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ONE CHILD POLICY: IMPLICATIONS ON CHINA'S FUTURE

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## Abstract

This thesis analyzes China's one child policy and how it has caused an aging problem that can be seen through an increasing aged dependency ratio. The paper starts with an overview of the policy and some of the reasons the government implemented it. It then examines how the policy changed the age structure of the population and how this shift will affect the savings rate and the pension system. The analysis of the savings rate will be based on Nathaniel Leff's regressions from his 1969 paper. The regression results show that there is a negative relationship between dependency ratios and savings rates and support my argument that China's rising aged dependency ratio will cause their savings rate to go down. Finally, there is a discussion of China's pension system and how the current pay-as-you-go system is not sustainable; the one child policy created an aging problem and will force China to rethink its current system in order to accommodate the elderly

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## **Introduction**

The one child policy has been a source of controversy since its inception in 1978. Officially, the policy states that married urban couples can only have one child and is enforced at the local level through fines. With the goal of decreasing the total fertility rate in China, the policy curtailed the population boom that most developing countries have and has left a lasting impact on China's future. Because of the rapid pace of their demographic transition, the severity of the challenges that China faces is heightened. Now a country that is characterized by an aging population and a fertility rate below replacement, it is important to consider the implications this policy has on future generations. The one child policy served as a catalyst for China's demographic transition and is causing the aged dependency ratio to increase, which in turn will lower savings rate and force pension reformation.

The goal of this thesis is to examine the implications of the one child policy specifically with regards to the decreasing savings rate and change in pension structure. The paper will start with an overview of the policy. Then, to understand why the government was so adamant about reducing the fertility rates, it will look at how a country can be characterized as developing or developed based on whether or not they have gone through their demographic transition. The changes in China's fertility rates, death rates, and life expectancy will be compared to India and Pakistan to show the speed at which China went through its transition. The next section will focus on an explanation of the dependency ratio and why it is a valuable measure of the aging problem and the one child policy's impact on China. Then, an analysis on the regressions run by Nathaniel Leff in his 1969 paper will be done to examine the relationship between dependency ratios and savings rates. This data and econometric testing is pivotal to my paper because it will allow me to comment on how the change in dependency ratios will affect China's future. The

final section of the paper is on why there is a need for pension reform and how the one child policy has caused the 4:2:1 phenomenon that we now see in China. This section will also include an analysis of different alternatives for pension reform and offer suggestions for which policy is beneficial to China. Following these discussions, there will be an overview of my findings, and some final thoughts on the one child policy and its impact on China.

## Overview of One Child Policy

The one child policy served as the mechanism from which the government would control its population. This government aided demographic transition, which was intended to be a “short term measure” to move the country towards a “voluntary small-family culture”, may have accomplished its goal of controlling the population growth but it has also created a series of problems for the country (Hesketh, Li & Zhu, 2005). A large population was originally seen as a source of strength and power for China but the government soon realized that it did not have the resources to meet the needs of its growing population. So, in the 1970s they came up with the *later, longer, fewer* policy to try and control the increasing birth rates. Citizens were encouraged to marry at a later age, have a larger gap between kids and have fewer children. Though this policy wasn't enforced and merely recommended, it helped set a precedent for the one child policy that would come at the end of the decade.

Under the one child policy, the state family planning bureau sets population targets and the local government comes up with initiatives to ensure its implementation. Contrary to its name, the policy only strictly applies to a certain percentage of the population and there are exceptions to the rule. For example, in the wake of the Sichuan earthquakes that occurred in 2008, families that lost their child, or whose child was injured, were allowed to have more children; there are also a lot of families that are looking to adopt the children that were left orphaned in the aftermath of the earthquake. Residents of rural areas can petition to have more than one child and ethnic minorities are also exempt from the one child policy. There is also an exception where couples that are both without siblings can have more than one child. Though the one child policy is not as rigorous as its name, there is no question that it has had an impact on the reduction in total fertility rate.

Because of the loopholes in this legislation, there is some debate as to the effectiveness of the one child policy – China saw a sharp decline in its fertility rates before the policy was implemented in 1979. The point of my paper is not to argue about how effective the policy is but how it will shape China’s future. “Many of the often-problematic consequences of the demographic transition that have been observed elsewhere have also emerged sooner and are unfolding at a faster pace. China, in other words, is destined to pay a price for being a demographic overachiever” (Wang, 2011). What was originally a short run solution to the population boom has lasted over 30 years and there are policy implications that need to be discussed.

## **China's Demographic Transitions**

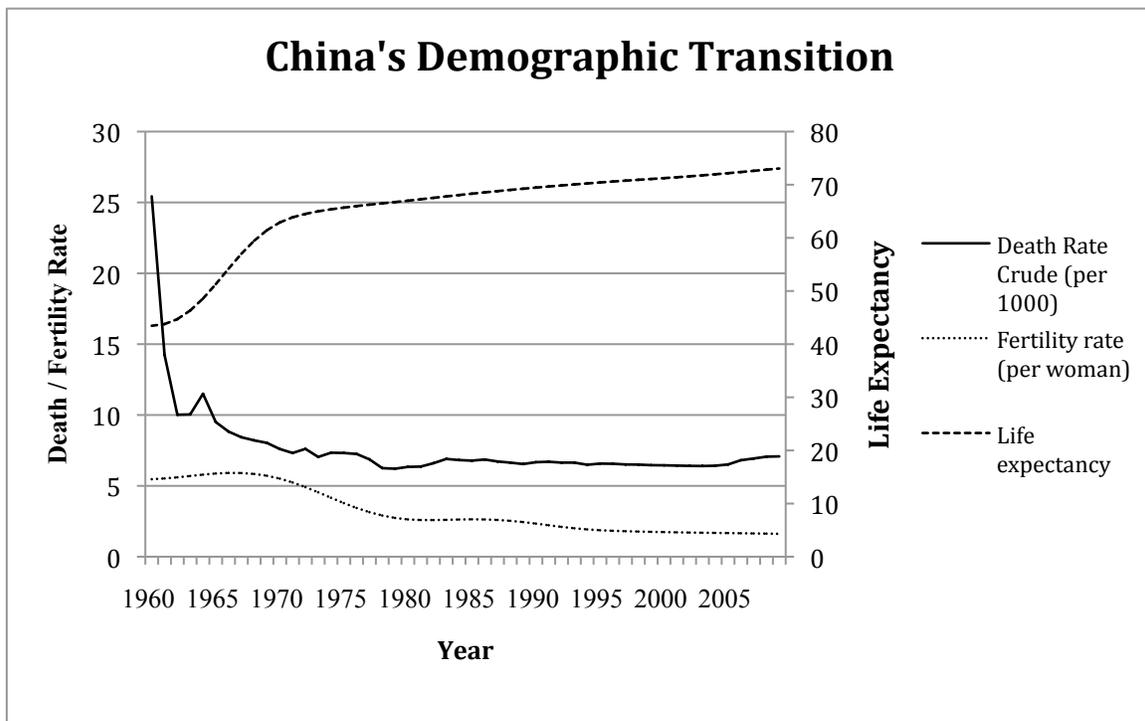
Based on the model that Warren Thompson developed in 1929, there are 4 stages involved in a demographic transition. During the first stage, death rates and birth rates are about equal which means that population growth is very slow. There are high death rates due to lack of adequate medical attention and technology, and women tend to have a lot of children. In stage two, improvements in the standard of living and technology lead to a decline in death rates and since this stage does not include a decline in birth rates, we see a large increase in population. Stage three of a demographic transition is characterized by a fall in birth rates that leads to a reduction in population growth. This fall in birth rates can be caused by urbanization, change in culture, or more access to birth control methods. The final stage of a demographic transition is characterized by low birth rates and low death rates. Some scholars argue that there is a stage 5 where a birth rate that is below replacement that leads to a shrinking population. Through the demographic transition, a country goes from having little population growth due to high birth rates and high death rates to little population growth due to low birth rates and low death rates.

The speed at which China went through its demographic transition was unprecedented. Between 1950 and 1975, the average life expectancy for China went from around 44.6 years to 64.6 years. During that same time frame, their crude death rate per one thousand people went from around 22.2 to 8. Some reasons for this drastic increase in life expectancy and decrease in death rate are that the government started a public health initiative that made basic health care relatively cheap, China was exposed to modern technology and there was a reduction in poverty levels. Since 1970, the death rate has remained pretty stable around 8 per one thousand people and the life expectancy has increased to 73 years. This data supports the idea that China went

through stage two of its demographic transition between 1950 and 1975 when their death rates fell and life expectancy increased greatly.

With regards to birth rates, we can see that between 1950 and 1970, they were pretty constant around 6 births per woman. From 1970 to 1980, the average fertility rate went from 5.94 births per woman to 2.93 births per woman. This data supports the idea that was previously addressed – China’s fertility rates were already greatly reduced before the one child policy. From 1980, the birth rate has gone from 2.93 births per woman to 1.64. This reduction in fertility can at least partially be attributed to the one child policy that the Chinese government implemented in 1978. The fact that the policy is still in place and birth rates are continuing to decrease is a cause of concern for China.

*Table 1: Death Rate, Life Expectancy and Birth Rate*



Source: UN Population Division of the Department of Economic and Social Affairs, 2010

China's demographic transition started with a rapid decline in mortality. That decline coupled with the government intervention to reduce fertility rates lead China to have an expedited demographic transition. What makes China's demographic transition so different is that there was government intervention. But why did the government feel that there was a need to intervene?

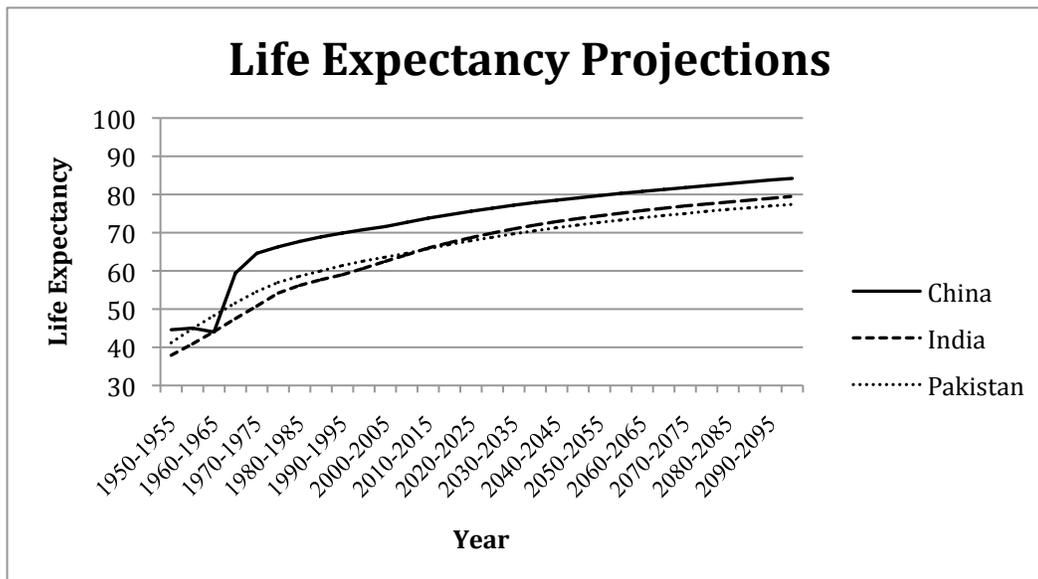
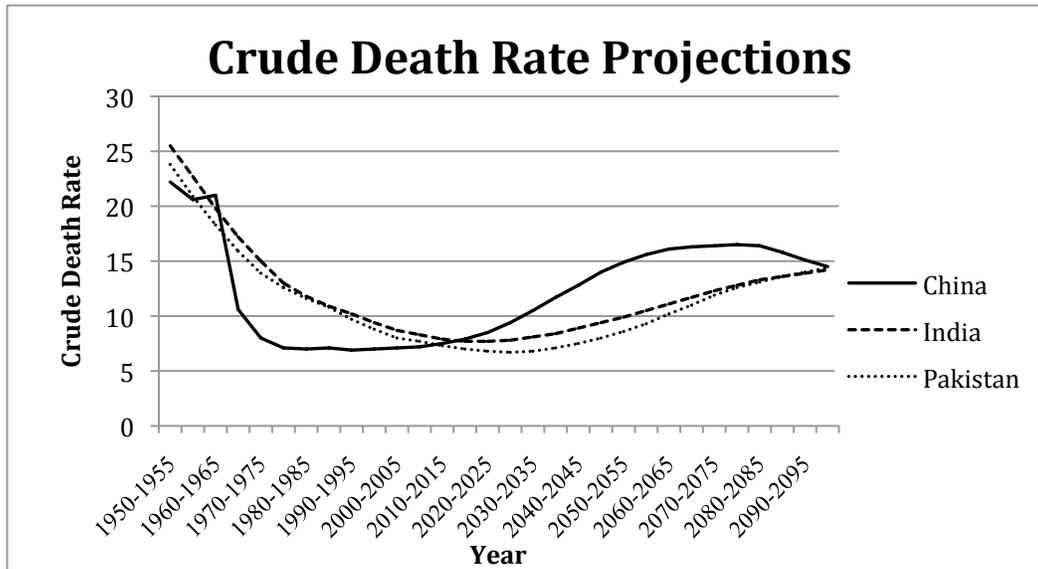
The demographic transition has enabled economies to convert a larger portion of the gains from factor accumulation and technological progress into growth of income per capita. It enhanced labor productivity and the growth process via three channels. First, the decline in population growth reduced the dilution of the growing stocks of capital and infrastructure, increasing the amount of resources per capita. Second, the reduction in fertility rates permitted the reallocation of resources from the quantity of children toward their quality, enhancing human capital formation and labor productivity. Third, the decline in fertility rates affected the age distribution of the population, temporarily increasing the fraction of the labor force in the population and thus mechanically increasing productivity per capita. (Galor, 2)

## **Speed of China's Demographic Transition: Comparative Analysis**

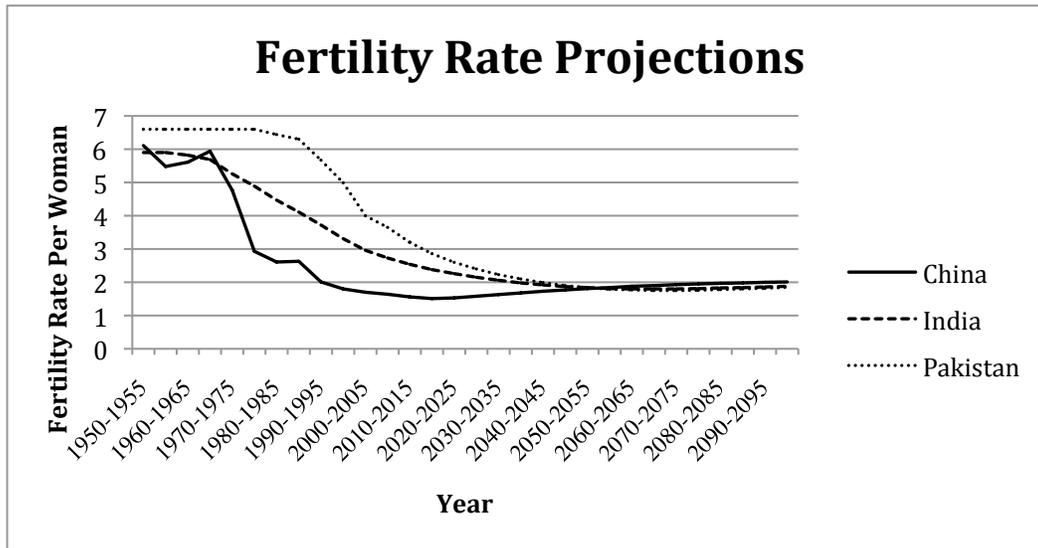
One of the key elements of my thesis is to show how the speed of China's demographic transition has played a crucial part in its aging problem and increasing aged dependency ratio. The one child policy "through the use of force" accelerated the demographic transition that China went through (Wang 2011). Since I have already gone into detail about China's transition, I will compare it to the demographic transitions of India and Pakistan to further illustrate why China's was so unprecedented and unique. The reason that India and Pakistan are used as comparison countries is that they are both populous emerging economies that have seen substantial economic growth in the past few years. Plus, India and Pakistan are going through their transition at a slower pace compared to China, which supports the idea that government intervention in the form of the one child policy played a role (Choudhry, 2010).

As previously mentioned, one of the reasons that China went through its demographic transition so quickly is because its mortality rate declined sharply between 1950 and 1970. In contrast, India and Pakistan have seen a steady decline of their mortality rates. Since a decline in mortality is the first step to a demographic transition, it is evident that India and Pakistan are behind China with regards to their progress towards becoming classified as a developed country.

Life expectancy also increases as a country goes through its demographic transition and China's increased dramatically from 1960-1970. We can also see that even though there was a point in time when Pakistan's life expectancy was higher than China's they have since lagged behind and India's life expectancy has always been lower than China's.



Using the same time frame of 1950-2010, India's birth rate per woman went from 5.9 to 2.73 while Pakistan's went from 6.6 to 3.65. Considering the fact that in 1950 China, India, and Pakistan all had birth rates around 6, it should be noted that China's birth rate in 2010 is 1.64 births per woman and India's birth rate is still at the level that China was in the 1980's while Pakistan is lagging even more at the level that China was in the 1970's (UN, 2010). All three of these countries have used measures to try and reduce their fertility rates and one of the most common ones that they have attempted is family planning.



Source: UN Population Division of the Department of Economic and Social Affairs, 2010

It is worthwhile to note that both Pakistan and India had government sponsored family planning programs in place before China did. A big part of the one child policy was the encouragement of contraceptives but well before the one child policy was enacted in 1979, India established the Family Planning Association (FPA), in 1950, whose original goal was to get couples to accept contraceptives. FPA of India now works closely with the government to promote reproductive health by preventing unsafe abortions, reducing infant and maternal mortality, and reducing the presence of sexually transmitted diseases. Pakistan created a similar agency in the 1950s but their program was also met with limited success.

According to the United Nations *World Contraceptive Use 2011*, 84.6% of women who are married in China use a contraceptive compared to 56.3% in India and 27% in Pakistan. Even when comparing China to countries other than India and Pakistan, the prevalence of contraception is higher than most developing countries. In countries that the United Nations

categorizes as most developed, 72.4% of women use some form of protection. As a part of the one child policy, the Chinese government encouraged contraceptive use. This coupled with the fact that there are repercussions for having more than one child; we can see that China's contraceptive use is much higher than most countries.

## **Changes in China's Dependency Ratio**

China's demographic transition and the one child policy have caused death rates to decrease, life expectancy to increase, and birth rates to decrease. This has greatly affected the dependency ratios and population structure of the country.

The aged dependency ratio compares the number of people over the age of 65 with the number of people in the labor force – age 15-65. On the other hand, the youth dependency ratio compares the number of people under the age of 15 with the total labor force. These two ratios combined give us the total dependency ratio that measures the burden that the work force feels in its effort to support the non-working. Economists have used these changes in dependency ratios to predict other factors such as total consumption, breakup of consumption, economic growth and savings. For this paper, we will focus on the relationship between the dependency ratio and savings.

The youth dependency ratio is a good measure of how effective the government intervention was in its goal of decreasing fertility. Even though the labor force is shrinking, the birth rates are also continuing to dwindle so the youth dependency ratio will decrease. By examining this ratio, I will again be able to show how the one child policy has affected China. I will not go into specifics as to how the decreasing ratio will change China, such as how it leads to a reduction in schools, I will merely use it to again illustrate the effects of the policy on population.

The aged dependency ratio is a valuable measure of aging because an increase signifies that a greater percentage of the population is beyond their working years. The increasing dependency ratio and aging problem that China faces is caused by the speed of their demographic transition. Because of the one child policy and other measures of government

intervention, we saw birth rates start to drop drastically starting in 1970. This decrease in population growth is now leading to a shrinking working class. With less people in the labor force, there will more of a burden on each individual worker to support the elderly generation. Especially since the birth rates are continuing to decrease and the government has not lifted the one child policy, the problem with aging will just increase in severity.

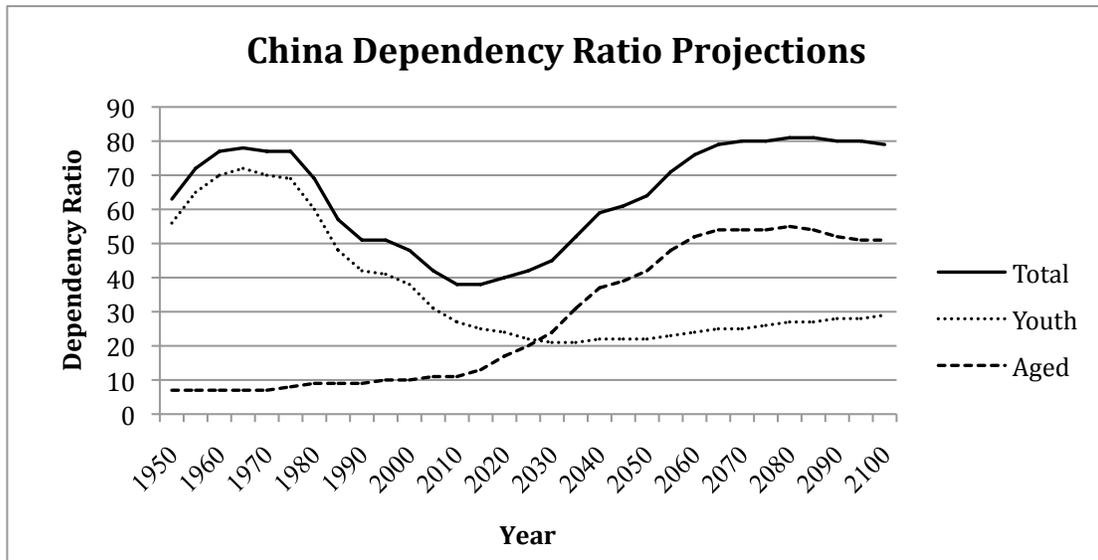
This aging problem is especially troublesome in the rural areas where traditionally, elderly tend to depend on children for support. “In a typical situation, the elderly in rural China live with or next door to one of their sons in an extended family arrangement” (Pang, Brauw, Rozelle, 2004). Even though many are exempt from the policy and have more than one child, especially if the first one is female, there are not enough resources to support the elderly. This decrease in fertility, coupled with the fact that a lot of young workers are moving to the cities, implies that while many rural couples are allowed more than one child and the fertility rate is higher in rural areas, the “degree of population aging” is still higher in rural areas. (Gu, 2006).

*Table 2: Youth and Aged Dependency Ratio by Year*

Year	Youth Dependency Ratio	Aged Dependency Ratio
1960-1965	70	7
1965-1970	72	7
1970-1975	70	8
1975-1980	69	9
1980-1985	60	9
1985-1990	48	9
1990-1995	42	10
1995-2000	41	10
2000-2005	38	11
2005-2010	31	11

Source: UN Population Division of the Department of Economic and Social Affairs, 2010

As seen in the graph below, the UN predicts that the aged dependency ratio will increase as the youth dependency ratio decreases. As the population ages further and the effects of the one child policy become more prominent, the aged dependency ratio will also increase to over 50% as the youth dependency ratio drops to under 30%.



Source: UN Population Division of the Department of Economic and Social Affairs, 2010

This data further shows that China is facing a severe aging problem so they must think of ways to reform their pension system so that they will be able to take care of their elderly. It will also help me in my empirical analysis of the savings rate. After completing my empirical analysis of the relationship between savings and dependency ratios, I will use those results and these projections to comment on how the dependency ratios will affect China's future savings rate.

## Dependency Ratio and Savings Rate – Literature Review

Throughout this paper, I have commented on how China's one child policy has sped up its demographic transition and even though it has caused the youth dependency ratio to decrease, the aged dependency ratio has severely increased. This increase in the aged dependency ratio will eventually overcompensate the drop in the youth dependency ratio caused by the one child policy and the total dependency to raise which in turn lowers the savings rate – this argument that there is an inverse relationship between dependency rates and savings rate was notably argued by Nathaniel Leff in his 1969 paper. In this paper, Leff starts out mainly talking about the youth dependency ratio and how a high ratio can lead to more money being spent on children and less money being saved. Since the one child policy has led to a decrease in the youth dependency ratio, one would expect the savings rate to rise. However, Leff makes the point to separate aged and youth dependency ratios in his regression and justifies adding the aged dependency ratio as a factor reducing savings by claiming that the elderly's "imperfect foresight" might have caused them to not adequately prepare for sustaining themselves after retirement and they might be spending their savings. "Hence, at any point in time, *ceteris paribus*, a large proportion of retired people in the population would mean a lower aggregates savings ratio" (Leff, 1969).

From his analysis, Leff determined that:

The regression coefficients...are much larger for  $D_1$  and  $D_2$  than for the other terms...the t-values are all significant above the .025 level, indicating that the dependency variables should be considered statistically distinct variables in the explanation of aggregate savings rates. (Leff, 1969)

There was a lot of debate about the implications and accuracy of Leff's findings and many economists including Gupta (1971), Kelley (1973), Ram (1982), Kelley and Schmidt (1996) have gone on to run their own regressions to counter Leff's findings.

Gupta used Leff's data and divided the countries into groups based on their per capita income. The idea was that for underdeveloped countries, the dependency ratio was not a good indication of savings rate. The regressions were then run on the three groups of countries separately and then they were combined and regressed together. Gupta's study found that the dependency ratio variables did not become significant until the countries had reached a income per capita greater than \$249. This lead to the conclusion that "demographic factors, like the dependency ratios, become ... significant only when per capita income ... reaches a level that can provide more than a minimum level of living, thus generating savings" (Gupta 1971).

In his 1973 paper, Kelley argues that the relationship between savings rate and dependency ratio is misunderstood and is based on an over simplified model. For the relationship between the youth dependency ratio and savings rate, Kelley said that there is a substitution effect associated with having more children and less will be spent on other goods so total savings could stay constant or even increase. He also stressed that the relationship would be different depending on how developed the country is; a family that lives in poor country might be more affected by an increase in the number of children based on the fact that they are living at minimum wage. With regards to the aged dependency ratio, Kelley argues that the aged dependency ratio acts in the same way as a youth dependency ratio and is a resource cost to society.

Ram did a cross-section study in 1982 that used data from the 1970s for all countries where data was available. He concludes that even though a lot of credit has been given to Leff

and numerous papers have been written to back the results of his paper, the link between dependency ratios and savings rates does not appear strong for developing countries. Ram also argues that his results differ from Leff's mainly because he used a different data set. When using Leff's data, the results are fairly similar.

More Recently, in 1996, Kelley and Schmidt also examined Leff's regression using a cross-section study and panel data approach with data from 1960-1980. They found that in the 1960s, 1970s, the dependency ratios had little effect on the savings rate but in the 1980s, there was a negative relationship. When a panel data approach was used on all 30 years, it was found that the aged dependency ratio had a negative coefficient but was not significant while the youth dependency ratio had a significant positive coefficient. Overall, Kelley and Schmidt concluded that there was a weak correlation between dependency ratios and savings rates.

Even though there has been much criticism of Leff's research, it is cited today as one of the most influential papers and has "been useful in framing the issues" (Kelley and Schmidt, 1996) and I will use his model as the basis of my empirical work.

## Dependency Ratios and Savings Rates – Econometric testing

Based on Leff's regressions, I expect dependency variables to have a negative coefficient when regressed against savings. Through my literature review, I realized that the relationship Leff found is not robust and the results can vary greatly depending on the type of regression, assumptions made, and data used.

Using all four of Leff's equations, I ran tests on the relationship looking for an inverse relationship and I can then infer that the increasing dependency ratios caused by the one child policy will limit the amount of savings China has.

$$1. \ln\left(\frac{S}{Y}\right) = \delta + \beta_1 \ln\left(\frac{Y}{N}\right) + \beta_2 \ln(g) + \beta_3 \ln(D_1) + \beta_4 \ln(D_2) + \varepsilon$$

$$2. \ln\left(\frac{S}{Y}\right) = \delta + \beta_1 \ln\left(\frac{Y}{N}\right) + \beta_2 \ln(g) + \beta_3 \ln(D_3) + \varepsilon$$

$$3. \ln\left(\frac{S}{N}\right) = \delta + \beta_1 \ln\left(\frac{Y}{N}\right) + \beta_2 \ln(g) + \beta_3 \ln(D_1) + \beta_4 \ln(D_2) + \varepsilon$$

$$4. \ln\left(\frac{S}{N}\right) = \delta + \beta_1 \ln\left(\frac{Y}{N}\right) + \beta_2 \ln(g) + \beta_3 \ln(D_3) + \varepsilon$$

Where  $\frac{S}{Y}$  = savings over income,  $\delta$  = constant,  $\frac{Y}{N}$  = income per capita,  $g$  = growth rate of income,  $D_1$  = youth dependency ratio,  $D_2$  = aged dependency ratio,  $\frac{S}{N}$  = savings per capita, and  $D_3$  = total dependency ratio.

The approach that I will take is to perform a panel analysis using data from the World Bank. The time frame is from 1970-2010 and all 154 countries<sup>1</sup> where data was available are included. The variables used are: total population, adjusted net national income (current US\$),

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<sup>1</sup> List of countries in appendix

gross savings (current US\$), age dependency ratio (old) and age dependency ratio (young).

Because of the availability of data, we will have an unbalanced panel and some countries where data for one variable was missing entirely for the time frame in question are not included. This makes our data biased towards countries that are more developed – countries that have more data available. Data for the variables was also collected for the 1960-1969 time period but, there was no data available for adjusted net national income (current US\$) which forced us to drop that decade from our analysis all together. There were also different measurements for income and savings available through the World Bank but the selected data was chosen based on the fact that it measures savings and income in current US dollar terms.

The data was regressed by decade and as a collective set. This was mainly done to see if there is a difference in the relationship given different time periods and because there is a lot of missing data for the early time frames. The data was first regressed without establishing the panel – this analyzes the relationship ignoring the fact that there are different time periods and countries. The results of these tests showed a fairly strong negative relationship between savings and the dependency rates for all data sets except for 1970-1979 time period. Other than this time frame, the STATA results showed that the dependency variables had a negative correlation with savings rate that was significant at the 5% level. For the period of 1970-1979, our results show that there is a positive relationship between youth dependency ratio and savings as well as total dependency and savings while there is still a negative relationship between aged dependency ratio and savings rate – all these results are significant at the 5% level. One reason that the results for this period might differ from the others is that there is a lot of missing data. For this decade, we only had 420 observations for our data to regress. Given that we collected data on

154 countries and there is a time span of 10 years, there would be 1540 observations if we had complete data. The fact that we have less 1/3 of our data, greatly affects our results.

After running the log-linear regression, we set our panel data and ran it as fixed effects model. The fixed effect model is useful when the sample is representative of the population, which is true in our case because we included countries where we could access the necessary data. When a panel was established for country and year, the results differed greatly between our data sets.

### All Data:

All four of Leff's equations were tested and the variables that were significant at the 5% level are youth dependency, rate of income growth, income per capita, and dependency. For both regressions that involved the aged dependency ratio, the variable had a very small positive coefficient and was not significant, even at the 50% level. For all other variables tested, the relationship seen supported Leff's original conclusions that there is a negative relationship between savings and dependency variables.

	eq 1 (logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	.0519308	-	.0519308	-
	(.61)	-	(.61)	-
logYD	-.3588882	-	-.3588883	-
	(-4.69)**	-	(-4.69)**	-
logIC	-.0554971	-.0427681	.9445029	.9572319
	(-2.47)*	(-2.3)*	(42.09)**	(51.53)**
logR	.0546617	.054872	.0546617	.054872
	(7.13)**	(7.17)**	(7.13)**	(7.17)**
logD	-	-.5043731	-	-.5043731
	-	(-6.07)**	-	(-6.07)**
_cons	.3588174	1.072456	.3588179	1.072456
	(.73)	(2.36)*	(0.73)	(2.36)*
R <sup>2</sup>	.0360	.0767	.8915	.9025
# Observations	3145			
# Countries	154			

### 1970-1979:

Once again all four equations were tested and the same variables were found significant. Again, the age dependency ratio was not a significant variable but instead of having a p-value of over 50%, the p-value is now around 20%. Also contrary to the regression results involving all of the data, the coefficient for aged dependency ratio was negative.

	eq 1(logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	-.6331268	-	-.6331262	-
	(-1.26)	-	(-1.26)	-
logYD	-.900911	-	-.900911	-
	(-2.35)*	-	(-2.35)*	-
logIC	-.0943178	-.1114319	.9056822	.888568
	(-1.59)	(-2.08)*	(15.24)**	(16.61)**
logR	.0669082	.0675708	.0669083	.0675708
	(3.58)**	(3.64)**	(3.58)**	(3.64)**
logD	-	-1.325057	-	-1.325057
	-	(-2.94)**	-	(-2.94)**
_cons	4.486734	5.228656	4.486733	5.228657
	(1.95)	(2.39)*	(1.95)	(2.39)*
R <sup>2</sup>	.0211	.0033	.8915	.8667
# Observations	420			
# Countries	93			

### 1980-1989:

For this time period, the only variable significant at the 5% level for all four equations was rate of income growth. Income per capita was significant at the 5% level when it was regressed against savings per capita and then it had a positive coefficient. Aged dependency ratio had a p-value just above 5% and it had a positive coefficient. This means that at the 10% confidence level, there is a positive relationship between savings rate and aged dependency ratio. Youth dependency ratio also had a positive coefficient but its p-value was over 50% and the

same goes for total dependency ratio. This particular data set gave results that varied greatly from the others. Overall, there was not a strong indication that Leff's equations hold. The dependency ratios were not significant, and when they were, the relationship was the opposite of what Leff argued. There is also the problem of income per capita not being significant for all equations.

	eq 1(logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	.8287943	-	.828794	-
	( 1.96 )	-	(1.96)	-
logYD	.1761958	-	.1761956	-
	( 0.526 )	-	(0.63)	-
logIC	.072205	.0966845	1.072205	1.096684
	(1.07)	(1.52)	(15.95)**	(17.19)**
logR	.034961	(.036246)	.034961	.0362459
	(2.84)**	(2.94)**	(2.84)**	(2.94)**
logD	-	.1773506	-	.1773503
	-	(0.52)	-	(.52)
_cons	-4.459746	-2.909634	-4.459744	-2.909633
	(-2.71)	(-1.75)	(-2.71)**	(-1.75)
R <sup>2</sup>	.0375	.1459	.8444	.8907
# Observations	713			
# Countries	117			

### 1990-1999:

The results of this data set were similar to those from the regression where all the data was used and from 1970-1979. Like those two time periods, aged dependency ratio was the only variable that was not significant at the 10% level and it had a p-value of 19%. The coefficient for the aged dependency ratio was also positive and the income per capita coefficient was negative for the two regressions where it was regressed against the savings per income.

	eq 1(logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	.4815773	-	.4815777	-
	( 1.31 )	-	(1.31)	-
logYD	-.6004969	-	-.600497	-
	(-2.00)*	-	(-2.00)*	-
logIC	-.2728266	-.2190701	.7271733	.7809299
	(-3.69)**	(-3.21)**	(9.83)**	(11.43)**
logR	.0363996	.0344649	.0363996	.0344649
	(2.87)**	(2.73)**	(2.87)**	(2.73)**
logD	-	-.7474694	-	-.7474693
	-	(-2.09)*	-	(-2.09)*
_cons	1.874022	3.283174	1.874021	3.283173
	( 1.05)	(1.84)	(1.05)	(1.84)
R <sup>2</sup>	.0058	.0476	.8513	.8972
# Observations	915			
# Countries	146			

### 2000-2009:

Lastly, the 2000-2009 data set was regressed and with these results, all of the dependency ratios were significant and had negative coefficients. This is the only data set where the relationship between aged dependency ratio and savings had the relationship matched what Leff found in his original paper. What also sets these results apart is the fact that income per capita was found to be insignificant when regressed with savings over income. Overall, these results were the most consistent with Leff's findings and other than the regression where all of the data was regressed, this set was the most complete with regards to the number of countries that were included and it also had the most observations.

	eq 1(logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	-1.203795	-	-1.203795	-
	(-4.4)**	-	(-4.4)**	-
logYD	-1.068766	-	-1.068766	-
	(-4.98)**	-	(-4.98)**	-
logIC	.0055858	-.0276172	1.005586	.9723828
	(.13)	(-.74)	(23.24)**	(26.19)**
logR	.0264171	.0258095	.0264171	.0258095
	(2.33)*	(2.28)*	(2.33)*	(2.28)*
logD	-	-1.564744	-	-1.564744
	-	(-6.37)**	-	(-6.37)**
_cons	5.441248	5.243543	5.441248	5.243544
	(4.39)**	(4.35)**	(4.39)**	(4.35)**
R <sup>2</sup>	.0808	.1589	.9045	.9070
# Observations	1097			
# Countries	146			

### Average data

After running the regressions on each decade, the five year and ten year averages were taken to see if there were any trends in the data. Again, the data set was first regressed without declaring our panel. The results of these regressions for the five-year averages show that all of the coefficients fit Leff's conclusions and all the variables were significant at the 5% level. When the ten-year averages were regressed, the results differed in that the only dependency variable that was significant at the 5% level is aged dependency. The other two dependency variables still had the negative coefficients but they were not significant. Income per capita and rate of income growth had positive coefficients and were also significant for all 4 equations.

## 5 Year Average

	eq 1(logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	-.3541844	-	.3434979	-
	(-5.32)**	-	(-5.0)**	-
logYD	-.2695521	-	-.2641596	-
	(-2.78)**	-	(-2.65)**	-
logIC	.1726368	.1107099	1.165216	1.106097
	(7.82)**	(5.36)**	(51.22)**	(52.07)**
logR	.1438893	.1427521	.1520251	.1510172
	(6.44)**	(6.29)**	(6.6)**	(6.47)**
logD	-	-.2581135	-	-.2484431
	-	(-2.3)**	-	(-2.16)**
_cons	-.5569278	-.8673091	-.521237	-.8478878
	(-.96)	(-1.46)	(-.87)	(-1.38)
R <sup>2</sup>	.1962	.1719	.9033	.9008
# Observations	789			
# Countries	154			

## 10 Year Average

	eq 1(logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	-.3208873	-	-.3152197	-
	(-4.07)**	-	(-3.55)**	-
logYD	-.2011849	-	-.1843628	-
	(-1.71)*	-	(-1.39)	-
logIC	.1864451	.1265299	1.179797	1.120914
	(6.83)**	(4.98)**	(38.3)**	(39.2)**
logR	.286915	.281247	.3162836	.3114228
	(8.97)**	(8.62)**	(8.95)**	(8.68)**
logD	-	-.181518	-	-.1555801
	-	(-1.31)	-	(-1.00)
_cons	-.6436567	-.958621	-.5667462	-.9169864
	(-.90)	(-1.3)	(-.71)	(-1.10)
R <sup>2</sup>	.2930	.2687	.9053	.9027
# Observations	473			
# Countries	154			

When the five-year averages were regressed as a panel, none of the dependency variables were significant at the 5% level. For both these data sets, the income per capita and growth rate of income had positive coefficients and were significant at 5%.

### 5 Year Average Panel

	eq 1 (logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	.250588	-	.2111341	-
	(1.56)	-	(1.38)	-
logYD	-.123599	-	-.0800879	-
	(-0.81)	-	(-0.49)	-
logIC	-.363627	-.0273643	.9080783	.9324674
	(-0.83)	(-0.74)	(19.31)**	(23.35)**
logR	.0737431	.0729485	.0804044	.0800906
	(4.08)**	(4.03)**	(4.15)**	(4.11)**
logD	-	-.2811049	-	-.2164631
	-	(-1.72)*	-	(-1.23)
_cons	-1.088684	.0871935	-1.179833	.1385184
	(-1.10)	(0.10)	(1.064808)**	(.14)
R <sup>2</sup>	.0291	.0718	.8784	.9000
# Observations	789			
# Countries	154			

### 10 Year Average Panel

	eq 1 (logSI)	eq 2 (logSI)	eq 3 (logSC)	eq 4 (logSC)
logAD	.2220561	-	.2349897	-
	(1.10)	-	(0.96)	-
logYD	-.22093115	-	-.0788135	-
	(-1.15)	-	(-.34)	-
logIC	-.0464172	-.0246031	.8797448	0.900858
	(-0.77)	(-0.50)	(12.02)**	(15.13)**
logR	.14927	.1505645	.1644458	.1661681
	(5.19)**	(5.26)**	(4.78)**	(4.86)**
logD	-	-.3445432	-	-.1473361
	-	(-1.71)	-	(-0.60)
_cons	-0.383885	0.5144408	-0.367852	-1.126361
	(-0.31)	(0.46)	(-0.25)	(-1.23)
R <sup>2</sup>	.9082	.1791	.8900	.9010
# Observations	473			
# Countries	154			

### Conclusions from econometric testing:

Overall, the results from my replication of Leff's study convinced me that there is a negative relationship between dependency ratios and savings rate. Even though aged

dependency ratio was found to be insignificant for most of the regressions, youth dependency ratio and total dependency proved to have the negative coefficient that I was looking for. Also, other than the time period from 1980-1989, there was never a positive relationship between savings and dependency ratios that was close to being significant. For that time period in question, there was also not a strong relationship between savings per capita and income per capita which makes me question this data set because for all other periods, there was always a very strong relationship between these two variables. When the data sets were averaged to observe trends, the results from the regression backed Leff's conclusions "that demographic conditions are a major determinant of aggregate savings rate" (Leff, 1969). The two data sets were also run as a panel and all the dependency ratios were found to be insignificant at 5%. This finding supports the conclusions of many that the result one gets from Leff's regression is highly dependent on the data set used and the method of examining the data.

I will use my results to argue that the one child policy sped up China's demographic transition to an extent where their aged dependency ratio will increase rapidly causing their savings rate to go down. For the past few years, China's savings rate has been high and increasing steadily while their youth dependency ratio has been decreasing as a result of the one child policy. But, as exhibited by the UN projections, youth dependency is predicted to stay pretty consistent at the level that it is currently at while the aged dependency ratio is predicted to rise which will cause the total dependency ratio to rise. Based on these UN projections and the fact that I found a negative correlation between dependency ratios and savings rate through my regressions, I can argue that the increasing dependency ratio, caused by an increasing aged dependency ratio, will lower China's savings rates in the future.

## **Pension History**

Based on the regression results and UN projections, it is likely that China's savings rate will decrease in the future as a result of their increasing aged dependency ratio. This decrease in savings rate intensifies the pension problem that the country faces because workers are busy supporting current retirees and not putting as much money away for their own retirement. In a society where it is typical that extended families live together and the elderly depend on their children, the one child policy has caused the "4-2-1" problem that we are starting to see in China where one child is forced to pay for the retirement of their parents (2), and their grandparents (4) as well as save for their own retirement. This creates a huge burden on the working class so China needs to replace its pension system, which is very fragmented, and establish one that will be sustainable. The current system is based on "pilot projects or trial programs for the development of social pension policies" (Impavido, Hu, & Li, 2009) in place, there is no continuity within the country. In order to adequately accommodate its aging population, China needs to start making pension reforms now so that it can have sufficient funds to support its current and future retirees.

When it was first set up in the 1950s, China's pension system was based on state owned enterprises. Each SOE provided their employees with basic pension that was financed by the enterprises and government; the employee did not have to contribute anything. Most employees that did not work for the state had no pension program. In the 1980s when the government tried to reform the SOE, they were met with budget constraints and a reduction in the SOE's ability to provide for its employees. The government realized that their current system was not working and started piloting different pension programs in provinces. These programs aimed at seeking a

balance between employer and employee contribution and pooled the contributions at higher levels of government so that the funds could be distributed more effectively.

Based on the results of their pilot programs, the government enacted a program in 1997 to cover its urban labor force. Instead of relying on the SOE, pensions would be transferred to social insurance agencies that started at the local government level and would end up at the national level. The new system was composed of three pillars: defined benefit, defined contribution, and a pension pillar. The defined benefit program, the only one that has really been established, is composed of two parts. Part one was pooled for distribution, it ensured that all retirees could live above the poverty line and part two was mainly funded through pension taxes for individual use upon retirement. The defined contribution was an individual system and the pension pillar was a voluntary program, one managed by an agent outside the government by the individual or an insurance company.

Since the defined benefit program was the main method for collecting pension, the pension program was largely pay-as-you-go. A pay-as-you-go system works if your population is growing. Because the current workers pay for the current retirees, as long as there are more people in the work force than people requiring pension, there should be enough money to cover expenses. As we have already shown in this paper, China, as well as many other developed countries, has a declining population growth rate and an increasing aged dependency ratio which makes the PAYG pension unsustainable.

The new pension system established in 1997 was also met with a slew of challenges. To start with, the transition from the old SOE sponsored system to the new PAYG one created a gap in funding and left many local pension pools in deficit or bankrupt. The money from the new pension system was supposed to be invested but it was used to pay current pension plans instead.

Workers who started working before 1997 got funding from the both the new and old program, they would get the benefits of the new program and a transition benefit. The transition into the new system has also been slow as evident by the fact that only pillar one is in use.

Because there were gaps in funding the National Social Security Fund (NSSF) was created in 2000 to help ease China through the peak of its demographic transition and help fund the pension systems. It is used as a last resort for pension pools that have run out of money and is funded by the central government. The NSSF is run by a group of 21 individuals and comprised of three committees: the investment committee, the risk management committee, and the expert appraisal committee. The responsibilities of the committee are to administer assets generated from NSSF, come up with investment policy, select and evaluate fund managers, prepare financial reports, publicly disclose returns, cash flows and assets and distribute funds (Impavido, Hu, & Li, 2009).

*Table 6: Size of NSSF by Year*

Year	Asset Size of National Social Security Fund (100M RMB)	Accumulative Net Fiscal Capital Injection (100M RMB)
2000		200
2001	803.12	795.26
2002	1241.86	1211.02
2003	1325.01	1260.1
2004	1659.56	1538.64
2005	1954.27	1767.34
2006	2769.82	2341.57
2007	4337.83	2649.71
2008	5140.89	2976.66
2009	7765	3802.56

Source: National Council for Social Security fund, The People's Republic of China

On top of all the problems that the urban system faces, the rural sector's pension system is still in its development stages – “less than 4% of the rural elderly stated that a pension was their principal source of income in the 2005 Census ” (Herd, Hu, & Koen, 2010) The pension program established in 1992 was a voluntary savings account that converted to an annuity when the person turned 60 years old. Individuals made payments and the local government guaranteed pension. This program was not very popular with the public because of the high fees that were associated with it. With administrative costs at over 25% of contributions, the money was used to finance local projects and the local governments tried to make the voluntary program mandatory. There was also a lot of corruption and lack of funds. (Herd, Hu, & Koen, 2010)

In 2009, the government launched a new pension program that it hoped would cover the rural population by the year 2020. The new pension's goal was to provide participants pension that is equal to 25% of average per capital rural household income and have them contribute of 10% of the average income in their geographical area. For the 25% of the pension that is non-contributory, the central government or provincial government would pay the individual and local governments were also free to contribute to the individual accounts. The individual must contribute to their account for at least 15 years before they can take money out or if they are over the age of 45 before the program started, they must make up the funding. If they are over the age of 60 in 2009, then they can still take part in the program if their children are contributing to the system. One problem with the individual account is that the final pension might not be 10% because of disparities between interest rates and the rate at which household real income grows so it will likely need a government subsidy in order it to reach 10%.

## **Pension Reform**

As indicated above, the current pension system that China has is unsustainable and highly fragmented. Even though a lot of changes have already been made to improve the system, there are many more that need to be made. The main problem that China has faced with regards to its pension system is the transition between the old system and the new ones. Pension reform has created a gap between funding and created a deficit. Instead of focusing on how to make up the lack of funding, the government needs to start focusing on how they are going to fund future pension.

One way to alleviate some of the strain on the system is to raise the retirement age. With life expectancy increasing and the population aging, more funds will be needed to support the elderly so they should work longer. The current retirement age for men is 60 and it is 55 for women, which is low compared to some other countries because China has a large labor force; the retirement ages were set with the intention of creating more opportunities for younger workers. This policy may have been needed in the past when China had high birth rates but now that their population is quickly aging, it is time to rethink these early retirement ages that force capable workers out of the market. By increasing the retirement age, the workers will also be able to contribute to the pension system for a longer period of time.

The current system is unfunded (PAYG) which means that the benefit they receive may not be equal to their contribution. Again, this goes back to the problem of the transition between the old pension system that left a gap of funding. In 1999 Feldstein proposed that China move from its PAYG system to a funded defined contribution one. Many countries implement a PAYG system because they can defer the cost of current retirees but they are now realizing that because people are living longer, future generations will have to be taxed even more to sustain

funding. For China specifically, Feldstein recommends moving away from the PAYG system to a funded system because the current system will increase taxes and moving to a funded one will cut costs. Feldstein also goes on to recommend that China enforce a “conditional defined benefit system” where an individual would have a contribution account but also be guaranteed a lump of money. (Feldstein, 1999)

Nicholas Barr and Peter Diamond have also done extensive research on China’s current pension system and in 2010, they wrote a paper offering suggestions for how to improve the system and secure its future. Their first recommendation was to make sure that there is consistency throughout the country by adapting a set of rules at the national level. As mentioned above, because so many provinces conducted pilot programs, there are a lot of discrepancies with the current system which makes it fragmented. By establishing a set of rules at the national level, that will increase the amount of confidence in the current system and “foster labour mobility.” Barr and Diamond also argue that in order for the individual accounts to function properly, there needs to be more transparency so that confidence in the system can be built. The best way to complete this task is to turn the individual accounts into funded defined contribution accounts. (Barr and Diamond, 2010)

In 2008, Shuanglin Lin proposed a system that would constitute an individual account, social account and a “family support system.” The individual account would be mandatory and would provide the majority of the pension received at retirement. The social account would provide a “safety net” for those who do not have enough funds at retirement. These two elements of the proposal are very similar to the conditional account that Feldstein suggested. What separates this proposal from the ones previously reviewed is part where Lin argues that the

children should be forced to support their parents and be obligated to provide money if there is not enough money in the pension fund. (Lin, 2008)

## **Concluding Remarks**

By now, it should be clear that China's one child policy has had a major impact on the country's future. With the aim of reducing the rate of birth and speeding up the demographic transition, the policy also severely changed the composition of the population. The method that the government used to intervene and reduce fertility rates was unconventional. On top of setting up family planning programs to help educate the population, the state instituted population targets that limited the number of children a couple could have. This restriction reduced the fertility rate in the country and has caused the youth dependency ratio to decrease. Though it helped China achieve its goal of reducing its population, the one child policy also created a severe aging problem in the country which can be seen through their increasing aged dependency ratio and this burden on the working class will cause the savings rate to decrease and force the government to reform the pension system. The point of this thesis was not to criticize the policy or comment on how efficient it was at meeting its goal; instead, this paper examined the aging problem that the policy caused and the implications that this has on the country's future.

The argument that there is a negative correlation between savings rate and dependency ratio was examined in this paper. Through the literature review and subsequent econometric analysis, it was decided that even though the relationship was not as strong as Leff originally argued, there was enough evidence to support the relationship that it could be applied to the current problem that China faces. Based on projections made by the United Nations, China's dependency ratio will continue to rise in the future as its aged dependency ratio rises and the youth dependency ratio stays constant. The testing of Leff's regressions showed that there is a

negative relationship between dependency rates and savings so this increase in dependency rates caused by the one child policy will decrease savings rates in China.

The aging problem that China faces will also force the government to rethink its pension structure. The country has already made progress towards implementing a system that is cohesive and sustainable but there are still many improvements that need to be made. First off, there needs to be more continuity and transparency throughout the entire program. The current pension system is highly fragmented because it is not aggregated at the national level and local governments each of their own policy. In order for participants to willingly input funds, they need to be confident that there will be adequate pension for their retirement. There is also the problem of the transition that needs to be taken care of. Currently, the pension system is unfunded so the current workers are paying for current retirees. This PAYG method is effective if there is a steady population but as we have already proven, China's population growth is declining. There are now fewer young people to support the elderly and we continue using the PAYG system, the tax rates will have to increase.

There is a lot of work that needs to be done in order to understand how the aging problem caused by China's one child policy will affect the country's future. A more in depth analysis of Leff's research on the negative relationship between dependency ratio and savings rate would clarify how exactly the increase in dependency will affect the savings. Countries should be grouped by their GDP as there seems to be a stronger relationship between the variables as the country becomes more developed. Different methods of testing the regression should also be used because as exhibited in the literature review, results can vary depending on the data sample and regression technique. There also needs to be more research done on the pension system in order to determine what changes the government should make. A case study analysis of pension

systems from different countries would be helpful so that we can examine what has worked in the past. It would also be beneficial if we examined how much deficit the transition between the old system and the new one will cause.

## Appendix: List of Countries Used in Regression

Albania	Comoros	Hong Kong	Mauritius	Islands
Algeria	Congo, Rep.	SAR, China	Mexico	South Africa
Angola	Costa Rica	Hungary	Moldova	Spain
Argentina	Cote d'Ivoire	Iceland	Mongolia	Sri Lanka
Armenia	Croatia	India	Morocco	St. Vincent
Australia	Cyprus	Indonesia	Mozambique	and the
Austria	Czech	Iran, Islamic	Namibia	Grenadines
Azerbaijan	Republic	Rep.	Nepal	Sudan
Bahamas,	Denmark	Ireland	Netherlands	Suriname
The	Djibouti	Israel	New	Swaziland
Bahrain	Dominican	Italy	Zealand	Sweden
Bangladesh	Republic	Jamaica	Nicaragua	Switzerland
Belarus	Ecuador	Japan	Niger	Syrian Arab
Belgium	Egypt, Arab	Jordan	Norway	Republic
Belize	Rep.	Kazakhstan	Oman	Tajikistan
Benin	El Salvador	Kenya	Pakistan	Tanzania
Bolivia	Equatorial	Korea, Rep.	Panama	Thailand
Botswana	Guinea	Kuwait	Papua New	Togo
Brazil	Eritrea	Kyrgyz	Guinea	Tonga
Brunei	Estonia	Republic	Paraguay	Trinidad and
Darussalam	Ethiopia	Lao PDR	Peru	Tobago
Bulgaria	Fiji	Latvia	Philippines	Tunisia
Burkina	Finland	Lebanon	Poland	Turkey
Faso	France	Lesotho	Portugal	Uganda
Burundi	Gabon	Liberia	Romania	Ukraine
Cambodia	Gambia, The	Libya	Russian	United
Cameroon	Georgia	Lithuania	Federation	Kingdom
Canada	Germany	Luxembourg	Rwanda	United
Cape Verde	Ghana	Macedonia,	Saudi Arabia	States
Central	Greece	FYR	Senegal	Uruguay
African	Guatemala	Madagascar	Sierra Leone	Vanuatu
Republic	Guinea	Malawi	Singapore	Venezuela,
Chad	Guinea-	Malaysia	Slovak	RB
Chile	Bissau	Maldives	Republic	Vietnam
China	Guyana	Mali	Slovenia	Yemen, Rep.
Colombia	Honduras	Mauritania	Solomon	Zambia

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University Park, PA

Smeal College of Business

Class of 2012

Bachelor of Science: Finance

Bachelor of Science: Economics

## RELEVANT EXPERIENCE:

### The Vanguard Group

Malvern, PA

Procurement Services Intern

June 2011-August 2011

- Created an Excel based project plan to guide procurement leads on engagements and ensure continuity among the department
- Communicated with coworkers to understand and streamline the procurement process
- Negotiated with vendors and clients to reach a mutually beneficial non-disclosure agreement

### Penn State, Department of Economics

University Park, PA

Investment Technology Group – The Research Experience for Undergraduates Program

January 2011-May 2011

- Conducted granger causation, impulse and other tests using EViews to determine significance of economic relationships
- Strengthened economic intuition by relating research to current events and economic theories
- Worked with professor to create graphs and analyze data to be used in lectures

### Lower Providence Township

Norristown, PA

Finance Intern

Summer 2010

- Reconciled daily cash drawer and monthly bank statement
- Balanced accounts by creating and paying invoices
- Presented a budget projection at annual capital projects workshop

### China Life Insurance Company Limited

Beijing, China

Global Markets Intern

Summer 2009

- Followed the HKSE, SZSE, TSE, NYX, and NASDAQ to gain exposure to international financial markets
- Attended seminars concerning the macro-economy and investment strategies

### Penn State Investment Association

University Park, PA

Telecom Sector Analyst

January 2010 – May 2010

- Participated in mock portfolio competition to exhibit skills in analyzing and picking stocks
- Presented a stock pitch to show progression of knowledge

### Wall Street Bootcamp

University Park, PA

Certificate Candidate

January 2010 – May 2010

- Selected based on academic success and interest in Finance
- Attended presentations on career paths such as investment banking, asset management and other careers in finance

## LEADERSHIP:

### Sapphire Leadership Program

University Park, PA

Member

August 2008 - Present

- Admitted as a result of academic achievement and previously held leadership positions
- Collaborate with high achieving business students to develop professionally and academically

### Fall Leadership Program

University Park, PA

Executive Chair

August 2009 – Present

- Coordinate with committee to deliver an enlightening program about leadership and diversity
- Serve as a liaison between committee, administration, and guest speaker

## ACTIVITIES:

### Penn State Dance MaraTHON

University Park, PA

Security Leader, Rules and Regulations Committee

October 2009 – March 2010

- Educated fellow committee members about the logistics of THON, a 46 hour event benefitting pediatric cancer care and research and attended by over 15,000 people

### Sapphire Leadership Program

University Park, PA

Teaching Assistant

August 2010– Present

- Mentor freshman through resume reviews, and lectures about leadership, diversity and ethics

## OTHER:

- Language: Proficient in Mandarin Chinese, took six years of French
- Computer: Excel, PowerPoint, Microsoft Word, Access, EViews, STATA