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Debt Overhang and the Effects on Developing and Developed Economies

Abstract

This paper explores the connection between debt, future payments and investments which is part of the debt overhang hypothesis. The purpose of the paper is to expand the understanding of debt overhang and to examine its effects on developing and developed countries. The study begins with a theoretical discussion of the incentives on investment together with the relationship between debt and debt-servicing. The theory follows with a deeper analysis of capital flight and austerity measures which further affect the debt overhang. Empirically the paper covers 19 severely indebted developing countries and 5 indebted developed countries during two different crises, the LDC-crisis in the 1980s and the PIIGS-crisis of the late 2000s. For the developing countries external debt exercised a negative influence on investments during the whole LDC-crisis which supports the theory of debt overhang. The outcome for the developed countries was ambivalent, only Greece and Portugal showed a significant negative relationship between external debt and investments. For the rest of the PIIGS the effects were either mitigated or positive once country specific variables were accounted for.

Keywords: Debt overhang; External debt; Investments; Promised Payments; PIIGS

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1. Introduction

Until recently, the idea that advanced economies might default on their sovereign debt was very distant. Emerging economies were the ones that defaulted, not advanced economies. There have been plenty of debt crises that involve emerging economies in the past decades alone, Argentina, Mexico, Ecuador, Russia, The Philippines and many other countries have endured debt-crises. This pattern has persisted through decades but one thing has been certain, crises have had a tendency to evolve around developing economies. The current debt situation in Europe and its going effects might change this common perception.

The aftermath of the debt crisis in 1982 saw a decline of investments in the severely indebted countries (SICs)¹ and there is research that relates the fall of investment to high levels of debt. The supposed negative relation between debt and investments is called debt overhang. The linkages between external debt and capital formation, investments, are in the center of the analysis and this paper is ultimately an attempt to examine if there is empirical evidence for the debt overhang hypothesis in developing as well as developed economies. A comparison between the debt situation that the less-developed-countries (LDCs) endured in the 1980s (the LDC-crisis)² and the situation of modern Europe today (the PIIGS-crisis)³ will be our focus.

2. Historical Context

Investment climate widely differs across countries and regions, investments differ from public to private, residential to non-residential and so forth. Despite these differences the periods after both the PIIGS- and the LDC-crises behaved in similar ways, a sharp decline in investments followed by a period of slow recovery. In 2009 and 2010 the Euro area investments suffered a decline of 10.7% and 2.2% respectively (OECD, 2010, p. 71). For the troubled European countries, more commonly known as PIIGS, the investments fell even more drastically by an average annual rate of 10.9% between 2008 and 2010 (OECD, 2010). As a comparison, in the midst and aftermath of the LDC-crisis, 1980-1987, the investments declined at an average annual

¹ If three out of four of the following criteria are present, the country is severely indebted: Debt to GNP of 50% or more, debt to exports of goods and all services of 275% or more, accrued debt services to exports of 30% or more and accrued interest to exports of 20% or more (World Bank definition).

² LDC-crisis started with Mexico defaulting on sovereign debt and this debt-crisis spread throughout many less-developed-countries around the world.

³ The PIIGS include Portugal, Ireland, Italy, Greece and Spain which are all members of the European Monetary Union (EMU).

rate of 5.3% for the heavily indebted countries (HICs⁴). This decline in investments was crucial in converting the LDC debt crisis into a growth crisis that lasted for almost a decade in many of the SICs. The link between investments and future growth lay with the expansion of industrial capacity and overall investments in other sectors such as construction, services and housing. The decline in investments in the 80s was followed by a decline in growth and the European situation might follow a similar pattern. The real average annual growth rate of GDP per capita changed from 3.1% in 1970-1980 to -1.6% in 1981-1990 for the SICs (UN, 1991). For the PIIGS-countries the real average annual growth rate of GDP per capita declined by 3.9% in 2008 and 2009 (World Bank data catalog, 2011). A decline in investments can plausibly be related to lower future growth prospects and thus also curtailing the ability to generate resources for repayment.

In addition to the decline in investments and growth, both the period in the 1980s and the current situation in Europe have seen changes in debt. For the HICs the ratio of external debt to GDP increased from 32.1% in 1980 to 65.5% in 1987 and the ratio of external debt to exports increased from 168.5% in 1980 to 262.6% in 1989 (UN, 1991). For the PIIGS the ratio of external debt to GDP increased from 113% in 2003 to 184% in 2010 and the ratio of external debt to exports increased from 350% in 2003 to 545% in 2010 (World Bank data catalog, 2011). These high levels of debt seem to create a situation where investments are discouraged, which in turn reduce the future prospects of repayment, thus creating a debt overhang.

Economic- and Financial Research about Debt Overhang

The theory of debt overhang was first postulated by Stewart C. Myers in 1977 with his theory of company valuation in corporate finance and the effects of debt-financing. His paper examines why companies do not finance their activities with maximum debt even though there clearly exists a tax-advantage due to the deductibility of interest rates. The reason, he explains, for this is that high amounts of debt, or debt itself, distorts the possibilities for companies to make optimal future investment decisions. Debt induces a behavior where positive net present value projects do not get undertaken due to the fact that parts of future earnings from projects goes to creditors in the form of promised payments (Myers, 1977).

The debt defaults by many developing countries in the 1980s lead to further studies of debt overhang but now in economics and on a country basis. In a 1988 paper Paul Krugman investigated whether debt forgiveness or debt financing is preferable in the case of a defaulting developing country. This and other literature that Krugman references to is largely focused on

⁴ HICs are the fifteen most indebted economies among the SICs. These were classified at the program for sustained growth meeting of the IMF and the World Bank in Seoul 1985 (Deshpande, 1997, p. 169).

the problem from a creditor's perspective. The definition of debt overhang varies with Krugman defining debt overhang as "the presence of an existing, 'inherited' debt sufficiently large that creditors do not expect with confidence to be fully repaid." A definition that fits our perspective better is the IMF definition that emphasizes the distorted incentives as a debtor. They state debt overhang as "the debt overhang hypothesis does not describe a situation where foreign debt is merely large, but one in which the existence of foreign debt distorts the relevant margins considered for production and investment decisions." (IMF, 1989 p. 63)

A researcher that managed to establish a link between debt and investments is Ashwini Deshpande (1997). She studied the SICs and sampled thirteen of them to investigate how their economies behaved during 1971-1991. Her regression established a negative influence on investments by the presence of a large debt. She also used a time variable to separate the debt effect from other effects. The time variable had up until 1984 a positive effect on investments while between 1984 and 1991 that effect turned largely negative as a response on the changed investment climate.

There is critique relating to the research field of debt overhang and its effects on country growth through the channel of investments. Cohen (1993) empirically examined several countries and ultimately concluded that there was no conclusive evidence that linked debt overhang to growth. Another critic comes from Erdal Karagöl (2005) in his summary of the state of knowledge in the debt overhang research field. He concluded that there are country differences and that no theory of debt overhang can be applied to all countries unilaterally, each country is a special case due to social, economic and political differences. To summarize there is no clear consensus in regards to the effects of debt overhang and the results are diverse depending on scope, countries sampled and techniques used to obtain inference.

3. Relevance and Purpose

Debt Overhang and Relevance

From the past decades we can conclude that debt crises are something that happens regularly in the modern economy. The American savings and loans crisis of the 1980s happened at the same time as the LDCs started to default on their sovereign debt. Around the turn of the millennia Argentina plunged into a debt crisis and many Asian countries suffered currency crises related to debt. Similar crisis have even been seen close to the Europe with Russia and Ukraine defaulting on some of their debt. Debt-crises might not be a yearly occurrence but with the speculative

climate that festered in the world economy up until the Great Recession in 2008 it is only natural to believe that debt allocation has not been conducted in the most efficient of ways and that many countries lived beyond their means on borrowed money. This made us interested in looking further into the mechanics of debt and the debt overhang hypothesis.

The Purpose and Scope of the Paper

The debt crisis of the 1980s spurred an interest in debt overhang research. Much of the research has been conducted on developing countries, which is natural since debt problems were contained within SICs during the LDC-crisis. In the current crisis of 2008 and in the aftermath of the Great Recession we have seen an increasing problem of leverage from several countries not traditionally belonging to the same group as the LDCs. Many countries including those with strong economic fundamentals such as Spain and Ireland face debt problems that traditionally belonged to the developing world. The PIIGS-countries in southern Europe are an example of mismanaged debt. The current situation brings the question to mind if there is a chance that we can see a debt overhang tendency arise in the developed part of the world economy. Relatively little is known about the effect of debt on developed countries which makes it difficult to predict the effects of current policies undertaken by creditors and debtors associated with the developed part of the world. A big part of modern policy discussion relates to debt in one way or the other. Keynesian stimulus policies usually lead to large deficits in the balance of accounts for a nation that needs to be funded through debt. There is also the question of debt forgiveness or debt financing that Krugman (1988) discussed in the 1980s. If there are debt overhang tendencies in the developed part of the world it would imply that the long term consequences of Keynesian stimulus are not all together positive for growth. It would also matter in regards to how to handle a sovereign debt crisis. Without debt overhang tendencies a program of bailouts (debt financing) may very well be seen as the most effective solution. However also considering debt overhang we can learn from Krugman and find that maybe a program of debt forgiveness is what is most efficient. In the modern economy we can clearly say that debt has become important but our understanding of it is not all encompassing. Hence the purpose of this paper is to expand the understanding of debt overhang and to examine its effects on developing- and developed countries.

Since there is no clear consensus about the debt overhang hypothesis we will perform a comparative study of the experiences of developing and developed countries alike. More specifically we will examine external debt and its effects on investments for a sample of the SICs affected by the LDC-crisis, and for the PIIGS previous to and after the Great Recession. It is

worthwhile not only to study the bad years of the crises, but also the good years of the 1970s and the 2000s to counteract bias and make inference more generalized.

Research Questions

We have used two questions to guide us through our paper when examining the debt overhang effect for two different time periods with two different sample groups. These two questions will guide us closer to understanding debt and its effect on nations with differing economic fundamentals.

- 1. Is there empirical evidence for debt overhang in regards to the LDC- and the PIIGS-crises?*
- 2. Is there a difference in how debt overhang affects the SICs and the PIIGS-countries?*

These are the overarching questions for this paper and will be narrowed and made precise after a review of the relevant theory in the debt overhang research.

Method

Our goal of estimating the general behavior of investments during times of high external debt for a chosen sample of countries during a chosen period of time fits best with conducting a quantitative study using econometric methods. The quantitative method is well suited for explaining patterns and differences across a large sample. The method used is primarily deductive in that we tried to use established theories to explain potential differences in economic behavior. The use of regression studies fits the nature of deductive and quantitative studies well since they are mainly used for testing relationships and hypotheses in settings with large samples of data. Through the use of regression studies we can estimate relationships between external debt and investments for the PIIGS and the SICs. These estimates can then be compared against each other and a conclusion in regards to research question (1) can be reached. To answer research question (2) we employ mostly a deductive method. We employ a thorough review of the state of knowledge in the debt overhang research field and the hypothesis of earlier researchers becomes one component of the explanation of eventual differences between the SICs and the PIIGS-countries. After the state of knowledge review we form a four field matrix for use as an analytical tool. This matrix attempts to, in a simple way, explain the relationship between trust levels and differing levels of external debt. The model is an attempt to operationalize our research question 2 and the state of knowledge to provide for better understanding of the implications of eventual differences between the results for the SICs and the PIIGS-countries.

We did not employ a random sampling method since the country selection was based on countries possessing certain characteristics, more specifically high amounts of external debt. This sampling method makes it hard to draw general conclusions from the results obtained. Generalization is in this paper a working hypothesis and not a conclusion because of local conditions concerning debt. The investigation becomes focused on determining the relationships that existed at a certain point in time and for a select group of countries. Even though we should be wary of generalizing our results for the entire population of nations the inference that can be drawn from these specific cases and eventual differences can be of use to policy makers. The results can be used to widen the understanding of the fundamentals underlying the debt overhang theory and the debt overhang behavior.

The final result is that our study is positivistic in the sense that we seek to explain objective data through the debt overhang hypothesis of a causal-chain between increasing external debt and declining will to invest. Establishing causality in regression models is tricky. A thorough examination of the theory connecting debt to investments is used to argue for the existence of a causal relationship. We aim to show the effect of external debt on investments and measures have been taken to remove as many variables with explanatory power as possible from the error term. Our goal is to provide high validity of our results however there might be spurious relationships that we have failed to account for.

4. Debt Overhang Theory and the Disincentive Effect

In the original theory of debt overhang Myers (1977) condensed the problem into a simple example concerning a corporation with current and future assets, which yielded current and future cash flows. A part of the future cash flows would, from being indebted, then be transferred to the creditor in the form of promised payments and would by that effect create disincentive effects for the corporation's investments policy. To be able to apply Myers theory we will attempt to present his theoretical reasoning in connection with a country perspective instead of a corporate perspective.

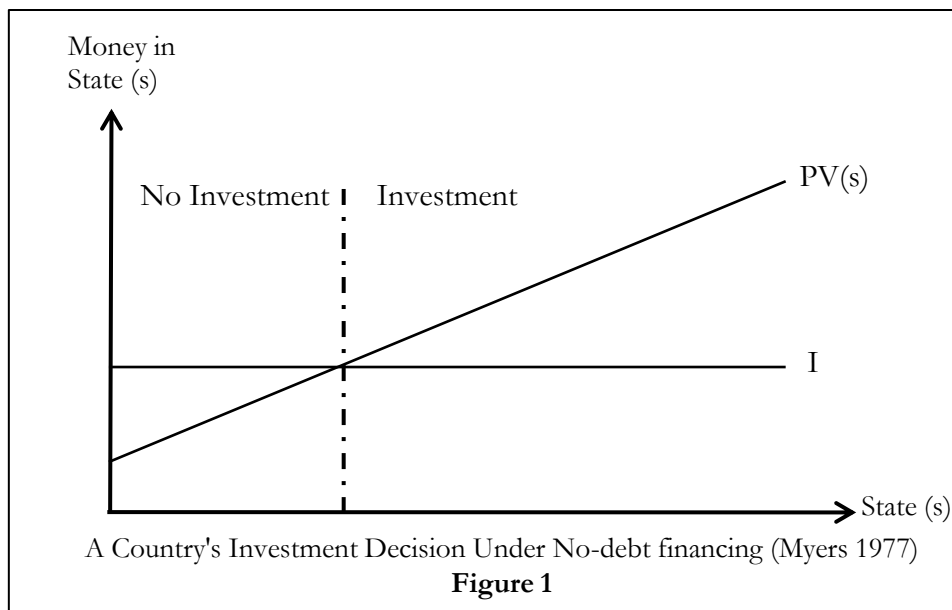
A country cannot be valued exactly as a corporation per se but we argue that there is a will to maximize the economy. The citizens will want to have the highest possible consumption over all time periods. This can be enabled by maximizing the output of the country due to the fact that if output increases the value of being a part of the nation increases. Using the Keynesian formula for output $Y = C + I + G$ an increase in Y would lead to a corresponding increase on the other

side of the equation. We would argue that a country can be seen having a value which can be defined by the formula $Y = Y_A + Y_G$. The value of the country (Y) depends on the value of current assets (Y_A) and the country's option to make future investments (Y_G).

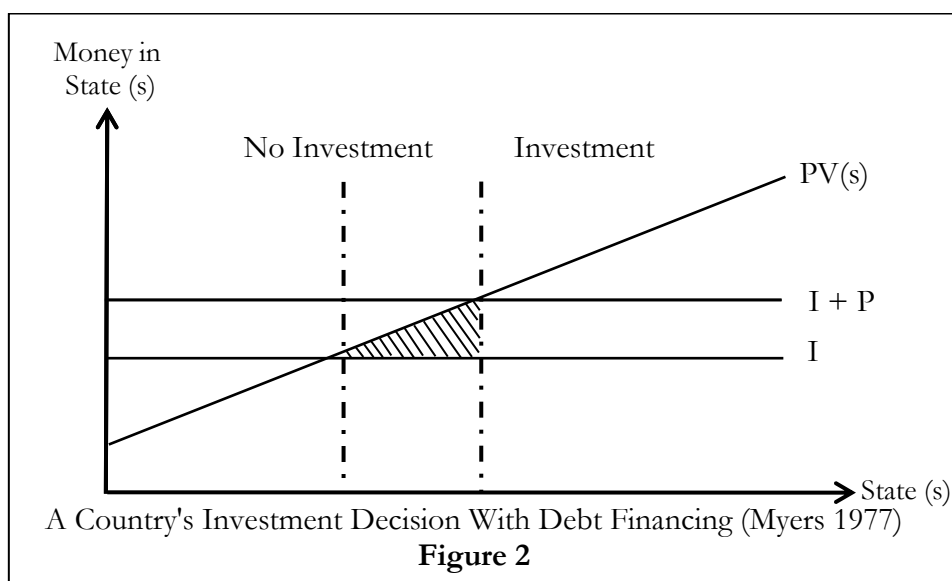
Krugman (1988) argues that there is an important difference between the revenue streams, the current and future investments, of corporations and countries. A company will have a probability distribution of streams of future earnings and from these earnings debt can be serviced. A country has a similar probability distribution but the difference appears because corporations can fully commit their revenue streams to their debt servicing, while countries on the other hand can only use a fraction of their national income for debt service. The presence of citizens and other obligatory commitments must be of priority and take precedence to keep the country stable.

This difference leads us into how debt is handled differently between corporations and countries. No one really has a legal jurisdiction over a country so a default could pass by without expropriation in favor of the creditors. If a company defaults they go into bankruptcy procedures where creditors are paid back as much as possible of the debt owed to them. A sovereign country can on the other hand not be forced into servicing their debt or be liquidated. There are however negative effects associated with defaulting for countries. Trust is an important aspect of lending and a country that defaults might find their future access to credit constricted. It could also find its assets in foreign countries seized.

The link that creates the negative influence of debt to investments follows from the promised payments, also called debt servicing, created by the accumulation of debt. A country without debt that faces an investment opportunity at the cost I that has a present value of $PV(s)$, where s denotes the general outcome of the investment, will decide to invest if $PV(s) \geq I$. A project or an investment where the present value exceeds the cost would cause an increase in the output of the economy (see figure (1)) (Myers, 1977).



In relation to the model and figure (1) the addition of debt will generate a negative influence on investments. This is due to the fact that a part of the future revenues from the country or the investments, $PV(s)$, will be used to cover promised payments to outside creditors and will thus not benefit the country as much. Promised payments, here denoted as P , becomes a part of the new decision rule, invest if $PV(s) \geq I + P$. The introduction of debt and promised payments creates a situation where a better outcome of the investment is required for the investment to be undertaken. In some situations the promised payments will make some previously positive net present value investments negative to the country due to the distortions of the future revenues. Outflow of parts of the potential earnings will thus lead to potential positive net present value projects not being taken since the country will not receive the full benefits of their investment. The inefficiency is shown in the shaded area of figure (2) (Myers, 1977).



5. A Deeper Examination of the Disincentives to Invest and Adjustment Effects

For a country, debt overhang can affect investments through two distinct effects. The first effect is the pure disincentive for investments which is the result of promised payments to creditors. When promised payments are present the country will receive a smaller share of any gain they have from investments. This lowers the will to invest since the incentives are no longer as lucrative. This can also appear as capital flight from the country if no capital controls are in place. With promised payments accruing to creditors, there might be no profitable projects to undertake domestically so there will be a capital out-flow from the country.

The second effect, mentioned by Deshpande (1997), is adjustment effects related to debt overhang. These adjustments appear as a result from negotiations between creditors and debtors. The IMF is frequently involved in negotiations with indebted countries and the result is usually that the debtor countries are tasked to make policy changes, due to the implementation of austerity programs. Historically these changes have commonly resulted in exchange rate devaluations and attempts to reduce government deficits. Adjustment effects have potential negative influences on investments since policy changes might result in less fiscal activity and exchange-rate devaluations, which reduces public investments and makes capital imports more expensive.

The Direct Disincentive Effects

Debt levels and Debt Servicing

What we present above (section 4) is the basic theory of debt overhang where rising debt levels lead to disincentives to invest. There are different views on how debt affects investments negatively. The first view determines debt servicing, or promised payments, as the factor that distorts investment. The second view argues that debt-level is the main variable since debt has an uncertain nature and sooner or later has to be repaid. Empirically the exact relation of debt and investments is difficult to verify and depending on the assumptions around debt varied empirical results can be obtained. It all comes down to how citizens, governments, debtors and creditors view uncertainty and risk and whether these actors truly recognize that an increased debt will lead to a loss of future revenue.

As long as debt is not forced to be repaid it will not actually cause any outflows of revenue apart from debt servicing. This leaves room for differences across nations in how debt overhang appears. Some nations may never have to repay their debt in full because of trust awarded to

them by the market allows them to roll over debt year to year and just focus on interest payments. In times of unstable financial markets developed countries might get margin calls on their debt a lot later than developing countries that may be perceived as more risky and therefore lack credibility. Cohen (1993) found empirical support that it is not actually the debt level but the debt service that affects investment. According to him debt cannot be seen as an unconditional predictor of low investments. This suggests that country analysis cannot be generalized in such a way as to say that a lot of debt always leads to low investments (Karagöl 2005). Rather one would need to look at specific factors of each country and then see which institutions might actually be the most important for determining debt overhang. With good institutions the actual burden of debt could be lower than for the same amount of debt with bad institutions.

The government and the people of a nation may however think of debt as something that one day in the future has to be repaid and debt overhang would in that case result from the mere presence of debt. It is hard to say which of the two ways of thinking around the relationship of debt and investments that is correct and as mentioned in the historical context empirical studies have a wide variety of results (Karagöl 2005). The explanation might be that there are differences in the sampling that leads to this. As stated above, a country that does not recognize debt as something that eventually has to be repaid, or with the ability to roll over debt, will not face the same pressure on investments. Country differences could then appear because of history and earlier debt mismanagement. Countries that have previously been involved in debt crises, where they have been unable to roll over or service debt, could have expectations surrounding debt that exercise a negative influence on investments. If a sample is dominated by countries of either type it could explain why a certain type of result is obtained.

Capital Flight

Capital flight was a serious problem for many developing countries in the 1980s because of uncertainty and a risky investment climate. A common necessity for developing countries have been to replace private capital out-flows, capital flight, with debt. Debt serves as a replacement for capital that has fled and does not necessarily improve capital allocation and the use of debt to negate capital flight is not a long term option since the real cause of capital flight remains. To counter the issue of capital flight developing countries often impose capital controls. However, austerity measures imposed by the IMF and creditor nations usually demands easing of capital controls. The argument is that easing restrictions help countries to attract more foreign capital which in turn would boost their investments, and this boost of investments would then in turn lead to higher growth. This might be true, it certainly sounds plausible, but relaxing capital controls can also enable capital flight again due to the risky nature of developing countries.

Austerity measures act as a double-edged sword with the possibility of both capital in-flight and out-flight. Debt can, as described in the situation above, become a replacement of domestic capital that has fled. Yasemin Yalta (2010) studied the impact of capital flight on domestic investments and found that in emerging markets one dollar of capital flight led to a 61 cent reduction of private investments.

An estimation conducted for 40 African countries for the years 1970-2004 concluded that \$420 billion (2004 U.S.-dollars) had fled the African continent (Boyce & Ndikumana, 2008). These developing countries actually turned into net creditors towards the world as a whole. Combined with Yasemin Yalta's findings of the 61 cent loss of private investment per dollar of capital flight we can see how capital flight can lead to enormous real losses of investment power. Capital flight is not only related to loss of investment power but can also be connected to external debt. The causality between them can run both ways, external debt promoting capital flight and capital flight leading to debt to fill the void left by private capital. External debt leads to a higher degree of capital flight because a higher amount of external debt leads to a greater likelihood of a sovereign debt crisis (Boyce, 1992 cited in Boyce & Ndikumana, 2008 p. 11-12). More debt services, or promised payments in the future, naturally worsen the outlook for the future. Smaller future deviations of revenues could then upset the economy and plunge it into a crisis since reserves are less plentiful. Consideration should also be given to the pure disincentive to invest from debt overhang. It follows in the same lines as we have argued before that debt causes parts of future revenue to be promised to creditors which will lower the amount of positive net present value projects available for investment. If there are no attractive projects to undertake in the country capital flight will be a natural reaction, capital will seek profitability in foreign markets instead.

If there are good institutions in place to promote investments in a country capital flight will not be visible to the same degree. If we look at economic growth as somewhat of an indicator of a good investment climate we can conclude that this stands true. According to Levine (1997) there exists a strong link between a functional financial system and long term economic growth, so this assumption is not unreasonable. Studies have shown that economic growth deters capital flight from taking place (Boyce & Ndikumana, 2008). From this we can conclude that healthy financial institutions are good for negating capital flight.

Adjustment Effects

Exchange Rate Depreciation or Devaluation

A common consequence of crises is that exchange rates depreciate or financial pressure causes fixed exchange rates to devalue. This happens either through speculative attacks on fixed currencies or through policy decisions by governments and central banks to lower interest rates by open market operations. Exchange rate depreciation or devaluation affects a country's balance of payments through exports and imports, but also through the real value of external debt and the amount of debt servicing. The use of monetary policy to handle crises is not possible for all countries in the world as members of monetary unions give up some of their monetary autonomy, hence losing some of their ability to counter crises in exchange for the stability offered by the union.

A depreciated or devalued currency makes a country's exports cheaper on the world market while making world market goods more expensive for the country. This can be good for the country if it has already made investments that are idle during the previously prevailing exchange rate. Then the boost of export opportunities, made possible by the lower exchange rate, can provide just what is needed to make these investments profitable. This happened in the beginning of the 1980s for South Korea. They overinvested into the heavy petroleum industry during the 1970s and a large part of the capacity was idle because of the high oil prices. When the country was balancing on the edge of a debt-crisis in 1980-1982 they chose to devalue their currency. The previous idle capacity became active and combined with declining oil prices South Korea avoided the LDC-crisis.

On the other hand if there are no idle capacity from prior investments the economy will not benefit in the same way from currency devaluation or depreciation. Without idle capacity exports will have to grow at the expense of internal consumption, so either internal consumption must go down or exports will not be able to grow. In this case the biggest effect of the devaluation or the depreciation will be on imports. Countries that rely on capital imports to serve their industry will through a weakened currency face higher relative prices on capital than before and this can have a negative effect on investments. This situation appeared in Mexico after the LDC-crisis hit in 1982. Mexico had during the 70s focused on inefficient investment policies and this led to less resources being available for the exporting sector. When the Mexican currency devaluated in 1982 the exporting sector had no idle capacity and capital imports became relatively more expensive than before. This situation led the exporting sector to demand more investments but

the higher prices on capital imports due to the weakened currency prevented industrialization and export growth.

The effect of devaluation or depreciation on domestic currencies have negative effects on debt, or more precise external debt, since the value of the external debt increases when denominated in foreign currencies. Few countries have external debt denominated in their own currency, normally one of the big world currencies is used, like the U.S. dollar. We can see how the weakened currency works as a double-edged sword where exports are boosted but debt-burden also get heavier. Austerity measures can therefore turn into a vicious cycle where the country instead of lowering their debt burden by using monetary policy boosts the real value of debt. If debt overhang exists this would then push future investments to become even lower, potentially making future growth prospects even bleaker.

Government Spending Reduction

A result of the sharp contraction in available means for external financing during the LDC-crisis was that developing countries in the world had to start to generate trade surpluses. Without surpluses they had no way to service their debt (IMF 1989). Prevalent policy from the IMF during the period pushed countries towards austerity measures which advocated positive trade balances. These measures, or policy changes, were required for developing countries to activate emergency funding from the IMF. There are two main ways to achieve a positive trade balance, a country can lower either the consumption-output ratio or the investment-output ratio (IMF 1989). If debt burden increase exogenously this would imply a drop in national wealth since parts of future revenue streams need to be allocated to creditors. To adjust for this the consumption-output ratio should be decreasing. After all, a sound investment will still be profitable no matter what the state of debt is and hence we should not expect the investment-output ratio to decrease. However the data tells the opposite story where the decline actually affects the investments instead of consumption (IMF 1989). When the heavily indebted countries were monitored during 1975-1987 consumption-output actually increased, putting further downward pressure on the investment-output ratio. This could be explained as people seeing the debt as unserviceable and then electing to consume as much as possible until the unavoidable default. So the whole burden of adjustment was taken up by the investment side of the economy (IMF 1989).

The question whether public and private investments crowd-in or crowd-out each other is relevant. If we believe in the crowding-out theory a lowering of public investments would promote a growth of private investments, the private capital would rush in to fill the void. The views on public investment are many and whether it crowds-out or crowds-in private investments

are not the subject of this paper. However, we do argue that there are forms of public investment that works as complements to private investments, infrastructure is a good example. If a government elects to cut its investment in infrastructure the result will probably be that the private sector faces a less favorable situation since logistics and communication are affected. This leads credence to the idea that private investments, at least somewhat, are crowded-in by increases of public investments. Of course this is only true to a certain extent since after investments have been undertaken by the public, the need for further investments gradually decreases. The marginal utility of obtaining more public investments will decrease with growth and after a while the government might find it favorable just to invest enough to make sure the current level of assets do not depreciate. If this level is sufficiently high this should not cause a drop of private investments.

While there is no definitive proof that public investments crowd-in or crowd-out private investments it is plausible to believe that there exists, at least to a certain extent, a crowding-in factor in public investment. This relation between public and private investments affect debt overhang since the view of citizens and government often differs. In times of crises, reductions in consumption are unlikely since the citizens are affected directly and governments are afraid of civil unrest. The natural choice of the government is therefore often to reduce public investments instead of consumption. This can have long going effects since changes of public investments might also affect private investments.

6. Investments and Economic Growth

So far we have shown the theory of debt overhang and how it affects investment. Before we start to analyze the data we need to investigate the relationship between investments and economic growth for a country. In an earlier section we defined the value of a country's present and future output as $Y = Y_A + Y_G$. If a country does not invest in any future opportunities (Y_G) they cannot expect to enjoy real growth of Y since Y_A , the current level of assets, is stable. A country is actually more likely to see contraction in assets since the value of current assets decrease as the years pass by through natural depreciation. Intuitively it seems natural to hold the belief that there can hardly be sustainable growth without investments.

There are plenty of studies on the effect of investments on growth. The IMF report of 1989 links the drop of investments to the decline of growth in output. However their estimations find no proof of a close link between investments and the decline of output. Only a third of the drop of growth can be explained by the decline in investments given the most favorable circumstances.

The explanation for this could be the influence of the adjustment effects. A slowdown in investments could result in a reduction of growth in capacity. If a country also is employing a restrictive aggregate-demand policy, which is common in countries which are heavily indebted, this can cause real output to grow even slower due to the low demand. Or the other way around, where decline in investment demand affect the aggregate-demand and output of the nation. This in turn creates a spiral with a lesser propensity to invest and less capital goods to be demanded. If there is no demand there will not be any supply either, which will affect the output of the economy (IMF 1989).

Attempts to improve the trade balance can also have an influence on economic growth. Earlier we mentioned the negative effects of attempts to obtain trade surpluses on investments. However imposing constraints on import quantity or rationing foreign exchange can result in a negative supply shock. This could be the explaining factor behind a part of the decrease of output that is not covered by slower capital accumulation (IMF 1989). Due to price increases from import constraints, previous levels of investments are now relatively more expensive. These policies could also have a harmful effect on overall economic efficiency since they distort incentives. In the long run these incentives could lead to unfavorable business practices being pursued even though they would not be possible under an open economy.

A model that relates investments and GDP is the multiplier accelerator model originally developed by Paul Samuelson (1939). The model begins with the notion that a certain amount of capital is required to support a given level of economic activity. The relationship follows:

$$K_t = qY_t$$

Where K_t is the amount of capital required to support Y_t , and q is known as the accelerator and represents the constant proportionality between capital and GDP at any given time period.

Net investment, I_t , represents changes in the stocks of capital in the different time periods and dK_{t-1} is the total depreciation of capital.

$$I_t = K_t - K_{t-1} + dK_{t-1}$$

Rewritten:

$$I_t = qY_t - qY_{t-1} + depreciation$$

The basic understanding in this model originates from the multiplier effects of government spending, tax reductions or increases in net exports and we need to look at the determinants of income to be transparent:

$$Y_t = C_t + I_t + G_t + NX_t$$

Consumption can also be defined as disposable income and taxes are introduced to support government spending:

$$C_t = bY_d = b(1 - t)Y_t$$

Where b is the marginal propensity to consume, Y_d is the disposable income and t is the tax. With these terms introduced we can now rewrite the relationship of income:

$$Y_t = C_t + I_t + G_t + NX_t = b(1 - t)Y_t + qY_t - qY_{t-1} + dK_{t-1} + G_t + NX_t$$

For simplicity the depreciation term is eliminated and we create a variable $A_t = G_t + NX_t$. After some rearranging we get:

$$Y_t[1 - b(1 - t) - q] = A_t - qY_{t-1}$$

Rewritten:

$$Y_t = [1 - b(1 - t) - q]^{-1}(A_t - qY_{t-1})$$

And the term in the bracket $[1 - b(1 - t) - q]^{-1}$ is known as the multiplier which represents the effects of government expenditure or increases in net exports.

An increase in government expenditure or in net exports would make the economy grow due to the multiplier effect. The larger economy would then require a larger capital base to sustain this higher economic activity. In more detail the autonomous spending in A_t would cause an initial boost in GDP and investments in the first period and the economy would start to oscillate towards a new equilibrium. After a number of time periods the GDP and the investments will stabilize and stay in a new higher equilibrium. Investments are directly related to economic growth in the accelerator model.⁵

The causality of how economic activity increases investments is shown in the accelerator model. The opposite causality is also possible through boosts in aggregate demand from investments. So in a word the causality works both ways and which is intuitive since investments can be a part of

⁵ For a better understanding of the multiplier accelerator model see the example in Appendix A.

both the public and the private sector. An investment in infrastructure or in a hospital would be called government expenditure but this would increase the gross fixed capital formation in a country. From these expenditures follows multiplier effects that boost aggregate demand. People get employed and acquire wages that are spent and the multiplier takes effect if marginal propensity to consume is withheld. Likewise, a private investment like a factory would work in the same way as a public investment. The investment multiplier looks like the government expenditure multiplier but the source of expenditure is changed:

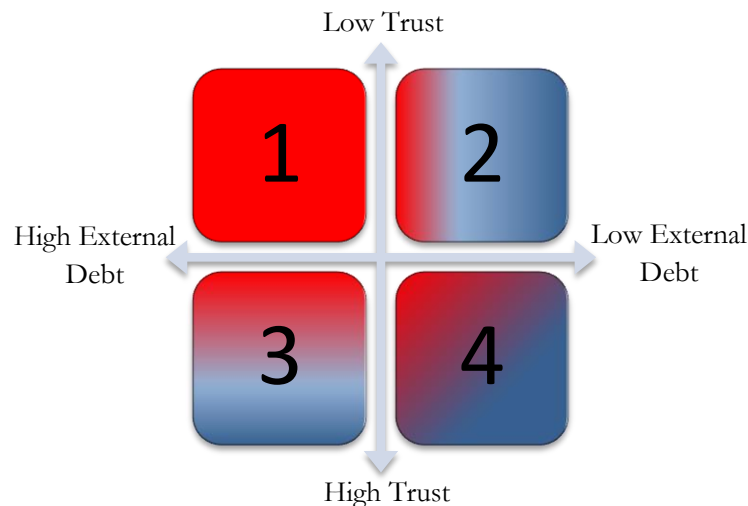
$$\Delta Y_t = [1 - b(1 - t)]^{-1} \times I_t$$

Where $I_t = K_t - K_{t-1}$ and I_t is net investments and K_t and K_{t-1} are capital base at time t and $t - 1$ respectively.

7. Summary of Theory and Elaboration of Research Questions

To summarize the theory we emphasize two main ways for debt to influence investments, through the direct disincentive effects and through the indirect adjustment effects. Disincentive effects arise in two distinct ways. The pure disincentive effect is related to debt levels that create promised payments to outside creditors which in turn lower expected revenue from future investments. The second disincentive effect is capital flight which is related to stability and institutions. Adjustment effects arise because of the implementations of austerity measures which include fiscal contraction and exchange-rate depreciation or devaluation. These different effects affect either incentives or market conditions which in turn influences capital formation negatively. Capital flight and austerity measures are linked by their relation to trust and stability. Stable institutions and political stability deters capital flight and might reduce the severity of austerity measures. Hence the effect of debt overhang might be mitigated in developed countries by stability and trust.

With knowledge and understanding of the deeper implications of the direct disincentives to invest effects as well as the adjustment effects we tried to specify an analytical tool to help evaluate subsequent results from the regression study.



Analytical Model for Debt and Trust
Figure 3

Situation (1) describes low trust in the economy at the same time as the external debt is high. High debt will stress the economy and some type of reaction will be the result. With low trust in the economy we can expect capital flight taking place. When residents and investors of a country cannot trust the government or the economy, they will fear expropriation, tax increases or a declining investment climate and capital will flee the country. If a country is forced to seek emergency credit on the world market we can expect austerity measures to be forced upon a country where the government cannot be trusted. The outcome of austerity measures can protect the creditors at the cost of economic growth due to constraints in fiscal and monetary activity.

With higher trust in the economy, situation (3), comes less stress from debt. Higher trust in institutions improves confidence in the economy and the government which leads to less interference in policy matters. There should also be less capital flight from a country where the public and foreign investors trusts the government. The distorting influence investment decisions will not be as negative as when private investors also have to account for the risk of a rapid turnaround in government policy just to service debt. In a functioning system of democratic governance there is a separation of power. This provides private investors with safety and stability in that they can form expectations about future legislation. Hence there is no need to preemptively move the capital out of the country just because of a high external debt.

After reviewing the theory we further specified our second research question. The differences in how debt overhang affects the SICs and the PIIGS-countries can potentially be explained by how trust influences austerity measures and capital flight. The question then becomes:

2. Is there a difference in how debt overhang affects the SICs and the PIIGS-countries? If there is a difference can it be related to the different impacts of austerity measures and capital flight on developed and developing countries?

8. An overview of the LDC- and the PIIGS-crises

The geographical span of countries chosen for our empirical analysis covers Asia, Africa, Europe, and Latin America. The LDC-crisis covers all the continents mentioned except Europe and the chosen countries, 19 of the SICs, are Algeria, Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Egypt, Ivory Coast, Honduras, Kenya, Mexico, Morocco, Peru, Philippines, Sierra Leone, Uruguay, Venezuela and Zambia. For the PIIGS-crisis the countries investigated are Portugal, Ireland, Italy, Greece and Spain. The LDC- and the PIIGS crises will be explained in brief and the most prominent countries will be the focus. The main point of this topic is not to be a large part of the paper but to give a historical overview.

The LDC-crisis

On August 12, 1982, Mexico's minister of finance informed the Federal Reserve chairman, the secretary of treasury, and the International Monetary Fund (IMF) managing director that Mexico would be unable to meet its August 16 liabilities, a debt service of 80 billion dollar that was mainly dollar denominated (Wellons, 1987). This announcement would within a year shake the fundamentals of many less developed countries that were in similar situations as Mexico. Mexico triggered the so called Latin American Debt Crisis and the effects were widespread across many developing countries in the world and created the LDC-crisis. By October 1983, about a year after the Mexican announcement, 16 countries from Latin America were in deep trouble. The largest countries, Mexico, Brazil, Venezuela and Argentina owed 176 billion dollars which accounted for 74% of the LDC debt outstanding (Wellons, 1987). Many developing countries had rescheduled their debt or were in the process of doing so and others would soon follow. The situation was fragile because banks in the United States had a large exposure to these countries.

Mexico and other emerging economies had during the 60s and 70s been influenced by import-substitution industrialization and protectionist policies.⁶ These policies included regulations on financial markets, restriction on foreign investments and ownership. In the early 70s these policies

⁶ Import-substitution industrialization was a common policy during the Second World War. Developing countries thought that they had to imitate western economies and produce output that they imported instead of importing the products. This policy gave birth to many infant industries and was usually combined with regulations and tariffs. The policies are based on Raúl Prebisch and Hans Singers theories (Prebisch, 1950).

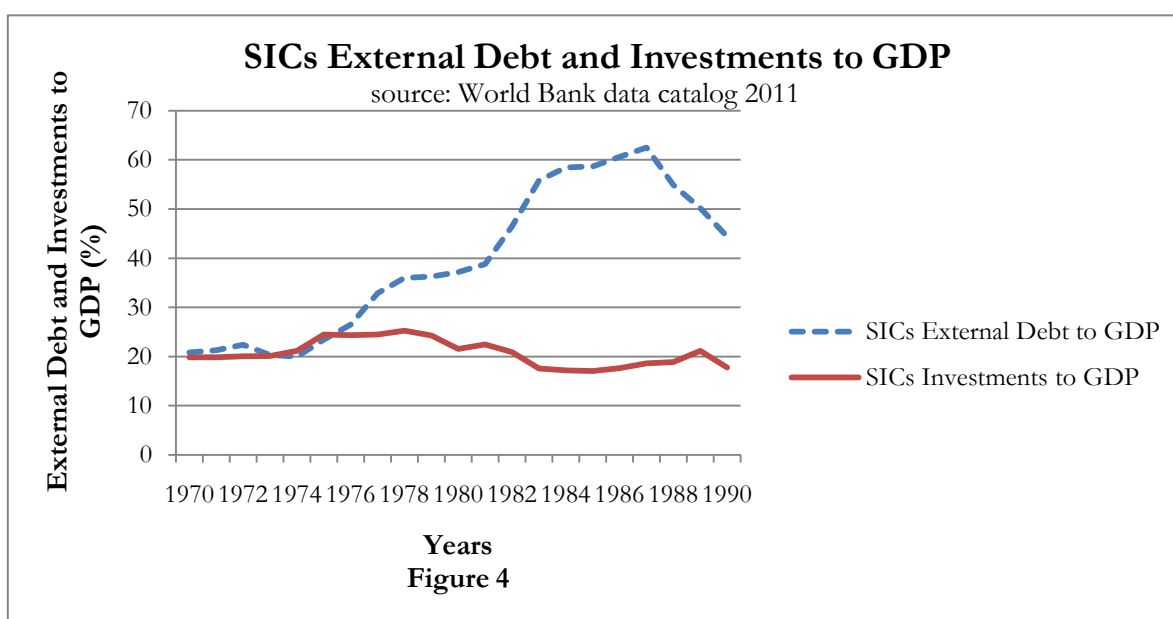
started to create inefficiencies that increased government spending. According to Lustig (1992) these policies created, together with the oil crisis in 1973, inflationary pressure and balance of payments issues for Latin American economies. This happened because much of the developing world, including the SICs, relied on oil and imports of capital goods. Trade deficits emerged for many developing countries because the exogenous oil shock plunged the world economy into recession in 1974-75. This led demand and prices for commodities, like minerals and agricultural goods, to decline rapidly. Mexico and other Latin American economies tried to reduce negative effects on employment by participating in active fiscal policies and these actions were together with increasing trade deficits financed by external debt (Gould, 1995). All the SICs did not pursue the same policies as Latin American economies but they all suffered from the decreasing demand and the price decline in commodities, thus created trade deficits or reduced trade surpluses. As a result of the severe recession balance of payments crises erupted for many developing economies and created pressure on their respective currencies.

Favorable interest rates in combination with the Eurodollar-market lifted financial constraints for developing countries in the 1970s.⁷ The easy accessibility of funds led to an increase in the external debt in much of the developing world. According to World Bank data catalog (2011) the external debt to GDP increased from 23.4% in 1975 to 58.7% in 1985 for the SICs. These funds were used to finance trade deficits, invest in infrastructure and to further industrialize both the private and public sector (IMF, 1989). The expansion of credit created together with inefficient policies and doubtful expectations of future profits in industry, as well as speculation in oil, a sensitive situation for the Latin American economies. With the decline of oil-prices and the rise in Prime-rates in mid-1981 investors started to doubt the booming Mexican economy which had pursued heavy industrialization in their newly discovered oil-industry. In fear of a balance of payments crisis investors withdrew their capital and eroded the confidence in the Mexican peso which eventually led to a devaluation of 260% (Gould, 1995). The external debt was mainly denominated in dollars, so in effect the devaluation led to a real increase in the external debt. Mexico was the trigger in the crisis and it is important to mention that many Latin American economies were in similar situations. In other parts of the world, like in Africa or in Asia, the countries did not have the same exposure but the common factor for all the SICs was however

⁷ Oil exporting economies like Saudi Arabia enjoyed increases in revenues, due to the increased oil price, and placed much of their assets in U.S.-dollar denominated deposits in European/American banks situated in Europe. This allocation of funds outside of the U.S. provided funding with dollars outside of the regulation from the Federal Reserve, thus allowing lower margins and more risk. This increased the availability of funds in the world economy made it possible for developing countries to borrow more cheaply, sometimes even with a negative real interest rate.

the accumulation of external debt which made them all sensitive to movements in the financial market.

The default of Mexico started the LDC-crisis and made creditors more risk-averse which put pressure on the international financial market and especially the Prime-rate. Interest rates increased and capital flight appeared due to eroded confidence in the SICs economies. It became harder for these countries to service their external debt which often was denominated in dollars and connected to the Eurodollar market. This crisis had a big impact on all the SICs and for some of them the 1980s are known as the lost decade due to large debt services and decline in both investments and growth. In our sample LDC-area, consisting of 19 SICs, the investments to GDP declined from 25.2% in 1977 to 17.0% in 1985 and GDP declined on average by 3.0% per year between 1981 and 1985 (World Bank data catalog, 2011). The trends in debt and investments can be seen in figure (4).



The PIIGS-crisis

In the spring and early summer of 2010 the European Union faced a crisis of confidence and fears of a sovereign debt crisis started to emerge. On the 28th of April 2010 the bond yield spread between Greek and German 10 year bonds was 1021 basis points as a result of the downgraded Greek government bonds (Matlock, 2010). Some estimates suggested that about 70% of the Greek government bonds were held externally which in turn created a situation of uncertainty (The Economist, 2010). Concerns about high debt levels and rising government deficits across Europe and the globe in combination with the recent downgrading of Greek government debt created alarm in the financial markets and stock markets plunged. The crisis that originated from Greece reduced the confidence in other European economies with large government deficits and as this paper is being written (Spring of 2011) both Ireland and Portugal has turned to the EU and the IMF for financial help.

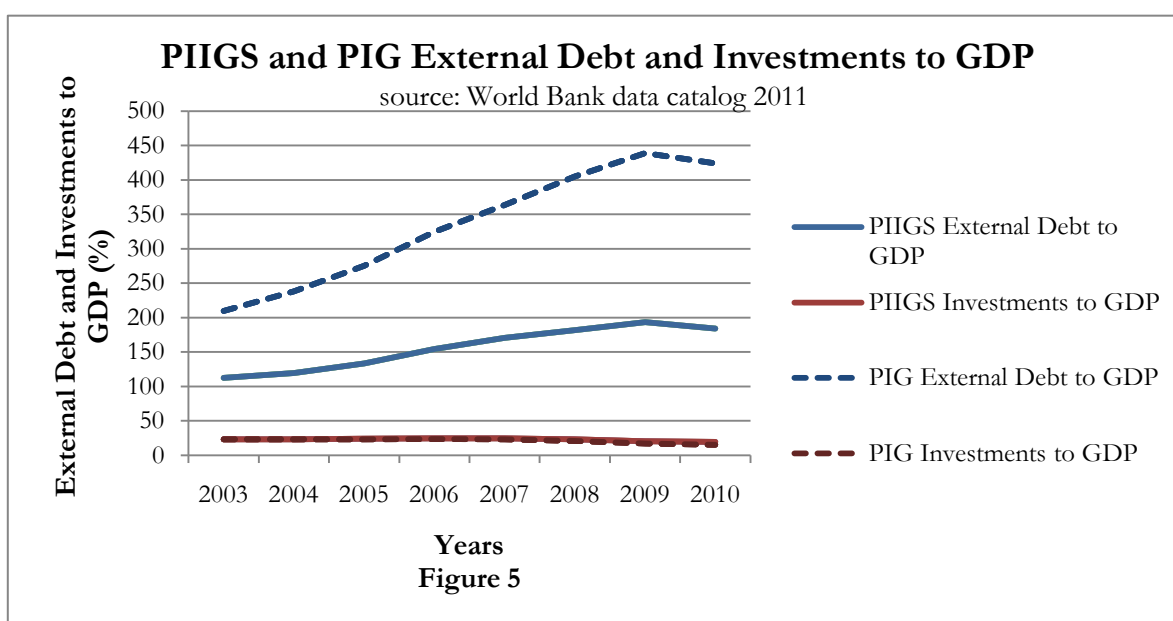
The cause of the PIIGS-crisis, just like the LDC-crisis, involved classical debt-mismanagement and an exogenous shock that lifted financial constraints and thus improved the accessibility of funds. Greece was one of the fastest growing economies in Europe during 2000-2007 with an average annual growth rate of GDP of 4.2% (World Bank data catalog, 2011). A strong economy together with a favorable financial climate allowed Greece to run large deficits. Structural deficits have according to Floudas, A. Demetrius (2010) been a normal feature of the Greek social model. Greek governments have, since the removal of the military junta in 1974, run large deficits to finance public sector jobs, pensions and other social parts of the economic system. The membership of the EMU and the introduction of the euro in early 2001 made Greece able to borrow more due to the lower interest rates that government bonds could command. However, the membership in the EMU demanded structural reforms for the Greek deficits but to continue with the improvements of the public sector Greece had to deliberately misreport the country's official statistics just to keep with the monetary guidelines of the union. The debt-mismanagement of Greece unraveled when it was discovered in the beginning of 2010 that Goldman Sachs and other banks had since 2001 arranged transactions that hid the Greek actual level of borrowing (Story & Thomas Jr. & Schwartz 2010). In May 2010 the budget deficit of Greece was revised to 13.6% which was one of the highest deficits relative to GDP in the whole world at the time and only a few days earlier, the 27th of April, Standard & Poor decreased the ratings of Greek debt to the first levels of junk status (Petrakis, 2010). The effect of a probable Greek default would in itself be small due to the small size of the Greek economy, only 2.5% of the euro zone. The contagion of the effect would however be harder to counter since the default would lead investors to lose faith in other euro zone countries as well.

To counter the debt problems the Greek government started to cut back on spending by reducing wages and pensions in the public sector. On the 2nd of May 2010 Greece activated the EU/IMF bailout, a total of €110 billion, to be able to roll over debt. The international support came at a cost, the Greek economy had to impose austerity measures which included tax-increases, increases in the retirement age, fiscal tightening and reductions in public-owned companies (Friedman, 2010). The positive impact of a lower borrowing cost, that the bailout made possible, could partly be offset by the negative impact from a tighter fiscal policy that the austerity program demands. Together with social disruption this tightening could prove to have a negative effect on investments and thereby growth in the long term. Debt overhang might become present with the high external debt and the effects of the austerity program.

The Greek bailout did calm the world economy but uncertainty of other economies with similar debt problems and large budget deficits lingered. The government deficit of Ireland with 14.3% of GDP in 2009 was even larger than the Greek deficit of 13.6%. Spain and Portugal had somewhat lower deficits, 11.2% and 9.4% respectively. These countries showed signs of financial distress when credit-default swaps jumped during April 2010 (Moses, 2010). Ireland was bailed out in November 2010 when the European governments sought to quell the market turmoil by handing an €85 billion aid package, where €45 billion belonged to European governments and the rest to IMF and the Irish cash reserves (Neuger & Kennedy, 2010). Ireland had suffered from a huge housing bubble, the average Dublin home had experienced price increases of 500% since 1994, and large losses in the private sector was the result of the financial crisis (Lewis, 2011). Years of rampant property speculation, fed by loose lending made possible by being the Tiger-economy of Europe, left tracts of Ireland covered with half-finished property that nobody wanted or could pay for. The next country to face debt-servicing problems was Portugal. In the end of April 2011 Portugal started to formalize a request with the EU and the IMF about a rescue package that could reach €85 billion. This happened after the Socialist government resigned on March 23 after the parliament rejected the government austerity plan. This sparked a crisis that pushed Portuguese borrowing rates sharply higher and led to multiple downgrades of the country's credit rating (Goncalves, 2011).

Spain and Italy have not yet faced the same problems as Greece, Ireland and Portugal. Spain and Italy have less external debt to GDP, 160% and 112.1% respectively, compared to the three crisis countries and have not yet faced difficulties servicing their external debt (World Bank data catalog, 2011).

The total PIIGS-area has seen an increase External debt to GDP from 112.6% in 2003 to 183.9% in 2010. The three crisis countries, Portugal, Ireland and Greece, have during the same period seen increases in external debt from 209.8% in 2003 to 424.3% in 2010 (World Bank data catalog, 2011). This relatively larger exposure to external debt exists due to the Irish housing boom and the more favorable interest rates that the monetary membership gave them. Investments to GDP for the PIIGS peaked at 24.7% in 2005 and then started to decline in 2008 when the Great Recession hit. Investments to GDP declined from 22.9% in 2003 to 19.4% in 2010 for the PIIGS-area and from 23.2% in 2003 to 15.2% in 2010 for the PIG-area⁸ (World Bank data catalog, 2011). These numbers imply that Portugal, Ireland and Greece face a larger decline in investments compared to Spain and Italy, and this might be due to the relative larger exposure to external debt and the austerity programs demanded by EU and IMF. The general trends in debt and investments can be seen in figure (5).



⁸ Portugal, Ireland and Greece.

9. Empirical analysis

We have earlier discussed the theoretical impact of debt to investments, but the appropriate measures or definitions around investments and debt are not always clear. Domestic capital environment varies by a lot between nations and the investments, also known as capital formation, differs a lot from developed to developing economies. Some economies rely heavily on public investments and others on private investments. These investments must also be financed and depending on economic sector and the country-specific investment climate the public and private sector might play different parts. To make cross-country comparisons concerning investments and debt it is thus crucial to find some variables that are relatively uniform across countries. We have attempted to adopt a standardized approach where these cross-country comparisons are meaningful.

Investments relate, in our paper and in our regressions, to gross fixed capital formation⁹ due to the fact that this measure excludes inventory investments. Inventory investments has an inherent problem with volatility since some countries have more production orientated corporations than others and that the factors explaining inventory investments differs and varies across countries, thus making the standardization approach harder. Gross fixed capital formation is the dependent variable in our analysis and to overcome the differences in country size we have deflated this variable by GDP. Our initial thought was to divide investments into two groups, public and private investments, to make more detailed regressions. The idea was to see if and how debt overhang affected investments through different channels in investments, public and private, but limitations in the data prevented this approach.

In regards to the indicator of debt burden we chose total external debt¹⁰ as our primary independent variable. Just as we did with the dependent variable we deflated this debt variable with GDP to make the regression applicable to cross-country comparisons. An earlier paper on debt overhang, Cohen (1993), argued that it is not total debt that reflects the disincentive effect, but rather the debt servicing. This critique is true but the fact is that servicing of debt is not always transparent since the IMF and creditors of troubled indebted nations often reschedule debt servicing. So usually no standard amounts for debt servicing are decided and rescheduling is made on a country-to-country basis. These negotiations and changes are made ex-ante and might

⁹ The World Bank definition of gross fixed capital formation includes land improvements fences, ditches, drains, and so on; plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.

¹⁰ When we talk about debt in this paper we always refer to external debt.

have large impacts on debt servicing and thus on the effect of debt overhang itself. In some cases comparing effects on investments with altered amounts of debt servicing will not produce unbiased outcomes. So when investigating debt overhang in specific countries debt servicing would prove to be a better indicator of the effect on investments. However, in our case we are dealing with a larger sample of countries and to allow for cross-country comparisons we use total debt burden as an indicator to overcome this possible bias.

When a country finds itself in a situation of debt overhang with difficulties to continue normal debt servicing a situation of uncertainty can appear. Uncertainty could be due to the probable inability to roll over debt, or on what terms debt will be rescheduled, or whether there would be any additional lending. Governments might react differently depending on uncertainty and events like fiscal contraction or expropriation could become possibilities. In a situation like this external debt would capture many effects that under normal circumstances would need separate consideration. Expectations and uncertainty of future events are therefore of importance in a debt overhang situation and the effects of indebtedness is not known beforehand. Hence the relationship between external debt and investments would therefore be a dynamic one with debt affecting investment with a lag.

The purpose of this exercise is not to create or improve an investment model per se but rather to see the nature of the relationship between external debt burden and the levels of domestic investment. Econometric estimation of investment behavior has not been very robust and there is hardly any consensus when trying to determine the relevant variables. Different models in circulation put emphasis on different theoretical frameworks and each model has its adherents and its critics. Earlier we mentioned the accelerator model of investment when trying to link economic activity to investments. This model relates to Keynesian economic theory with multiplier effects and aggregate demand. Other models like the neoclassical model and the Tobin Q-model have slightly different angles when trying to determine the nature of investments. The neoclassical model argues that it is marginal productivity of capital and the cost of capital including depreciation that is the determinant of investments. The Tobin Q-model is closely related to the neoclassical model and argues that it is the marginal productivity and the cost of capital through expectations of current and future revenues that determine if an investment is desirable. More precisely the Q-model uses a ratio, the q-ratio, based on the stock market as numerator and the replacement cost of installed capital as denominator. If the q-ratio is greater than 1, then the stock market values installed capital more than its replacement cost which then

implies that marginal productivity of capital is higher than the cost of capital and that managers can raise more capital.

When deciding which variables to choose in explaining investments we did not try to apply any specific model since the validity of such a regression would rely on the particular model used. The models are partial in the way that they focus on explaining investment behavior in regards to select set of underlying variables. Instead we tried to include many of the underlying variables from all of the earlier mentioned investment-models. The focus in the regression was to isolate the effect of external debt and variables such as international rates of interest¹¹, annual change of GDP, exchange rates and past levels of investment were therefore considered along with external debt as explanatory variables. This kind of regression did however prove to be inadequate since the explanatory value was low and the significance of variables such as exchange rates and interest rates was negligible once a debt term was added to the regression. Past investments did also prove to claim a lot of explanatory value from the other variables included. This made us look at empirical analyses in earlier debt overhang papers, Deshpande (1997) and Cohen (1993), and to alter the regression to include dummy variables to help verify the effect of debt over time and in specific countries.

When working with regressions and quantitative methods a potential drawback is that the study loses flexibility. The raw data needs to be organized in a systematic way because of the nature of regression studies. In our case this is a positive thing since it ensures objectivity, reliability and reproducibility. The only external influence we have on the data is that we arrange it to satisfy the needs of the software used to compute the regression studies. This ensures that intersubjectivity is possible, which is important to keep the study credible.

All the data has been taken from the World Bank data catalog (2011)¹² and for the 19 SICs the availability of data was extensive. In general every variable we wanted to use to explain investment behavior was available from 1970 and onward. This provided us with a healthy amount of observations further ensuring reliability of the regressions used. The added variance from such a large sample makes the inference drawn more reliable. However the PIIGS data was not nearly as extensive. These countries only began reporting to the World Bank data catalog at

¹¹ The Prime Rate is an interest rate that commercial banks charge their most credit-worthy customers, generally large corporations in the America. The prime interest rate, or prime lending rate, is largely determined by the federal funds rate, which is the overnight rate which banks lend to one another, and the default risk of individual borrowers. The Prime Rate is the American counterpart of the London Interbank Offered Rate (LIBOR).

¹² World Bank data catalog (2011) used for data include Global Development Finance (GDF), Joint External Debt Hub (JEDH) and Quarterly External Debt Statistics (QEDS).

the start of the 21st century. This in combination with the fact that the PIIGS-crisis is still ongoing left us with a limited amount of observations. This can be leveled as critique against the reliability of the results from the regressions run on that data. The overall variance of the sample might not be high enough to make generalized inference possible but hopefully a tendency can be demonstrated.

10. Results

Now that the appropriate variables have been settled upon the data needs to be revised and considered. The data is in the form of panel data, meaning that it has a time- and panel group aspect to it. Namely for the SICs the analysis encompasses the years from 1970 up to 1991 and the sample is of 19 different countries over the same time period. Equivalently for the PIIGS the time period is 2003 up to 2010, from the introduction of the euro to the present, and the sample is of 5 different countries. With panel data there are some immediate concerns that need to be addressed to correctly specify the model. First there is the question about the ability to pool data and this can be addressed by running a Chow-test on the unrestricted and restricted versions of the model. If H_0 cannot be rejected by the Chow-test there is homogeneity in slopes and the model can be pooled. After the Chow-test a Hausman-test will be computed to help determine if a fixed or random effects model should be applied to the data. After these steps have been taken a preliminary model will be specified. This model will then be tested for serial correlation and heteroscedasticity.

The use of year dummies is common in the study of debt overhang. This analysis uses them as a way to differentiate and to consider differences in investment climate over time and countries. These differences are accounted for with the use of dummy variables on intercepts and slopes (compare Deshpande 1997 & Cohen 1993). Previous research has shown that time factors can have a strong positive influence on investment to GDP (Deshpande 1997) and this would make the regression biased if not accounted for. For the SICs two time-dummies are used and the first one will be referred to as **Years₇₅₋₈₃** and it encompasses the years 1975-1983. The second time-dummy for the SICs refer to the years 1984-1987 which will, for convenience, be labeled **Years₈₄₋₈₇** (compare Deshpande 1997). As discussed in earlier sections these time-variables represent periods of investment climate. The first period was influenced by easy finance and cheap credit which in itself had an impact on investment policy. This second period was one where credit was hard to come by as higher interest rates created problems with debt-servicing and risks of default caused external finance to dry up. Equivalently for the PIIGS a year dummy was also employed to account for the financial crisis starting late 2008. Since the crisis broke out late in

2008 only 2009 and 2010 are incorporated into the dummy. These are also the years when the PIIGS began to face problems with their debt-servicing.

Because of the inclusion of time-dummy variables there will be in total three F-tests to determine if data can be pooled, two for the SICs and one for the PIIGS. The models to be tested are:

For the SICs:

$$InvtoGDP = constant + \alpha_i DebttoGDP(2) + \beta_i Year\ dummy$$

For the PIIGS:

$$InvtoGDP = constant + \alpha_i DebttoGDP(1) + \beta_i Annual\ GDP\ growth + \delta_i Year\ dummy$$

$i = 1, 2 \dots 5 \dots 19$ denotes the different countries present in the SICs and the PIIGS samples and the figure in the brackets indicates the lag effect.

The independent variable is gross fixed capital formation to GDP. External debt to GDP is the main explanatory variable and it is present in both the SICs model and the PIIGS model. For the SICs external debt to GDP was lagged with two years to account for the effects of expectations and the PIIGS were lagged with one year instead of two due to the low number of observations. Compared to the SICs the PIIGS equation also contains annual GDP growth as an explanatory variable since this variable was significant for them. The null hypothesis for the Chow-test is that the pooled model describes the data just as well as what can be obtained if the test is broken up country by country.

The Chow-test statistic used is constructed as follows (Wooldridge, 2009, p. 450):

$$F_{chow} = \frac{(SSR_r - SSR_{ur})}{SSR_{ur}} * \frac{n - T - T * k}{(T - 1) * k}$$

To obtain SSR_r the regression is run without any constraints in regards to countries. Like follows:

For the SICs:

$$InvtoGDP = constant + \alpha DebttoGDP(2) + \beta Year\ dummy$$

For the PIIGS:

$$InvtoGDP = constant + \alpha DebttoGDP(1) + \beta Annual\ GDP\ growth + \delta Year\ dummy$$

The sum of squares residual from the regression is then stored for use in the Chow-test. Then the regression is run separately for each country to obtain $SSR_{ur} = SSR_1 + SSR_2 + \dots + SSR_{19}$. N is the total number of observations, T stands for the amount of time periods and k how many explanatory variables are involved.

First the Chow-test is conducted on the SICs regression with the year dummy for 1975-1983 in place. The n is in this case equal to 360, T is 22 and k is equal to 1. The obtained $SSR_r \approx 1.2249$ and

$SSR_{ur} \approx 0.2894$. The F-statistic equals 48.64 which mean that the null hypothesis, that the restricted model describes the data as well as the unrestricted model, is rejected at both the 5 percent and the 1 percent significance level.

The same process is applied to the second SICs equation with the time dummy for 1984-1987. The n , T and k do not change since only a dummy variable is swapped. In this case $SSR_r \approx 1.2954$ and $SSR_{ur} \approx 0.4219$. As a consequence the F-statistic for the Chow-test is equal to 31.15 which again lead to a rejection at both the 5 percent and 1 percent level. There is heterogeneity in the slopes and the intercepts for the SIC's panel data. This has to be considered when the model is specified.

The same test also needs to be applied to the panel data and model of the PIIGS countries. In this case there is only one time dummy for the years 2009 and onwards to 2010. Since a lag is used for external debt to GDP a few observations are lost, n for the test is 30 instead of the 35 that would have been the case if there was no lag incorporated.¹³ The period sampled is 2003-2010 which gives a T of 8. The explanatory variables are in this case external debt to GDP and annual GDP growth so k is 2. Only one Chow-test is needed to test if pooling is possible, since there are not two different equations to estimate because of year dummies. For the PIIGS $SSR_r \approx 0.02915$ and $SSR_{ur} \approx 0.000283$ which gives the F-value of 43.73739. There is heterogeneity in the slopes and intercepts for the PIIGS at both the 5 percent and 1 percent significance level.

¹³ Note here that the PIIGS estimation only has a one year lag on external debt compared to the SICs estimation which has a two year lag. This is due to the implication of few observations in the PIIGS sample.

The next specification problem to address is if a random or fixed effect model should be used. Ordinarily a Hausman test can be used to determine this. Under the Hausman test the null hypothesis is that both fixed and random effects are appropriate but random effects are efficient. However if the null can be rejected fixed effects should be employed. Three Hausman test were computed, one for each equation. For the SICs equation with the first time dummy we obtained $\chi^2(2) = 1.80$ with 2 degrees of freedom. The critical value for $\chi^2(2)$ at a 5 percent significance level is $\chi^2(2) = 5.99$. Hence the null hypothesis cannot be rejected and both random and fixed effects are appropriate but random is efficient.

The same test was run for the SICs with the second time dummy. The $\chi^2(2)$ that resulted was $\chi^2(2) = 0.69$, the degrees of freedom remained the same. Using the same critical value as earlier ($\chi^2(2) = 5.99$) once more the null hypothesis cannot be rejected at a 5 percent level. This results in having to consider both the fixed and random effect for the model specification.

For the PIIGS countries the $\chi^2(3) = 0.08$. Important to consider is that the degrees of freedom have increased to 3 since GDP growth per year has been added to the model. The critical value of the χ^2 distribution at a 5 percent significance level with 3 degrees of freedom is $\chi^2(3) = 7.82$. The result is that we cannot reject the null hypothesis at any reasonable significance levels and hence both fixed and random effects are considered.

The results from the Hausman tests indicate that a random effect model would be preferable to use since it is more efficient than the fixed effects model. However, what also must be considered is how the countries or the groups of panel data were selected. A precondition for using random effects is that the observations are drawn from a random sample. Since the sampled countries were selected because of certain common characteristics they cannot be said to be of a random sample. Hence the fixed effect model will be used since it is still consistent under the results from the Hausman test (Dougherty, 2006, p. 419-421 and Wooldridge, 2009, p. 493).

This leads into the model specification. The model used is a LSDV model (Least Squares Dummy Variables Model) (compare Deshpande 1997 & Sen, Kasibhatla, Stewart 2007). This model includes added dummies to allow for different intercepts on a country-to-country basis. It also contains an interaction dummy to allow the country variable to affect the slope coefficient. In this way the heterogeneity in slopes and intercepts is expressed in the model. Since LSDV is also a fixed effect model it is appropriate to use given the sampling process used to obtain the data. Through a process of elimination dummy variables that were not significant were removed

from the models to free up degrees of freedom and to make the specification more accurate. After the elimination the regression models end up looking like follows¹⁴:

For the SICs:

$$\begin{aligned} \text{InvtoGDP} = & \text{Intercept} + \beta \text{DebttoGDP}(2) + \beta \text{Years}_t + \beta \text{Algeria} + \beta \text{Sierra Leone} \\ & + \beta \text{Uruguay} + \beta (\text{Egypt} * \text{DebttoGDP}(2)) \end{aligned}$$

Where Years_t denotes the two different time periods investigated in the SICs analysis, Years_{75-83} and Years_{83-87} .

For the PIIGS:

$$\begin{aligned} \text{InvtoGDP} = & \text{Intercept} + \beta \text{DebttoGDP}(1) + \beta \text{Annual GDP growth} + \beta \text{Years}_{09-10} \\ & + \beta \text{Portugal} + \beta (\text{Spain} * \text{DebttoGDP}(1)) + \beta (\text{Italy} * \text{DebttoGDP}(1)) \\ & + \beta (\text{Ireland} * \text{DebttoGDP}(1)) \end{aligned}$$

With the regression models specified the Wooldridge test for serial correlation was employed. The null hypothesis for the Wooldridge test for serial correlation is that there is no first order serial correlation. For the PIIGS the null hypothesis can be rejected even down to the 1 percent significance level ($\text{Prob} > F = 0.0053$). Doing the same test for the SICs the result is an even stronger rejection of the null hypothesis ($\text{Prob} > F = 0.00$ for both year dummies). In both cases a Prais-Winsten estimation was used to correct for the AR(1) serial correlation in the model. The Durbin-Watson statistic obtained after employing the Prais-Winsten test was much higher for the SICs, around 1.8, than when using the original model, originally around 0.49. This indicated that the correction for autocorrelation was warranted. However for the PIIGS the Durbin-Watson statistic indicated that serial correlation may not be present. The actual change from applying the Prais-Winsten estimation was negative on the Durbin-Watson statistic, both statistics were around 1.2. Because of these contradictory results both the LSDV estimation, obtained from an OLS regression, and the Prais-Winsten estimation are presented in table (2).

The last concern to be addressed is if the errors are heteroscedastic or homoscedastic in their distribution. The test employed was the Breush-Pagan test. The test statistic from this test is a χ^2 statistic with the null hypothesis that there is constant variance i.e. homoscedasticity. First the SICs were tested and different results were obtained depending on which year dummy was used. With the early period year dummy, 1975-1983, the $\text{Prob} > \chi^2$ -value equals 0.0127 which means

¹⁴ Argentina was eliminated due to missing variables of gross fixed capital formation for the whole of the 1980s.

that the null hypothesis cannot be rejected at a 1 percent level of significance but can be rejected at the 5 percent level, hence a correction for heteroscedasticity is warranted . The results when using the dummy variable for 1984-1987 is a $\text{Prob}>\chi^2$ -value of 0.0022. This leads to a rejection of the null hypothesis at both the 5 percent significance level and at the 1 percent significance level. Since we can reject the null the model will be specified with robust standard errors when the estimation is conducted with the year dummy for 1984-1987. Naturally the PIIGS must also be tested for heteroscedasticity in the errors. For the PIIGS the χ^2 -test statistic equals 3.2 and hence the null hypothesis cannot be rejected ($\text{Prob}>\chi^2=0.0735$) at either the 5 percent or 1 percent significance level. The results of the Breush-Pagan testing is that the regressions for the PIIGS will be estimated with normal standard errors, while the estimation for the SICs will be using robust standard errors.

The Outcome of the Regressions

The results of the regressions are interesting in the way they vary depending on if it is the SICs or the PIIGS being investigated. The time variable for the SICs follows the expected pattern with the interval of 1975-1983 having a positive influence on investments to GDP due to a favorable investment climate, see table (1). The latter period, 1984-1987, has a negative influence due to the tension in financial markets. The inference that can be drawn from these variables is that there were time specific factors across all nations in the sample that contributed to how investments were made.

Table 1 SICs		
Prais-Winsten estimation ^a		
Variable	Estimated coefficients	
	Regression. (1)	Regression. (2)
Intercept	0.202921 (26.45)	0.219455 (26.14)
DebttoGDP(2) ^b	-0.032992 (-4.88)	-0.0405222 (-5.75)
Years ^c	0.0292317 (5.39)	-0.014491 (-3.22)
Algeria	0.1294179 (5.27)	0.1273794 (4.51)
Sierra Leone	-0.0763221 (-4.59)	-0.0723499 (-4.02)
Uruguay	-0.049402 (-2.10)	-0.0511017 (-1.99)
Debt(2)*Egypt	0.0742349 (2.54)	0.0747671 (2.55)
R ²	0.4016	0.3503
D-W statistic	1.8323	1.774281

^a Dependent variable, InvtoGDP; number of observations, 360. Figures in brackets are t-values.

^b DebttoGDP(2) is external debt to GDP with a two-year lag.

^c Years is the time dummy for 1975-1983 in Reg. (1) and for 1983-1987 in Reg. (2).

In the regressions both external debt to GDP and the investments to GDP have been expressed as ratios, i.e. in decimal form. This is important to keep in mind when conducting inference. The result of a 1 percentage point increase of debt to GDP would in regression (1) lead to a decline of investments to GDP by 0.032992 percentage points, or consequently a 100 percentage points increase of debt to GDP would lead to a decline in investments to GDP of about 3.3 percentage points. The results for regression (2) are similar in their inference but the decline is a bit steeper with a 100 percentage points increase leading to a decline of investments to GDP by around 4.1 percentage points.

The PIIGS, table (2), differ a bit in their results. From the start the variable of annual GDP growth was included in the regression since it proved to be significant. GDP growth has been included as a percentage value, i.e. 1 percent growth is noted as 1 in the data. The impact of a 1 percentage point increase of GDP growth on investments to GDP is higher than from an equivalent change in external debt to GDP. Note that apart from the year dummy the results obtained from using the Prais-Winsten correction method for serial correlation and the results

obtained using the normal regression command are very similar. There are no changes in the overall effect from any variable except that the significance of some variables increases in the Prais-Winsten regression.

Table 2 PIIGS		
Prais-Winsten and OLS estimation ^a		
Variable	Estimated coefficients	
	PW regression	OLS regression
Intercept	0.2176982 (15.72)	0.2082848 (13.96)
DebttoGDP(1) ^b	-0.0276001 (-2.32)	-0.0232579 (-2.08)
Years ^c	-0.0078528 (-0.91)	-0.0024533 (-0.29)
GDPgrowth	0.0060414 (6.47)	0.0069466 (5.75)
Portugal	0.0505647 (5.26)	0.050092 (5.59)
Debt(1)*Spain	0.0653644 (11.38)	0.0677005 (15.13)
Debt(1)*Italy	0.0186692 (2.2)	0.0213036 (3.11)
Debt(1)*Ireland	0.0242804 (2.88)	0.0218059 (2.72)
R ²	0.9599	0.9481
D-W statistic	1.1718	1.1980

^a Dependent variable, InvtoGDP; number of observations, 30. Figures in brackets are t-values.

^b DebttoGDP(1) is external debt to GDP with a one-year lag.

^c Years is the time dummy for the years 2009-2010.

The interesting variable to the purpose of this paper, external debt to GDP, is in both PIIGS regressions significant at the 5 percent significance level but not at the 1 percent level and the effect on investments from external debt is questionable. The effect is economically significant but the statistical significance differs between the Prais-Winsten and the OLS estimation. In the OLS estimation it is significant at exactly the 5 percent level and not below, while in the Prais-Winsten estimation it is significant at the 2.5 percent level. An explanation is that there are many slope interaction variables left in the PIIGS estimation relative to the countries in the PIIGS sample. This could be sapping the external debt variable of explanatory power. Combining the interaction variable with external debt to GDP leads Spain to have a positive effect on

investments from increasing external debt. It also almost neutralizes the impact of debt for both Italy and Ireland. In general for the PIIGS countries the effect of external debt to GDP appears to be much smaller than for the SICs.

The PIIGS sample is fairly small with only 30 observations remaining after introducing a lag effect in external debt to GDP. This could explain why the R^2 obtained in both cases are over 0.90. There could be a problem with too low variation in the observations. We noticed that the inclusion of dummy variables for slopes and intercepts caused a significant increase in explanatory value of the model. Most of the variation in how debt affects investments for the PIIGS can be attributed to country specific differences and once these are controlled for much of the variance in the model is explained.

11. Concluding Remarks and Discussion

For the 19 developing countries and the 5 developed countries in our sample tendencies towards debt overhang are present. In other words external debt has been found to exercise a negative effect on investments. More precisely the relationship between external debt and gross fixed capital formation for the SICs remained negative through favorable and unfavorable investment climates during the LDC-crisis 1975-1987. For the developed countries (the PIIGS) the same relationship was negative during 2003-2010 but the real economic effect is questionable since the country specific factors around external debt almost or completely mitigates the negative effect of external debt. The results found for the PIIGS were not as significant as for the SICs. For Greece and Portugal external debt exercised a negative influence on investments compared to Spain, Italy and Ireland where the effects were negligible or positive. It needs to be emphasized that the sample period for the developed countries ought to be larger and cover a larger time span to allow for more observations. Therefore the conclusion drawn from the PIIGS indicates that debt overhang could be a possible outcome even for developed countries but it is still too early to draw any absolute conclusions, more sample countries and a larger time span would be desirable.

The regressions in this paper show that developing and developed countries differ in the effect that debt overhang exerts on investments. The sample of the 19 SICs showed a clear negative relationship between debt and investments while the same relationship for the PIIGS was economically and statistically questionable. An outlier in the PIIGS regression was Greece which neither had a significant slope dummy nor a significant intercept dummy. This indicates that they suffered from a more severe negative relationship concerning debt and investments than the other PIIGS, more in line with the effect attributed to the SICs. To explain the difference in debt overhang between developing and developed countries one would need a deeper analysis on the channels of investments. This can be done by exercising regressions separating foreign direct investments, public investments and private investments which are outside the scope of this paper. However, we can discuss the origin of potential differences concerning debt overhang in developed and developing countries.

The effect of debt overhang could differ since trust and confidence varies between developed and developing economies. Developed economies often have sound institutions regarding property rights and stable political environments. These institutions can probably affect the ability to service and to roll over debt in times of crises, but also ultimately to mitigate private capital out-flows when public finances are constrained. This form of stability could prevent

capital out-flow from developed countries when they are heavily indebted and thus reduce the effect of debt overhang. The reduction in gross fixed capital formation might therefore not be as severe in developed economies as in developing economies with weaker institutions. This difference is in line with the conclusions from using our four field model of trust and in line with the ambivalent results of the PIIGS regression.

Another factor that could create differences in debt overhang would be the adjustment effects from austerity programs and weaker currencies. The developed countries in our sample, the PIIGS, are all members of the EMU and the external debt of the PIIGS is mainly denominated in a common currency, the euro. This in contrast to the LDC-crisis in the 80s where many countries had fixed exchange-rates and had external debt denominated in foreign currencies. The monetary union could work as a source of stability for the PIIGS and reduce the effect of debt overhang. However, a member of the EMU cannot induce increased exports due to a decline in exchange rates in the same way as if they had an autonomous monetary policy. This could together with fiscal contraction, an effect from austerity programs, hurt the short term growth and recovery of a country in crisis and thus further amplify the effect of debt overhang. In effect a country's membership in a monetary union could be a double-edged sword with the benefit of stability but with the disadvantage that the country cannot increase exports with an autonomous monetary policy. The variation in the debt overhang effect, as we see between the SICs and the PIIGS regressions, could be due to implications of capital flight and austerity measures combined with levels of trust.

A period of low growth was the outcome for many developing countries in the LDC-crisis and this further worsened their capacity to service debt. This lack of growth was related to mismanaged debt and reductions in investments. The strategy employed for the troubled SICs during the 80s concerned further lending which proved to lower growth even more and the PIIGS could come to face a similar situation due to the fiscal contraction and the lack of autonomous currencies. The effect of debt overhang in Greece and Portugal are, just as for the SICs, negative but the significance is not yet clear. Holding the line against moral hazard, with demands for high interest rates, severe austerity programs and additional lending which seems to be the focus of the present debt strategy, could prove to be a self defeating strategy due to the effects on investments and long term growth for the PIIGS.

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Appendix A

Example Calculations for the Multiplier Accelerator Model

$$Y_t = [1 - b(1 - t) - q]^{-1}(A_t - qY_{t-1})$$

Where $A_t = G_t + NX_t$.

Using the following values and parameters we can calculate some examples to clarify the accelerator model:

- Marginal Propensity to Consume – $b = 0.75$
- Income tax rates – $t = 0.20$
- The accelerator – $q = 0.10$

The multiplier:

$$[1 - b(1 - t) - q]^{-1} = [1 - 0.75(1 - 0.20) - 0.1]^{-1} = 3.333$$

Yields the following equation:

$$Y_t = 3.333(A_t - 0.10Y_{t-1})$$

Period	0	1	2	3	4	5	6
Y_t	3000	3000	3666.3	3444.2	3518.3	3493.6	3501.8
A_t	1250	1250	1400	1400	1400	1400	1400
$I_t = qY_t - qY_{t-1}$	0	0	66.6	-22.2	7.4	-2.5	0.8

In time periods 0 and 1 the economy is in equilibrium. An autonomous increase in A_t will increase the output of the economy and investments needs to increase to maintain this new economic activity. After some time periods the economy will oscillate towards a new equilibrium.

Appendix B

Detailed results of the regression for the SICs with Year₇₅₋₈₃

Iteration 0: rho = 0.0000

Iteration 1: rho = 0.7492

Prais-Winsten AR(1) regression -- twostep estimates

Linear regression	Number of obs =	360
	F(6, 353) =	20.76
	Prob > F	= 0.0000
	R-squared	= 0.4016
	Root MSE	= .02849

		Semirobust				
		Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
invtogdp						
debtogdp						
LAG(2)		-.032992	.0067596	-4.88	0.000	-.0462862 -.0196978
YRS75-83		.0292317	.0054236	5.39	0.000	.018565 .0398984
Algeria		.1294179	.0245616	5.27	0.000	.0811124 .1777234
Sierraleone		-.0763221	.0166197	-4.59	0.000	-.1090082 -.043636
Uruguay		-.049402	.0235264	-2.10	0.036	-.0956715 -.0031324
Egypt*Debt(2)		.0742349	.0292154	2.54	0.011	.0167767 .1316931
_cons		.202921	.007673	26.45	0.000	.1878305 .2180116
rho		.7492168				

Durbin-Watson statistic (original) 0.501566

Durbin-Watson statistic (transformed) 1.832300

Detailed results of the regression for the SICs with Year₈₄₋₈₇

Iteration 0: rho = 0.0000

Iteration 1: rho = 0.7605

Prais-Winsten AR(1) regression -- twostep estimates

Linear regression	Number of obs =	360
	F(6, 353) =	16.21
	Prob > F	= 0.0000
	R-squared	= 0.3503
	Root MSE	= .02951

		Semirobust					
invtogdp		Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
-----+-----							
debttogdp							
LAG (2)		-.0405222	.0070471	-5.75	0.000	-.0543819	-.0266625
YRS84-87		-.014491	.0045023	-3.22	0.001	-.0233457	-.0056364
Algeria		.1273794	.0282196	4.51	0.000	.0718797	.182879
Sierraleone		-.0723499	.0180169	-4.02	0.000	-.1077839	-.036916
Uruguay		-.0511017	.0256154	-1.99	0.047	-.1014798	-.0007237
Egypt*Debt(2)		.0747671	.0293322	2.55	0.011	.0170793	.1324549
_cons		.219455	.0083963	26.14	0.000	.202942	.235968
-----+-----							
rho		.7605292					

Durbin-Watson statistic (original) 0.478942

Durbin-Watson statistic (transformed) 1.774281

Detailed results of the regression for the PIIGS ordinary OLS

Source		SS	df	MS	Number of obs =	30
-----+-----					F(7, 22) =	57.42
Model		.042829805	7	.006118544	Prob > F	= 0.0000
Residual		.002344368	22	.000106562	R-squared	= 0.9481
-----+-----					Adj R-squared =	0.9316
Total		.045174173	29	.00155773	Root MSE	= .01032

invtogdp		Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
-----+-----						
debtogdp						
LAG(1)		-.0232579	.0111636	-2.08	0.049	-.0464097 -.000106
YRS09-10		-.0024533	.0083601	-0.29	0.772	-.0197912 .0148846
gdpgrowth		.0069466	.0012078	5.75	0.000	.0044416 .0094515
Portugal		.050092	.008959	5.59	0.000	.0315121 .0686718
Spain*Debt(1)		.0677005	.0044731	15.13	0.000	.0584238 .0769772
Italy*Debt(1)		.0213036	.0068526	3.11	0.005	.007092 .0355151
Ireland*D.(1)		.0218059	.0080234	2.72	0.013	.0051665 .0384454
_cons		.2082848	.0149248	13.96	0.000	.1773327 .2392369

Detailed results of the regression for the PIIGS Prais-Winsten

Iteration 0: rho = 0.0000

Iteration 1: rho = 0.4010

Prais-Winsten AR(1) regression -- twostep estimates

Source	SS	df	MS	Number of obs =	30
-----+-----				F(7, 22) =	75.19
Model	.051615469	7	.007373638	Prob > F	= 0.0000
Residual	.002157412	22	.000098064	R-squared	= 0.9599
-----+-----				Adj R-squared =	0.9471
Total	.053772882	29	.001854237	Root MSE	= .0099

	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
-----+-----						
debtogdp						
LAG(1)	-.0276001	.0113136	-2.44	0.023	-.0510631	-.0041371
YRS09-10	-.0078528	.0072781	-1.08	0.292	-.0229468	.0072411
gdpgrowth	.0060414	.001065	5.67	0.000	.0038327	.00825
Portugal	.0505647	.0116723	4.33	0.000	.0263578	.0747717
Spain*Debt(1)	.0653644	.0063737	10.26	0.000	.0521463	.0785826
Italy*Debt(1)	.0186692	.0087375	2.14	0.044	.0005487	.0367897
Ireland*D.(1)	.0242804	.0083214	2.92	0.008	.0070228	.041538
_cons	.2176982	.0142088	15.32	0.000	.1882309	.2471655
-----+-----						
rho	.4010072					

Durbin-Watson statistic (original) 1.197986

Durbin-Watson statistic (transformed) 1.171785