Age Structure, Economies and Markets:
Our Interview with Diane Macunovich

We're very excited about this edition of The Idle Speculator, in which we interview labor economist Diane Macunovich about her work on age structure and its many effects on individuals, economies, and societies. It's long and rather technical in parts, but we've moved especially technical material, which may be of interest to economic and financial practitioners, to footnotes. It's our hope that the implications of her work will be apparent to anyone who reads the interview, and that it will enhance the ongoing debate over market and economic trends and appropriate policy responses.

There are some fascinating takeaways to ponder as well. For example, could the pronounced shifts in age structure caused by the baby boom cohort in many nations have been a primary cause of the economic volatility and inflation of the 1970s, or the 'Great Moderation' of the 1980s and 90s? If so, what are the implications for widely held assumptions and longstanding disagreements regarding appropriate economic policy? And what are the implications for emerging economies, interest rates, inflation, or expected returns on various asset classes? This is powerful stuff. Enjoy!

Demographics for Contrarians!

Regular readers of our website know that since 2008-2009, we've become fascinated by demographics, specifically the underlying age structure of a population, as a key factor in economic and financial market outcomes. We think it's a powerful domain of knowledge for a couple of reasons. First, empirical studies support the idea that age structure can have significant and far reaching effects in economies, markets, and other areas of social interest. And second, very few people in the investment business have paid attention to recent developments in the field.[1]

As Exhibit A, we present the following Amazon Bestsellers Ranks: Birth Quake, an essential primer on age structure, is currently ranked 1,851,062nd; This Time Is Different, by Ken Rogoff and Carmen Reinhart, one of our industry's current "must reads," is ranked 96th. Yet we humbly submit that reading Birth Quake and related research on age structure offers much greater value to investment strategy and public policy in the years ahead than Reinhart and Rogoff's work. More value in a book that ranks 1.8 millionth versus one that ranks 96th – that's a situation any contrarian would love!

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[1] Notable exceptions include strategist Ajay Kapur and Yale economist John Geanakoplos. In fact, we found our way to Macunovich's work after discovering Geanakoplos et al's "M/Y" paper while reading his work on systemic fragility and leverage. At least one other strategist out there recently made the same discovery.

Economist [Diane Macunovich](#), the author of [Birth Quake](#), kindly agreed to an interview with Symmetry Capital Management. Diane holds a Ph.D. and an M.A. in Economics from the University of Southern California, and completed her undergraduate studies at MIT. She has worked as a consultant, a researcher, and an educator, and is currently a Professor at the University of Redlands in California, and a Research Scholar at the Institute for the Study of Labor (IZA) in Germany. Her full [curriculum vitae](#) (.doc) and [publications](#) list are available online.[2] Investors should pay especially close attention to her less-than-bullish outlook for the U.S. economy and financial markets in the years ahead.

SCM: How did your interest in demographics come about?

DM: I was working in the 1970s and 1980s as an economic consultant for developers and municipalities in Canada, often conducting housing market analyses, and realized there were tremendous effects of the post-WWII baby boom on housing demand. I was able to predict, for my clients, the housing slump that occurred in the late 1980s and early 1990s.

That led to work on a PhD. and a great deal of subsequent research in the area. As an example of the magnitude of the baby boom's effect, a 2007 study of mine found that the passage of the U.S. baby boom from childhood through the teen years and into family formation caused marked swings in patterns of aggregate consumption demand in the United States during the second half of the twentieth century. Applying that study's estimated age-group effects to time trends of national U.S. population age structure suggested that, holding other factors constant (including income and total population size), baby boom-generated changes in age structure accounted for swings of about 25% in real aggregate personal consumption.

SCM: Do you think the subject receives adequate attention from social scientists?

Sociologists and demographers sometimes use measures of population age share, but those aren't really similar to kinds of measures that I and a few other researchers use. And as far as I'm aware, it's done primarily to describe compositional effects - for example, the proportion of the population that will require nursing home care – and not to explain changes in age specific behaviors like marriage, juvenile delinquency, unemployment, etc. I could be wrong about that, but as far as I know, these tools are not widely used by social scientists, including economists.

In fact, I think it's a major shortcoming of most economic models that they omit demographics. The swings that I just mentioned could have been projected as much as twenty years earlier if demographics had been used. And the beauty of demographics is that current birth rates provide us with so much information for projecting future patterns.

SCM: What differentiates the demographic measures you've used in your research from

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[2] For those who are wondering, Macunovich is pronounced with a short a, hard c, short u, long o, short i, and accent on "un".

cruder measures like median age, or birth rates, that are commonly used in the press and by many analysts?

DM: It is important to work with fairly small age groupings – to divide the population into a fairly large number of age groups – in order to allow for effects which may vary significantly, even between age groups that are fairly close. Think, for example, of 0-4 year olds as compared with 10-14 year olds. Researchers typically lump them together in the "dependent" 0-14 age group, and yet their own behavior – and parental spending on the two groups – can vary significantly. Time patterns of changes in these smaller age groups can be quite pronounced, whereas changes in larger aggregates such as the total adult population, or median age, move only very gradually and can be difficult to relate to any economic effects. In my own work I have found that it is most advantageous to focus on young adults in the household formation stage: the growth rate of their population share, and their numbers relative to older prime age adults.

SCM: From the literature on demographic composition, there appear to be quite a few important first and second order effects – relative income, unemployment, educational enrollment and returns, wage structure, gender roles, marriage patterns, and fertility – that are impacted by a population's age structure. Can you give us a basic idea of the dynamics that cause demographic shocks – what you refer to as "birthquakes" – to have so many powerful and wide ranging social effects?

DM: Birth Quake *is my most extensive work, and in it I use what is known as "relative cohort size." In the book I focus primarily on the ratio of younger men just starting out in the labor force to prime age males in the economy. The main effect, which was first demonstrated by Richard Easterlin, a prominent economist at USC, and subsequently by a number of researchers including myself, is on the earnings of young males relative to those of prime age males.*

This effect occurs largely because of the fact that young, less experienced workers are not perfect substitutes in the labor market for older, more experienced workers, and the production function is sensitive to the balance of these two types. If we have an oversupply of one type of worker relative to the other (think of it as an oversupply of assembly-line workers relative to management) the wages of the oversupplied group will tend to go down relative to the wages of the undersupplied group. There might also be increased demands on managers to train and supervise the inexperienced workers, which could increase the wages paid to managers. In addition, the age group in greater relative supply will experience higher levels of unemployment and part time employment, which will lead, through the discouraged worker effect, to reduced labor force participation. Their lower wage rates might even induce employers to substitute them for more expensive capital investments, which would in turn produce the lower productivity rates we saw in the 1980s.

In the U.S., I found that young men's relative income fell from over 1 in the 1950s when there was a relative shortage of younger workers, to less than 0.3 by 1985. That means that a young man just out of school in 1950 could more than match his own parents' current income, but by 1985, he typically earned only 30% of his father's income. For African Americans this ratio was even higher in the 1950s, and lower by 1985.

A number of other effects have been postulated, including overcrowding: in the family, leading to less parental time with each child; and in schools, leading to higher student-teacher ratios and half-day sessions and hence to lower average performance. These other effects would all tend to decrease the productivity and hence the wages of younger workers relative to those of prime age workers, all other things being equal.

These lower relative wages are highly significant for behavioral patterns among the young, because as hypothesized by Easterlin, and later demonstrated in my own work, the material aspirations of young people are a function of their parents' economic status. The older prime age males in the population are actually the fathers of the younger workers, so the older males' earnings help to determine the material aspirations of the younger workers.[3] If young men's income falls short, they will make various demographic adjustments in order to maintain a higher per capita income. These adjustments, for the baby boomers, included postponing or avoiding marriage and fatherhood, and for those who married, impetus for wives to supplement husbands' earnings. In anticipation of increased labor force participation, young women pursued college educations in higher numbers. But younger men's college enrollment rates fell because the "college wage premium" – the ratio of wages of the college-educated relative to those of high school grads – declined along with relative wages, because of the glut of college graduates in the larger cohorts. Many other effects, such as changing industrial structure, women's occupational choices, and reductions in the average wage, can in turn be traced to these demographic effects.

SCM: Are there any demographic rules of thumb that you rely on for particular purposes? For example, if you were forecasting GDP trends, what age cohort might you look most closely at, if any?

DM: A significant portion of the growth in demand in the economy comes from new household formation. Some of this new household formation will result from immigration, but the vast majority of it results from young adults leaving their parents' homes and forming their own households. Historically over the twentieth century that has been the 15-24 age group. They generate additional demand for housing and consumer durables including automobiles. They also, obviously, generate significant educational expenditures. If there is growth in this segment of the population, there will be overall growth in consumption. Similarly, rates of growth in consumption will fall with declines in the growth rate of this significant group.[4]

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[3] One of the interesting points Diane raises is that prime age males tend to be the fathers of young adult males. She has pointed out elsewhere that the challenges faced by a large cohort should be expected to impact the economic behaviors and choices of other related cohorts, especially between parents and children. One of the research innovations she's helped pioneer is to measure the population in ways that can account for those inter-generational or household effects at a macro level.

[4] **DM:** This group's expenditures do not appear to be significant in Consumer Expenditure Surveys such as those conducted by the Bureau of Labor Statistics in the U.S (the CES), but shelter costs are represented there only in terms of interest or rental payments, not total expenditure. Expenditures on house purchase appear as changes in total assets and liabilities. Thus the actual total expenditure generated in the economy by the age group in providing new housing units – whether rental or owned – is not represented as expenditure in the CES. This effect is magnified by the fact that a good deal of expenditure on education, cars, housing, and furnishings for the group is often made by parents, and reported as

In general, I use the growth rate in the population share of this age group (15-24), in examining effects on GDP. I wouldn't try to actually forecast GDP with this variable, but rather use it to indicate points where it's likely that there might be a reversal in GDP growth. For the more developed nations I have used the 20-24 portion of the age group in the years after 1950, whereas for less developed nations I use the 15-19 age group, to reflect different average levels of educational attainment (and hence age of household formation).[5] In terms of relative cohort size effects,

I use the number of 20-22 year old males relative to the number of males aged 45-54.[6]

SCM: Although much of your work focuses on first and second order effects of changes in demographic composition, you have also done some interesting research on third order effects like asset prices, interest rates, economic growth, and inflation, which are clearly relevant for investors and financial markets. What are some of the key insights you've developed into those effects, and how might an investor put them to use in decision making?

DM: *I have found a very significant relationship between the growth rate of the population share of young adults, and the incidence of recessions, over the past 110 years. This is shown in* Figure 1.

The curve on the graph represents a three year moving average of the (one year) lagged annual rate of change in the proportion of young adults in the U.S. population, as reported by the U.S. Census Bureau. "Young adults" are defined as those aged 15-19 prior to 1950, and 20-24 in the years after, given changing levels of education. The vertical lines mark the start of recessions, as defined by NBER. There is a very close correspondence between the vertical lines, and peaks in the curve, as well as points where the curve goes negative. In addition, the deep trough between 1937 and 1958 contained another four recessions, and there were two in the trough between 1910 and 1920 (not marked on the graph).

The only recessions over the last one hundred ten years that don't appear to correspond to features of the curve are those in 1920, 1926 and 1960. The correspondence isn't exact for the 2008-2009 recession because that one was officially defined as beginning in December 2007, rather than in 2008.

SCM: Fascinating! What possible explanations have you come up with?

DM: *The relationship shown in that graph holds, I hypothesize, because of the relationship between changes in this rate, and producer expectations. On the "upside" of*

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  expenditure by the parental age group rather than by the target age group. The only way to see the total impact of this or any age group is to analyze econometrically the relationship between the growth in various age group shares, and growth in GDP per capita. Using this type of analysis I have been able to demonstrate a highly significant (statistically and substantially) effect of this young adult age group.

[5] **DM:** For an exogenous proxy, I use a one- to five-year lag of the original measure, depending on whether I have data by single or five-year age group.

[6] **DM:** For an exogenous proxy I have used a twenty year lag of the General Fertility Rate (GFR). However, we are now entering a period when the age ratio and the lagged GFR begin to diverge, so it may become necessary to begin using a lagged age ratio there, as well.

the demographic curves producers anticipate continued and even increasing growth, often assuming linear trends, leading to expansion plans and related strong borrowing. When those expectations aren't met – when the growth rate slows or even turns negative – they cut back on production and even default on loans, creating a downward spiral. Globally over the past 50 years, 80% of such demographic declines have been associated with declines in GDP growth. This is true whether one looks at countries' own demographics, or at the relationship between their economies and U.S. demographics. Over 50% of the time, globally, there has been a direct one-to-one correspondence between turning points and outright recessions.

It should be noted that I'm not saying that only demographic effects are at work in these cycles. Rather, I believe that the demographics determine <u>when</u> the crises happen: the straw that breaks the camel's back. The magnitude of crises and recessions has to do with a host of other economic and institutional effects.

The relationship shown in the previous graph is bolstered by the pattern observed in Japan in recent decades in <u>Figure 2</u>. One can see there the remarkable decline in the growth rate of this crucial 20-24 age group that corresponded with Japan's "lost decade".

In terms of the inflation rate, I have found that it appears to be directly related to relative cohort size. In an earlier study, for example, I was able to "predict" 1985-1995 inflation rates based on a model calibrated using only data from 1949-84. When there is a high relative share of young people in the economy, inflation tends to be high, as we saw in the late 1970s and early 1980s. At the moment, although we have just experienced the peak of the "echo baby boom" in the young adult stage, inflation is not high because the <u>relative population share</u> of young adults has remained low given the presence of the baby boom itself, in the remainder of the population.

In terms of the stock market, I found that a model fitted on population age shares calibrated over the years 1934-1975 was able to "predict" a three year moving average of observed movements in the DJIA over the period 1976-1995. This model was based on the full population age structure, rather than simply on young adults. It showed an inverse relationship between the DJIA and the young adult and senior populations, and a strong positive effect from the 5-19 and 35-55 age groups.

SCM: Where does the U.S. stand now in terms of age structure, and what are the potential implications for markets and investors?

DM: As you can see <u>Figure 1</u>, *for the U.S., the growth rate in the share of this crucial population of young adults will turn negative in 2012, and then remain negative until the late 2020s. This would suggest another recession around 2012 (unless, of course, economic actors were to recognize trends ahead of time, and act accordingly!), and then possibly a period of very slow growth thereafter. In terms of the stock market, I've prepared projections for various moving averages of the DJIA, based on the changing <u>overall</u> population age structure (not just the young adults). They also do not bode well for the next ten years, suggesting a long period of bear markets until the early 2020s, similar to what we saw in the 1970s. The period after that should begin to be more*

buoyant, however.

SCM: In a 2002 paper by Geanakoplos, Quinzii and Magill, the authors found that certain third order effects in the U.S. and Japan appeared to be far more sensitive to changes in demographic composition than they were in France and Germany. Are there any particular factors that you would study to try to explain that difference?

DM: I am really gratified to see the work presented by Geanakoplos et al. They have provided the theoretical framework lacking in my own work. Mine has been very much an intuitive and empirical approach, which certainly benefits from such theoretical underpinnings. Although they have used larger age groupings in their measure, their results are qualitatively similar to my own, in terms of age group effects on the stock market.

I think that the difference between effects in European and U.S. economies has to do with institutions. There is more "cushioning" and regulation in many of the European economies, relative to here in the U.S., with regard to demographic effects – for example, in the labor market with regard to unemployment. One can see this in the U.S., for example, by comparing – in Figure 1 – the period of the 1920s/1930s, with the 1970s/1980s. The demographic changes in the earlier period were minor compared with those we experienced in the later period. But due to stronger government financial controls in the later period, markets were stabilized so that the effects of those major demographic changes were much less severe than in the earlier period. Unfortunately, those financial controls were weakened in the decades leading up to the most recent recession.

SCM: One interesting feature of Japan's "lost decades" was that an increasing number of young adults chose to live with their parents, possibly due to the difficulties many of them had finding permanent employment. Empirically, it looks like the U.S. has entered a period where permanent employment is much harder to come by for young adults, with the 16 to 24 year old unemployment rate at levels not seen since the last of the baby boomers entered young adulthood (Figure 3). And anecdotally, we've been seeing more stories in the press and in our personal lives about young adults, especially recent college graduates, moving back home while they look for a first career. Is it reasonable to expect that new household formation in the U.S. could be stagnant in the coming decade, much as it was in Japan?

DM: I definitely believe new household formation will be stagnant. We just reached the peak growth rate of the proportion aged 18-20, and although their growth rate is still positive, it's counteracted by the high unemployment inflicted on them by the recession. By the time the economy recovers and unemployment has declined for this age group, we'll be into a long period of declining growth rates among those in the household formation stage. So even if they don't move in with Mom and Dad, there will be fewer of them to replace the disappearing baby boomers.

One might think that the declining relative cohort size of the young would paint a rosier picture - that is, a small relative cohort size might mean higher relative wages. But that only holds if the relative cohort size phenomenon is symmetrical around the peak of a

baby boom, and my own work has shown that it's not. Declining relative cohort size means we're on the downward side of a baby boom, and that means weaker aggregate demand effects. So even though the supply side favors them in the labor market, the demand side does the opposite. So I don't see great news for the young over the next decade.

SCM: Getting back to Japan for a moment – despite the increase in its ratio of middle aged to young adults, which Geanakoplos et al found to be positively correlated with certain financial and economic variables, its growth remains modest, and its inflation rates are still close to zero or negative. Looking at the earlier chart of the growth in age share of Japan's young adult cohort, is it possible that Japan could actually experience some inflation in the second half of this decade? Or do you think that the larger relative population share of older adults could mitigate this, as suggested by your findings on inflation in the U.S.?

I ask because there are some analysts out there who predict a return in the U.S. to the kind of inflation experienced by developed economies in the 1960s and 1970s (or worse!), due to rising public sector spending, dovish monetary policy, etc. But I'm wondering if a higher relative population share of older adults won't keep a firm lid on inflation, even absent the deflationary effects of household balance sheet contraction.

DM: *Well, there's no growth happening in the share of the young adult cohort in Japan. The rate of decline is slowing, but the growth rate is still negative. You can see that in* [Figure 2](). *So I wouldn't expect that cohort to exercise too large an effect on inflation or household formation led growth in the next few years.*

And while an M/Y ratio may predict more positive outcomes for asset prices and other variables there, I think there's a danger in using too simplistic a measure, or trying to stretch one indicator too thin.

Japan's young adult cohort will grow positively in the second half of this decade, but I'm uneasy making too much of a statement about the country ten years hence, since I haven't done a complete analysis there looking at the full age structure.

My "on one hand, on the other" view is that because of the low birth rates we've seen since the 1980s, nearly all industrialized nations are facing declines in the young adult age group by about 2012-2015. Nearly all the former Soviet block countries, and many South American countries, are already into negative growth rates in this crucial age group's share, as you can see from the graphics in one of my [working papers for IZA]() *(pdf). This does not argue for rising inflation. But interestingly, Japan could be the first to break from that pattern, since it will begin to experience modest positive growth in this age share towards the end of this decade.*

I also found some interesting contrasts between age structure effects in the U.S. during its "developing" and "developed" phases in [another paper]() *(pdf), which may be relevant to your question, and to international comparisons and analysis.*

SCM: You point out in [Birth Quake]() (p. 231) that there's a *"tendency at the dawn of each*

'new era' to assume a linear trend: to assume that long-term forecasts should be based on the new parameters. But this type of linear approach could be very misleading if the underlying forces are in fact – like the pattern of population change – highly nonlinear." Clearly this is relevant for financial markets, investors, and economic forecasters. But how important is it for policy makers to understand this, especially given the stark political divide over the appropriate direction of economic policy, e.g., stimulus, deficits, debt?

DM: I think it's essential that policymakers become aware of these demographic effects – especially since they can be forecast fairly well at least twenty years in advance! Again, the severe repercussions of relatively small demographic changes in the 1920s and 1930s, relative to the muted effects we've seen after the 1950s, shows how much government intervention can smooth demographic effects.

But the demographic changes have to be anticipated in order to be addressed by government policy – and right now most economic models used in policy making are notable for their complete omission of any demographic variables, much less properly defined ones. Understanding the role of demographics could help, for example, in determining policy with regard to inflation. The demographics suggest that inflation will not be a problem over the next decade, so in my view, it would be better to focus on policies intended to alleviate unemployment.

SCM: Thank you, Diane!

Takeaways

We've paid limited attention to demographic variables in the past, because while they are clearly relevant, generalized measures like median age didn't seem to have much explanatory power. In a serendipitous moment, we came across the 2002 paper by Geanakoplos et al while digging into his work on credit cycles, leverage, and systemic fragility. With our curiosity piqued, we eventually found our way to Diane's work, and have been truly impressed by the long term forecasting possibilities that demographic variables offer when specified properly, measured effectively, and modeled well. In order to drive home the importance of her work to policy makers and investors, we would point to two specific examples.

The first is her prediction in 1997 (pdf) that "If the economy continues to over-react to demographically-induced declines, we could face another serious recession in about ten years' time." The second is her use of demographic data to model the pattern of long term stock market returns since the start of the twentieth century. Figure 4 is from her 1997 paper, which she referred to in our interview, and Figure 5 is from the appendix to chapter 15 of Birth Quake. *She is careful to point out that the usefulness of these models is limited, especially for any kind of short to intermediate market timing*.[7] But for long-term, liability-driven investors, the information provided by these types of models should

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[7] **DM:** Sensitivity analyses presented in the chapter 15 appendix show that the timing of the forecast trough and peak in Figure 5, and their magnitude, are sensitive to modifications in the population variables; the timing can vary by as much as five years! But all forecasts, regardless of model specification, show the definite trough and then peak pattern exhibited in Figure 5.

clearly have value. For example, predicting in the late 1990s that U.S. stock markets were in for a decade or two of rough sledding would certainly have improved many asset allocation decisions.[8]

Besides its relevance to policy discussions and investment processes, Diane's work raises some fascinating questions for further study, which she outlines in Birth Quake's final chapter. One that jumps out at us, and she touches on it in the book, is whether there is an important association between young adult cohorts and credit cycles. Looking at Japan in the run up to 1990, and the U.S. in the 2000s, a rise in the rate of new household formation appears to have coincided with a peak in the credit cycle. Given the nature of purchases made by newly formed households – homes, appliances, automobiles – it makes sense that there would be an accompanying credit component. And if the producers, sellers, and financers of those goods modeled their expectations too optimistically, a negative turn in the business cycle would be the likely result, as Diane hypothesizes.

This line of inquiry could be relevant to systemic risk monitoring, which is a key component of recent financial regulation legislation. Using John Geanakoplos' terminology, the techniques developed by Easterlin, Macunovich, and a handful of other researchers could potentially help the financial industry and its regulators better predict, avoid, and manage periods of financial exuberance and "fragility".

And a final thought: 'Austrian' types will clearly see their credit-driven malinvestment and boom-bust at work here. But unfortunately, the main culprits appear to be individual reproductive decisions and poor decision making in the private sector, rather than government overreach, meddling, and stupidity!

The bottom line is that this is powerful and largely overlooked stuff. Investors ignore it at their peril.

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[8]   Of course, one would have needed to be confident that sufficient errors would unfold in the private sector and not be offset by public sector measures. And as this type of research becomes more widely disseminated, the probability of that happening *should* decline. As with most things economic and financial, and in complex systems generally, path dependence, conditionality, uncertainty, and non-linearity abound!

References

Aversa, Jeannine. "Use of temps to fill jobs may no longer signal permanent hiring", *USA Today,* 2/16/2010,
http://www.usatoday.com/money/economy/2010-02-15-temp-jobs_N.htm

Geanakoplos, John, Michael Magill, and Martine Quinzii (2002). "Demography and the Long-run Predictability of the Stock Market",
http://cowles.econ.yale.edu/P/cd/d13b/d1380.pdf.

Macunovich, Diane J. (1997). "Discussion Comments Related to 'Social Security: How Social and How Secure Should It Be? By Steven Sass and Robert Triest", Prepared for *Social Security Reform: Links to Saving, Investment, and Growth*, Reserve Bank of Boston Conference No.41, June 16-18, 1997, Chatham, MA.
http://newton.uor.edu/Departments&Programs/EconomicDept/macunovich/frb.pdf

Macunovich, Diane J. (2002). *Birth Quake: The Baby Boom and Its Aftershocks*, Chicago: Univerity of Chicago Press.

Macunovich, Diane J. (2002). "Online Appendix to Chapter 15: Statistical Analysis of Age Distribution Effects on the Stock Market", *Birth Quake: The Baby Boom and Its Aftershocks*, Chicago: Univerity of Chicago Press,
http://newton.uor.edu/Departments&Programs/EconomicDept/macunovich/birthquake/chp15app.pdf

Macunovich, Diane J. (2002). "Effects of Changing Age Structure and Intergenerational transfers on Patterns of Consumption and Saving",
http://newton.uor.edu/Departments&Programs/EconomicDept/macunovich/taiwan_paper.pdf

Macunovich, Diane J. (2009). "The Role of Demographics in Precipitating Crises in Financial Institutions", IZA Discussion Paper No. 4436,
http://ftp.iza.org/dp4436.pdf

Reinhart, Carmen and Kenneth Rogoff (2010). *This Time is Different*, Princeton and Oxford: Princeton University Press.
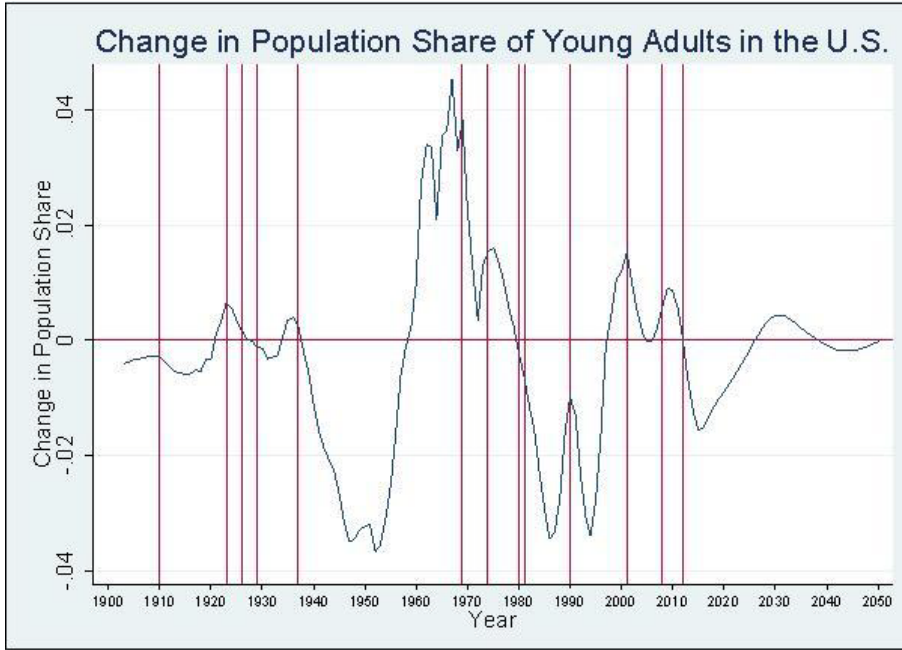
Exhibits
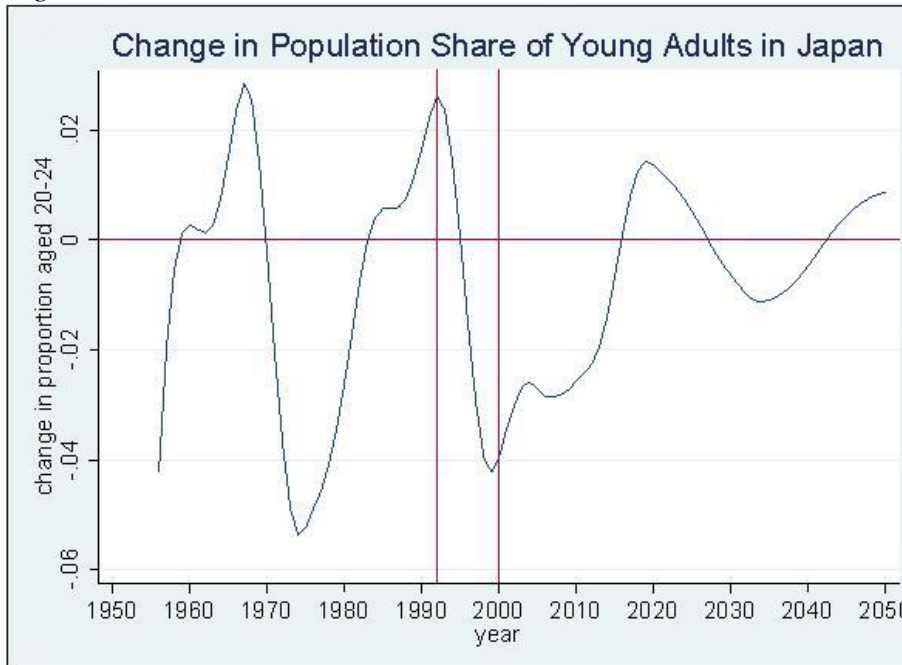
Figure 1

Figure 2

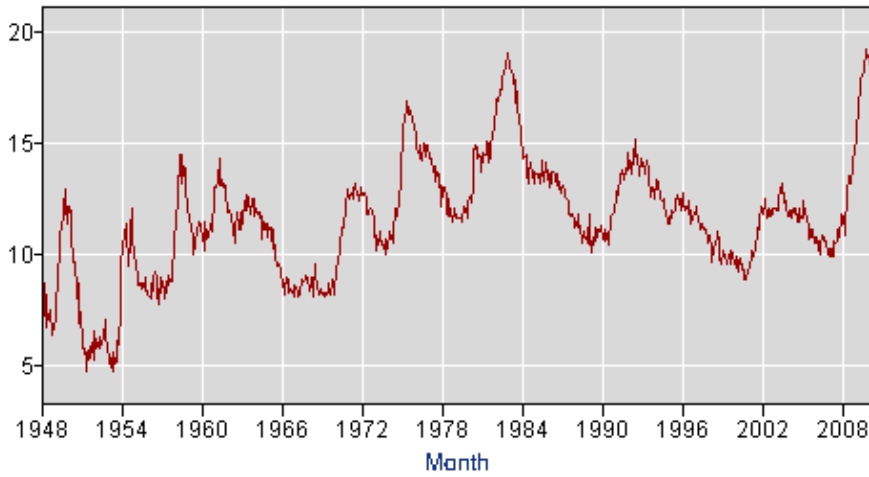*Figure 3 - Unemployment Rate, Ages 16-24 (Bureau of Labor Services)*

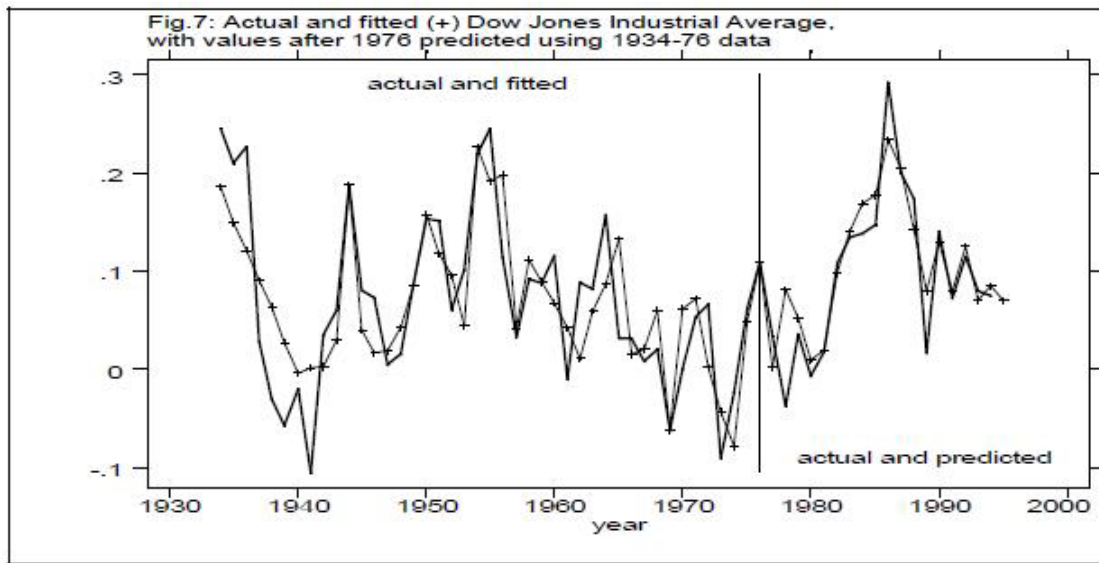*Figure 4 - Three year moving average of real (PPI adjusted) DJIA returns*

Figure 5 - Changes in 11 year moving average of DJIA

Predicted and actual % change in DJIA
using 6th degree polynomial