Magna Cum Laude Team Prize – $15,000

Immaculata High School – Team #20, Somerville, New Jersey
Coach: Elaine Petsu
Students: Christopher Fajardo, Mary Germino, Robert Lee-Own, William Pugh, and Matthew Tom-Wolverton

Team #020

S^3: Social Security Secured!

Summary

We have determined, through analysis of much data found on the internet, that the current Social Security system will not remain solvent for 75 years. This agreed with other documentation found which reported the same. We fitted data on Mathematica to enable us to predict the number of those receiving benefits for a given year, the amount they would receive, the number of contributing workers, and the amount these workers would contribute if the current system were continued. These projections allowed us to identify that in 2081, the system will not be viable. In fact, the system ceases to be viable long before then. To keep the system viable, we opted to adjust the scheduled age for full benefits. We did not want to increase taxation, as we feel that tax rates are already exorbitantly high and have been raised at least 20 times. We believed that introducing private investment accounts would be risky and relatively unpredictable, so we chose not to pursue that path. Revising the benefit structure to fix deficits would require stricter regulation of beneficiaries. Since we found the guidelines as to what disabilities warranted Social Security rather vague, it would be difficult for us to determine how to reduce the number of those receiving benefits who shouldn't. Anyway, the retirees receive the largest percentage of the Social Security funds, and therefore it would make sense to focus on that subset of beneficiaries before others.

When Social Security was established, people lived an average of 12.5 years after starting to receive benefits. Today, people live much longer. So we decided to adjust the age for receiving full benefits to 12.5 years before that person is expected to die. This relieved the deficit existing in Social Security, even for as far in the future as 2081. We also like the idea of starting partial benefits 10 years prior to the age where one could receive full benefits, and we outlined a simple suggestion. However, because of time restraints, an estimated cost for these partial benefits could not be determined.

Overview of Social Security / Restatement of the Problem

Social Security has provided a solid base of economic security for Americans over the last 71 years. A combination of retirement, disability benefits, and survivors insurance is and has always been an integral part of the Social Security system. The Great Depression of the 1930s made millions of Americans as well as the government realize that a safeguard that would guarantee that the elderly would have a monthly income on which to survive needed to be put into place. The system was later expanded to include the disabled, veterans, and surviving spouses. In effect, it has been a complex social institution. The Social Security system that currently exists today evolved from the Social Security Act of 1935 which was signed into law by President Franklin D. Roosevelt. This bill established a benefit system for the retired and was financed equally by a payroll tax and an income tax. However, there are have been a lot of concerns with this system.

The main concern arises from key demographic changes in the population of the country. The impending retirement of the "baby boomers" will put incredible stress on the system. Currently the ratio of workers supporting the program to retirees is much lower then when the program was instituted. Additional stress is added by the growing costs of disability payments. The government has forecasted that expenditures will outpace income in the year 2014. At this point, the Social Security trust fund will have to be utilized and if nothing is done to fix the system, the Social Security trust fund will be depleted in 2042.

Although the problems facing Social Security in its present form are complicated and numerous, there are measures that can be taken to salvage the system to ensure economic security for generations to come. There is a multipronged process to ensure the survival of one of the greatest American institutions of the 20th century.

The first measure that should be put in place involves a slight adjustment of the retirement age that is regulated to vary directly based on the average life expectancy of American workers. Upon its introduction, people lived for an average of 12.5 years after starting to receive Social Security. Today, this life expectancy is significantly longer, averaging about 17 years for an Aged 65 person that has worked for a portion of his or her adult life. Obviously, the system cannot remain the same and still provide the same quality of economical assistance to retired American workers.

Assumptions

1. Number of workers, worker contribution, number of beneficiaries, and average benefits received under the current system of Social Security will follow predictable trends if nothing is changed, and these trends can be approximated by simple curves as fitted by Mathematica from data found on the internet.

Explanation: We need some way to predict whether and when the current Social Security system will become insolvent. We also need to determine how much we need to compensate for with our revised system.

2. The census data is accurate.

Explanation: The census bureau is known to be a reputable source and is responsible for correctly reporting its estimation of the demographic data of the United States to the United States government every ten years. Also, we assume that the citizens of the United States are truthful in reporting their personal information to the census bureau.

3. While we acknowledge the existence of the trust fund, we opt not to rely on it to solve deficit problems. Therefore, our calculated yearly deficit for the whole Social Security system does not take this fund into account.

Explanation: It is preferable that this fund not be a crutch, since it could prove invaluable if there were ever to be an unexpected national emergency.

4. As life expectancy becomes higher, people's ability to work lasts longer accordingly (i.e., in the future, people will both live longer and work longer).

Explanation: It makes sense that as advances in technology and medicine increase the length of a person's life, they will also increase the quality of that person's life. So a person will remain fit and mentally competent longer, and thus be able to hold a job longer.

5. We do not include overhead/administrative costs in our analysis, under the assumption that these costs are not significant compared to the cost of paying benefits.

The following sections list the various curves that we used to model our data. All data was fitted in Mathematica. These curves were used to make projections for the future.

Workers

Workforce data from:
http://www.bls.gov/opub/rtaw/pdf/rtaw2001.pdf#search='American%20workforce'

Curve of best fit: a=-2.4*10^7+(1.6*10^6)y
(a is the number of workers contributing to Social Security; y is the number of years since 1900.)

Contribution per Worker (Payroll Tax Included)

Data from:
http://www.ssa.gov/
Curve of best fit: b=-5.6*10^3+84y
(b is the contribution per worker per year; y is the number of years since 1900.)

Using data from the Social Security Association for the number of beneficiaries and the amount of their monthly benefit received each year, we found the yearly amount of benefits that they received and multiplied this by the number of beneficiaries to find the total pot. We divided the pot by the number of workers contributing for each year (from report on the American workforce) to find a contribution of approximately $9638 per worker. We multiplied this by the projected number of workers for the year 2081 and subtracted this from the projected amount of benefit to be given out in the year 2081. There will be a deficit of 2.25*10^12, even without taking into account overhead costs. Therefore, the current Social Security system is not viable and will not last until 2081 assuming the continuation of current trends.

Number of Retired Persons

Population data (65+) from:
http://www.census.gov/ipc/www/usinterimproj/natprojtab02a.pdf

Curve of best fit: c=-7.9*10^4+(1.1*10^3)y

(c is the number of retired people in thousands; y is the number of years since 1900.)

Number of Combined Widow(er)s and Disabled

Data from:

http://www.ssa.gov/

Curve of best fit: d=-7.0*10^6+(1.7*10^5)y

(d is the number of widow(er)s/disabled people combined; y is the number of years since 1900.)

Average Benefits Received per Beneficiary per Month

Data from:

http://www.ssa.gov/

Note that this multiplied by 12 to find the annual benefit after the average monthly benefit was calculated for the year 2081 (181).

Curve of best fit: e= -1.6*10^3+24y

(multiply e by 12 to find yearly benefits per beneficiary; y is the number of years since 1900.)

Projections for Future Years

Projected workers: By the year 2081 (75 years from now), there will be 2.6*10^8 persons in the workforce. By the year 2014 there will be 1.6*10^8 persons in the workforce.

Contribution per worker: By the year 2081, the average worker will contribute $4802 to Social Security, as will the employer, bringing the total to $9604. By the year 2012, the average worker will contribute $1988, as will the employer, bringing the total to $3976.

Projected retired persons: By the year 2081, there will be 1.2*10^8 retired persons. By the year 2014 there will be 4.6*10^7 retired persons.

Projected disabled/widow(er)s: By the year 2081, there will be 2.4*10^7 disabled/widow(er) persons. By the year 2014 there will be 1.2*10^7 disabled/widow(er)s.

Total Social Security beneficiaries: Projected retired persons + Projected disabled/widow(er)s

2081: 1.44*10^8 persons

2014: 5.8*10^7 persons

Projected average benefits: By the year 2081, the average benefit package will be $3.3*10^4 per year. By the year 2014, the average benefit package will be $1.3*10^4 per year.

Total revenue: (Projected workers)*(Projected contribution per worker)

2081: $2.5*10^12

2014: $6.4*10^11

Total expenditures: (Projected beneficiaries)*(Projected benefits)

2081: $4.7*10^12

2014: $7.5*10^11

Cash flow: Total revenue-total expenditures

2081: -$2.2*10^12

2014: -$1.1*10^11

Data Explanation

The model that was created by using these five equations accurately portrays the current Social Security system. By using demographic data, accurate models representing workforce growth and the growth of the retired/disabled/widowed population were obtained. From these models, projection for the years 2014 and 2081 were computed. These values can be viewed in the Data Calculation section. Using historic worker contribution records as well as benefit records, projected worker contributions and projected benefits were computed from a model that was created. These values can be seen in the Data Calculation section. Combining all of this data, it was found that in the year 2081 (if the current system is left as is), the Social Security system will experience a $2.2 trillion shortfall. Current forecasts predict that the expenditures will outpace revenue in the year 2014. This model predicts a shortfall of $110 billion for that year. The model does not account for the Social Security trust fund and thus shows large deficits earlier than predicted. Therefore, this model is a good representation of the current Social Security system and supports the facts that the fund shows deficits in the year 2014 and that these deficits (if nothing is done) continue to increase. A possible solution to this incongruity

is to insert a correction factor to the final step. The predicted deficit for the year 2013 according to this model is -$1.41*10^11. According to government predictions, the last year that the system remains solvent is 2013. Therefore to all calculated budgets or deficits, $1.41*10^11 may be added. This allows the year 2013 to remain the last solvent year and shows that the year 2014 is the first year for deficits. With the correction factor, the predicted deficit for the year 2014 is now $9.0*10^9 and the predicted deficit for 2081 is $2.06*10^12.

As shown in "Number of Retirees vs. Time" the number of retired Americans will increase linearly from now into the foreseeable future, resulting in approximately 1.2*10^8 elderly persons living in the United States by the year 2081. If the retirement age remains the same, then this is far too much stress on the system, assuming linear growth of the amount of benefit each retiree receives as well as linear growth on the number of Americans in the workforce.

As projected by our models, by 2081 the ratio of workers contributing to the pool will reach (2.6*10^8)/(1.44*10^8) or 1.806. This is much lower than the current ratio of about 4 (according to our estimates) in 2005. A lower ratio of those contributing to those taking out of the pool means more that needs to be contributed per worker, or fewer benefits must be given to break even. Eventually, if the ratio gets too small, then the system will be too taxed and not able to comfortably support the beneficiaries.

Using Life Expectancy Data to Solve the Social Security Problem

One way problems with Social Security could be remedied is by adjusting the age at which retirees receive full benefits. When Social Security was established in 1935, retirees lived an average of 12.5 years after beginning to receive their full Social Security benefits. However, life expectancy has increased significantly since then and is continuing to increase. As a result, people today are living a lot longer on Social Security benefits than they originally had. It might make sense to adjust the age at which retirees can receive full benefits according to the life expectancy, so that people will always live approximately 12.5 years after beginning to receive benefits. We realize that this would mean people might not receive full benefits until their eighties in the distant future. Despite the rising quality of living and health for the

elderly, we realize that many people in their eighties may not be capable of holding jobs. However, we assume that many people will be able to retire later, or else live off savings until full Social Security kicks in. We propose that partial benefits should be started at

We found data relating age, the year, and life expectancy in a National Vital Statistics Report from 2004 on http://www.cdc.gov/nchs/data/nvsr/nvsr53/nvsr53_06.pdf. (p. 29). Using the CAS, Mathematica, we fit this data to an equation of the form $z = ax + by + c$, where z is the life expectancy, x is the age, and y is the number of years since 1900. The fit produced by Mathematica was $z= 45 - .5x + .06y$ (see appendix for demonstration of accuracy of this fit). Rearranging this equation to solve for x (age), we get $90 + .12y-2z=x$. If we set z equal to 12.5 (meaning that the life expectancy is 12.5), we can solve for x (the age at which full benefits should be started), for each year y.

For example, right now, in 2005, the approximate age at which the life expectancy will be 12.5 more years is $90 + (.12)(105) -2(12.5) = 77.6$ years. This is a lot greater than the current age at which full benefits are received, 67 years of age. Seventy-five years from now, in 2081, the approximate age at which the life expectancy will be 12.5 more years is $90 + (.12)(181) - 2(12.5) = 86.7$ years. So full benefits should start at 86.7 in 2081. However, since this is an admittedly old age, partial benefits should commence relatively early.

We think it is reasonable to start partial benefits 10 years prior to whatever the calculated age for receiving full benefits is. We are assuming that people will still be working at the start of partial benefits, if in a lesser capacity. As they approach the age to receive full benefits, they will be working less and Social Security will be paying them more. We have decided to set up our benefit schedule as follows:

10 years prior to applicability to receive full benefits: 10% of full benefits
9 years: 20% of full benefits
8 years: 30% of full benefits
7 years: 40% of full benefits
6 years: 50% of full benefits
5 years: 60% of full benefits
4 years: 70% of full benefits
3 years: 80% of full benefits
2 years: 80% of full benefits

1 year: 90% of full benefits

Using this method, the American workforce will be able to gradually ease into their Social Security benefits, while gradually working less and adopting a partly retired lifestyle. Social Security expenditures would surely decrease since fewer people would be eligible for benefits than if we included everyone over 67 years of age every year.

To determine how much this program would cost (to compare it to the unmodified system), we came up with a crude model of the number of people in the population over age 80 for a given year. (To do this we fitted a number of data points from the United States Census Bureau to the equation -10^7+200000x using Mathematica, where x is the number of years since 1900.) Although we could not locate appropriate data to input a given age and year and output the number of people over that age, we can get a rough estimate of the number of people receiving Social Security in 75 years with this equation (though in reality this value should be lower). This estimate is 2.6 x 10^7 people. So multiplying this by the average benefits per person per year as projected by a previous curve-fit, we get (2.6 x 10^7 people)($3.3 x 10^4)= $8.6 x 10^11. (We would like to note that this estimate for expenditures is most likely higher than what it would be if we included people strictly over 86 years of age, rather than people over 80 years of age.) According to the current system, we said the projected expenditures will be $4.7 x 10^12. So we are saving the difference of these two values, or $3.84 x 10^12. Since the projected deficit was $2.2 x 10^12, our revised system more than makes up for the deficit. In fact, it gives us a surplus of $1.6 x 10^12.

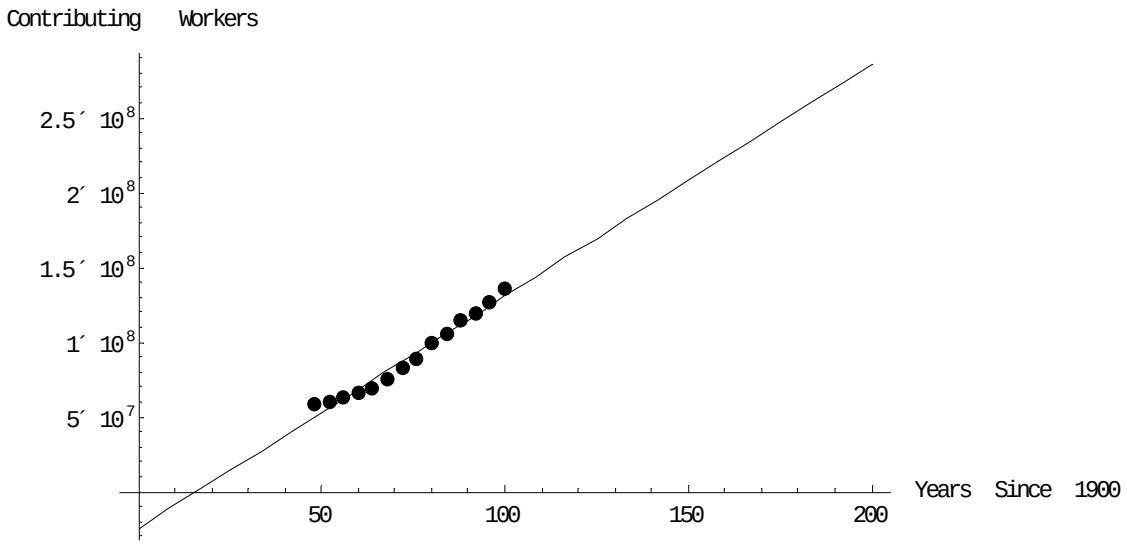
We did not have time to further investigate the expenditures required for a partial benefit program. If such a program would again put us in the red, we would seek alternative methods for funding, including benefit cuts (perhaps for the wealthiest bracket of society).

How the Models Can be Tested

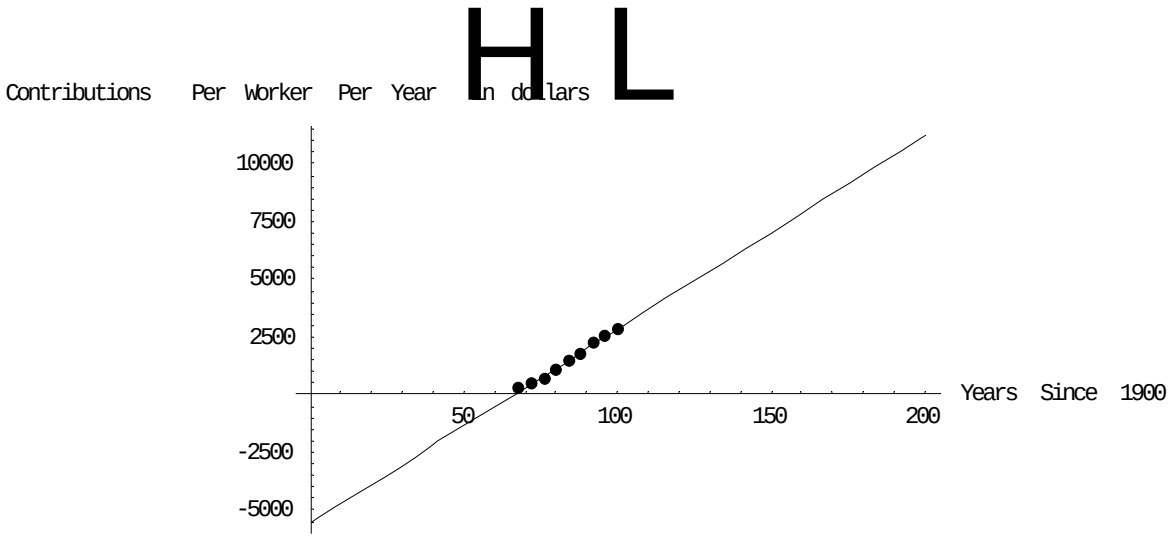
These models can be tested in comparison to current statistics and third party estimates. When previous years are entered into the models, they should yield data that is close to historical data that is already known. Any errors that arise would be caused by the unpredictable nature of the data, but the results should still be sensible.

Graphs (curves fit on Mathematica):

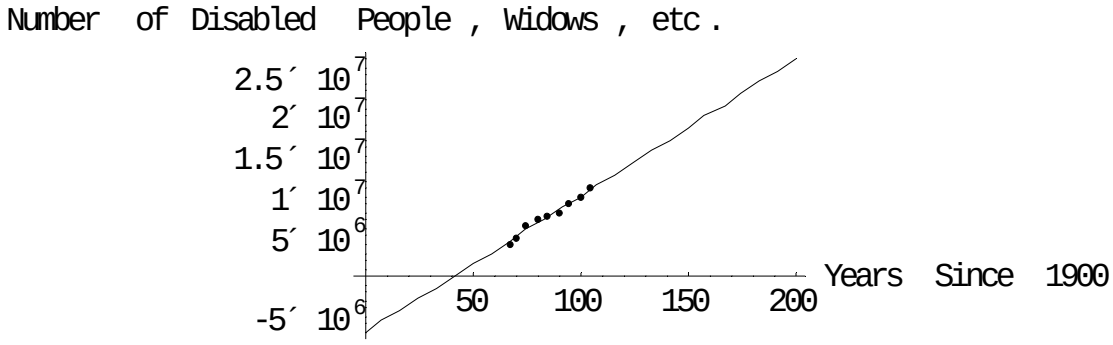
Number of Contributing Workers vs. Time



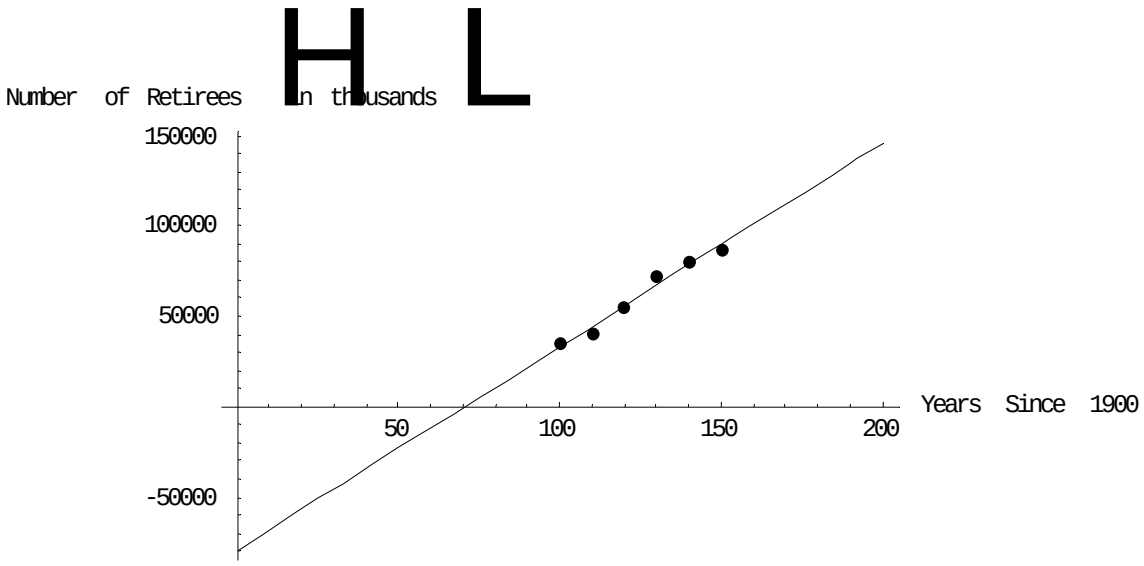
Contributions per Worker per Year vs. Time



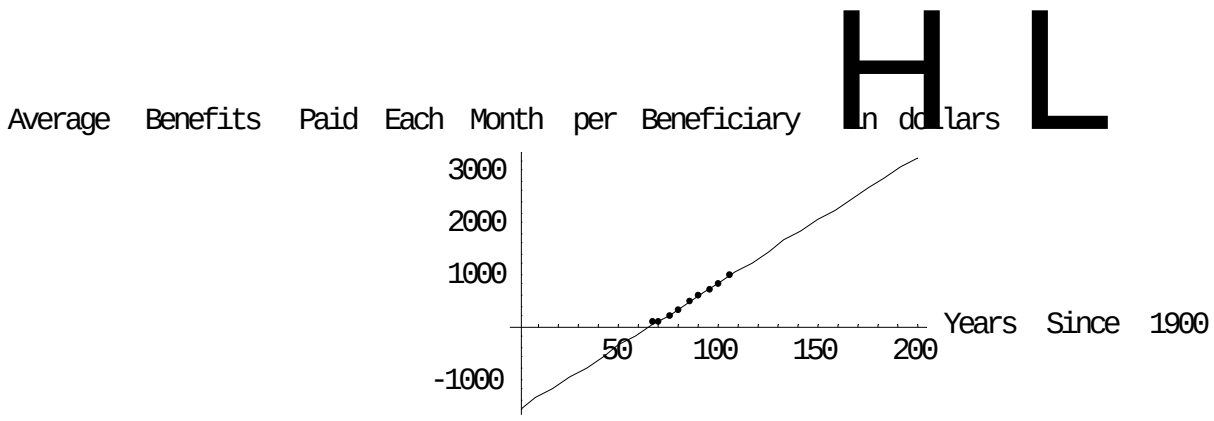
Number of Disabled, Widows, Etc. vs. Time



Number of Retirees vs. Time



Average Benefits Paid Each Month per Beneficiary vs. Time



Works Consulted

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http://www.ssa.gov/OP_Home/handbook/handbook-toc.html "Social Security Handbook"

http://www.ssa.gov/budget/2007bud.pdf "THE FISCAL YEAR 2007 BUDGET PRESS RELEASE"

http://www.ssa.gov/pubs/10055.html#future "The Future of Social Security"

http://www.ssa.gov/cola/automatic-cola.htm "History of Automatic Cost-Of-Living Adjustment"

http://www.ssa.gov/OACT/TRSUM/trsummary.html "Status of the Social Security and Medicare Programs"

http://www.ssa.gov/OACT/TR/TR05/V_demographic.html#wp79479 "ASSUMPTIONS AND METHODS UNDERLYING ACTUARIAL ESTIMATES"

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http://www.census.gov/cgi-bin/ipc/idbagg "Midyear Population, by age and sex"

http://www.bls.gov/opub/rtaw/pdf/rtaw2001.pdf#search='American%20workforce' "Report on the American Workforce (2001)"

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http://www.cato.org/testimony/ct-mt092496.html "Social Security & Baby Boomers"

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