An Intuitive Understanding of Social Security

Kevin Klus

Robert Morris University

Abstract

Each year, the Social Security Board of Trustees compiles a report detailing the expected future status of Social Security. In order to forecast Social Security, economic and demographic variables are input into actuarial models. The result is a distribution of possible scenarios classified as low-cost, intermediate, or high-cost depending on their financial impact on Social Security. The modeling is completed through complex stochastic calculus techniques, which can sometimes cause the innate understanding to become lost in the mathematics. Even some everyday American citizens may struggle to be able to quickly and efficiently explain how movements in interest rates, mortality rates, or other factors impact Social Security. This paper will summarize the most important variables and their influence on Social Security with little or no calculations. By starting with the basics of each variable and explaining its usefulness with diagrams and/or exhibits, an intuitive understanding will be gained.

Introduction

Social Security – or otherwise known as Old-Age, Survivors, and Disability Insurance (OASDI) – the largest and most popular government program – is facing future risk of not being able to pay the full amount of promised benefits if action is not taken soon (Aaron, 2011; Béland, 2008). Current forecasts estimate that in 2021, total expenditures will start to exceed total income. This will begin a steady reduction in the trust funds' reserves until 2033 when the accounts will be depleted (Munnell, 2013). Future projections of Social Security depend on many assumptions that are commonly being assessed by stochastic modeling. These assumptions are based on forecasted ultimate rates that are difficult for everyday Americans to conceptualize. Pictures and time diagrams can be used to demonstrate how economic and demographic variables affect the relationship between Social Security income and expenses, which indirectly determines the amount of money within the trust funds. This paper is structured to provide the background information to understand the state of Social Security and the history of the relevant variables that affect it. Moreover, this knowledge can be applied to better intuitively comprehend the movements of the Social Security trust funds.

History

In the late 1800's, approximately 72% of America's citizens lived in rural areas. Most families lived on farms that were run by not only the nuclear family but also by extended family members. If a family member, such as a father, passed away due to a premature death, the rest of the family was insured by the mere fact that they lived on a farm and conducted their work with multiple family members – meaning, there was limited income lost because of the death of the individual. In a sense, there was not a predominant breadwinner that the family heavily relied upon, and in turn, there was not a demanding need for a life insurance program (Social Security Administration, 2005).

At the same time in Europe, an industrial transformation was happening. This conversion from the farm to the factory carried with it the movement of the father of the household to become the independent earner for a family. A type of social program was needed to combat the mortality risk associated with the premature death of the breadwinner; therefore, the world's first Social Security program materialized in Germany in 1889 (Social Security Administration, 2005).

Not long after in the early 1900's, just like Europe, America faced its own migration and needed its own social program. In fact, by 1930, only 44% of the U.S. population lived on farms compared to the 72% as mentioned before. This changing of the guard brought about America's own Social Security program enacted by President Franklin D. Roosevelt on August 14, 1935. Over the next several decades, Social Security acted as a pay-as-you-go program – employees and employers paid periodic payroll taxes and when reaching the age of retirement, the employees were paid in the form of an annuity until they passed away (Social Security Administration, 2005).

Until 1950, these annuity payments were a fixed payment, meaning that each payment was of the same amount. After 1950, a COLA (Cost of Living Adjustment) was added and is still applied to benefit payments to compensate for inflation. Also in the 1950's, Social Security was amended to include the disability portion of the OASDI (Social Security Administration, 2005).

Until the 1980's Social Security procedures remained relatively unchanged, but in the Trustees Report of 1983, projections suggested a possible short-term risk that tax revenue may

not be enough to cover expected benefits. As a response to this, the combined employee/employer payroll tax rates increased progressively from 10.8% in 1983 to 12.4% in 1990, remaining the same since then (King & Soneji, 2012).

Current State and Future Status

Social Security, the largest and most popular government program is facing future risk of not being able to pay the full amount of promised benefits if action is not taken soon (Aaron, 2011; Béland, 2008). Although well-liked, less than 50% of people are confident that Social Security can pay its long-term commitments (Nuschler, 2012). This concern is not invalid if changes are not made to the system.

In 2012, total expenditures were $786 billion while non-interest income was only $731 billion – meaning that expenses were larger than tax revenues in the past year and interest was withdrawn from the trust funds to pay for a portion of the benefits (Board of Trustees, 2013). This occurrence is not expected to change anytime soon. In fact, as the baby boomers age, the proportion of workers to retirees is expected to move from 3:1 to 2:1 (Munnell, 2013). This implies that there will be fewer workers paying taxes to support a growing number of Social Security recipients. In addition, those recipients will collect benefits longer because the 20th century saw a rapid decline in mortality rates due to increased access to medical care, discovery of new antibiotics, and increases in the standard of living (Wade, 2009). The change in the portion of workers to retirees will cause increased expenses and decreased tax revenue, taking a toll on the trust funds. Fast population or productivity growth could improve tax revenue, although, recently, America has encountered the exact opposite effect (U.S. Department of the Treasury, n.d.). The Great Recession has caused high unemployment accompanied by stagnate wages and high inflation – further reducing the tax revenues and increasing the benefits paid putting extra stress on the trust funds (Warshawsky, 2012).

Current projections estimate that in 2021 total expenditures will start to exceed total income (interest included) beginning to reduce the trust funds' reserves until 2033 when the accounts will be depleted (Munnell, 2013). At this point, only 77% of the total benefits will be able to be paid because of the Antideficiency Act that prohibits government to spend more in benefits than are in the trust funds (Board of Trustees, 2013; King & Soneji, 2012). Discounting the benefits alongside the tax revenues, Social Security has a deficit of $9.6 trillion equivalent to 2.72% of taxable payroll. This means that a program that made benefit payments to approximately 57 million people last year will not be able to fully pay promised benefits unless combined employee/employer payroll tax rates (equally spilt) are increased by 2.72% immediately (Board of Trustees, 2013).

Even though Social Security tax rates have increased in the past, it is unlikely to happen in the current political environment. As politicians wait to either cut benefits or increase taxes, the impact will become more severe and centralized. If taxes were to be raised soon, it would help spread out the burden over more years. Diversifying the problem over more years prevents fewer individuals from falling below the poverty threshold. If full benefits cannot be paid, the replacement rate – proportion of benefit amount divided by past average income – will drop significantly leaving older Americans with less retirement income than they had planned (Scott, 2009). This would be catastrophic since 40% of Americans 65 and older avoid falling into poverty solely because of their Social Security benefits (Arno, House, Schechter, & Viola, 2011).

Even though the future of Social Security looks grim, the magnitude of its eventual negative impact can be mitigated by current political action and/or a possible implementation of an alternate program.

Controversies and Uncertainties

Social Security polices and alternatives are highly debated among politicians and other citizens. Some advocates of Social Security argue that only minor tweaks are needed because it is serving its fundamental duties as a social program, which is providing safe and stable income to retirees and disabled. Those not in favor of Social Security push for changes as extreme as re-hauling the entire system to improve retirement benefits (Estes & Svihula, 2007).

One common proposed alternative to Social Security is to replace it with individual private accounts (Béland, 2008). Supporters of this method say that there are no "real" trust funds – rather money is always going in and out as IOU's between the Social Security Administration (SSA) and the U.S. Treasury Department (Armstrong & Gorin, 2012). Furthermore, because payroll taxes are invested in U.S. Treasury securities, the rate of return is very low when compared to investing in the open market (Buffin, 2012). In addition, some see Social Security as unfair because the replacement rate for workers that had higher lifetime earnings is lower than workers that had low lifetime earnings because of Social Security's progressive tax system (Congressional Budget Office, 2012). Even though Social Security may not maximize the benefits for some workers, it does have a societal impact.

Social Security also serves as a type of life and disability insurance – not just an investment account. It guards against mortality risk, the risk that a worker may die a premature death leaving his/her family at a substantial income decrease. It has also vastly enhanced the health and longevity of the elderly by improving living conditions and access to medical care (Arno et al., 2011). The current age to start receiving full benefits is 65 and will increase to age 67 by 2022, but some people argue that increasing the retirement age has a minor impact on the relationship between tax revenue and benefit expenses at the cost of having adverse effects on women, people of color, and other low-wage workers (Gorin, 2012). While some citizens debate the policies to enact, actuaries and economists ponder about the most accurate ways to project Social Security.

Projections

The mathematics behind forecasting the future of Social Security is a function of variables including birth rates, mortality rates, immigration rates, employment rates, inflation rates, interest rates, and many other inputs (Board of Trustees, 2013). Calculating a best estimate for each variable is tedious and not yet a perfected science; therefore, the figures that are used as assumptions in the Social Security models are surround by uncertainty.

For example, there are competing views between Futurists, Optimists, and Realists about future longevity. Futurists believe an unconstrained age can be eventually reached, Optimists believe that life expectancy will surpass 100 years old within the next century, and Realists say that exceeding an average life expectancy of 85 is unrealistic because it would require the equivalency of the complete elimination of cancer and heart disease (Carnes & Olshansky, 2007). Also, obesity, a relatively new factor to assess, is becoming ever more important to accurately predict because it affects mortality rates; currently, a third of the U.S. population is reported as being obese, and this trend is increasing (Gutterman, 2008). In addition, future inflation rates are predicted by the Consumer Price Index for Urban Wage Earners and Clerical

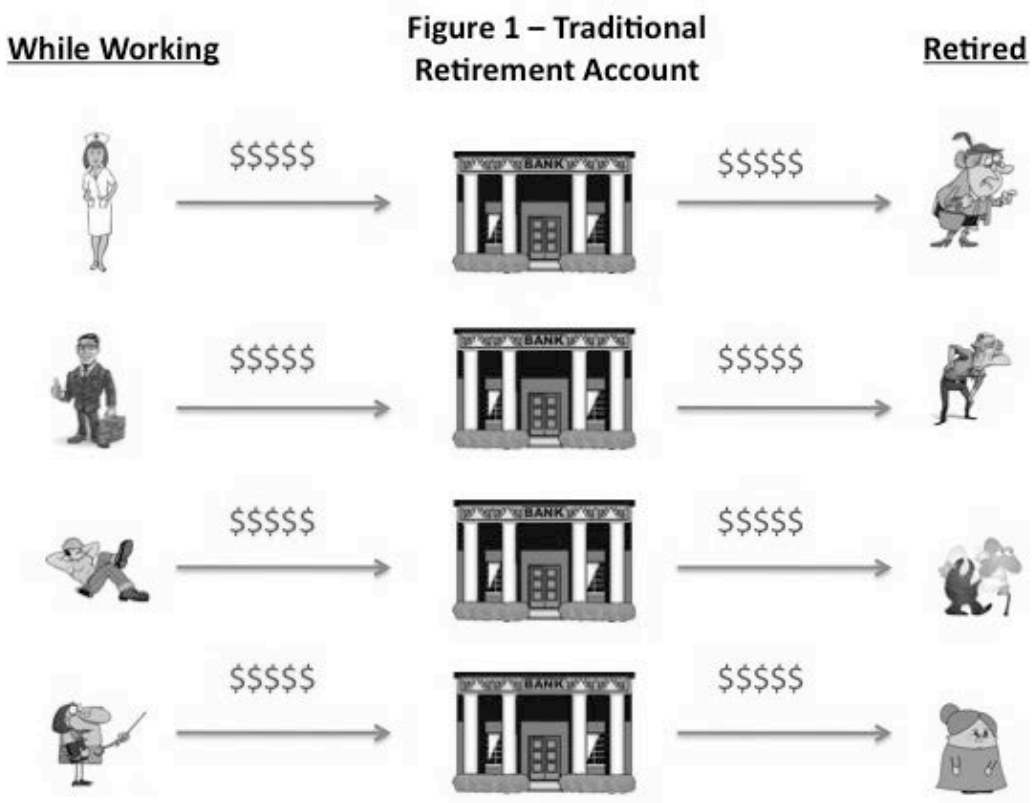
Workers (CPI-W), which some argue does not accurately capture the inflation on goods that the elderly tend to buy, rather it measures inflation based on a basket of goods that current workers tend to buy (Goda, Shoven, & Slavov, 2011). This is not favorable for the elderly since medical costs, which have been increasing rapidly, are not included in the CPI-W calculation.

Luckily in recent years, the forecasting of these assumptions has been conducted by a process called stochastic modeling. Stochastic modeling simulates hundreds and sometimes thousands of possible future scenarios. It then places a probability distribution around these occurrences to help quantify the likelihood of future events. Because assumptions tend to lag behind current demographic and economic experience, stochastic modeling can predict the future probability of changes in data, making it a popular, efficient, and accurate way to forecast the future of Social Security (American Academy of Actuaries, 2012). With this being said, stochastic modeling requires the probabilities of assumption inputs so there is still considerable uncertainty in the results, especially when predicting many years into the future.

In cases like Social Security, where the calculations are complex, it is sometimes best to take a step back and attempt to intuitively predict the results before the calculations are even computed. The goal of this thesis paper is to better grasp the variables being input into the Social Security projections and how they impact future Social Security tax income and benefit payments. An innate understanding of the Social Security projections should be gained without having to know advanced financial mathematics. Before analyzing the structure of Social Security and its components, it is important to understand how it differs from a traditional retirement account.

A Traditional Retirement Account

Money that is earned by an individual and is not spent on current expenses is usually saved or invested. Two main advantages stem from saving money and/or investing it. First, when saving money, it mitigates the effects of future hardship. For example, if you have money saved and suddenly your car has mechanical issues, you can pay for some or all of it immediately, which reduces the financial burden upon yourself. Secondly, when investing money, a monetary return is gained as result of lending the money for a period of time. The return that is earned on the balance can reduce the effects of inflation or even completely eliminate it.

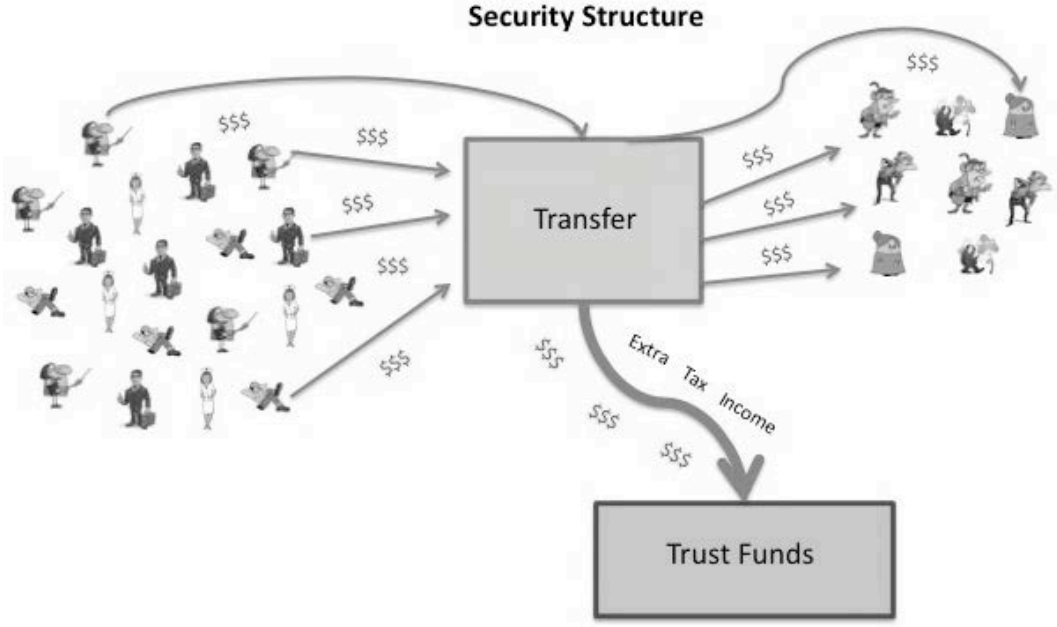


Investing and saving earnings for retirement are prudent financial decisions if an individual can manage to set money aside for some period of time. Usually, employees set aside some percentage of their income to save and invest in financial assets so they can receive the money during retirement – reducing their financial burden at that time. In the case of 401(k)'s and other traditional retirement accounts, as shown in Figure 1, the employee (and maybe the employer) contribute money to a personal account. This account is person-specific, and the employee, their financial advisor(s), and/or the place of employment uniquely decide upon the methods that the money is invested. The money can be invested in stocks, bonds, mutual funds, and other types of financial instruments. During the employee's working years, this account will acquire interest based upon the returns of the financial assets, and at retirement, the person will draw directly from his/her own account. This differs from the setup of Social Security.

Social Security Structure

Contrary to what some people believe, the taxes they pay towards Social Security – a portion of the FICA (Federal Insurance Contributions Act) taxes – does not go into an account with their name on it like a traditional 401(k) retirement account. When Social Security began in 1935, there was no saved money in the trust funds to start paying for new retirees; therefore, like now, the income taxes collected from current workers pay the benefits for the retirees. This setup is completely different from a traditional retirement account.

Figure 2 – Social Security Structure

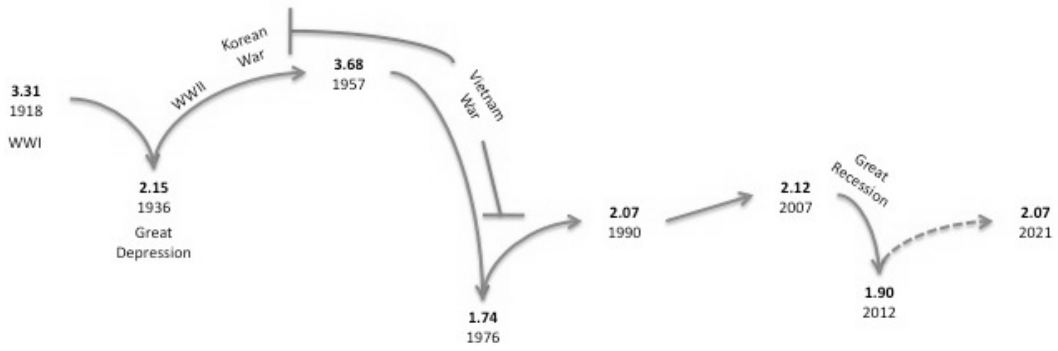


As Figure 2 shows, money is collected from employees and transferred directly to the retired. Any surplus in taxes over benefit payments is put into the trust funds to be saved and invested in order to guard against times when deficits occur. This diagram is our fundamental starting point for this paper. Almost every major variable used to forecast Social Security will be explained with modifications to this diagram. From this point forward, all facts and statistics presented in this paper were taken from the 2013 Social Security Board of Trustees Report.

Fertility

When evaluating the importance of a certain variable related to Social Security, it is always important to understand some background information about the input being discussed. Providing additional information gives a starting point to get the thought process headed in the correct direction. The first variable to be discussed is fertility. The Board of Trustees measures fertility as births per woman (ages 14 to 49) and is evaluated mid-year. For example, if a 35-year old female has four children, then the "births per woman" in this case would be four. Summing this information for every female in the United States between ages 14-49 and then dividing by the total number of females between ages 14-49 in the United States gives the aggregate births per woman. Figure 3 displays the movement of the aggregate births per woman in America between years 1918 to a projected year of 2021.

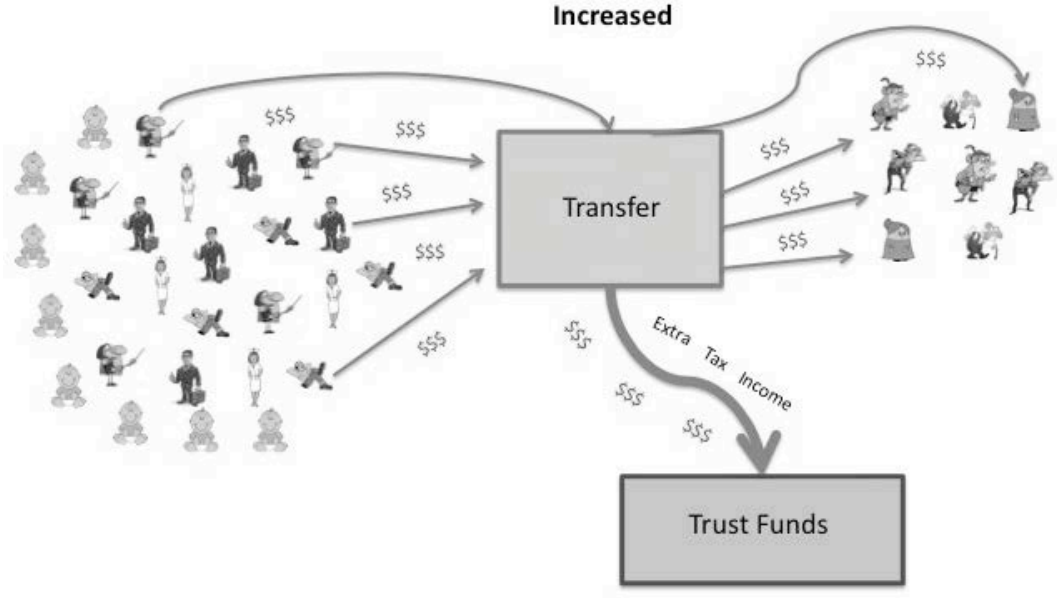
Figure 3 – Births per Woman
(Evaluated Mid-year)



As can be seen, the births per woman statistic has varied across time. The movement of this statistic is a function of many factors including, but not limited to, social attitudes, economic conditions, birth control practices, racial/ethnic composition of population, percentage of women married/divorced, and the percentage of young women in the labor force. Knowledge of the previous movements of the fertility rate is advantageous, but questions remain about fertility rates in the future. If the rates go up or down in the future, how will that affect Social Security? For some people, this might be a 50/50 guess, but it should not be, because this can be intuitively understood. Going back to Figure 2, consider what happens when the fertility rate increases (more children are being born per woman).

It can be seen from Figure 4, that the only adjustment that was made to the original diagram (Figure 2) is the addition of babies on the left-hand side. The inclusion of infants symbolizes that the fertility rate has increased. What does this ultimately imply? This means eventually these children will develop and be able to work, which is more people working and more income to tax. If the right-hand side, the retirees, stays at the same amount, then there will be an even larger surplus to deposit into the trust funds. The question about how fertility affects Social Security has been answered with this diagram; the answer being that if fertility increases, the trust funds are also expected to increase because tax revenue has increased in relation to benefit expenses. To check if intuitive understanding matches the calculations, consider the Board of Trustees' ultimate rates.

Figure 4 – Fertility Increased



The ultimate statistics (or rates in this case) are measurements into the infinite future about a certain variable. The ultimate statistics are broken into low-cost, intermediate, and high-cost depending on their financial impact on Social Security. Intermediate is the expected measurement of the variable in the long-term, and it is also the expected variable value that will impact Social Security. Low-cost means that Social Security is benefiting (trust funds are possibly growing) more than expected. High-cost means that Social Security is suffering (trust funds are possibly shrinking) more than expected. Table 1 lists the ultimate rates for fertility.

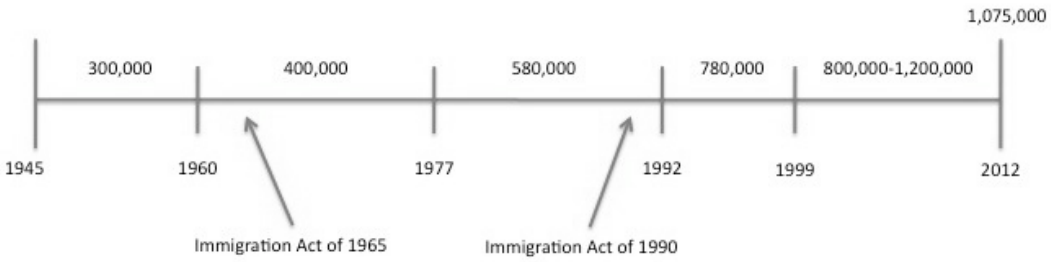
Table 1	
Fertility Ultimate Rates	
Low-cost	2.30
Intermediate	2.00
High-cost	1.70

Considering what has been learned about how fertility affects Social Security, these ultimate rates make sense intuitively. It has already been determined that an increase in the fertility rates increases tax revenue indirectly increasing the balance in the trust funds, which would be appropriately classified as low-cost. Also, we know the opposite is true; that if fertility rates decrease, the balance in the trust funds decreases, which in ultimate context is denoted as high-cost. In the next several sections, this type of analysis will be done on the major variables that affect Social Security. Following this method, one can deduce a simple way to envision how the trust funds move in relation to fluctuations by the impacting variables.

Immigration

The next variable to be investigated is immigration. The Board of Trustees defines net legal immigration as the difference between legal immigration (people entering the country) and legal emigration (people leaving the country). As one might expect, as attractive of a country as America is, the United States has more legal immigrations each year than legal emigrations. Visible in Figure 5, the average number of people that have been legally immigrating into the

Figure 5 – Legal Immigration
(Persons per Year)



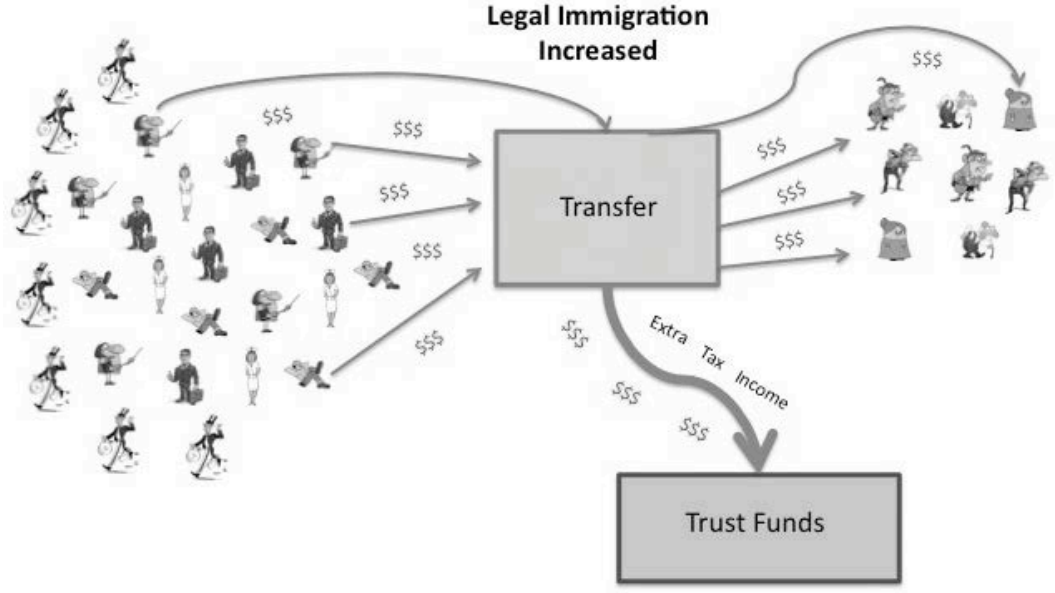
United States each year is increasing steadily. Most of this growth can be explained by the shear enlargement of the world's population over the past several decades, but multiple Immigration Acts have also been put into place that have encouraged immigration into the United States. Over the last decade, America has seen around one million legal immigrants enter the country annually.

Table 2 - Ultimate Immigration Predictions			
Alternatives	**Annual Legal Immigration**	**Annual Legal Emigration as a Percentage of Annual Legal Immigration**	**Net Annual Legal Immigration**
Low-cost	1,250,000	20%	1,000,000
Intermediate	1,050,000	25%	787,500
High-cost	850,000	30%	595,000

Table 2 displays the ultimate statistics for immigration. The annual legal immigration column is the expected long-term future number of immigrants that will enter the country each year. The next column lists the percentage of annual legal emigration in relation to the annual legal immigration under each cost category. It is critical to show this number as a percentage because the emigration is conditioned on the amount of expected immigrations – if shown as a number, each category could not be compared easily. Finally, the last column is the net annual legal immigration as defined above. To better understand these statistics, consider the original diagram (Figure 2) with modifications.

This time, the change that was made to the initial diagram is the addition of American citizens, as seen in Figure 6. Comparable to the fertility example, an addition of workers on the left-hand side results in more tax revenue and more money deposited into the trust funds. An increase in annual legal immigration, similar to fertility, benefits Social Security, and this is verified by the low-cost category having the higher ultimate annual legal immigration amount.

Figure 6 – Annual Net Legal Immigration Increased



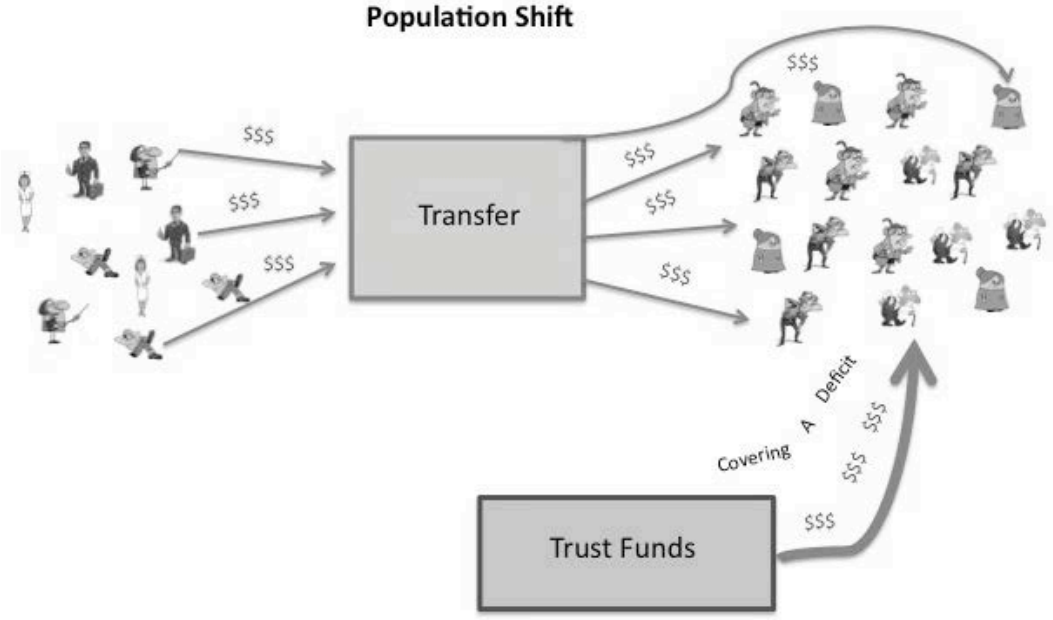
Increasing emigration would remove people from the left side of this diagram. Less workers on the left-hand sided would result in fewer people to tax, i.e. less tax income. The trust funds would suffer in this case possibly to the point that some money may have to be taken out of the trust funds to pay for current retirees. Also, it is possible to deduce that the statistic that really matters in this scenario is the net annual legal immigration as shown in the last column in Table 2. As long as annual legal immigrations are greater than annual legal emigrations, then net annual legal immigrations will be positive, and Social Security will benefit. The knowledge gained about how fertility and immigration affect the trust funds can be generalized to a broader idea such as how total population shifts affect the trust funds.

Total Population Estimates

Thus far, cases have been covered where Social Security is affected by either increases or decreases in fertility or immigration. This is illustrated by fluctuations in the left side of Figure 2. Consider what happens if the right side of the diagram changes.

In Figure 7, there has been a shift in the total population as demonstrated by less current workers showing on the left-hand side and more retirees on the right-hand side. This population shift is not at all unrealistic. In fact, currently and for the next decade or more, the baby boomers are starting to retire. The baby boom happened soon after WWII when men returned from the war and pregnancies increased. This was characterized as a time of high birth counts relative to the total population. The children born during this era are now ready to retire, and a population shift is happening. In this modern situation, total tax income cannot pay for the total benefits owed to retirees each payment period. Because the direct transfer of money from taxes to retirees is not fully covering all their benefits, money from the trust funds must be used to cover the remainder of owed benefits. This is why the trust funds were initially set up – to guard against times when tax income is less than total benefits. From the perspective of the trust funds, this situation has a negative impact.

Figure 7 – A Population Shift



A measure to quantify the magnitude of this population shift is known as the dependency ratio. The dependency ratio is calculated as the ratio of the population at ages 65 and over to the population of ages 20-64. To better understand how the dependency ratio works and how it relates to population shifts, consider the following example.

For numerical simplicity assume that in year 2000, America had 70 million people who were 65 and older and 140 million who were between 20 and 64. Next, assume that in year 2014, 100 million people are 65 and older and 130 million people are between ages 20 and 64. A population shift happened in this scenario between the years of 2000 to 2014 and can be seen in the change in the dependency ratio below.

Figure 8 - Dependency Ratio Example

$$\text{Dependency Ratio}_x = \frac{\text{Population 65 and Older}_x}{\text{Population 20-64}_x}$$

$$\text{Dependency Ratio}_{2000} = \frac{70 \text{ million}}{140 \text{ million}} = \mathbf{0.5}$$

$$\text{Dependency Ratio}_{2014} = \frac{100 \text{ million}}{130 \text{ million}} = \mathbf{0.7692}$$

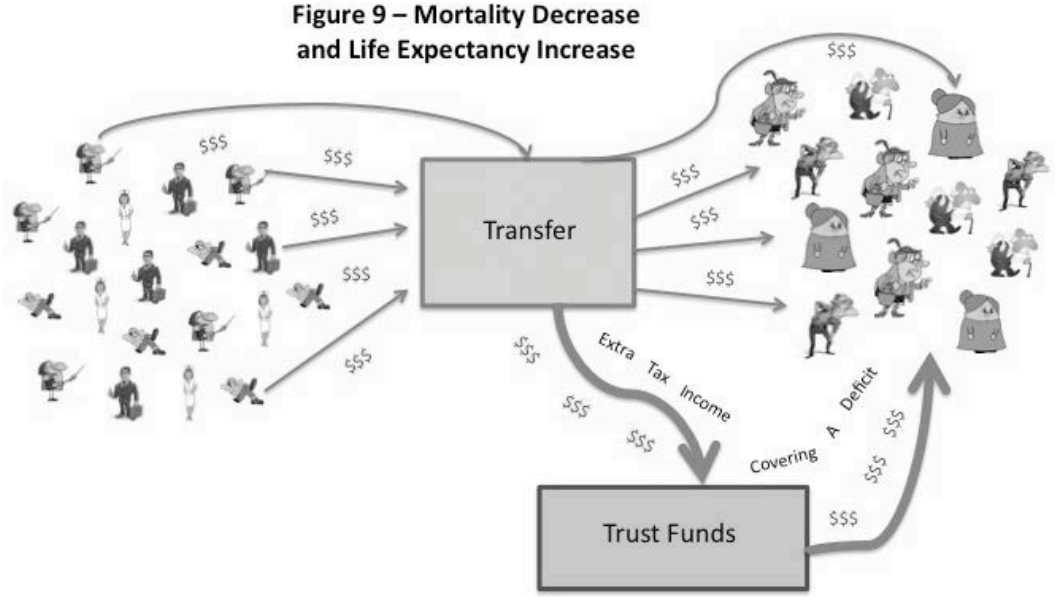
In this case, as in Figure 7, the number of retirees in relation to the number of workers increased, which caused the dependency ratio to increase. As explained above, this type of migration hurts Social Security. It is possible to verify this intuitive understanding by looking at Table 3, which has the ultimate statistics for the dependency ratio. As can be guessed, a low dependency ratio – more current workers in relation to retirees than expected on average – is low-cost, increases tax revenue, and benefits the trust funds. Moreover, a higher dependency ratio than expected on average increases expenditures and burdens the trust funds.

Table 3 - Ultimate Predictions	
Dependency Ratio	
Low-cost	Low
Intermediate	-
High-cost	High

Mortality and Life Expectancy

While analyzing the right-hand side of Figure 2, the remainder of the variables that affect the right side will now be evaluated. Mortality and life expectancy mainly affect the older cohorts of the population, which by association means they affect the right side of the diagram. In the last century, the mortality rate has declined significantly. This rate has generally declined more slowly for older ages and more rapidly for younger ages. As the last century progressed, it has declined faster for younger ages because birthing and medical advances have enabled relatively fewer children to die during or soon after birth. Breakthroughs in medical knowledge, increased availability of health-care services, and improvements in sanitation and nutrition are among some of the factors that have catalyzed the decrease of morality rates and consequently, the increase in life expectancy. Life expectancy is expected to continue to increase in conjunction with consistently lower mortality rates but at a slower pace than the last century.

Figure 9 – Mortality Decrease and Life Expectancy Increase



Although mortality rates are expected to decrease and life expectancy is expected to increase, the magnitude by which either happens will affect the number of benefit payments. Decreasing mortality rates and increasing life expectancy can be shown by more retirees on the right-hand side in Figure 9. Pictorially, the retirees appear "bigger" than normal because they are collecting more money by living longer.

When looking at this diagram, it can be seen how the aging population puts stress upon Social Security. As the mortality rate decreases and people continue to live longer, more and more benefit payments are needed. This explains why the low-cost scenario in Table 4 contains lower declining mortality rates (mortality not decreasing as fast as expected) and lower life expectancy than expected. This case would be considered low-cost because Social Security is not suffering as much as expected due to an increasingly aging population. The high-cost scenario

would be just the opposite. For example, in an extreme case, if a cure for cancer were to be developed, although it would be favorable for society, Social Security would be negatively impacted significantly because of a decrease in mortality and increase in life expectancy would rapidly increase the number of benefit payments.

Table 4 - Ultimate Predictions		
	Decline in Mortality	**Expected Future Lifetime**
Low-cost	Low	Low
Intermediate	-	-
High-cost	High	High

Productivity

The next variable to be assessed is productivity. The Social Security Board of Trustees defines total economy productivity as real GDP divided by total hours worked by all workers. The history of productivity is shown in Table 5.

Table 5 - History of Productivity	
Complete Economic Cycles (Peak to Peak)	**Average Annual Increases in Total Productivity**
1966-1973	2.26%
1973-1979	1.08%
1979-1989	1.30%
1989-2000	1.75%
2000-2007	2.06%
2007-2012	1.33%
1966-2012	**1.68%**

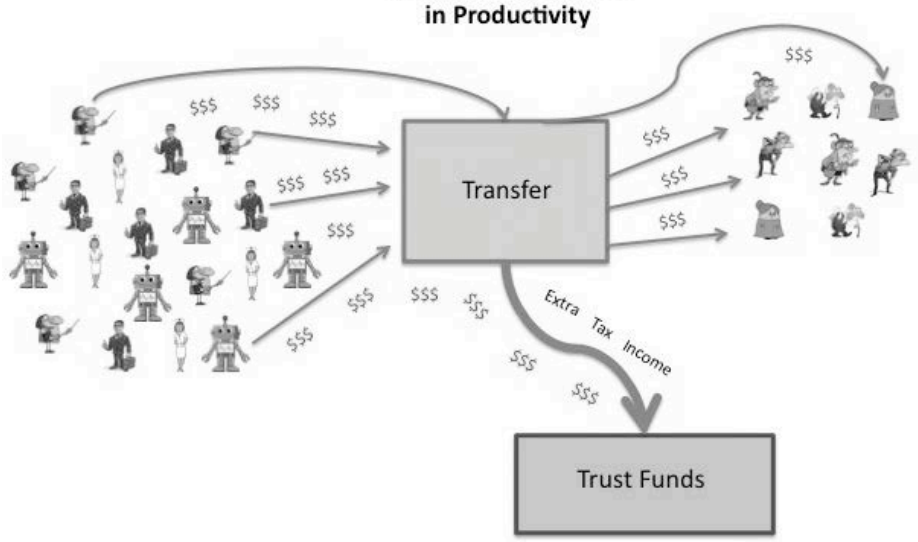
The higher relative productivity during the 1989-2000 and 2000-2007 time periods may be attributed to the increased use of computers to efficiently complete tasks. Additionally, showing productivity from economic peak to peak gives a sense of how productivity has changed during different time periods in America's history.

Table 6 - Ultimate Predictions	
Annual Increases in Productivity	
Low-cost	1.98%
Intermediate	1.68%
High-cost	1.38%

Productivity is a measurement that is generally expected to have a positive increase. That is why the ultimate rates in Table 6 are all positive increases into the indefinite future. The

difference in the low-cost, intermediate, and high-cost alternatives is the magnitude in the increases in productivity.

Figure 10 – Increases in Productivity



In Figure 10, the increases in productivity are shown by a removal of unproductive workers on the left side of the diagram and replacing them symbolically by computers. As the diagram suggests, when productivity increases, there will be more tax revenue that can flow into the trust funds because an increase in aggregate economic productivity means more income is being generated in the economy. More income means more money to tax and increases to trust funds balances. The low-cost percentage in Table 6 aligns with the intuitive understanding that increased productivity means a positive impact on Social Security – a low-cost situation. The next variable under consideration, unemployment, has the opposite effect on Social Security.

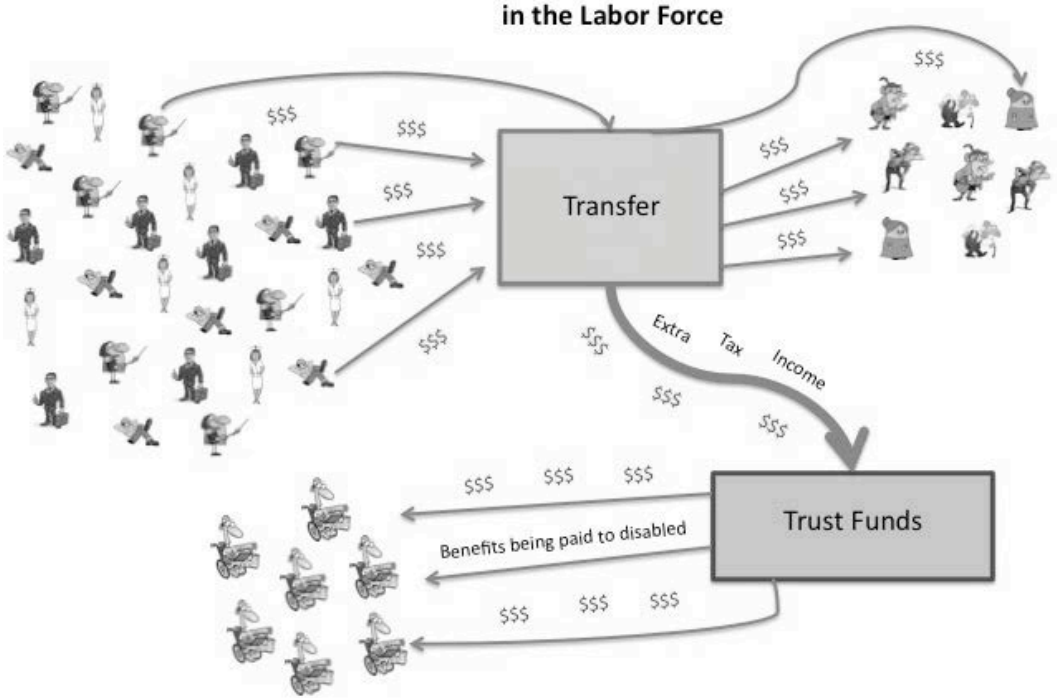
Unemployment and Labor Force Measurements

A common economic measurement cited in the media is the unemployment rate. Especially since 2007, when the Great Recession hit, unemployment has been a topic of great discussion. Even though the general belief is that the economy, as a whole, has recovered from the recession, unemployment has dragged behind having a difficult time making headway toward the pre-recession levels. Factors related to the labor force will be discussed in this section. Unemployment is an important statistic related to the labor force, and is included in this section.

Table 7 - History of Labor Force Growth	
Complete Economic Cycles (Peak to Peak)	**Average Annual Growth in the Labor Force**
1966-1973	2.40%
1973-1979	2.70%
1979-1989	1.70%
1989-2000	1.30%
2000-2007	1.00%
2012-2022	**0.90%**
2022-2087	**0.50%**

Table 7 details the history of the average annual labor force growth rate from economic peak to peak. There are also some projections for future years. Total population growth and the increase in the number of jobs created would be examples of variables that could boost the labor force growth rate. The decreasing of future expected growth rates is credited to the population shift of baby boomers leaving the work force over the next decade, which, as mentioned in the Total Population Estimates section, will put a burden on Social Security.

Figure 11 – Increase in the Labor Force



A consideration not mentioned in previous sections was that an increase in the amount of people working (whether it be an increase in rates of fertility, immigration, the labor force participation, etc…) does have negative impacts on Social Security as well as positive ones. Intuitive understanding has explained why an increase in the number of people working eventually means more tax income and more money that may be funneled into the trust funds, but not everything happens in a closed box. Recall that Social Security really stands for Old-Age, Survivors, and Disability Insurance (OASDI). As the name suggests, Social Security pays disability benefits to certain individuals. Figure 11 shows how an increase in the labor force and/or the labor force participation rate can have a negative impact on Social Security as well a positive one.

More people working means more tax income, but it also implies that a higher amount of people could become disabled. So if more people are disabled, that indirectly suggests that Social Security is under more stress. This is why when looking at the Board of Trustees' labor force participation rate projections in Table 8, the low-cost, intermediate, and high-cost alternatives are numerically close to each other. This phenomenon of more tax income and more benefit payments to disabled individuals at the same time virtually cancels each other out. Although as can be seen, the magnitude of positive effects on Social Security is projected to be slightly greater than the magnitude of the negative effects in this case. This is why the low-cost alternative still has a higher relative expected labor force participation rate.

Table 8 - 2012-2087 Labor Force Participation Rate Projections		
	Men (16+)	Women (16+)
Low-cost	73.70%	61.10%
Intermediate	73.50%	61.10%
High-cost	73.30%	61.00%

Transitioning back to the topic of unemployment, Table 9 shows the average annual ultimate unemployment rates. The unemployment rate is a slightly different factor than labor force participation rate. In layman's terms, the labor force participation is the percentage of people that are working or actively seeking employment that are able to work. The unemployment rate is the number of people that are unemployed as a ratio of the number of people in the labor force.

Table 9 - Ultimate Predictions	
Average Annual Unemployment Rate	
Low-cost	4.50%
Intermediate	5.50%
High-cost	6.50%

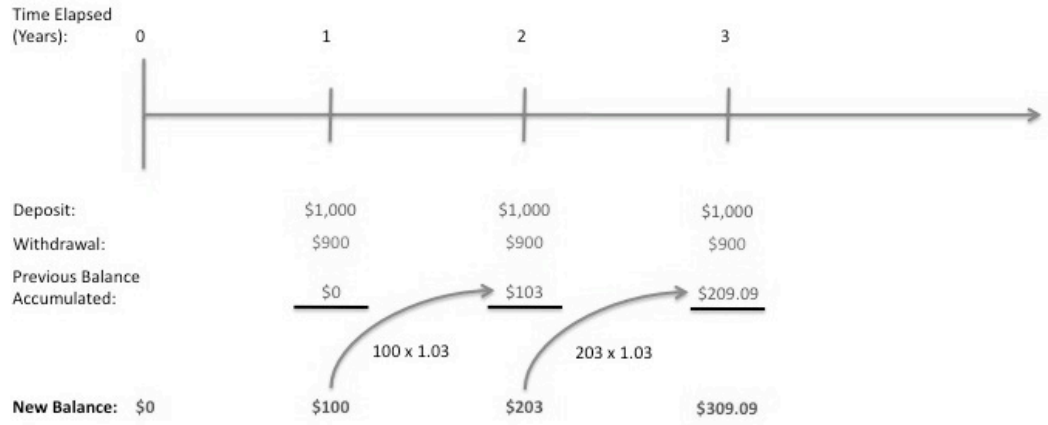
Normally, an increase in the unemployment rate is not ideal. Greater unemployment rates means the economy is steering away from its potential output. Put simply, relatively high unemployment means the economy is not being as productive as it could possibly be, which indirectly results in less tax income and burdens Social Security. This is why the low-cost alternative in Table 9 is the lowest projected unemployment rate, and the highest projected unemployment rate falls under the high-cost alternative.

Understanding Interest Accumulation

So far, discussion has centered on changes to tax revenue or benefit expenditures, i.e. how certain variables change the left side or right side of the original diagram (Figure 2). At this point, it is time to transition the thought process to analyze what is happening within the trust funds. In order to further discuss this topic, some basic understanding regarding how interest rates work within an account will be reviewed.

Figure 12 illustrates a time diagram consisting of three years of data. The numbers are not an accurate representation of the trust funds, but the interest accumulation is the same concept. Since the money in the trust funds is invested in treasury securities, there is very little risk. In this simple example, there is $0 in the account at time zero. At time one, $1,000 is deposited into the account and $900 is withdrawn. One can compare the $1,000 deposit as tax income flowing into the trust funds and the $900 withdrawal as benefit payments leaving the trust funds. Thus, there is a net $100 gain in the trust funds.

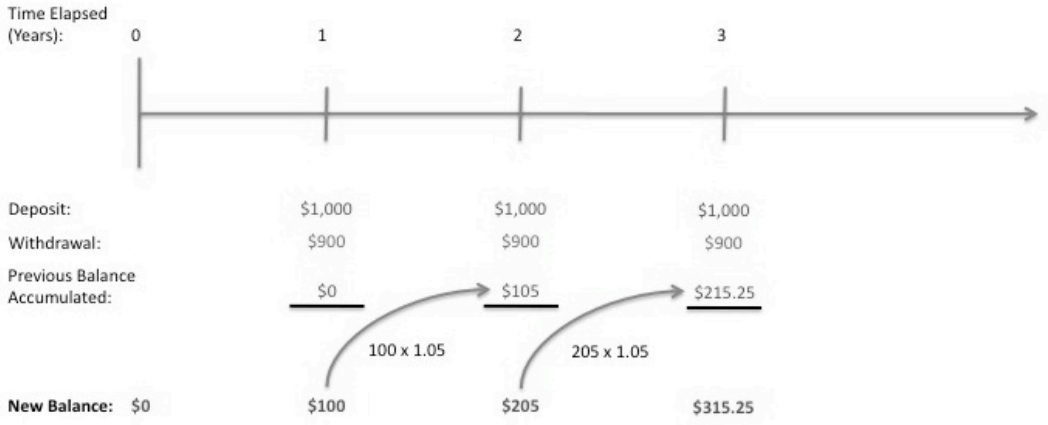
Figure 12 - Compounding Interest at 3% Yearly



Over the course of the next year, the $100 earns 3% interest. Note that this interest rate is the rate of accumulation without consideration of the inflation rate. This gives a new balance of $103 at the start of year two, at which point there is another deposit and withdrawal resulting in a new balance of $203. Once again, over the course of the next year, 3% interest is applied to the $203 increasing it to $209.09. This process can continue indefinitely. However, the treasury rates vary from year to year so the interest calculation will also vary.

If the interest rate increases to 5%, Figure 13 shows the changes mathematically; the only changes made were multiplying the previous balances by 1.05 instead of 1.03. This increase in the interest rate boosts the accumulation of money within the fund. Generally, this happens the same way in the trust funds. Holding everything else constant, an increase in the interest rate benefits the trust funds and would be considered the low-cost alternative. Hence, a decrease in the interest rate would be considered high-cost. The Board of Trustees does not express historical or future data in terms of experienced interest rates. Rather, the real interest rate is examined. The real interest rate is the rate of accumulation taking into account inflation. The effects of the inflation rate on Social Security will be discussed so an evaluation can be made of the real interest rate.

Figure 13 - Compounding Interest at 5% Yearly



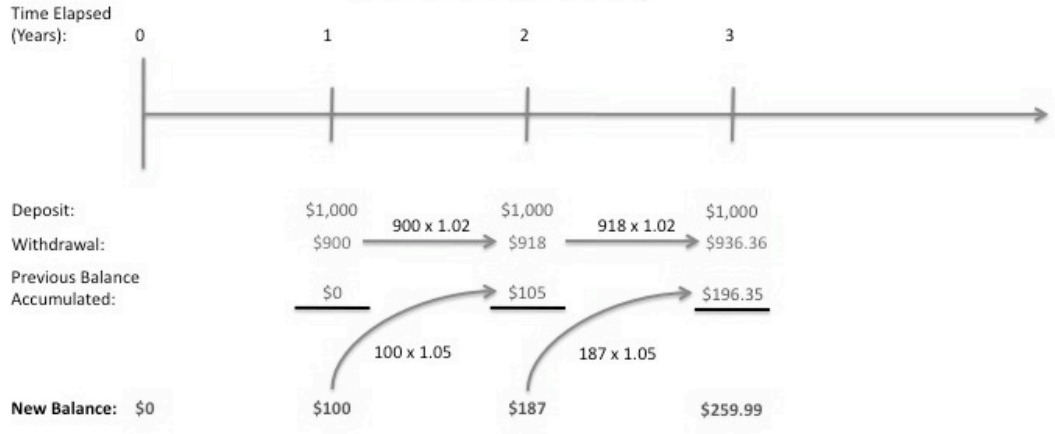
Price Inflation

Just as the interest rate was examined with time diagrams, price inflation will also be analyzed the same way. Inflation can be considered a measurement used to quantify an increase in prices. Since Social Security benefit payments are cost of living adjusted, the inflation rate plays a crucial role in the amount that might be leaving the trust funds at any given time. Specifically, price inflation is measured as movements in the Consumer Price Index for Urban Wages Earners and Clerical Workers (CPI-W) and the GDP deflator. The GDP deflator is based on U.S. production, and the CPI-W is based on U.S. consumption. Since the two are highly correlated, just one of them can be projected for the ultimate inflation predictions. The CPI-W will be used in this section interchangeably with price inflation. Table 10 shows the history of the CPI-W over the last several economic cycles.

Table 10 - History of Inflation	
Complete Economic Cycles (Peak to Peak)	**Average Annual CPI Increases**
1966-1973	4.60%
1973-1979	8.50%
1979-1989	5.30%
1989-2000	3.00%
2000-2007	2.60%
2007-2012	2.20%
1966-2007	**4.60%**

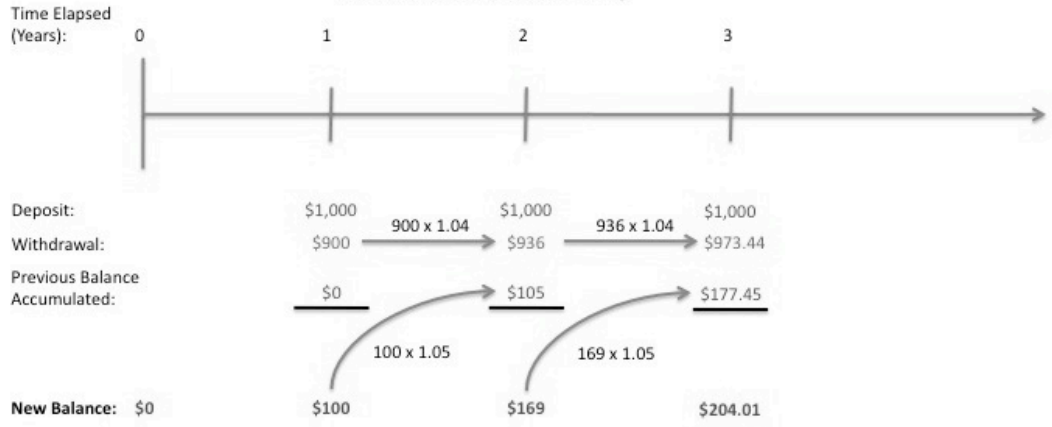
As an example of how inflation works, consider Figure 14. The interest rate is 5%, as in the previous example, except this time there is also inflation at 2% yearly. Since inflation is tied to the benefit payments, a positive inflation rate increases the benefit payments each year.

Figure 14 - Compounding Interest at 5% Yearly and Inflation at 2% Yearly



In general, this makes sense for those receiving the benefits – with an increase in the price of goods, additional income is required to purchase the same amount as in the past; therefore, when benefit payments are tied to the price inflation, the cost of living should theoretically remain constant. However, an increased inflation rate, as shown in Figure 15 (an inflation rate of 4%), does not benefit Social Security. A greater inflation rate means benefit payments are increased.

Figure 15 - Compounding Interest at 5% Yearly and Inflation at 4% Yearly



Once again, to verify the intuitive understanding behind this logic, consider the ultimate predictions for the CPI-W. According to Figures 14 and 15, a higher inflation rate leaves the account balance at time three with less money. Therefore, in Table 11, it is logical that the highest forecasted inflation rate falls under the high-cost alternative.

Table 11 - Ultimate Predictions	
Average Annual Increase in CPI	
Low-cost	1.80%
Intermediate	2.80%
High-cost	3.80%

The Real Interest Rate

As mentioned previously, the real interest rate takes into account inflation. This enables economists and actuaries to compare year-to-year interest rates on a level playing field. The Fisher Equation, named after Irving Fisher, allows one to approximate the real interest rate as the experienced interest rate minus the inflation rate. This equation interlocks everything learned in the previous two sections and is useful in evaluating the total change in the trust funds over a time period.

For illustration purposes, consider an example of how to use the Fisher Equation. In 2011, the experienced interest rate was 2.4%, and the inflation rate was 2.1%. This would result in a 0.3% annual real rate of interest acting upon the trust funds during 2011. A positive real interest rate would increase the trust funds and a negative real interest rate vice versa.

Table 12 - History of Real Interest Rates	
Complete Economic Cycles (Peak to Peak)	**Average Annual Real Interest Rate**
1966-1973	1.30%
1973-1979	-1.00%
1979-1989	5.20%
1989-2000	4.00%
2000-2007	2.20%
1966-2007	**2.80%**

As illustrated in Table 12, the average annual real interest rate was -1% during the 1973-1979 time period. This means that inflation was high enough and/or the experienced interest rate was low enough that on average the trust funds suffered during these years. With this understanding, it should be expected that the low-cost alternative for the ultimate real interest rate projections would be the highest of the projections, as illustrated in Table 13.

Table 13 - Ultimate Predictions	
Real Interest Rates	
Low-cost	3.40%
Intermediate	2.90%
High-cost	2.40%

Note that none of these variables act in a box. Unlike the real world, for simplicity, all other variables were held constant when examining the fluctuation of a particular variable. The movements of variables in many cases are correlated (positively or negatively). Furthermore, it is advisable to attempt to clearly determine what ranges of values for variables are intuitively acceptable before starting any projections.

Conclusion

Currently, Social Security is facing future risk of not being able to pay the full amount of promised benefits if action is not taken soon. Many variables determine the magnitude of tax revenue or benefit expenditures affecting Social Security at any given point in time. Forecasting Social Security is completed using stochastic modeling, which is layered with complex financial mathematics. It is important to clearly define what results are expected before modeling the data. Background information and an intuitive understanding should be gained to fully interpret the future status of Social Security. Filling in the gaps of Social Security literature, this paper provides the groundwork for analyzing the effects of certain demographic and economic variables upon Social Security.

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