rather, these difficulties are more likely due to the fact that such cycles are a new phenomenon. They emanate more from the transition to a pattern of cycles than from the demographic cycles themselves. This leads to the conclusion that members of future large cohorts are less likely to suffer
economic misfortune than the present baby boomers.

The demographic experience of the United States this century can be briefly summarized as follows: from 1900 to 1940 the proportion of the population between the ages of 15 and 24 fluctuated between 18 and 20 percent. This proportion then fell sharply, reaching 13.1 percent in 1955 before rising again to 19 percent in the late 1970's. These numbers reflect the low birthrates of the late twenties to mid forties followed by the baby boom which lasted until the early sixties.

The Model

In economies where the need to save for retirement is a significant factor in savings decisions, it can be expected that the demographic profile of the population plays an important role in determining economic conditions. In particular, one would expect that in populations with unequal cohort sizes, caused by events such as wars or baby booms, members of different cohorts would differ in their lifetime profiles of wages and savings. One obvious reason for this is that when there are relatively large numbers of old and retired individuals who supply capital but not labor, the capital to labor ratio would be different than when there are fewer such individuals.

An overlapping generations model with cohorts of unequal sizes provides a useful framework for analyzing such questions. In this paper such a model is used to investigate
how the pattern of wages and savings of members of a small cohort would be expected to differ from that of members of a large cohort.

To analyze the pattern of wages we need to assume that workers work for two periods and retire for one period. In this way we can analyze whether one cohort tends to have relatively high wages during a particular period of life. At any given period, we assume that there are three cohorts. The young and middle-aged generations supply labor. The old generation is retired. We also assume that successive generations alternate between small and large cohorts. In this way, the middle-aged cohort is always of a different size than the other two at any given moment.

There are a number of explanations for why such demographic cycles might be self-perpetuating. In his book, *Birth and Fortune*, Richard Easterlin argues that members of small cohorts will tend to have a high fertility rate because they will tend to be more economically prosperous. Their prosperity is due to their relative scarcity in the labor market. The opposite argument holds for members of large cohorts. They will have fewer children because of their poor economic prospects. Easterlin concludes that this will lead to demographic cycles featuring twenty year periods of alternating high and low fertility rates. He leaves open the possibility that other long-term factors could dampen the cycles over time.

Alternative explanations of self-perpetuating demographic
cycles could also be constructed without appeal to differential fertility rates. If fertility rates are constant even in the face of varying economic conditions, then one-time demographic perturbations due to events such as wars would be self-perpetuating. This would lead to demographic cycles whose periodicity would correspond to the age at which individuals have their children.

The scenarios discussed above are meant to provide some motivation for the assumption that a society could be subjected to self-perpetuating demographic cycles. In the model below, it will be assumed that there demographic cycles, for whatever reasons, exist. We will abstract from other demographic trends in order to concentrate on the long-term economic effects of such cycles.

We assume that large cohorts have size \( n \) and small cohorts have size \( m \). It is convenient to make the normalization: \( m + n = 1 \). In this way, the size of the working population is always one and the ratio of retired people to workers in always equal to the size of the old cohort.

Each person is assumed to have an intertemporal utility function \( U(C_1, C_2, C_3) \) based upon his consumption during the three periods of his life and an intertemporal budget constraint requiring that the present value of consumption equal the present value of wages:

\[ C_1 + \frac{C_2}{1+r_1} + \frac{C_3}{(1+r_1)(1+r_2)} = W_1 + \frac{W_2}{1+r_1} \]

For convenience, we will initially assume that the utility function is of the form:
\[ U = \ln C_1 + \beta \ln C_2 + \beta^2 \ln C_3 \]

An interior solution to this optimization problem implies that:

\[ C_1 = \alpha [W_1 + W_2/(1+r_1)] \]
\[ C_2 = \alpha \beta [W_1 (1+r_1) + W_2] \]
\[ S_1 = W_1 - C_1 = \alpha (\beta + \beta^2) W_1 - \alpha [W_2/(1+r_1)] \]
\[ S_2 = C_1/(1+r_2) = \alpha \beta^2 [W_1 (1+r_1) + W_2] \text{ where } \alpha = 1/(1+\beta+\beta^2). \]

These equations apply to members of all cohorts.

Wages and interest rates are determined by the production technology. We assume a constant returns to scale aggregate production function, \( F(K,L) \). Since each worker supplies one unit of labor, it follows that \( L=m+n=1 \). The amount of capital is equal to the total savings of the middle-aged cohort \( (S_1) \) and the old cohort \( (S_2) \).

When the old cohort is large (of size \( n \)):

\[ K = K^k = mS_{s_1} + nS_{s_2} \]

\( K^k \) denotes the supply of capital when the old cohort is large. \( S_{s_1} \) is savings supplied by middle-aged members of small cohorts and \( S_{s_2} \) is savings supplied by old members of large cohorts. Similarly, \( K^s \) denotes the supply of capital when the old cohort is small.

\[ K^s = nS_{s_1} + mS_{s_2} \]

where \( S_{s_1} \) is savings supplied by the middle-aged members of large cohort and \( S_{s_2} \) is saving by old members of a small cohort. Note that there is no reason for \( S_{s_1} \) to be equal to \( S_{s_1} \) or \( S_s \) to be equal to \( S_{s_2} \). In fact, it is a goal of this paper to characterize the ways in which the patterns of savings
differ between the two types of cohorts.

A natural starting place for answering this question is to compare $K^L$ and $K^S$:

$$K^L - K^S = n(S_{l2} - S_{l1}) - m(S_{s2} - S_{s1})$$

Since $n > m$, a sufficient condition for $K^L > K^S$ is $S_{l2} - S_{l1} > S_{s2} - S_{s1}$. The large cohort must do relatively more of its savings after receiving its middle-aged wage ($W_2$).

From the solution to each individual's optimization problem we see that:

$$S_{2} - S_{1} = \alpha \beta^2 [W_1 (1+r_1) + W_2] - \alpha (\beta + \beta^2) W_1 + \alpha [W_2 / (1+r_1)]$$

Since wages and interest rates depend on the level of capital we can write:

$$S_{2} - S_{1} = Z(K_1, K_2)$$

where $K_1$ and $K_2$ are the levels of capital for a worker to work with during youth and middle-age.

In order to characterize the pattern of wages and savings we need to know the signs of $\delta Z/\delta K_1$ and $\delta Z/\delta K_2$:

$$\delta Z/\delta K_1 = [\alpha \beta^2 (1+r_1) - \alpha (\beta + \beta^2)] \delta W_1 / \delta K_1$$

Since $\delta W_1 / \delta K_1 > 0$ and $\beta r_1 < 1$ we can conclude $\delta Z/\delta K_1 < 0$. The sign of $\delta Z/\delta K$ is more ambiguous:

$$\delta Z/\delta K_2 = [\alpha \beta^2 + \alpha (1+r_1)] \delta W_2 / \delta K_2 + [\alpha \beta^2 W_1 - \alpha W_2 (1+r_1)^2] \delta r_1 / \delta K_2$$

The first term is positive, but the sign of the second is indeterminate. We will assume that $\delta Z/\delta K_2$ is positive. We can see that this is a plausible assumption by using the relations $r_1 = f'(K_2)$ and $W_2 - f'(K_2) - K_2 f''(K_2)$ to substitute $r_1$ and $W_2$ out of the expression for $Z(K_1, K_2)$. Henceforth, the variable $K$ will denote the amount of capital per unit of labor and $f(K)$ is the
production function after dividing $F(K,L)$ by $L$. Differentiating with respect to $K_2$ gives:

$$\frac{\delta Z}{\delta K_2} = \alpha \beta^2 [W_1 f''(K_2) - K_2 f''(K_2)] - \alpha [K_2 + f(K_2)] f''(K_2) \frac{1}{(1+f'(K_2))^2}$$

$$> 0 \text{ iff } \frac{[K_2 + f(K_2)]}{(1+f'(K_2))^2} > \frac{W_1 - K_2}{K_2}$$

This inequality will hold so long as $K_2$ is not much smaller than $K_1$. The plausibility of assuming the inequality is confirmed by the simulation results presented later.

Given the assumption that the $Z$ function is increasing in $K_2$ but decreasing in $K_1$, it can now be shown that $K^L > K^S$. To see why this is the case, suppose the contrary: $K^L < K^S$. Then from the properties of the $Z$ function $S_{t_2} - S_{t_1} > S_{s_2} - S_{s_1}$ since the small cohort works with $K^S$ first and the large cohort works with $K^L$ first. So $n(S_{t_2} - S_{t_1}) > m(S_{s_2} - S_{s_1})$ since $n > m$. This in turn implies $K^L > K^S$, a contradiction.

The above proposition establishes that small cohorts have less capital to work with when young and more when middle-aged than large cohorts. This implies a difference in their life cycle pattern of wages. Small cohorts will typically have lower wages when young and higher wages when middle-aged. It is worth emphasizing that such factors as productivity growth and non-cyclical trends in population growth are ignored here in order to focus exclusively on the effects of demographic cycles. Therefore, the conclusions stated above have implications for the relative shapes of each cohort's lifetime profile of earnings but should not be interpreted as saying that for any given period time one group should have a higher wage.
In order to attempt a similar characterization for the pattern of savings, we use the first-order conditions for the individual optimization problem. These indicate that the savings rate after the first period of work is:

\[ S_1/W_1 = \alpha(\beta+\beta^2) - \alpha[W_2/W_1(1+r_1)] \]

For small cohorts \( W_2/W_1(1+r_1) \) is larger than for large cohorts. This makes it likely that members of small cohorts have a lower savings rate during their youth. Since members of such cohorts also have lower wages during youth their absolute level of savings will be lower. This result is strikingly at variance with the commonly made observation that young baby boomers tend to have low savings rates and high levels of debt accumulation. It seems unlikely that a demographic pattern of alternating baby booms and bust would generate such savings behavior by members of large cohorts.

**Welfare**

In this section, the implications of demographic cycles on the relative welfare of different cohorts are analyzed. This analysis is best facilitated by using the first order conditions of the consumer optimization problem to solve for the indirect utility function. To simplify the algebra, let \( Y \) denote permanent income:

\[ Y = W_1 + W_2/(1+r_1) \]

Using the first order conditions, the indirect utility function is:

\[ V = 31\ln(\alpha\beta) + 31\ln Y^g + 21\ln (1+r_1) + \ln(1+r_2) \]
Interest rates enter the indirect utility function in two ways. First, they affect permanent income. Second, the affect the price of future consumption as seen in the last two terms. Furthermore, the benefits of having a high $r_1$ are more important than having a high $r_2$ because $r_1$ affects prices for both second and third period consumption.

The indirect utility function for a member of a small cohort is:

$$V^S = 31n(\alpha \beta) + 31nY^S + 21n(1+r^L) + \ln(L+r^S) \quad \text{where} \quad r^L = f'(K) \quad \text{and} \quad r^S = f'(K^S).$$

Note that for a member of a small cohort $r_1 = r^L$. Similarly, for a member of a large cohort:

$$V^L = 31n(\alpha \beta) + 31nY^L + 21n(1+r^S) + \ln(L+r^L)$$

The welfare levels of members of the two types of cohorts can be compared by evaluating the sign of the following expression:

$$V^L - V^S = 31n(Y^L/Y^S) + \ln((1+r^S)/(1+r^L))$$

Since $Y^L = W^L + W^L/(1+r^S)$ and $Y^S = W^S + W^L/(1+r^L)$, the sign of the first term cannot be determined with certainty. Since $W^L > W^S$, there may be a presumption in favor of the term being positive. In general, the relative magnitudes of $Y^S$ and $Y^L$ will depend upon the specific functional form and parameter values of the production function. For the case of the Cobb-Douglas production function, $Y^L > Y^S$ as long as the factor share of capital is above some critical value less than .5. The second term is positive since $r^S > r^L$. Although no definite statements can be made about relative welfare levels, it appears more likely that member of large cohorts may be better off. The
simulation results presented in the next section suggest that this is likely to be the case.

**Numerical Simulations**

The analytical results so far suggest that members of large cohorts benefit from a higher capital to labor ratio early in life. This in turn makes it likely that they will have a higher welfare level over the entire lifecycle. Since these results are not definite and depend on relative magnitudes of opposing effects, the need for numerical simulations is apparent.

In order to produce such simulations, a specific functional form for the production function is needed. The functional form adopted here is the familiar Cobb-Douglas production function: \( Y = AK^\theta \), where \( K \) is the capital to labor ratio and is the factor share of capital. This form is chosen here for tractability and because the key parameter, \( \theta \), has been subjected to substantial empirical measurement.

Using this production function and the earlier equations for \( K_s \) and \( K_L \), we can write:

\[
K_s = (\alpha \beta^2 + n \alpha \beta)(1-\theta)AK_L^\theta + (1-\theta)AK_s^\theta \left[ m \alpha \beta^2 (1+\theta AK_L^{\theta-1}) - n\alpha / (1+\theta K_s^{\theta-1}) \right]
\]

and

\[
K_L = (\alpha \beta^2 + n \alpha \beta)(1-\theta)AK_s^\theta + (1-\theta)AK_L^\theta \left[ n \alpha \beta^2 (1+\theta AK_s^{\theta-1}) - m\alpha / (1+\theta K_L^{\theta-1}) \right]
\]

By using these two equations to solve for the steady state levels of \( K_s \) and \( K_L \), we can then determine the lifecycle profile of wages for each cohort and compare welfare levels.
The solution technique for solving these two equations involved making an initial guess as to what the steady state levels of \( K_L \) and \( K_S \) are and using these guesses to generate new estimates of \( K_L \) and \( K_S \). In turn these new estimates are used to generate further estimates until the solution converges. In most cases the solution is obtained after eight or nine iterations.

A key step in producing the simulations involves assigning values for the parameters: \( \beta, \theta, n, \) and \( A \). There is no need to assign values for \( \alpha \) and \( m \) since they depend on \( \beta \) and \( n \), respectively.

Realistic values for \( \beta \), the discount factor, fall between .8 and .99. Most of the simulations presented below assume \( \beta = .9 \). Varying the value of \( \beta \) did not alter any of the qualitative results reported below. The main influence of the discount factor in the results was to induce more savings and a high capital to labor rations when \( \beta \) was large.

The parameter \( \theta \) is the share of capital in production. After surveying the literature aimed at measuring this parameter, Auerbach and Kotlikoff (1987) concluded that the best estimate is \( \theta = .25 \). The value of the parameter \( A \) depends on the units of measurement used for the value of output. For convenience the units of measurement are assumed to be such at \( A = 1 \).

The size of the baby boom is given by the parameter \( n \). Since this is the variable of primary interest here, it is allowed to vary between \( .5 \), denoting equal sized cohorts for
all generations, and .7 which implies a large cohort more than
twice as large as the small cohort. The first table below
shows the results for the steady state levels of $K_s$ and $K_L$ as
$n$ varies between .5 and .7. The remaining parameters are fixed
as follows: $\beta = .9$, $\theta = .25$ and $A = 1$.

**Table 1**

<table>
<thead>
<tr>
<th>n</th>
<th>$K_L$</th>
<th>$L_s$</th>
<th>$V_L - V_s$</th>
<th>$V_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.332</td>
<td>0.332</td>
<td>0</td>
<td>-5.508</td>
</tr>
<tr>
<td>.55</td>
<td>.342</td>
<td>.322</td>
<td>.00146</td>
<td>-5.607</td>
</tr>
<tr>
<td>.6</td>
<td>.353</td>
<td>.314</td>
<td>.00290</td>
<td>-5.604</td>
</tr>
<tr>
<td>.65</td>
<td>.364</td>
<td>.306</td>
<td>.00433</td>
<td>-5.600</td>
</tr>
<tr>
<td>.7</td>
<td>.377</td>
<td>.299</td>
<td>.00571</td>
<td>-5.595</td>
</tr>
</tbody>
</table>

In the last two columns, results are given for the
relative welfare levels of the two cohorts ($V_L - V_s$) and the
absolute welfare level for the large cohort which is usually
negative since the original expression for $V_L$ involves taking
logs of fractions. In general these simulation results confirm
the arguments made earlier that $K_L$ will be larger than $K_s$ and
that the members of the large cohort will be better off over
the course of their entire lifetimes. It should be emphasized
that these are steady state results.
The results of further simulations indicate that $K_s$ is always larger than $K_L$, even for extreme parameter values. However, the result concerning relative welfare levels in overturned when capital's share of production is very low. This can be seen by the results presented in Table 2 where the value of was varied. The values of the other parameters were fixed as follows: $\beta = .9$, $n = .6$ and $A = 1$.

**Table 2**

<table>
<thead>
<tr>
<th>$\theta$</th>
<th>$K_L$</th>
<th>$K_s$</th>
<th>$V_{L-V_s}$</th>
<th>$V_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>.1</td>
<td>.436</td>
<td>.358</td>
<td>-.00230</td>
<td>-4.682</td>
</tr>
<tr>
<td>.2</td>
<td>.385</td>
<td>.342</td>
<td>.00025</td>
<td>-5.256</td>
</tr>
<tr>
<td>.3</td>
<td>.317</td>
<td>.281</td>
<td>.00658</td>
<td>-6.008</td>
</tr>
<tr>
<td>.4</td>
<td>.235</td>
<td>.207</td>
<td>.0178</td>
<td>-8.583</td>
</tr>
<tr>
<td>.5</td>
<td>.148</td>
<td>.129</td>
<td>.0367</td>
<td>-8.583</td>
</tr>
<tr>
<td>.6</td>
<td>.069</td>
<td>.059</td>
<td>.0685</td>
<td>-11.03</td>
</tr>
</tbody>
</table>

These results indicate that the first term in the $V_{L-V_s}$ equation is not always positive, that is the present value of lifetime income for the small cohort is larger than that of the large cohort when capital's share of production is small. In general, the differences in welfare between the two cohorts was quite small but increasing in both $n$ and $\theta$. The differences in capital stock are more significant and are
positively correlated with the difference in cohort sizes, as can be seen in Table 1.

**Transitional Effects**

It should be noted, however, that the patterns generated in this model are those of a demographic system where the boom and bust pattern is already established. The pattern generated by a demographic system making a transition from steady population growth or even-sized cohorts to alternating sized cohorts may be entirely different. This is a relevant consideration for the U.S. experience, since the pattern of both boom and bust has only been in place for two or three generations.

In light of the relatively recent emergence of the boom and bust pattern, the steady-state results presented above may not yet be relevant. Perhaps an analysis of the transition from a system of even cohort sizes to one with alternating cohort sizes would be more useful.

In analyzing such a transition, it is important to specify how such a change took place. It matters whether the first deviation was a boom or a bust. It also matters when the agents in the economy realize that such a change will occur. Here we will briefly discuss the case of a baby boom where the change is in the form of a larger than usual cohort. We will assume that this change is foreseen before this large cohort enters the labor force. This will affect the behavior of the two generations immediately preceding it.
The cohort two generations older will receive its wage and will need to decide how to allocate its resources between immediate consumption and savings for retirement. Since it foresees that a larger than usual cohort will be entering the labor force, it will realize that high interest rates will be in the offing for this group. The income effect will cause an increase in both second and third period consumption. The substitution effect will reduce second period consumption. If this substitution effect is larger than the income effect, this cohort will provide more capital for the new large cohort entering the labor market.

The calculations of the cohort immediately preceding the new large cohort are more complicated. First it knows that capital will be relatively scarce next period. This would tend to depress wages and increase interest rates. This might lead to some increase in savings by this cohort but not enough to return to the original capital to labor ratio. This will ensure that its wages next period as well as those of the baby-boomers will be lower. This will also lead to a reduction in both second and third period consumption for this group.

There are some empirical indications that societies with large cohorts of new workers are more likely to increase their savings rates. Bloom and Freeman (1986) divided twenty-two OECD countries into four groups depending upon the growth-rate of the 15-24 age group since 1960. The first group is characterized by a large and increasing youth percentage, the second by a sizeable or moderately increasing youth
percentage, the third by no noticeable change in youth percentage and the fourth by a decrease in the youth percentage. In Table 3, the behavior of the savings rates in these countries is compared. In general there appears to be a secular trend towards lower savings rates in all OECD countries. However, on averaged, the first group is the most likely to experience an increase in the savings rate, whereas members of the fourth group experienced the largest drops in their savings rates. In the next section, a more extensive empirical analysis of this issue is attempted.
<table>
<thead>
<tr>
<th></th>
<th>Savings 1960</th>
<th>Rates 1978</th>
<th>Change in Savings Rate</th>
<th>Average Group Change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>11.7</td>
<td>5.7</td>
<td>-6.0</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>9.3</td>
<td>11.2</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>6.6</td>
<td>10.0</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>9.9</td>
<td>12.5</td>
<td>2.6</td>
<td>0.8</td>
</tr>
<tr>
<td>New Zealand</td>
<td>14.2</td>
<td>11.2</td>
<td>-3.0</td>
<td></td>
</tr>
<tr>
<td>Portugal</td>
<td>12.7</td>
<td>20.2</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>9.2</td>
<td>8.4</td>
<td>-0.8</td>
<td></td>
</tr>
<tr>
<td><strong>Group 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>15.6</td>
<td>13.7</td>
<td>-1.9</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>16.7</td>
<td>13.4</td>
<td>-3.3</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>21.1</td>
<td>11.4</td>
<td>-9.7</td>
<td>-1.7</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>23.1</td>
<td>33.9</td>
<td>10.8</td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>20.9</td>
<td>12.0</td>
<td>-8.9</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>12.4</td>
<td>14.1</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td><strong>Group 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greece</td>
<td>10.7</td>
<td>18.4</td>
<td>7.4</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>18.9</td>
<td>13.4</td>
<td>-5.4</td>
<td>-1.7</td>
</tr>
<tr>
<td>Norway</td>
<td>14.1</td>
<td>7.1</td>
<td>-7.0</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>9.7</td>
<td>7.9</td>
<td>-1.8</td>
<td></td>
</tr>
<tr>
<td><strong>Group 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>18.2</td>
<td>10.4</td>
<td>-7.8</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>15.7</td>
<td>7.8</td>
<td>-7.9</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
</tr>
<tr>
<td>------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Japan</td>
<td>22.1</td>
<td>20.0</td>
<td>-2.1</td>
<td>-5.8</td>
</tr>
<tr>
<td>Sweden</td>
<td>14.4</td>
<td>6.4</td>
<td>-8.0</td>
<td></td>
</tr>
<tr>
<td>Switzerland</td>
<td>19.5</td>
<td>16.2</td>
<td>-3.3</td>
<td></td>
</tr>
</tbody>
</table>
Empirical Results

The disparate economic and demographic experiences of the industrialized countries during the postwar period provides some scope for analyzing the determinants of changes in their savings rates. In general, a country's savings rate is influenced by many noneconomic factors that can be difficult to measure. These factors probably can explain significant proportions of the differences in national savings rates. However, as long as they have not changed too much, they are unlikely to be important in explaining changes in savings rates. For this reason the dependent variable which is analyzed here is changes in savings rates between 1960 and 1978 rather than levels of those rates.

This allows us to focus on the economic and demographic variables which may explain the changes in the savings rates. Within a lifecycle model, two important determinants of an economy's savings rate are productivity growth and population growth. These two factors affect the savings rate by providing the larger group of younger workers with higher wages to save out of. An additional factor which theoretically should contribute to the savings rate is social security. Increases in the generosity of social security benefits should reduce savings by reducing the need to save for retirement.

In addition to the effect of population growth, deviations from the growth trend can also be expected to affect savings. As discussed earlier, a baby boom can be expected to at least temporarily increase the savings rate of
the cohorts preceding it.

In order to analyze the effects of these variables on changes in the national savings rate, data was gathered for nineteen OECD countries. The explanatory variables used are productivity growth, population growth, the size of the baby boom bulge and increases in social security benefits.

The measure for productivity growth was GDP per worker. Population growth was measured by the proportion of the population between 15 and 24 in 1980. In general, the higher the rate of population growth, the higher will the youth share of the population. The size of the baby boom was measured by the change in the youth share of the population between 1960 and 1980. Growth in social security benefits was measured by growth in the percentage of GDP devoted to such benefits.

These variables were regressed on the change in the savings rate. The results are reported below.
Table 4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-31.56</td>
<td>-1.68</td>
</tr>
<tr>
<td>Youth share</td>
<td>1.399</td>
<td>1.14</td>
</tr>
<tr>
<td>Change in YS</td>
<td>0.126</td>
<td>0.14</td>
</tr>
<tr>
<td>Social Security</td>
<td>-0.000324</td>
<td>-0.0007</td>
</tr>
<tr>
<td>Productivity</td>
<td>2.165</td>
<td>1.95</td>
</tr>
</tbody>
</table>

Although all coefficients are of the expected sign, only the productivity measure was statistically significant.

The possibility that savings can affect productivity growth makes it desirable to use an instrumental variables approach. The instrument used for productivity was the change in the women's labor force participation rate between 1960 and 1980. This is a desirable instrument since such changes are unlikely to be related to changes in the savings rate but nevertheless strongly affect GDP per worker. The results using the instrument for productivity are given below.
Table 5

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-46.89</td>
<td>-2.05</td>
</tr>
<tr>
<td>Youth share</td>
<td>2.461</td>
<td>1.96</td>
</tr>
<tr>
<td>Change in YS</td>
<td>-0.771</td>
<td>-0.96</td>
</tr>
<tr>
<td>Social Security</td>
<td>0.374</td>
<td>0.75</td>
</tr>
<tr>
<td>Productivity</td>
<td>1.284</td>
<td>0.56</td>
</tr>
</tbody>
</table>

The main change from the previous result is that now population growth is significant but productivity growth is not.

These results fail to provide any evidence that changes in the youth share of the population affect savings rates. Unfortunately, changes in youth share do not perfectly measure the extent of a baby boom. Such changes can be due either to demographic cycles or more permanent accelerations or decelerations in the rate of population growth. This introduces an element of uncertainty about the size of future cohorts which has been ignored here. Such uncertainty could have important effects on savings decisions.
Conclusions

The overlapping generations model developed here was devised with the intent of analyzing the economic effects of demographic cycles. The analysis focused on the effects of such cycles on the patterns of wages and savings and the relative welfare of members of different sized cohorts once a steady state was reached. The analytical results indicate that the pattern of wages will be such that members of large cohorts will tend to have relatively high wages and a higher savings rate during their first period in the work force. These results were dependent upon the per worker capital stock not varying too much over the course of the demographic cycles. Numerical simulations indicate that this condition will usually be satisfied.

In addition, analysis of the relative welfare of different cohorts indicated that members of large cohorts would probably be better off. Since this conclusion depended upon the relative magnitudes of sometimes opposing effects, numerical simulations were also used to evaluate relative welfare. Again the simulations confirmed that the analytical insights were correct for reasonable parameter values. It should be emphasized, however, that these results are dependent upon the three cohort structure assumed. This is not the only plausible demographic structure. Therefore, the simulation results should be interpreted as an interesting and plausible counterexample to the intuitive belief (see Easterlin) that it is better to be a member of a small cohort.
Most of the analysis focused on the steady state outcomes which would hold after the system of cycles had been in place for some time. A brief analysis of the transitional effects indicate that the initial effects of a transition to a system of demographic cycles are likely to be quite different from the steady state results. The first large cohort is likely to suffer from its size and the steady state effects may not become dominant for several generations.

This points to the need for caution in extrapolating the economic experiences of the current baby boom generation to those of future members of large cohorts. Even if demographic cycles continue to be important, their economic effects on future generations are likely to be quite different than their effects on current generations.
References


