I. Introduction

Greece's debt crisis of 2010 was triggered by high budget deficits that reached 13.6% of GDP – 4 times the amount allowed by the EU – and high national debt levels reaching €300bn, representing 124% of GDP. This high spending, mainly funded by other European counterparts, was done to heighten the luxurious life of Greeks, causing a furor throughout the region when the Greeks debt crisis threatened to collapse the entire Eurozone. The decisions by both Greece and the EU would have a substantial impact on the survival of Greece, the fate of the other the "PIIGS" (Portugal, Ireland, Italy, Greece and Spain - all of whom are running unsustainable debts and/or deficits and who either have at present, or are likely to, demand bailouts from the EU as well), and the entire European Monetary System (EMS). To better understand the situation, we have restated the key events in the following timeline.

II. Understanding the Situation – Timeline of Events[1]

Date	Event
20 01	**Greece joins Euro, but fudged budget deficits**
2009	**Beginning of financial crisis** • Greek economy contracted by 0.3% • National debt rose to €262bn, from €168bn in 2004and was projected to rise to 124% of GDP in 2010. • Its deficit reached 12.7% of GDP – more than four times the stipulated EU amount. • Fitch cut Greece's long-term debt to BBB+, from A-
Jan 2010	**Greece to clean its own house** • "We need no bilateral loans, we have never asked for bilateral loans," says Greek prime minister. • Jean-Claude Trichet, president of ECB, ruled out help for Greece, "Each country has its own problems. It is a problem that has to be solved at home. It is your own responsibility."
Feb 2010	**Announcement of austerity package, riots begin, EU leaders consider rescue package but some opposition** • Greece announces a wider austerity package, including a freeze on public sector pay and higher taxes for low and middle-income households. • Debt ballooned to €300bn while the spread between the interest charged on Greek and German debt widens to 4% as investors fret that Greece may default. • European leaders consider a rescue package for Greece at an economic summit.
11 Feb 2010	**Germany opposes a quick bailout of Greece** • "Greece must tackle its debt problems itself."
Mar 2010	**First bond issue oversubscribed, but 2nd issue received weak response** • Greece's €5bn 10-year bond issued on March 4, was well-received • However, the second €5bn 7-year bond issue on March 29 met with weaker response, as financial markets start to lose faith in Greece's ability to service its debts.
11 Apr	**EU ministers agree terms to bailouts, though Greece reluctant to activate**

[1] http://www.guardian.co.uk/business/2010/may/05/greece-debt-crisis-timeline

2010	• Finally, Eurozone agrees to a €30bn rescue package. • The interest rate expected to be pegged at about 5%, well below the market rates
16 Apr 2010	**Greece may need help from the IMF, pushing its bailout up to €45bn.** • The intervention of IMF would expose Eurozone's internal weakness and inability to solve a debt crisis.
23 Apr 2010	**Greece activates €45bn EU/IMF loans** • With €16bn of debt maturing in May, Papandreou officially requests a bailout.
27 Apr 2010	**Standard & Poor's downgrade Greek credit rating to BB+, junk status.** • Analysts warn that €45bn simply won't be enough to sort out the Greek crisis, with prediction that the country may need a €150bn rescue package. • Cost of servicing its short-term debt has increased to 14%.
28 Apr 2010	**EU and IMF officials hold crunch talks with German leaders** • Rumors of a €120bn package being planned. • The yield on Greek two-year bonds has skyrocketed to 38%. Austerity measures under discussion include: • Hiking VAT to between 23% and 25% (it's 21% at present) • Cuts in the bonuses and wage supplements on offer to state workers • A 10% (or greater) hike in taxes on petrol, tobacco products and alcohol • Slashing the budget deficit by 6.5% in 2010
2 May 2010	**Greece granted €110bn aid to avert meltdown** • A three-year package to rescue Greece. Of the €110bn over three years, the other 15 Euro countries are to supply €80bn in bilateral loans, while the IMF puts up the remaining €30bn. • In return for the lifeline, Papandreou will implement spending cuts amounting to more than €36bn, or 11% of national GDP, over the next three years. Wages, pensions, and benefits in Greece's bloated public sector will be cut, and large VAT and other tax rises will be imposed. The retirement age is to be raised.

III. Understanding the Options for EU and Greece

<u>Options for EU</u>

Before we analyze 'game' dynamics, it is important to understand the pros and cons of each option, in order to understand the rationale behind each decision.

1) Let Greece default

Pros	Cons
• Sets an example for other EMU countries to emphasize self-discipline. Each country will need to conduct structural reforms, increase competitiveness, and pursue sound public finances. • Prevents the moral hazard problem within EMU members. This emphasizes the "no	• Letting Greece default could lead to a contagion effect, which will result in lower confidence and higher borrowing costs for other high debt countries, in particular, the PIIGS. • Destabilizes the banking sector as over €200bn are held by European banks, including

bailout" clause of the Maastricht treaty, which states that there will be no bilateral assistance for other economies. • Satisfies the public of other EU countries as tax money will not need to be spent on the bailout of Greece.	€30bn and €55bn held by German and France banks, respectively. • The massive political and financial turmoil in Greece could force Greece to leave the Euro. • Harmful to EU's image in its ability to handle internal problems

Assessment: Letting Greece default is the most costly option for the EU. The contagion effect of the default could lead to debt crisis among the other PIIGSs, especially Spain, which has a much larger economy, and its crisis will have a much larger impact than that of Greece.

2) Let Greece call the IMF for unilateral help

The main issue with this option is that the IMF is unlikely to have sufficient financial resources to support Greece's debt default on its own. However, the intervention of the IMF would help the EU in monitoring Greece's fiscal and structural reform process.

3) EU provides rescue package

Pros	Cons
The pros are mainly the opposite of letting Greece default, including: • Restoring confidence in EU • Demonstrating the strength of Eurozone and its ability to coordinate in dealing with internal problems • Likely to prevent Greece from defaulting and leading to contagion effect	• Potential public protests in countries that disagree with giving tax money for the bailout • Sets a precedence for providing assistance, which could reduce the incentive for ailing countries to reform • If the bailout fails, the costs are extremely high, including the EU's reputation and image • If the rescue package involves IMF intervention, there could be unfavorable policies and conditions placed on the EU. The IMF is also relatively US-influenced

<u>Options for Greece</u>

The key decisions of Greece throughout this crisis are mainly to (i) determine whether the country should receive external help from EU and IMF, or whether it should resolve the issues internally through austerity measures and (ii) if help is needed, when it should ask for help.

1) Resolve internally

Pros	Cons
• Lack of intervention from the EU and the IMF will allow Greece to have greater freedom to conduct its own fiscal and structural reforms, which should be less strict • Satisfies public interests of other EU countries	• Unlikely to be able to meet debt obligations due in May, and therefore, high likelihood of default. In the event of default, Greece will face severe bank runs through capital flight, financial and social crisis, and very high borrowing costs

2) Ask for EU/IMF rescue package

Pros	Cons
• Likely to prevent default if rescue package is large • Rate on debt is 5% - much lower than the current cost of borrowing by Greece	• The aid is very costly, including the loss of economic freedom and the strict policies to be enacted, including reduction in wages, large budget cuts, higher VAT and excise taxes. This will result in public unrest

IV) Game Theory Analysis

Game 1: EU vs. Greece

The EU and Greece are playing a one-shot game that is not likely to be repeated between them. Greece disobeyed the fiscal directives required of EU members in the Maastricht Treaty. The EU, in turn, has no credible forms of punishment given that any expulsion / suspension of Greece from the EU would carry its own risks and any penalty in the form of non-interest bearing deposits (as authorized by the European Parliament) would be difficult to enforce. Now each has to determine its best response.

For Greece, its optimal outcome is to run its deficit, keep its citizens happy, and get a bailout (a Greece "defection"). For the EU, it would prefer not to bailout out Greece and to see Greece fix its finances (an EU "defection"). If both countries act in such a manner, both parties will suffer as a result. Greece would be suspended from the Euro region and face extraordinarily high costs of new debt issuances, possibly defaulting on its outstanding debt and suffering a severe short-term economic pull-back. The EU would suffer as the Euro loses credibility as a stable currency and, as a result, other debt-laden members of the EU could see their own costs of debt rise as Greece's problems spread throughout the union (see Game 1a for further discussion of this).

It is therefore in the best interest of Greece and the EU to cooperate: for Greece to implement fiscal prudence and slash its deficit to reduce its future debt burden, and for the EU to bailout Greece to help the latter through its short-term debt commitments. However, they are currently in a Hawk/Dove game, and in particular, in a war of attrition. Although they are currently in the (-1,-1) cell, both the EU and Greece are playing the waiting game, seeing if the other will move first. If Greece decides to cut its deficit, EU would be inclined to provide no bailout. However, if Greece decides to keep running a deficit, it is more beneficial for the EU to bail Greece out (although with some penalty). Meanwhile, Greece is also waiting to see if EU will act first, in which case, Greece could take advantage by delaying or lessening its austerity measures. The best outcome would be for both to act simultaneously and cooperate, which was what eventually happened.

	Greece continues to run deficit	Greece cuts deficit
EU bails out	1,5	3,3 (cooperate)
No EU bail out	-1,-1	5,1

Game 1a: EU vs. the PIIGS

While as we noted above, the EU and Greece are playing a one-shot game that is not likely to be repeated, for the EU itself the game may very well be repeated with the other members of the so-called "PIIGS". This is essentially a sequential game in that (i) if the EU bails out Greece, the other PIIGS are more likely to demand bailouts as well, but (ii) if the EU bails out Greece and then faces the falling dominos of bailout demands by those other countries, it risks running out of funds for those bailouts and (iii) if it doesn't bailout Greece and panic ensues as Greece defaults on its debts, there's more likely to be a run on the debt of the other PIIGS, pushing them closer to default as well. The optimal solution to this game appears to be the one the EU and IMF adopted in practice - which was to bailout Greece, but to make it relatively painful (so as not to make it too attractive an option for those other countries) and at the same time to set up a very large, €750 million amorphous rescue fund that isn't dedicated to the bailout of any one of the other PIIGS specifically. This makes it harder for the market to put pressure on the bonds of any of the other PIIGS individually by demanding higher rates to fund new debt or to roll-over existing debt, since it doesn't know which countries will get bailed out and which ones may not. The amorphous rescue fund essentially creates a coordination problem within the market, potentially averting a run on ANY of the other PIIGS. If, on the other hand, the EU and IMF either made no commitment to the other PIIGS in advance or simply announced that they would set aside bailout funds for specific countries in sequence, as the need arose, the market might have been more inclined to test their commitment for subsequent bailouts. The key problem for the amorphous fund strategy, however, is that as the other PIIGS draw-down the fund, the market may then focus all of its attention on the last country standing, on the theory that the EU and IMF will have run out of money at that point and will not been able to come to the rescue. The obvious candidate for that country is Spain, whose economy has been crippled by the global recession and which currently has a seasonally-adjusted unemployment rate in excess of 20%. According to forecasts by the Bank of Spain, the country's GDP will grow at only 0.8% this year and 1.5% next year, and it is expected to run a deficit of 6.2% of GDP for 2011 and 5.2% of GDP for 2012, or approximately €66 million and €57 million respectively. When these amounts are combined with those needed roll-over of the country's maturing debts, they may be too large to be covered by the EU and IMF rescue fund.

Game 2: EU members vs. each other

To the EU, the problem of Greece's fiscal instability can have a severe and contagious impact. Under the assumption that the EU should provide a bailout to Greece to prevent any further spread of the latter's problems, the game becomes one of who should provide the bailout. Unfortunately, the problem becomes a prisoner's dilemma among the EU countries in that all of them would benefit from a bailout, but it is not in a country's best interest to act on its own and this results in inaction from all countries. Though benefits to each member of the EU for a bailout are different (e.g. Germany, being the dominant and most stable economy in the EU, has the most to lose from a destabilized Euro), the individual country decisions are essentially the same: supply funds for the bailout or wait for another country to do so. Moving individually risks that country providing bailout funds without knowing the actions of the other countries. From the other countries' perspectives, they receive a benefit from joining in a bailout but at some cost of doing so; they realize a higher benefit if another country agrees to fund a bailout and they don't have to (similar to a free rider problem). Ideally, the game would be a coordination game where all EU members would act simultaneously to help bailout Greece, and all share in the benefits and costs of doing so.

However, in reality, this coordination has proved exceedingly difficult since there are political and fiscal implications within each country that makes the bailout move less than ideal. For example, in Germany, a bailout is perceived as letting the Greeks off the hook for their profligate spending, lax attitude to work, and luxurious retirement benefits. If Germany moves on its own, not only will their leaders expose themselves to the political risks just described, they are also relying on political leaders in the other EU countries to come to the same conclusions themselves in order to avoid paying more than their fair share. The other countries have the choice of joining Germany in providing funds or waiting for other countries to help instead. Since most other EU countries have their own problems to face (like their own fiscal deficits and struggling local economies), and since they benefit most from a bailout where they don't participate, their best move is to wait for other countries to help out instead. This leaves the country that acted individually alone in their decision to bailout Greece and overly exposed to Greece's recovery, with no guarantee of success. Hence, their best decision at the start is to wait for other countries to join them. This decision repeats itself throughout the EU and absent effective coordination, results in inaction:

	Country B acts	Country B waits
Country A acts	3,3 (coordinated game, simultaneous moves)	1,4
Country A waits	4,1	2,2

<u>Game 3: Whether Greece should leave the Euro</u>

Greece's choice of whether or not to leave the European Monetary System (i.e. the Euro) and return to its own national currency is a difficult one. To a certain extent, remaining part of the Euro benefits the country by facilitating cross-border transactions within the Euro zone. However, to a larger extent, it burdens Greece by shackling its monetary policy in a time of economic crisis. In contrast, French and German interests are less conflicted and are strongly in favor of keeping Greece in the Euro zone.

The single currency facilitates cross-border transactions within the Euro zone by eliminating the need for, and the costs of, foreign exchange and hedging foreign currency exposure. However, at a time when the country would like to reduce its short-term interest rates to the lowest possible level so as to stimulate borrowing and investment, by having delegated its authority over monetary policy to the European Central Bank, it is forced to compromise with other ECB member countries, such as Germany and France. Those countries fear inflation in their own economies more than they fear recession in the Greek economy and therefore prefer to keep interest rates higher. Furthermore, because the French and German economies are more developed than the Greek economy, the latter is unable to compete with the former, absent lower wages. Though it's possible for Greece to reduce wages in nominal terms (e.g. by cutting salaries in the public sector), it is politically difficult to do so. By contrast, if Greece were to return to its own currency, the country would allow that currency to fall in value relative to where it stood when Greece first adopted the Euro. The resulting pain of devaluation would then be spread evenly across the Greek economy, instead of disproportionately on public sector employees. This action would be politically more palatable. Going forward, the country would then regain the authority to set its own interest rates and to further devalue its currency, as necessary to remain competitive.

To some extent, the risks Greece faces from unilaterally abandoning the Euro weigh against these benefits. Since the real burden of Greece's existing Euro-denominated debt would rise as the exchange rate of its currency falls, any Greek withdrawal from the Euro would almost certainly coincide with, or follow, a default on that debt. While default would eliminate a significant burden on Greece, it's likely the country would then be locked out of the capital markets for some time, putting additional pressure on public finances. It would also cause a crisis of confidence and the flight of capital out of Greece to countries that are more likely to maintain the values of their own currencies going forward. However, since it's almost inevitable that after the government defaults on its debts there would be a run on Greek banks anyway, any concurrent / follow-on decision by the government to abandon the Euro and devalue its currency would have little marginal cost and remain a net positive decision for the country.

In contrast, France and Germany face significant risks if Greece were to abandon the Euro. To begin with, a default and devaluation by Greece is likely to encourage similar actions by other heavily indebted European countries, such as Portugal and Spain, whose economies are also less efficient than those of France and Germany. In addition to the losses that French and German banks would suffer as a result of holding much of those countries' debts, the economies of France and Germany would lose their competitive edge within Europe. This is because as Greece and the other countries that follow it out of the Euro devalue their currencies, their purchasing power in Euro terms would also decline. Demand in those countries for what would then be more expensive French and German goods would decline as well. Conversely, France and Germany would consume greater amounts of what would then be cheaper goods from Greece and the other countries that follow it out of the Euro. This could lead to a renewed recession in France and Germany, whose economies are highly dependent on exports to the less efficient Euro zone members.

Assuming that (A) France / Germany are otherwise indifferent between (i) doing nothing and having Greece default but stay in the Euro and (ii) bailing out Greece but having it leave the Euro and devalue its currency, while (B) Greece is similarly indifferent between (i) defaulting but not leaving the Euro / not devaluing its currency and (ii) being bailed out and leaving the Euro / devaluing its currency, the payoffs to Greece on the one hand and to France / Germany on the other are as follows:

	Greece Devalues	Greece Doesn't Devalue
France / Germany Do Nothing (Assumes Greece Defaults)	1,2	2,1
France / Germany Bailout Greece (Assumes Greece Doesn't Default)	2,1	3,3

It thus seems that a Nash Equilibrium exists in the lower right corner (Bailout / Don't Devalue). Clearly all parties would benefit the most by ending up in the lower right corner (Bailout / Don't Devalue), but if France / Germany believe that Greece will devalue and/or Greece believes that France / Germany will not bail it out, the parties will end up in one of the other corners instead. To avoid this problem, the parties will need to negotiate carefully and build trust, so as to best coordinate their actions for the good of all concerned.

<u>Game 4: Generational Struggle between Retirees and the Workforce</u>

As demonstrated by extreme spikes in the prices of CDS contracts covering Greek sovereign debt, investors are skittish about the ability of the nation to service its debt and interest payments in the long term. A number of municipalities and industrial companies in the US also now face a similar problem – an inability to close their budget gaps, which are derived from relatively heavy support payments in form of pensions and healthcare for retired employees who are now separated from any revenue generating activities. Some form of compromise between retirees (or those going into retirement in the near future) and the workforce must be reached in order to solve the current fiscal deficit and the Greek government recently forced both groups to swallow some sacrifice through recent legislation.

The Greek pension system has long been singled out as a 'fiscal time bomb' by its observers, with generous retirement benefits for workers in the form of:

- Low contribution requirements as a percentage of their current income
- High pension payout as a percentage of wages earned
- Relatively few years of service required to retire
- The prevalence of 'arduous in nature' occupations where the retirement age is shortened by 10 years compared to the official retirement age

Prior to the crisis, Greek pension spending stood at 12% of total GDP and was ultimately projected to rise to 24% of total GDP. Like many countries, following the baby boom Greece was able to provide a generous pension system due to the relatively large number of workers compared to retirees (4:1) but it now faces a significantly different demographic make-up (1.7:1.0).

Application of Game Theory

Increase Minimum Retirement Age & Cut Retirement Benefits

Retirees\ Workforce	Agree to Cuts	Deny Cuts
Agree to Increases	• Retirees face reduced benefits • Workforce faces longer working life but lower funding responsibilities	• Retirees continue to enjoy generous benefits • Workforce faces longer working life and no change in funding responsibilities • Pension deficit creates continued burden on external capital raising

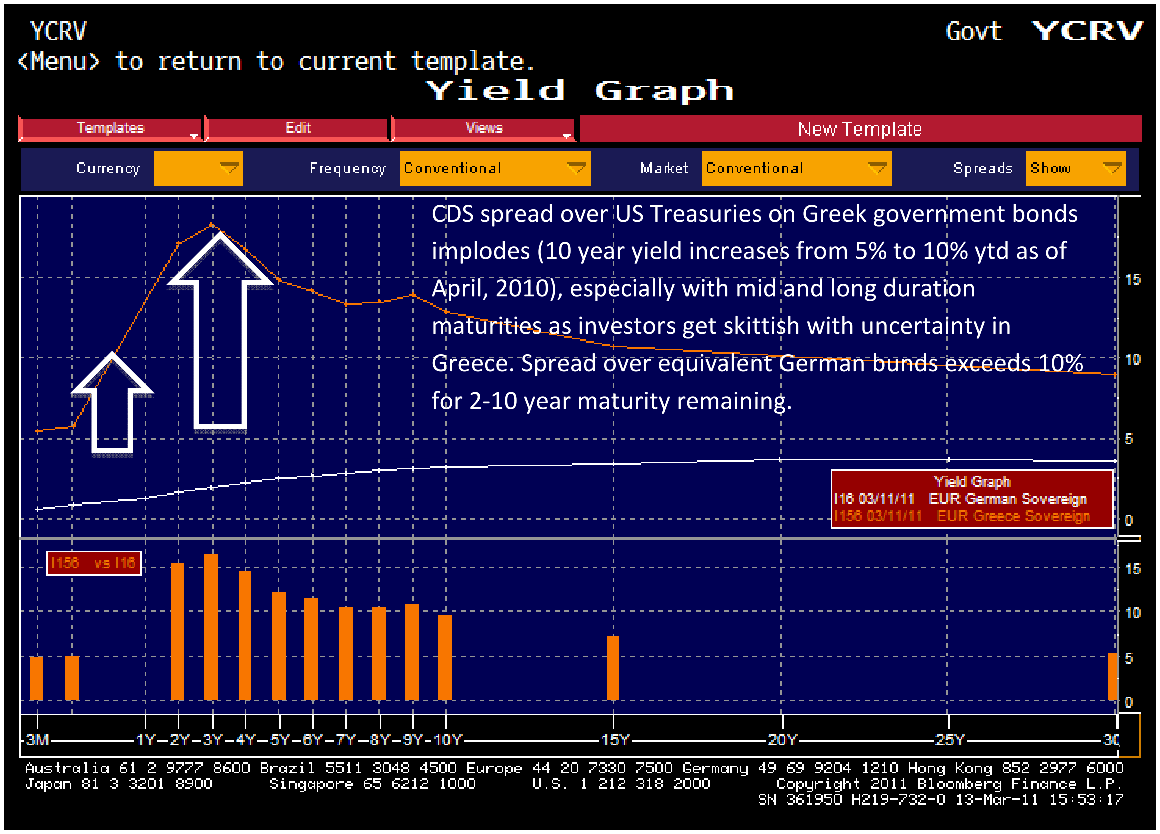
Deny Increases	• Retirees face reduced benefits • Workforce faces same working life, but somewhat lower funding responsibilities • Pension deficit may still create continued burden on capital raising	• Social unrest between factions • Workforce starts another diaspora to Australia, New Zealand and Astoria, NY

It is not in either party's interest to continue the current system. The heavy burden of pension payouts will further weaken an already fragile fiscal balance and young people who face the prospect of paying even higher financing costs with limited opportunities are likely to search for alternative options, such as immigration. Some form of negotiated settlement, in which both parties agree to a compromise, is the best choice the government faces.

In addition to direct conflict between the workforce and retirees, there can be alternative long term solutions – namely increasing tax collection revenues to close the deficit gap, a move toward a more progressive taxation system based on absolute levels of wealth rather than annual income, etc. Nevertheless, these solutions are more long term in nature and would be difficult to implement in the short term as the country struggles to appease the demands of creditor nations, who have themselves implemented tough austerity measures despite strong resistance from their own retirees.

As demonstrated by the government bond yield curves below, the added burden of financing the Greek government (in the form of increased bond yields) will heavily fall upon workers who will still pay taxes for the next 2-15 years.

Increased Financing Costs for the Next Generation



Choices for Retirees

Countries with rapidly aging societies began to implement stern austerity measures to solve potential pension deficits. Other countries in EU have implemented various measures and have pushed Greece to follow their suit in return for a financial rescue package

- Germany lifted the retirement age to 67 from 65 in 2007, affecting about half of the nation’s 82 million residents. While Greece has a statutory retirement age of 65, and 60 for women, exemptions and special rules can allow a retiree to receive a full pension at 58
- Greeks get a pension calculated on the last five years of their working life, which tend to be the highest-paid. German, Italian and Portuguese pensions are based on wages earned over a lifetime. Spain bases them on the best 15 years of work
- In the Greek civil service, the so-called wage replacement rate can be as much as 149 percent. (This is a measure of how effectively a pension system provides income during retirement.) Civil servants didn’t pay anything towards their pensions until 1992. Female civil servants with children under 18 can get early retirement.
- The EU and the IMF have imposed strict guidelines including raising women's retirement age from 60 to 65, imposing penalties on early retirement, cutting pensions compared to work earnings by some 10 percentage points, and increasing the number of contribution years for a full pension from 35-37 to 40. Pensions will also be frozen in 2011-2013 and red tape cut by merging the country's many pension funds into only three funds