On the determinants of the maturity structure of the government debt

Analysis of the OECD countries

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Abstract

This paper takes an extensive approach to determine what drives the maturity structure of the government debt. Most importantly, this paper introduces new factors to studies on debt management. Borrowing from the literature on the analysis of the private debt market, this research includes not only the macroeconomic and financial factors, but also socio-legal structure of the country, as well as the preference from the capital suppliers' and investors. The analysis of 30 OECD countries reveals that governments, when borrowing domestically, tend to trade-off between costs of financing debt and rollover risk, while, when borrowing externally, they take into account exchange rate risk. At the same time investors put a pressure on governments, who sometimes need to shift to shorter-term debt, when investors are unwilling to lend long-term. This is driven by many factors, such as the riskiness of debt, pension system type and citizens' reliance on each type, age of the society, law system adopted, levels of corruption, size of the banking system, income, and more.

Keywords: public debt, debt maturity, debt management, OECD.

All the graphs presented in this paper are based on the author's calculations.

Table of Content

1. Introduction

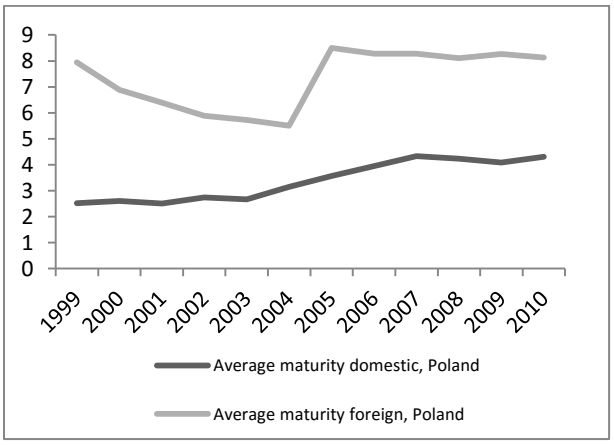
Debt management is an important task for the governments. If done appropriately, appropriate choice of the maturity of the newly-issue debt can help minimize the costs, as well as help avoid fiscal vulnerabilities, and even reduce the risk of sovereign debt crisis. Recently, these actions became more important, due to the financial crisis that emerged in the first decade of the 21st century. The recent crisis affected not only the poorest and most unstable countries, but also those that belonged to the group of the developed economies. It is noted that government debt to GDP ratio increased significantly (Abbas et. al., 2014), therefore careful debt management became a must to ensure the stable recovery of the world economy. The lengthening years of high Debt/GDP ratios caused public debt management more intertwined with monetary policy (Blommenstein & Turner (2012), Moessner & Turner (2012)). The OECD Sovereign Borrowing Outlook (2014) mentions that countries use debt management policies to evade fiscal dominance, a state when fiscal policy dictates the monetary one.

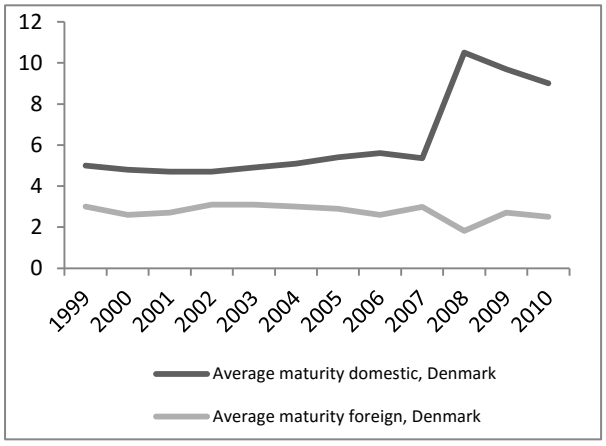
One of their tools is the choice of the maturity of newly-issued debt. By changing the proportions of the short-term and long-term debt, governments may reduce several risks, as well as decrease the cost of debt servicing. The maturity structure is usually regarded as the composition of the debt relating the maturity or time to repayment (Mosley, 2003). Countries also choose between borrowing domestically or externally and the choice of the maturity of the foreign debt is also taken into consideration. Usually, the biggest changes in the debt structure occurred when the sovereign debt levels spiked (Abbas et. al., 2014). However, no clear patterns are recorded, since the changes in the maturity are driven by many factors comprising of the interplay between demand and supply forces, government aims and economic constraints.

Up to this date, there exist a vast literature on the debt management, though each factor is studied independently (Mosley (2003) describes the main findings in this topic). Factors, such as debt level, inflation, or government spending, are recorded to have an impact on the changes in the maturity structure of the government debt, however changes in the monetary domain, such as, among others, interest rate rises, exchange rate volatility, interest rate spread increases or decreases, all affect the borrowing capabilities of the governments. Moreover, countries differ due to the level of corruption and saving patterns of the households, determined by age and income, which put pressure on the demand-supply forces. This study will try to analyze these factors between countries to determine what drives the maturity structure of the national debt. This research will be of particular interest for investors, investment banks and investment funds, portfolio managers and all those that invest globally in the debt market. Moreover, the government debt plays an important part in the country's economy. Careful debt management ensures financial stability. The case of Argentina is remarkable here, since their default in 2002 made the government unable to issue external debt for 14 years. The dispute over settlement between investors and Argentina and the proceeding battle in court finally ended in April 2016, when the court cleared the way after years of litigation and Argentina's senate approved the repayment of the debt (Bronstein & Marsh, 2016). Therefore the findings of this research may be important for policy makers and central banks as well.

There are significant differences between the average maturity in domestic currency and in the foreign one. The graph below shows the progression of the maturities, of both domestic and foreign debt for Poland and Denmark. The Polish external debt had much longer maturities than the domestic debt between 1999 and 2010. These

differences could be driven for example by the fact that the governments could put pressure to increase the inflation and shorten the maturities. Since the governments have more power to affect domestic markets, domestic debt can be regarded as more risky and investors would be willing to lend rather short-term than long-term. However, countries such as Denmark may be regarded as safe enough to issue debt with longer maturities. Moreover, the low average maturity of foreign debt in Denmark may be explained by very low amounts of external debt hold by Danish government (in 2016 country's external debt is only 0.02% of total government debt). This country may not have problems borrowing domestically and may hold only cheaper short-term external debt. Still, the decline in the average maturity of foreign debt in 2008 in Denmark was associated in fact with the rise in the external debt held by the government.





Possible explanations find some theoretical and empirical confirmation in the economic literature. However, the links between different determinants of the maturity have not been analyzed sufficiently, as well as the heterogeneity in the characteristics of the countries has not been addressed well. For instance, the research so far focused in detail either on stable countries, or only unstable ones. This research will use the broad sample of the OECD countries, that included heavily-indebted Japan or USA that can still borrow cheaply, as well as countries such as Greece that experience huge problems with servicing their debt. This paper will also introduce determinants from private debt market and merge with the existing theories on the relations with the maturity structure. Fan et. al. (2013) found that corruption, the presence of the strong defined-benefit pension schemes and strong banking sector affect the demand on the specific maturities of the corporate debt. In this analysis, these issues will be addressed regarding the government bonds. Moreover, the recent economic crisis and sovereign debt crisis in Europe provided the basis for further investigation of the determination of the public debt structure under stricken economic conditions, also among most developed nations.

By performing the empirical analysis, it will be possible to find, and confront with the literature, the relations between the maturity of the government debt and economic factors. Up to this date, there exist numerous research on this topic. Goudswaard (1990) already found, based on the data from the Netherlands between 1960 and 1985 that real interest rates, government demand on the capital market, and investors preferences play a role in the determination of the maturity structure of the government debt. Missale & Blanchard (1991) showed that within highly-indebted countries, the average maturity of the government bonds shortens as the debt level rises. Calvo and Guidotti (1992) established the optimal maturity structure model, where the increased government spending results in governments shortening the maturity of their newly-issued debt. Further, the research in this

topic has suggested that the choice of the maturity is also determined by the investors' demand, where countries regarded as more risky can borrow mostly short-term and those with unstable currencies need to rely more on the external debt (Guscina, 2006). Guscina (2006) provides the description of the crises in Argentina and Chile in the 1980s, where inflation spiked over 100% and as a result the domestic long-term debt almost disappeared. Jeanne (2009) mentioned that short-term debt gives incentive for governments to implement policies in favor of creditors, since the latter impose the discipline by rolling over the debt.

This research will take an effort to find the answer to the question: *Which factors determine the maturity structure of the government debt?*

This research will aim at confronting possible forces affecting the average maturity and establishing the universal determinants of the maturity of government debt. Most importantly, it will introduce socio-legal factors into the topic of public debt management. The results of the analysis of the determinants of the government's debt maturity for the OECD countries support the previous findings in this topic. The changes in inflation, debt level, age of the society, and interest rates have a significant impact on the change in the average maturity. At the same time governments aim at minimizing the costs of borrowing, by shifting to long-term debt when inflation rises. At the same time, the findings support the argument that when the riskiness of the government bonds' increases (measured through the interest-rate spread), investors prefer to lend short-term. More importantly, the differences in the socio-legal structure of the country, as well as its economic profile matters. Countries with defined-benefit pension systems tend to be associated with longer maturities of public debt. Moreover, the size of the banking sector, as well as law system and its enforceability (measured through corruption) are significant determinants as well. Also, governments in poorer countries borrow with shorter times to repayment, as governments trade-off between costs of borrowing and mitigating rollover risk.

In case of external debt, the maturity is strongly dependent on the size of the country, as well as the fraction of the debt in external currency. This relates to the problem of "original sin", where countries have impaired ability to borrow in domestic currency. Moreover, economic stability, measured through ratings and interest-rate spread also influences the maturity. Finally, more corrupt countries tend to borrow more long-term externally, while short-term domestically.

This paper contributes to the overall topic of what drives the maturity of government debt. There has been so far no extensive study of the impact from the social and legal factors, and capital suppliers' preferences on the public debt management. There have been efforts to analyze these either separately; for instance by analyzing the size of the banking sector only (Guscina & Jeanne, 2006), or by analyzing private debt market only. Extending these to the public debt market reveals new insights on what drives governments' choices about maturity of their newly-issued debt.

This research will be structured as follows: Section II will be devoted to the literature review, in section III the hypotheses formulation will be presented, section IV will describe the data and analyze the sample respectively, section V will be devoted to the methodology, section VI will provide results, VII will show robustness checks, section VIII will be devoted to the discussion of the results in light of the presented theory and IX will make conclusions, as well as describe paper's limitations and suggest further research.

2. Literature review

This part will describe the main literature on the debt management and the choice of the public debt maturity.

The problem of public debt management has been analyzed already for a long time. First, the economic theory focused on the positive economy to establish rules for the government on which maturity to choose. In theory if governments are certain about their expenditures and tax income, and taxes are non-distortionary, then the choices related to debt obligations would be irrelevant (Alfaro & Kanczuk, 2006). Consumers would anticipate all the changes and the government spending would be offset by the increase in the saving (Barro, 1989). However, when these assumptions are relaxed, then the choice between debt, expenditure and taxes becomes relevant. The maturity of the debt is important when the uncertainty is present. The inability to foresee the government expenditures, real interest rates, and output dictates the choice of the maturity that could mitigate risks. Since these are strongly related to financing the new public investments and economic growth, the importance of the public debt financing strategies is crucial. Public debt management especially influences the liquidity structure of the economy, capital market stability, the interest burden of the public debt and the size and frequency of redemption payments (Goudswaard, 1990).

Goudswaard (1990) provided concise overview of debt management strategies. He pointed out three main approaches:

1. The focus on keeping interest costs as low as possible. If the governments would follow the rule of keeping the interest costs as low as possible, then the debt maturities should be adjusted to the interest level. Basically, maturities of the newly-issued debt should be short when interest rates are relatively high and vice versa when the term structure has a positive slope. If the yield curve is inverted then the governments should borrow long-term (ideally governments do not have any restrictions or pressure from demand side).
2. To provide economic stability. following Tobin (1963) and as a response to the main objectives of the post-war economies after 1945, debt management should be used as a tool in economic stabilization through influencing the level and composition of aggregate expenditures. Tobin advocated the use of debt management in a countercyclical manner, in order to induce private capital formation (Tobin, 1963). Debt instruments differ according to their liquidity and risk, therefore managing them can affect interest rates, portfolio management and in turn real spending. Shorter maturities would cause the shift in the interest rates, where the short-term ones would increase and the long-term decrease. The demand for money would decrease and the demand for the private debt and the capital increase. This mechanism would increase in turn the investment expenditures. However, it is important to note the limited strength of such mechanisms. Interest rates in small, open economies with no capital restriction and with floating exchange rates need to be adjusted to the broader economic environment, dictated mostly by the exchange rate.
3. The neutrality objective, which aims at minimizing the effect of debt management on the financial markets. This approach claims that debt financing should not disturb financial markets and therefore be adjusted to the preferences of investors. The objective is not to crowd out the private investors and to

ensure the orderly market conditions. This has consequences also in the volume of the floating debt issued in the market. The maturities should not put too much pressure on the debt market and be set according to the existing conditions. This objective can be explained by strong market participants or unfavorable market conditions for the governments. Goudswaard (1990) finds that this objective has been followed by Dutch authorities between 1960 and 1985.

These three objectives can be attained through certain government actions, which need to take into account the existing economic situation (such as demand for government bonds from investors, or the attractiveness of issuing debt versus raising taxes). The choice of the maturity is one of the tools that governments can use to achieve their aims. Therefore, it is important to understand the causal links between maturity structure and economic factors.

There is a considerable amount of literature showing that the efficient debt management and its maturity structure may be used to minimize the costs of the debt. Missale and Blanchard (1991) provide the analysis of the relation between the inflation, maturity and the level of debt. The authors focus especially on the heavily-indebted countries such as Belgium, Ireland and Italy, which achieved their debt levels above 100% of GDP. Governments, which hold nominal debt, have a strong incentive to inflate it away, and thus decrease the debt burden. However, the trade-off arises, since increased inflation will be associated with the loss of reputation. Still, in their empirical study, the higher levels of debt are associated with higher inflation. The maturity structure plays a role here, since high unexpected inflation is more beneficial for the governments holding more long-term debt.

Calvo and Guidotti (1992) focused on the maturity structure of the government debt. They derived the formal model of the optimal maturity structure of nominal government debt obligations with assumptions of perfect-foresight, infinite horizon, unindexed bonds, distortionary taxes and costly unanticipated inflation. Their model predicted that as the governments try to minimize the burden of increased spending, the optimal debt maturity is negatively related to government expenditures and positively related to initial debt level: as the level of debt increases, the average maturity shortens (Calvo & Guidotti, 1992).

Moreover, Abbas et. al. (2014) notes that after II World War, together with the rise in the inflation, the average maturity of public debt shortened, which is likely the effect of the lower demand from the investors to lend long-term. Missale and Blanchard (1991) find that when the government debt is low or moderate, the maturity is not related to the debt level, however only when the debt is high then there is a negative relation between debt level and average maturity. It is however important to note that governments issue various types of bonds, among them indexed ones, which decrease the incentives for higher inflation. This reduces the proposed link between the maturity, level of debt and inflation.

However, the occurrence of random shocks, such as crises, which may cause sharp budget deficits can affect the maturity or the government debt as well. During such times, the debt should be structured in such a way that servicing it would be postponed to times when the output grows or spending decreases (Missale, 2012). According to this theory, the issuance of long-maturity bonds serves as a fiscal insurance against macroeconomics shocks. This is important when country's fiscal capabilities are very vulnerable. The issuance of long-term bonds decreases the risk of default in case of inadequate future surpluses. For instance, if the

government creates a consumption shock, and interest rates rise, it can be offset by the fall in the market value of long-term debt (Missale, 2012). Therefore, if the default is more probable, the governments would rely more on long-term bonds. Reducing short-term debt also insures governments against the market movement, such as interest rate shocks (Dornbusch and Draghi, 1990). Faraglia et. al. (2008) studied the effectiveness of the debt management for OECD countries and confirmed the fiscal-insuring role of such actions. Long-term bonds, although more expensive, insure the state also against the rollover risk (risk of increased costs of refinancing debt). Shorter maturities for all bonds are more sensitive to this risk (He & Xiong, 2012). Jeanne (2009) states that investors may impose new policies on the governments that issue short-term, as the former discipline the government by rolling over the debt only after certain policies are implemented.

Nosbusch (2008) constructed a model that deals with the relation between the maturity of the public debt and the interest costs. He argues that governments can achieve tax smoothing through debt management, as short-term and long-term debt has different interest rate sensitivity. His model assumed three periods and two states of the world: good and bad. In equilibrium, the implication was that governments borrowing long (even at the interest costs higher than for short-term debt) can achieve capital gains. Therefore, the insuring role of long-term debt can increase the welfare.

The choice of the maturity is driven also by the demand from the investors, depending on their preferences and size in the debt market. It is important to note that demographic forces may influence the public debt management objectives as well. Guibaud et. al. (2013) construct a two-generational model that introduce the clientele effect on the supply and demand for government bonds. They claim that governments can induce efficient risk-sharing between generations. To insure against low interest rates, the generation in period 1 will demand more long-term bonds. This is also due to the trade-off described by Campbell and Viceira (1999), where risk-averse investors choose between earning risk premia in the current state and the stability of their income in the long-run. As the risk-aversion increases, investors shift to longer-term assets to hedge against the interest rate decline risk. They choose mostly inflation-linked bonds. Guibaud et. al. (2013) claim in their model that the government "caters to clientele demand" and chooses the maturity of the bonds to meet the demand for it. However, this catering is bigger when the government is mostly focused on maximizing revenue, compared to maximizing the welfare. On the demand side, the younger generations also prefer more long-term bonds, which returns increase when interest rates decrease. This implies that the age of the society should be negatively related to the average maturity of the government debt. Authors tested this empirically, and found this effect in OECD countries. However, their analysis did not include other control variables, which could diminish or change this relation.

However, demography is not the only social factor that plays a role here. Cestau (2010) investigates the trade-off between safer long term bonds and cheaper short term ones in high, middle and low income countries. He finds that for developing and developed countries the income per capita was a significant predictors of the share of the short-term debt that the government has. Cestau (2010) ran a regression that dealt with the nonlinearity between income and maturity by using squared income per capita as one of regressors. His model suggests that short term maturity structure is more desirable for high income economies (low probability of rollover crisis) and low income groups (high costs of long term debt), while the middle income ones prefer long term maturity (high probability of rollover crisis). The main implication is that for low- and high-income countries the level of short-

term debt (debt due 1 year) is higher than for middle-income. The limitation of his research is that he studied empirically countries' debt levels and maturity only in one year. The panel data regressions could provide new insights on whether this pattern holds throughout the years.

Fan, Titman and Twite (2012) examined the debt maturity choices of international corporations and found strong relation to country's legal, tax system, corruption, bankruptcy codes, and the preferences of capital suppliers (such as banks or pension funds). Firms that operate in the countries with weak legal protection and law enforceability tend to rely more on short-term debt. This is because investors that are not protected would not be willing to invest in long-term debt, since the probability of them being not repaid is higher. This relation may be also similar when investors choose to borrow to governments, which would go in line with the findings about the monetary instability of the emerging countries. La Porta et. al. (1998) found that countries with common law system tend to have better creditor's protection. Fan, Titman and Twite (2012) confirmed that in such legal system maturities of the firm bonds' are usually longer. Corruption, as a proxy for enforceability of the law, was also playing a role, since investors are more willing to lend long-term if they are sure they will be protected against default. Moreover, the preference from capital suppliers dictates the demand for different maturities. Banks would typically tend to hold short-term bonds, while the pension funds usually use inflation-linked long-term bonds to mark to market their liabilities and thus demand more long-term bonds. They also suggest that the amount of government debt may affect the private debt market in two ways. One is that the government bonds crowd out the private debt market, while the other is that higher levels of government bonds on the market stimulate the supply of private debt, by helping in development of bond markets. Empirically, they find an evidence for the crowding-out argument.

The debt management problem is especially important for the developing countries. The relation between crises and amount of short-term debt has been already described in the field of finance (Dadusch, 2000). Emerging economies have different business cycles, since they experience usually higher and more volatile interest rates (Hatchondo & Martinez, 2009). The emerging markets are more vulnerable to shocks and the literature points them as having being more prone to debt crises (Arellano & Ramanarayanan, 2010). The model by Arrellano & Ramanarayanan (2010), supported by empirical research, suggests that when the interest rate spread rises, the short-term spread rises more than the long-term one, and the maturity of the newly issued debt increases as a government insurance against the crisis. Larrain et. al. (1997) uses yield spreads between government bond and US Treasury bond in the same manner as an indicator of risk of default. This relation may capture the recent economic crisis as well.

Moreover, the emerging markets shift to short-term debt during the crisis, as according to Broner et. al. (2008) the risk aversion among lenders tends to increase the risk premium more on long-term bonds than the short-term ones. Alfaro & Kanczuk (2006) claim that lengthening debt maturity decreases debt sustainability, and larger share of long-term debt increases the incentive for governments to default. The longer-term debt levels are associated with defaults occurring more often and associated decrease in welfare in these states. These authors compared the sovereign debt structure in developed and emerging markets. They found that only few countries were borrowing large amounts in the local currency long-term, even domestically. Most of the emerging market countries were borrowing internationally at medium-term or long-term, however it decreased in the recent decade. Referring to Sturzenegger and Zettelmayer (2005a) the ideal debt levels and structure of the country is

when the former are at low levels, the repayments are occurring systematically, there is a low share of short-term debt, and the foreign currency debt is low (to protect against currency crisis).

What is more, governments in the developing countries rely more on external debt compared to the developed ones. Most governments in the emerging markets borrow short-term and in the foreign currency (Guscina & Jeanne, 2006). These authors investigate the fact that more unstable countries have a greater share of short-term and external debt. When the monetary instability is high, governments have impaired ability to borrow in domestic currency at medium or long maturities. Moreover, Guscina and Jeanne find that the sharp rises in inflation (around or more than 100%), which force the governments to decrease the maturity of their debt, have a persistent effect. Countries such as Mexico, Israel or Turkey had hard times to issue domestically long-term bonds even when the inflation returned to more stable level. Moreover, the domestic long-term is more prone to disappear in response to high inflation than to reappear when the inflation is low. These authors introduce also the size of the banking sector as a determinant of the easiness of domestic borrowing. They find indeed that countries that have strong presence of the banks in their country tend to issue debt domestically more often. However, they use the size of the M2 money supply aggregate to measure the strength of the banking sector (compared to Fan et. al. (2012) who simply took the value of the private deposits in the bank) and one could argue that it is too much dependent on the GDP. Similar conclusion was stated by Burger and Warnock (2005), who claimed that countries characterized by low inflation and strong legal protection of the creditors have more stable bond markets and rely less on foreign-currency denominated bonds. Claessens et. al. (2003) point that the stronger domestic bond market is observed in bigger countries, with greater investor bases and flexible exchange rate regimes.

This is also confirmed by Hausamnn and Panizza (2003) who analyzed the determinants of the country's inability to borrow abroad in their local currency. This effect is called "Original Sin". They test several theories regarding original sin: monetary credibility, level of development, credit market imperfections, exchange rate regime, political economy and international causes. Domestically, if the monetary credibility is low, then firms (but also governments) will have a tradeoff between borrowing in local currency (which is expensive) or borrowing in foreign currency and face the exchange rate risk. Internationally, if the governments tend to inflate their debts, investors will be unwilling to lend in the local currency. Moreover, original sin may arise also because of the lack of political credibility. If foreign investors hold most of the debt, governments may try to weaken the value of these claims. If however, legal systems are well established, then governments may be punished for such actions. What is important, big countries are less prone to original sin problem, since their currency has a large share in the world portfolio. The empirical results of the authors show that the size of the economy of the country mostly plays a role here. Only smaller countries face the "original sin" problem, irrespective of the development, strength of their institutions and monetary plus fiscal solvency. On the other hand, the monetary credibility is important if country wants to borrow long-term domestically in domestic currency.

Guedes & Opler (1996) studied the relation between the debt maturity choices of the firms and their credit rating. Companies with investment grade ratings (above BBB using S&P rating scale) were usually issuing either short of long-term bonds, while those with a speculative one were in the middle-term range. The sovereign credit ratings may be related to the government bond issuance as well and play an important role as a maturity

determinant (Larrain et. al., 1997) (Gaillard, 2009). The credit rating should by principle convey all the information needed to assess the risk of a bond. In this manner, more credible nations should be able to issue more long-term debt, since these countries are obviously less risky from the point of view of an investor (Larrain et. al., 1997). Although this effect should be most visible in developing ones, the developed markets could fall from grace as well and the drop in the rating should be associated with a switch of the public debt to shorter maturities.

3. Hypotheses Formulation

Based on the literature, this paper will aim at comparing several theories and findings about maturity of the government debt. The amount of the factors to be examined shows the complexity of the debt management system, where different factors may affect the debt maturity differently. For instance, high inflation should be associated with low average maturity, as high inflation should be positively related to interest rates. When inflation increases, governments should borrow more short-term as a cost minimization policy. Previous research also shows that this relationship is not linear, countries that experienced high inflation levels in the past have hard time to issue long-term bonds. Moreover, the term structure (characterized by the interest rate spread) plays a role here, since when the yield curve flattens, then governments would issue long-term bonds, as a measure for insuring against rollover risk, or as Missale (2012) claims: to avoid a fiscal crisis. Still, countries may choose short-term debt when it is hard to impose savings in the near future to repay expenditures in the far future. In general, if interest rates are constant, governments would tend to borrow long-term, to avoid rollover crises, as well as insure their debt against the shocks. The instability in the country is reflected by risk premium that investors demand on lending to a certain country. Therefore, as the risk premium increases, the maturities should shorten, because investors would not prefer to lend with long repayment dates. Still, as the literature points, there are more forces affecting the choice of the maturity, driven by the demand from the creditors side. The predictions formulated from the literature would be as follows:

Debt level and government expenditures are taken into consideration by the governments when they decide on the maturity of the newly-issued debt. The increase in public debt and government expenditures would imply shorter maturities. Same happens when the inflation level is high. However, when the government debt is low, as suggested by Missale and Blanchard (1991), maturity should not be related to the debt level, nor inflation. Moreover, the monetary instability in the country, as well as the change in the yield curve should have an impact on the shortening the average maturity of the government debt.

Therefore, the first hypothesis is:

Hypothesis 1: *Debt level, government expenditure, inflation and interest rates affect the choice of the maturity for public debt.*

The demand from the creditors may stricken or influence the government's ability to issue at certain maturity. As the median age of the citizens increases, the maturities of the newly issued debt should decrease. Furthermore, the low-income countries are more prone to rollover risk, and investors would demand more short-term bonds.

The maturity structure of the public sector is also sensitive to the size of the domestic investors, as small domestic banking sector may impede the issuance of long-term debt. Similarly, pension funds that need to offer a stable yearly return would prefer to hold short-term bonds. On the other hand, the strong defined-benefit pension system puts a pressure on borrowing long-term, and thus affects the choice of the maturity. Finally, the strong investor protection, characterized by the favorable law system (common law) and its enforceability (low corruption) should be found in countries that borrow more long-term. These socio-legal factors should diminish the effect of the country's debt level, government expenditure and inflation on the average maturity of the government bonds.

Hypothesis 2: *The average maturity is driven by the preference of investors, and the country-specific socio-legal environment.*

Furthermore, the debt management is a tool in avoiding crises and ensuring financial stability. In volatile economies, the increase in the interest rate spread should cause the maturity of the newly issued debt to decrease. This issue addresses also the rollover risk, which is more important for less stable economies. Countries that experience interest rate shocks are more prone to rollover risk.

It is also more possible that the countries that have more vulnerable economies will turn to the external debt market more than the stable ones. The governments' credibility, or in general what makes investors believe that the country will pay back their debt, may be equally important in the case of the foreign debt as of the domestic one. External debt may be issued in the domestic or foreign currency. In the former case, investors may suffer from the government incentives to, for example, default. Thus, factors such as corruption should affect the average maturity of external debt as well. Naturally, the governments have more power in controlling debt issued in domestic currency, since they can increase inflation (by for ex. printing money), or impose policies that affect the price of this debt. Debt issued in foreign currency takes away such control from governments and shifts it to the market conditions. In this case there is no risk of higher inflation, however the risk of the exchange rate changes exists (which would be unfavourable for governments if the domestic currency depreciaties against the debt's currency). Therefore, the external debt is the combination of the domestic-currency and foreign-currency debt that is held by the external creditors. Since the creditors are not domestic, naturally there is no pressure from on the maturity of such a debt for instance pension system institution or domestic banks.

If the country has sharp rises in inflation and unstable economic situation, it may be regarded as very risky one and may have problems with issuing debt in domestic currency. The amount of the debt issued in foreign currency reflects this. Thus, the average maturity of the external debt should be controlled by the perceived riskiness of this debt by the external creditors, as well as the impaired possibilities to borrow domestically. Moreover, bigger countries should not suffer from 'original sin' problem, therefore the size should enable countries to borrow more long-term and in domestic currency. For the external debt, bigger countries should be able to borrow more long-term than the smaller economies, as well as those that hold lower amounts of foreign currency debt. Moreover, good rating should enable the country to borrow more long-term externally, since the rating reflects the riskiness of investing in the country. Therefore, the second hypothesis should be tested for the average maturity of the external debt.

Hypothesis 3: *The economic credibility, volatility and the 'original sin' affect the average maturity of the foreign debt.*

These hypothesis will be tested to determine whether theory rightfully suggests these variables as possible determinants of the average structure. The list of the factors affecting the average maturity is presented below:

Average maturity of domestic public debt

Macroeconomic factors	**country-specific factors**	**preference of capital suppliers**
1. Government debt	*1. Collectability of taxes*	*1. Pension funds*
2. Government expenditure	*2. Corruption*	*2. DB system*
3. Inflation	*3. Law system*	*3. Demand from banking sector*
4. Economic stability		*4. Age of the society*
5. national income		*5. marketable private debt*
6. Interest rate spread		
7. Interest rate yield structure		

Average maturity of external public debt

Economic stability	**Original Sin**	**Economic credibility**
1. exchange rate changes	*1. Foreign currency debt*	*1. Corruption*
2. Credit rating	*2. size*	
3. interest-rate spread		

The empirical analysis will aim at establishing which factors play a role. The next sections will be devoted to the empirical part of this research.

4. Data

This research focuses on the group of countries that belong to the OECD group in 2016. The choice of 30 countries was dictated by the feasibility of the data. The data used in this research was collected from different sources. Most of the information was gathered from World Bank World Development Indicators Database, OECD database, and supplemented with IMF World Economic Outlook data. World Bank and IMF now jointly operate one database that contains most of the macroeconomic information, however IMF World Economic Outlook is treated as an independent source.

Moreover, several series, such as credit rating, interest rate spread and exchange rate were obtained using Datastream database, while the variables measuring the corruption level and total spending on public pensions

were taken from Transparency International Corruption Index and Bank for International Settlements database respectively. These two measures take into account the values as estimated in 2010, however since these variables will help assess the difference between the countries, such an approach is justifiable. All the variables were obtained for the time period between 1989 and 2010. The average time to maturity was obtained from OECD Central Government Debt Statistical Yearbook, which was kept active until the end of 2010. This data was available for countries between 1990 and 2010 and this time period will be analyzed. The data was gathered annually, since most of the variables are slow-moving and policy action is taken based on the year-to-year information. Estonia, Korea, New Zealand and Switzerland, although belong to the OECD group, were excluded from the sample due to too many missing values.

The result is the unbalanced panel data ranging from 1989 until 2010.

The Appendix describes the source and the measure of the respective variable.

There are 449 observations for the average maturity of the domestic debt and 398 for foreign debt (there are 163 observations belonging to 7 countries that hold no foreign debt). In order to have a balanced panel data each variables would have 660 observations. All observations reflect the values at the end of each year.

Macroeconomic factors

At the core of this research are the universal determinants which in theory governments always take into consideration when choosing the maturity of the new debt. These are: already-existing government debt level, government expenditures and inflation. These variables are obtained directly from the sources. Since, the changes in the maturity usually take time, and government budgets are established yearly, the information about the debt, expenditures and inflation in the previous year should have an impact on the change in the average maturity. Therefore, these variables are taken as lag. Moreover, the dummy variable that takes the value of 1 when the debt level is above 100% is created. This will help to account for nonlinearity of the relation between debt and the maturity. The short-term spread, to proxy for risk-premium, was created as the difference between the short-term domestic interest rates and the interest rates assumed to be risk-free (i.e. US or German ones) with the same maturity (3-months). The variable long-short will represent the difference between domestic long- and short-term interest rates, in order to see whether flattening yield curve affects the choice of the maturity. Finally, the interest rate shock is simply the percentage change in the interest rates on a year-to-year basis.

Variables for country-specific factors

To account for country-specific factors, several variables are created. One is the dummy variable, taking value 1 if the country has a common law system, and 0 otherwise. The level of corruption is the value taken from the ranking in 2010. Since, corruption is a proxy for the difference between the countries' enforceability and the credibility of their law (and not to analyze how the change in corruption from year to year affects the average maturity), the ranking score in 2010 is assumed to be constant.

What is more, Fan et. al. (2012) analyzed private debt market, where defaults occur much more often. In the case of the countries, defaults are occurring less often. Therefore, the country-specific factors measure not only investor protection here, but also the legal credibility of country.

Moreover, to investigate whether indeed middle-income countries hold more long-term debt than the low- and high-income ones, 4 dummy variables are created, each assigning value 1 if the country belongs to one out of four income groups. Cestau (2010) used squared income per capita as the variable in his time-invariant regression, however, to avoid the multicollinearity problem in the panel data, different approach has been taken. Moreover, the dummy variables distinguish whether the income determines the maturity in each income-group , or for instance only for the poorest and risky developing states, while being irrelevant if the country is the rich.

Variables for preference of the capital suppliers

Pension funds' presence in the country was measured as the autonomous pension funds' assets as a percentage of nominal GDP. To proxy for the size of the banking sector, the amount of deposits from all banks was divided by the GDP. The age of the society was taken directly as a % of people aged 65+ compared to the whole population. The change in income was calculated as a percentage change on a year-to-year basis. Similarly to corruption, to proxy for the reliance on the DB pension system between countries, the amount of government DB spending as a percentage of GDP in 2010 was assumed to be constant. This is in fact acceptable assumption, since the changes in the pensions do not occur too often. To control for the crowding-out effect from the private debt, the new variable was created as a percentage of the private debt compared to total marketable debt in a country.

Variables measuring economic stability and original sin:

Economic stability measures are used in determining both average maturity of domestic and foreign debt. To account for the country's rating, the numerical score reflecting Moody's credit rating will be used. In order to analyze the exchange rate shock (exchange rate between domestic currency and US dollar) the new variable will be created that measures the percentage change on a year-to-year basis. Moreover, the amount of the debt issued in foreign currency as a percentage of GDP is calculated by dividing the amount of the debt in foreign currency (in millions of dollars) by the value of the nominal GDP estimated in millions of dollars (present exchange rate). The short-term interest spread was calculated as the difference between the interest rate on the 3-month bond in the country and the interest rate on similar bond in Germany (if the country is in Europe), or in the United States (if otherwise). The long-term spread was calculated analogically, but using interest rate on 10-year bonds. Corruption is taken from the same Corruption index. Finally, to account for the size of the economy, three dummy variables are created to represent to which GDP level group a given country belongs.

Descriptive Statistics

From the summary of the data below, it can be seen that the average maturity of the domestic debt has a mean of 5.42, with a minimum of 0.62 and maximum of 19.79 years. For the foreign debt the mean is 5.12, with a range between 0.08 and 15,42 years.

What is interesting, the inflation level and exchange rate shock experience very high maxima, though the means are in a normal level (7.4% and 1.45%). This is due to the existence of the post-soviet countries in the sample, especially Poland and Slovenia, which experienced very high levels of hyperinflation at the beginning of the 90's. The exchange rate differences were also driven mainly by this factor, which can be seen in the high maximum of 365.97 as a percentage change in the exchange rate against dollar. High debt level maximum is

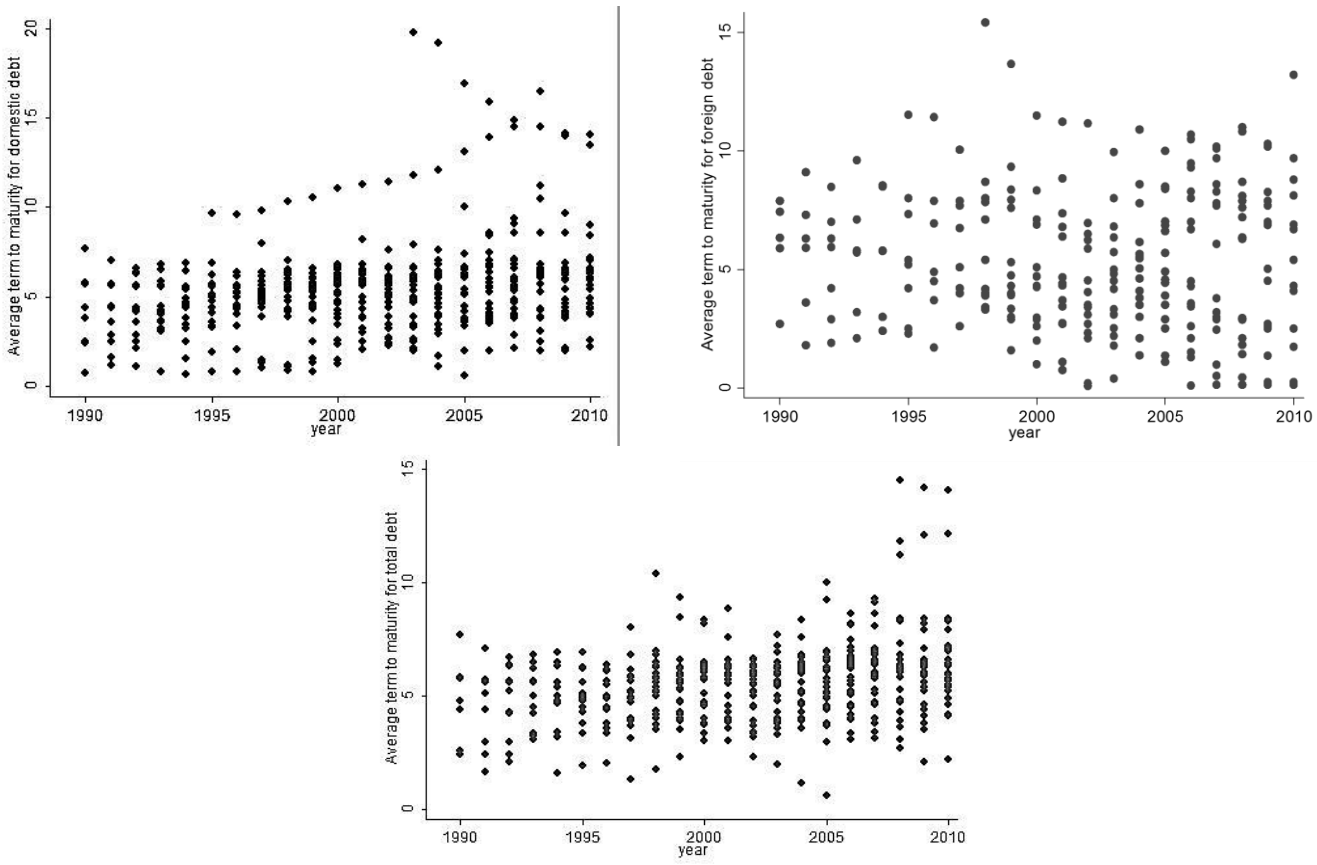
mostly due to the debt levels rising after 2007 and the sovereign debt crisis in the European Union. Moreover, the amount of deposits in some countries is very small (minimum: 16.15%), while in some it is even 269.05% of domestic GDP. This minimum is because of the poor monetary situation in Mexico at the end of the 1980s, while maximum occurs in Japan in 2000. The rest of the variables presented do not display any special irregularity, though there is a vast heterogeneity between the countries in different periods in time. Although belonging to the exclusive OECD group that contains most developed and stables states, this sample captures also the fact that some countries experienced severe crisis between 1990 and 2010, as well as takes into account the differences in the size and the economic stability between the states. For instance, Mexico had a crisis in 1994-1995, Turkey in 2001, while most of the post-soviet satellite states were fighting with hyperinflation after 1990. The mean difference between long-term and short-term interest rates is bigger than the difference between the means of these two interest rates. However, only for 485 observations there was data on both short-term and long-term rates, and different number of observations caused this difference.

TABLE 1 – Descriptive Statistics

Variable	*No. obs.*	*Mean*	*St. dev.*	*Min*	*Max*
Average maturity of the domestic debt	454	5.42	2.63	0.62	19.79
Average maturity of the external debt	253	5.28	2.97	0.08	15.42
Average maturity of the total debt	437	5.54	1.78	0.62	14.5
Debt level (% of GDP)	602	49.67	31.14	0.8	183.5
government expenditure (% of GDP)	580	43.61	9.10	17.99	68.31
Short-term rates (in %)	551	6.55	5.53	0.09	45.46
Long-term rates (in %)	509	6.01	2.41	1.00	14.68
Long-short	485	0.79	1.74	-9.70	8.28
Inflation level (in %)	644	7.4	27.4	-1.71	585.8
Age (% of total pop.)	660	13.61	3.46	4.18	22.94
National income 4 quantiles	547	2.50	1.12	1	4
defined-benefit pension spending (% of GDP)	660	7.92	3.54	1.70	14.90
Pension funds' assets (% of GDP)	315	0.33	0.41	0	2.30
Deposits (% of GDP)	403	16.15	45.93	0.20	269.05
Private sector debt (% of total marketable debt)	394	183.67	63.66	49.45	500.47

Common law	660	0.2	0.4	0	1
Short-term spread (%)	551	2.42	4.61	-4.83	35.96
Long-term spread (%)	509	0.94	1.69	-4.28	7.08
the exchange rate shock (year-to-year % change)	486	1.45	20.43	-1	365.97
Interest rate change (Year-to-year % change)	534	0.18	1.67	-0.90	17.54
Foreign currency debt level (% of total debt)	551	0.04	0.07	0	0.37
Average rating on the country	599	17.17	3.59	6	20
GDP (in $)	652	939041	1975630	5296.8	15000000

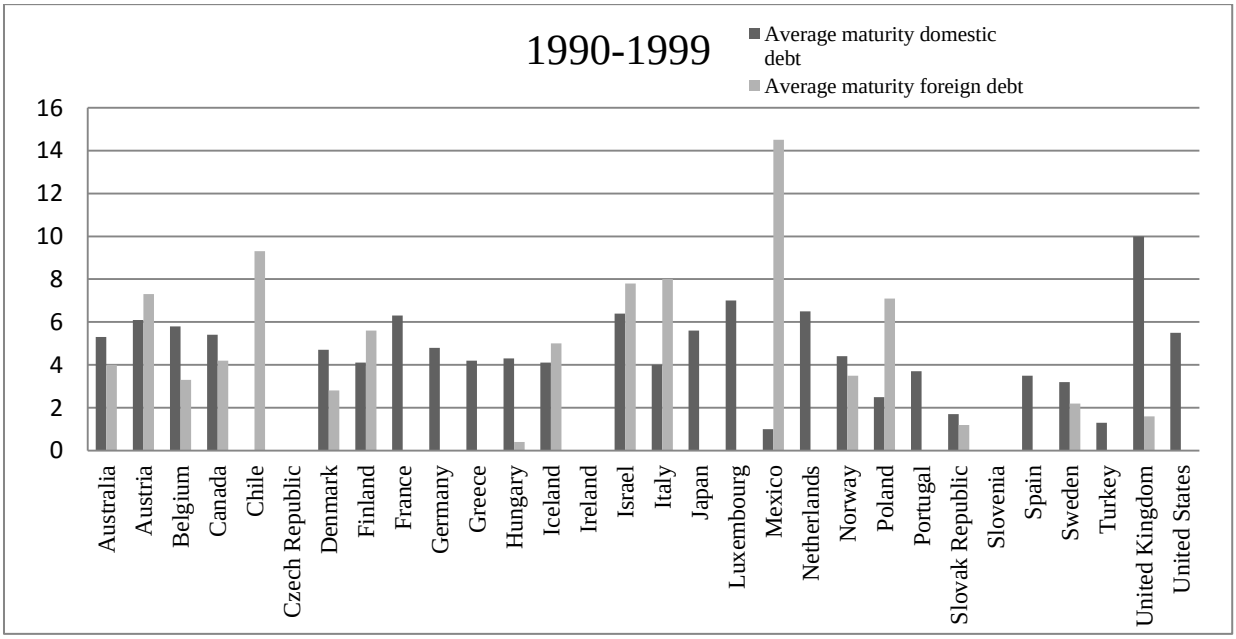
5. Average maturity for domestic and external debt development



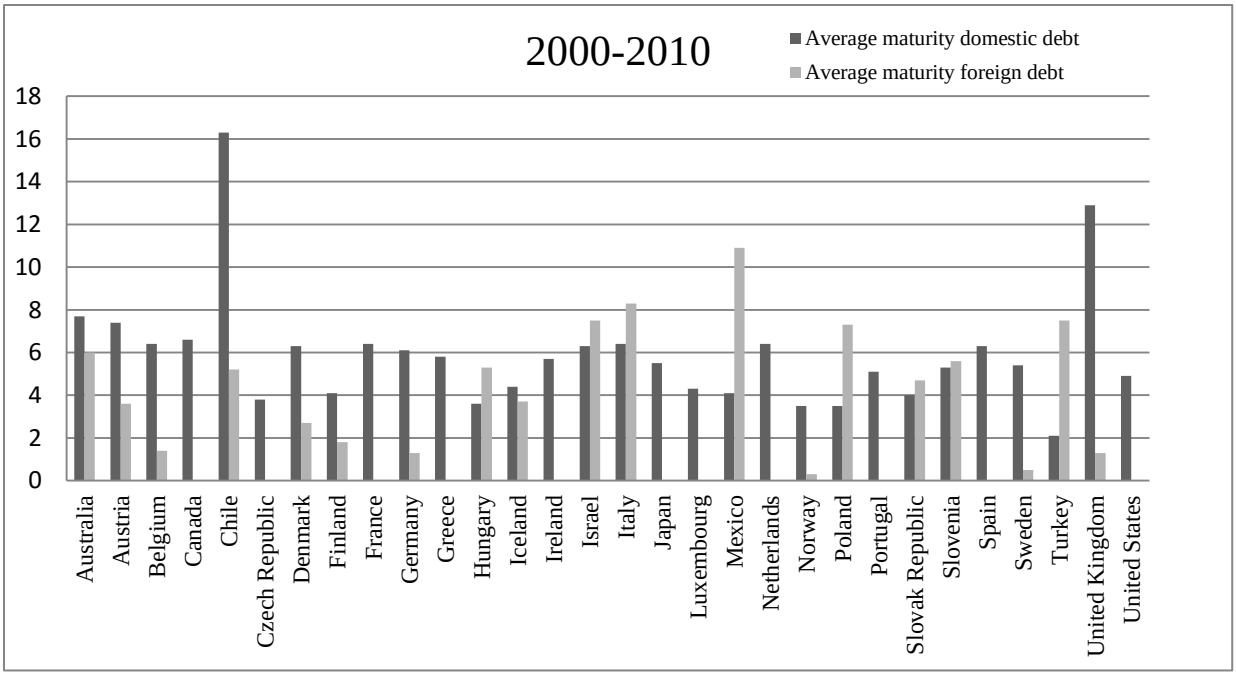
The scatterplots representing the average maturities are shown in the graphs above. The average maturity for the total debt shows a constant pattern with values mostly within a range between 1 and 8 years. This is not the case with the average maturity for the external debt. The values are scattered more among the countries, as well as throughout the years. However, the maxima in each year vary significantly, being above 12 years in the late 90s. There are no observations before 1995 where the average maturity of the external debt is greater than 10 year.

Moreover, the graph showing the average maturity of the domestic debt reveals that the maximum values keep increasing from 1995 onwards. This is due to two countries, Chile and United Kingdom which kept increasing their average maturity. With this exception, the distribution of the maturities of domestic debt is similar to the one for total debt, which suggests that countries rely mostly on the domestic currency, and the external debt does not alter the total maturity structure to a great extent.

The graphs below show the comparison of the average maturities between countries in two periods 1990-1999 and 2000-2010.



Mexico is most visible in this sample, having average maturity for foreign debt above 10 years and very short maturity for domestic one. The short domestic maturity may be explained by the fragility of the Mexican economy at this time. These conditions forced government to issue in the early 1990s famous dollar-linked domestic bonds (so called *tesobonos*) to gain credibility of their bonds that is granted by the stability of the US dollar (Hausmann & Panizza, 2003). Most countries in this sample were borrowing medium-term on average, with values oscilating around 5 years. United Kingdom had very high average maturity for domestic debt compared to other peers in the sample of OECD countries, which was around 10 years.



After 2000 this lengthened to around 12 years. Moreover, it is worth mentioning that some former sattelite states (Poland, Hungary), and newly created countries after the collapse of the USSR (Czech Republic, Slovenia(no observations before 1999 for these two), and Slovakia) had one of the shortest average maturities, however still comparable to, for example, Sweden. After 1999, the average maturity for these countries visibly increased. The comparison between these two decades shows that some countries could borrow more long-term and domestically. However, these are mean values that treat equally each year, therefore the sharp rises after 2007 may not be reflected on the graph proportionally to the magnitude of this event.

Table 2, presented below, shows the mean values of the average maturities of debt (domestic, foreign and total), as well as government debt level as a % of GDP and inflation for two periods: 1990-1999 and 2000-2010.

Domestic debt level and its structure changed at the turn of the century. With the exception of Greece and Japan, the average debt levels decreased. It is however again important to note that the mean value is calculated on the equally-weighted basis, therefore spikes in the debt levels due to the recent financial crisis and sovereign crisis after 2007 may not be reflected in these values. Nevertheless, these values help explore the long-lasting changes without putting too much emphasis on the crises that occurred. With an exception of Hungary, Luxembourg, Israel, Japan, Netherlands and USA, the 21st Century can be described as the period of the increase in the maturities for domestic debt. Countries with highest debt levels (Belgium, Greece, Israel and Italy) had average maturities for domestic debt in the 90's between 4.0 and 6.4. This is quite long, compared for instance to Slovak Republic, which had debt level of only 21.2% of GDP, while their average maturity was below two years (1.7). Belgium and Italy decreased their debt levels slightly in the first 10 years of the 21st century, however their average maturities lengthened. Surprisingly, Japan's average maturity for domestic debt decreased only by 0.1 years, while their debt level spiked to 152.0% of GDP.

It is also interesting to point that some Scandinavian countries; Norway, Denmark and Sweden, had average maturities for external debt way below the maturity for domestic debt between 1990 and 1999. After 2000,

Iceland and Finland, so most of the Northern Europe joined the group of countries with such maturity characteristics. However, these countries had very low levels of external debt and the shorter maturity could have reflected the fact that countries were reducing the external debt, or being less concerned about exchange rate shocks, simply borrowed short-term.

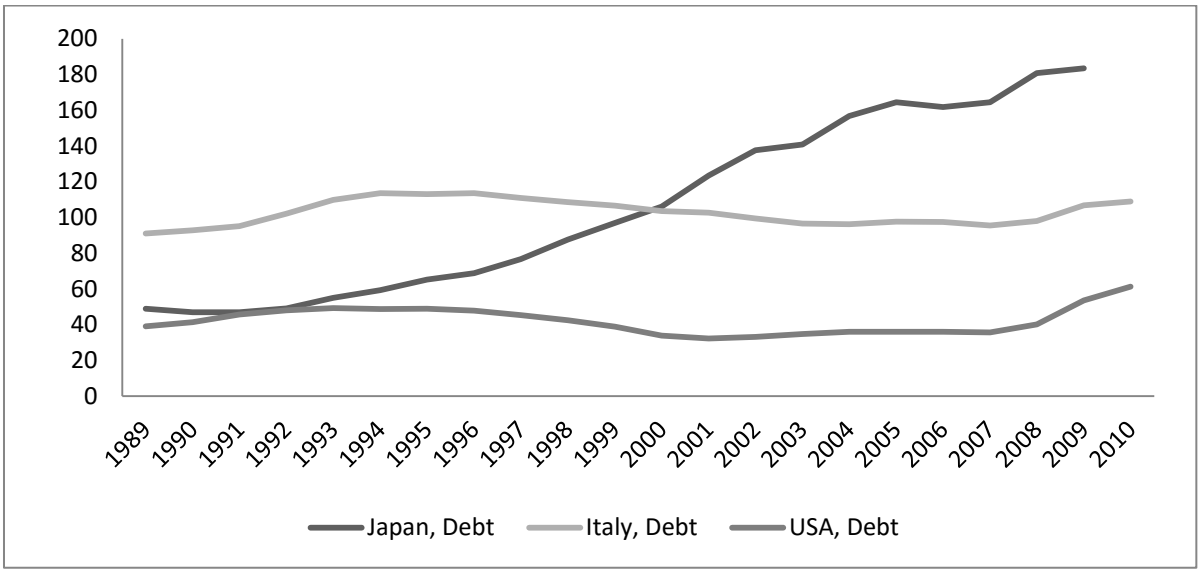
The average maturity for foreign debt in our sample was between 0 and 9.3 (Chile) in the 90's, with the exception of Mexico that was borrowing long-term with average maturity of 14.5 years. The new century was associated with average maturities for foreign debt to decrease. On the other hand, less developed countries such as Hungary, Poland, Slovak Republic and more developed Italy could now borrow externally more long-term. This could be due to the economic turmoil after 2001 and 2007 that made such countries more attractive for investors seeking higher risk-premia. Please note that in 2000-2010 period inflation levels are lower than in the 90s, which implies lower interest rates as well.

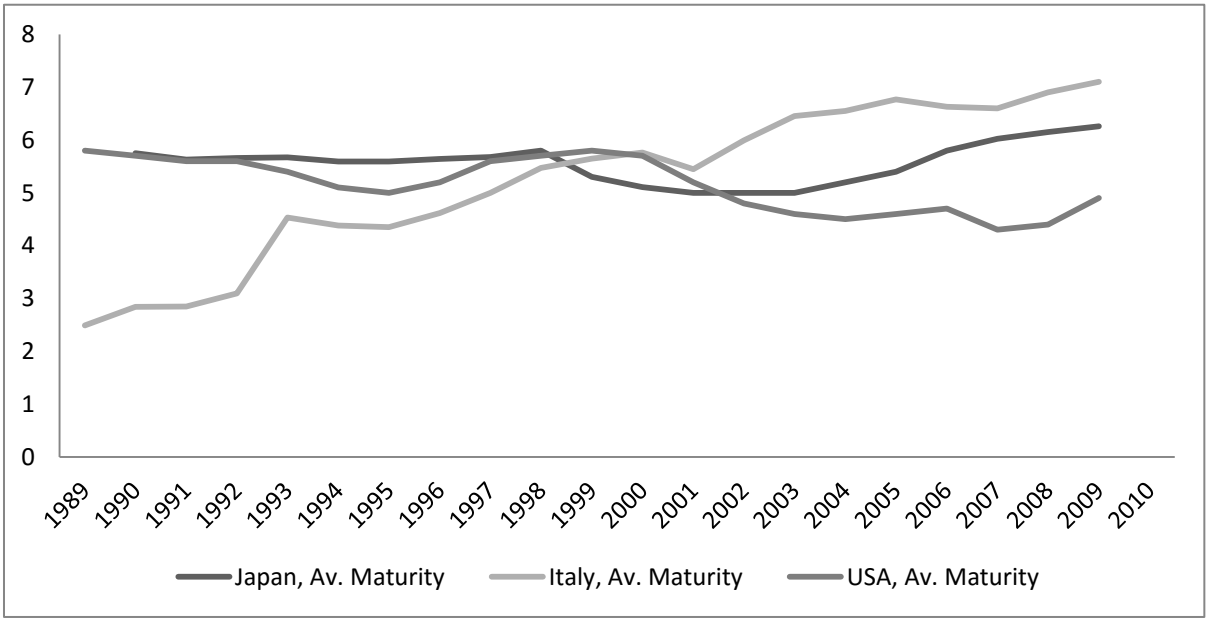
TABLE 2 – AVERAGE MATURITY COMPARISON

	1990-1999					2000-2010				
	Average maturity domestic debt	Average maturity foreign debt	Average maturity total debt	Government debt	inflation	Average maturity domestic debt	Average maturity foreign debt	Average maturity total debt	Government debt	inflation
Australia	5,3	4,0	5,1	13,2	3,0	7,7	6,0	7,7	7,8	3,1
Austria	6,1	7,3	6,4	53,1	2,1	7,4	3,6	7,1	61,4	1,9
Belgium	5,8	3,3	5,7	110,2	2,1	6,4	1,4	6,3	93,7	2,1
Canada	5,4	4,2	5,3	51,9	2,5	6,6	-	6,4	33,7	2,1
Chile	0	9,3	9,3	13,3	12,2	16,3	5,2	9,3	9,2	3,3
Czech Republic	-	-	-	11,0	7,5	3,8	-	5,6	23,1	2,7
Denmark	4,7	2,8	-	68,4	2,4	6,3	2,7	6,5	42,2	2,1
Finland	4,1	5,6	4,8	48,0	2,5	4,1	1,8	4,1	39,3	1,8
France	6,3	0,0	6,3	40,8	2,1	6,4	0,0	6,4	53,6	1,9
Germany	4,8	0,0	4,8	22,6	2,4	6,1	1,3	6,1	40,0	1,6
Greece	4,2	-	-	93,7	11,3	5,8	-	7,3	114,3	3,3
Hungary	4,3	0,4	4,4	72,3	21,7	3,6	5,3	4,1	60,5	6,0
Iceland	4,1	5,0	4,6	41,9	5,2	4,4	3,7	4,1	40,9	6,2
Ireland	-	-	5,1	72,1	2,5	5,7	0,0	5,4	31,4	2,5
Israel	6,4	7,8	6,7	99,9	12,1	6,3	7,5	6,6	85,4	2,1
Italy	4,0	8,0	4,1	105,3	4,3	6,4	8,3	6,4	100,3	2,3
Japan	5,6	0,0	5,6	63,8	1,3	5,5	0,0	5,5	152,0	-0,3
Luxembourg	7,0	0,0	7,0	2,6	2,3	4,3	0,0	4,3	4,1	2,8
Mexico	1,0	14,5	9,4	30,8	20,4	4,1	10,9	6,4	22,6	5,1

Netherlands	6,5	0,0	6,5	56,8	2,0	6,4	0,0	6,4	44,1	2,2
Norway	4,4	3,5	4,3	26,6	2,6	3,5	0,3	3,5	18,5	2,1
Poland	2,5	7,1	-	54,7	100,0	3,5	7,3	5,2	43,2	3,4
Portugal	3,7	-	3,7	55,1	6,4	5,1	-	5,1	65,3	2,5
Slovak Republic	1,7	1,2	2,0	21,2	8,7	4,0	4,7	4,4	32,5	4,8
Slovenia	-	-	-	-	14,1	5,3	5,6	5,5	27,7	4,6
Spain	3,5	0,0	3,5	46,8	4,5	6,3	0,0	6,3	41,0	2,9
Sweden	3,2	2,2	3,2	62,4	3,2	5,4	0,5	4,6	43,5	1,9
Turkey	1,3	-	-	20,7	75,9	2,1	7,5	3,5	51,4	21,8
United Kingdom	10,0	1,6	-	46,9	3,5	12,9	1,3	14,2	50,0	2,0
United States	5,5	0,0	5,5	45,1	3,2	4,9	0,0	4,9	39,4	2,5

The closer look at high-debt countries could show in more detail, how the average maturity is related to the debt level. Let us see the development of the maturity structure of the total debt for two countries that have debt levels around or above 100% after 2000: Japan and Italy, as well as USA, a country whose interest rates are used as an equivalent to risk-free ones.





Italy's debt in domestic currency is from 1999 in Euros (when this currency was adopted) which is subject to ECB policies and Italian government has lesser abilities to manipulate it through for example inflation. This increases the credibility of the Italian debt may explain highest average maturity after 2000 for Italy despite large debt. Moreover, what is striking is that the average maturity of the domestic debt in Japan did not increase linearly with the increase in the debt level. The debt levels of Japan were increasing steadily and having extreme value of around 180% of GDP in 2010. At the same time the average maturity was steady until 1998, then slightly dropped to pick up in 1999. Only recently the maturity lengthened above pre-1998 levels. This is contradictory to the literature presented, however, although Japan has debt levels above 150%, the Bank of Japan holds most of the Japan's government bond and this allows to keep the demand for longer-term bonds (Ito, 2014). From the graph. it can be seen also that the moderate rise in the debt level in the United States after the 2007 crisis is indeed associated with the decline in the average maturity. The relations between debt and average maturity show, whether at high levels of debt investors regard these countries as more risky debtors. Consistent with Missale (2012), countries with higher debt levels would be more susceptible to the rollover crisis or even default. Under such assumptions this relation should be negative. However, these three countries do not describe this pattern.

These observations show that the maturity structure of the government debt is not stable and differs between countries and changes in time. The empirical studies will help answer what drives these changes. The following parts will be devoted to the empirical analysis of the determinants of the average maturities.

5. Methodology

This part will present the methodology chosen. The research will test different determinants in the series of panel data studies.

First, different panel data regressions will be analyzed and the significance of the coefficients of separate variables will be assessed. Several control variables, mentioned in the literature, are introduced as well.

Since, this research aims at establishing what drives the change in the average maturity, as well as its nominal value, there are two dependent variables. The first will represent the difference between average maturity in one year and in the year before. Since, for example 10-year bonds issued in one year will have an impact on the average maturity for 10-years (with a drop in the average maturity in 11th year), using the difference as the dependent variable will take away the problem of the autocorrelation. The fact that the change each should reduce by a year *ceteris paribus* is captured by the constant. The following regression will be used:

$$difavmatdom_t = \alpha + \beta_1 * debt_{t-1} + \beta_2 * (dumdebt_{t-1} * debt_{t-1}) + \beta_3 * govexp_{t-1} + \beta_4 * inflation_{t-1} + \beta_5 * shortspread_{t-1} + \beta_6 * longshort_t + \beta_7 * intratechange_t + \varepsilon$$

Where $debt$ is the public debt level as a percentage of GDP, $govexp$ is the level of the government expenditures as a percentage of GDP, $inflation$ is the inflation level, $shortspread$ is the spread on the short-term bonds, $longshort$ represents the difference between long-term and short-term rates and $intratechange$ represents the interest rate shock.

The second, similar regression will be performed that uses the nominal value of the average maturity and if necessary corrects for the first-order autocorrelation. This regression will look as follows:

$$avmatdom_t = \alpha + \beta_1 * debt_{t-1} + \beta_2 * govexp_{t-1} + \beta_3 * inflation_{t-1} + \beta_4 * shortspread_{t-1} + \beta_5 * longshort_t + \varepsilon$$

Next, the determinants reflecting the socio-legal country-specific environment, as well as the preference from the capital suppliers will be introduced. These are as follows:

$$difavmatdom_t = \alpha + \beta_1 * debt_{t-1} + \beta_2 * (dumdebt_{t-1} * debt_{t-1}) + \beta_3 * govexp_{t-1} + \beta_4 * inflation_{t-1} + \beta_5 * shortspread_{t-1} + \beta_6 * longshort_t + \beta_7 * intrateschange_t + \beta_8 * age_{t-1} + \beta_9 * deposits_t + \beta_{10} * pensionfunds_t + \beta_{11} * privatedebt_t + \varepsilon$$

and

$$avmatdom_t = \alpha + \beta_1 * debt_{t-1} + \beta_2 * govexp_{t-1} + \beta_3 * inflation_{t-1} + \beta_4 * shortspread_{t-1} + \beta_5 * longshort_t + \beta_6 * age_{t-1} + \beta_7 * corruption + \beta_8 * DBspend + \beta_9 * deposits_t + \beta_{10} * pensionfunds_t + \beta_{11} * privatedebt_t + \beta_{12} * law + \beta_{13} * duminc1_t + \beta_{14} * duminc2_t + \beta_{15} * duminc3_t + \beta_{16} * duminc4_t + \varepsilon$$

where age is the percentage of the 65+ population in the country, $corruption$ is the corruption index value, $DBspend$ is the percentage of DB spending in the country, $deposits$ is the amount of private deposits in all banks as a % of GDP, $pensionfunds$ is the amount of autonomous pension funds' assets, $privatedebt$ is the

amount of private marketable debt as a % of GDP, law is the dummy taking value of 1 if the country has a common law system, $duminc1, duminc2, duminc3,\ duminc4$ are the dummies representing 4 quantiles of the income.

Finally, the determinants of the average maturity of the foreign debt will be established. To account for the economic volatility, its credibility and the possibility of the country to borrow in foreign currency, the following determinants will be tested, for two different dependent variables:

$$difavmatfor_t = \alpha + \beta_1 * xratechange_{t-1} + \beta_2 * shortspread_{t-1} + \beta_3 * fordebt_{t-1} + \beta_4 * rating_{t-1} + \varepsilon$$

and

$$avmatfor_t = \alpha + \beta_1 * shortspread_{t-1} + \beta_2 * fordebt_{t-1} + \beta_4 * rating_{t-1} + \beta_5 * GDP1_t + \beta_6 * GDP2_t + \beta_7 * GDP3_t + \beta_8 * corruption + \varepsilon$$

,where $shortspread$ is the spread on the short-term bonds, $xratechange$ is the percentage change in the exchange rate, $fordebt$ is the percentage of the foreign currency debt, $rating$ is the rating grade in the country, $GDP1,\ GDP2,\ GDP3$ are the dummies for each range of GDP, and $corruption$ is the corruption index value in the country.

Further, the short-term spread will be substituted for long-term spread to see which one of these two is a better predictor of the average maturity

In order to test different hypotheses, several independent variables will be picked for each regression. In this manner, a three step approach will be established to find if the optimal maturity structure theory is valid, second whether there is a pressure on the demand side that affects the proportion of short-term and long-term bonds issued and finally, whether factors mentioned above have impact on the average maturity of the external debt.

There may be also a problem of autocorrelation when the nominal values of average maturity are used. This could create bias in standard errors, which makes the results less efficient. Fan et. al (2012) used a panel data analysis with random effects. They accounted for the firm- and country-specific correlation, and used heteroskedastic-consistent standard errors. The method chosen by these authors is called "Generalized method of moments". This study will use ordinary least-squares regression with random effects, however it will include the fact that countries are correlated with each other (such as for ex. Changes in the US affect macroeconomic situation in other countries). To account for all that these regressions will be robust to cross-sectional dependence and possible autocorrelation (if detected) using Driscoll-Kraay Standard Errors. Moreover, Driscoll-Kraay nonparametric covariance matrix estimators correct for heteroskedasticity (Hoechle, 2007).

What is more, the autocorrelation will be tested using Wooldridge test (Drukker, 2003). This test can be applied under general conditions, and is well-suited for finding autocorrelation in fixed- and random-effect panel data models. If the autocorrelation is detected, the first lag of the dependent variable will be added in calculation of the coefficients of the independent variables. The statistical software STATA enables to account for this when calculating Driscoll-Kraay Standard Errors.

Finally, the choice of between random-effect and fixed-effect model may be different in each regression. To test the hypotheses, the assumption that the differences between countries affect the dependent variable needs to be taken. Countries differ between each other, either because there are some omitted variables, or their legal, social, economic structure is not fully reflected in the independent variables chosen. Moreover, in this analysis the time-invariant variables are introduced to compare countries' characteristics. These imply random-effects model, which will be used throughout the empirical analysis.

6. Results

This part will be devoted to the results of the empirical studies performed separately on the maturity of domestic and external debt.

Average Maturity of the domestic debt

Table 3 shows the Pearson correlation matrix. From correlation matrix presented it is possible to see that average maturity of domestic debt is strongly correlated (above 0.30 or below -0.30) only with government expenditure and the amount of deposits. Government expenditure has a correlation coefficient of -0.33. Surprisingly, debt and inflation has negligible correlation with average maturity, their coefficients are 0.08 and 0.03 respectively. At the same time the correlation between inflation, government expenditure and debt level is strong. The correlation between government expenditures and debt level is 0.34. Inflation is negatively correlated with both debt and expenditures, having coefficient of correlation -0.26 and -0.32 respectively. This could be due to the fact that as the inflation rises, the GDP rises as well, and there is less need to borrow funds.

It is also visible that with the increase of the age of the society the debt level and government expenditures increase as well. This suggests that age may put a pressure on increasing the funds to finance the ageing population, their pension, as well as smaller workforce makes the government to collect less taxes. What is interesting, the pension funds' assets are negatively correlated with age and DB spending (-0.35 and -0.52) respectively. Thus, when the amount of 65+ citizens increases the pension funds' assets decrease to finance the payment of the pensions. Countries where government spends bigger amounts of their funds in the DB pension system is associated with smaller pension funds' assets too (correlation of -0.52).

There are also high correlations between common law, age, DB spending and pension funds, or corruption and inflation. However, both common law and corruption variables are time invariant and the correlation should not pose multicollinearity concerns.

Table 4 presents the coefficients obtained from the panel data regressions. The first two regressions aim at testing the first hypothesis, where the demand from the capital suppliers, as well as country-specific variables are not yet included. First, the dependent variable is the change in the average maturity of domestic debt. The results show that indeed only high levels of debt have an impact on the change in the average maturity, however this effect is positive. The coefficient of the interaction variables has a value of 0.002. Moreover, inflation has also a positive coefficient (0.034). This provides the support for the theory that governments insure their debt when inflation rises. Moreover, the rise in the interest rates is also associated with the increase in the rise in the

average maturity (even though the long-term debt becomes more expensive). These three variables have coefficients significant at 5% level. Surprisingly, the difference in the long- and short-term rates has no significant coefficient.

The second regression takes as dependent variable the nominal value of the average maturity. The Wooldridge test shows no autocorrelation. Lagged debt has a positive impact on longer average maturity, where an increase in 1% makes the average maturity lengthen next year by 0.144 month (0.012*12). However, the government expenditures decrease the average maturity, where government expenditures lower by 1% are associated with average maturity lower by 1.032 month (0.086*12). Also, now inflation has a negative coefficient of -0.146. This supports the view that countries with high inflation usually are not able to issue longer-term bonds. In the first regression, the rise in the short-term spread does not affect the change in the average maturity. However, in the second regression, short-term spread has a coefficient significant at 1% level, where an increase in the spread by 1% is associated with the decrease in average maturity by 2.364 months. Thus, countries that are perceived as riskier are unable to issue longer-term bonds, comparable to those issued by the least risky countries. Moreover, the bigger difference between long-term and short-term interest should make governments borrow more short-term, as this is cheaper. This is supported by the results from the second regression, where the long-short variable has a coefficient of -0.106.

The results of the third regression reveal that (similarly to the first regression) at high levels of debt the change in the debt is associated with a positive change in the average maturity. However, at normal levels (debt below 100%) this relation is negative. Thus, as the debt level increases the average maturity decreases, and this effect is smaller when the debt level reaches 100%. These variables have coefficients significant at 1% level. Moreover, the inclusion new variables shows that age, pension funds' assets and level of private debt have all coefficients significant at 1% level. The results support the view that when the society ages, and there are more elderly people, there is an proportionate decrease in the average maturity, as their preferences are towards investing more short-term. The increase in the private debt seems to stimulate the credit market, and governments are able to issue slightly longer-term bonds (increase by 0.002 years). The biggest negative effect on the change in the average maturity of domestic debt have the size of the pension funds' (coefficient of -0.198). Interestingly, the interest rate shock has a positive impact on the change in the average maturity (same as inflation). However, the spread has a negative coefficient. Both have coefficients significant at 1% level. This suggests that higher domestic interest rates cause investors to be willing to lend long-term, which is desired by the governments wanting to insure their debt against rollover risk. However, if this rise in the interest rates is seen in connection to the increased risk of borrowing in that country (thus relatively to the risk-free rate), then the maturities do not rise that fast. This shows an important phenomenon, where investors seem to take into account whether the rise in the interest rates is seen as a good sign of growth, or as a compensation for higher riskiness.

The fourth regression shows the same signs of the coefficients for inflation, short-term spread and interest rate change. The first affects positively the average maturity, countries with inflation higher by 1% tend to have the average maturity higher next year by 3.3 months (0.275*12). The short-term spread has a negative coefficient of -0.219. Thus, higher short-term spread may make investors more anxious about borrowing long-term. This variable shows the difference in the interest rates between domestic country and USA or Germany, regarded as risk-free borrowers.

Not surprisingly, the corruption level has a positive coefficient, which suggests that countries with smaller levels of corruption usually borrow more long-term. On the other hand, the fact that a certain country adopts the common law system is associated with maturities shorter by 1.881 years. Whereas, the low levels of corruption can give government some credibility when it comes to repayment of the debt, however the common law system seems to have the opposite effect. This may be due to the bias arising from a small group of countries adopting common law system (only 6 countries).

Moreover, the amount of deposits (proxy for the strong presence of banks) enables governments to issue longer-term bonds (coefficient of 0.014). Moreover, the fourth regression introduces the dummies representing the income level of the country. It is visible that richer countries issue longer-term bonds. The countries belonging to the highest income group issue bonds with average maturity 1.022 years longer (3.372-2.350). These are all significant at 1% level.

The last two regressions exclude the pension funds' assets variable. The results confirm that the inflation level has a positive effect on the change in the average maturity throughout the years. Moreover, the age of the society, deposits, common law system, short term spread and the income all affect the nominal value of the average maturity. Countries with older generation (65+) tend to have maturities shorter by 0.333 year. This regression uses the dummy representing the lowest income quantile and the results shows that countries belonging to this group have maturities shorter than the rest by -2.394 years.

The R-squared of these regressions shows also that models with dependent variables as nominal value of the maturity of the debt have more explanatory power, although it is important to note that these models include more independent variables. Since, R-squared increases with the number of independent variables introduced, making conclusions based on this measure needs to be taken with caution.

No. of obs. = 142

TABLE 3 - PEARSON CORRELATION 1

	Av. domestic maturity	*Debt*	*Gov. expenditure*	*Inflation*	*age*	*corruption*	*DBspend*	*pension funds*	*deposits*	*Private debt*	*law*	*income*	*intratechange*	*longshort*	*income*
Av. domestic maturity	1,00														
Debt	0,08	1,00													
Gov. expenditure	-0,33	0,34	1,00												
Inflation	0,03	-0,26	-0,32	1,00											
age	-0,14	0,36	0,50	-0,29	1,00										
corruption	0,06	-0,25	0,14	-0,33	0,03	1,00									
DBspend	-0,08	0,26	0,31	-0,03	0,69	-0,45	1,00								
pension funds	0,11	-0,14	-0,24	-0,12	-0,35	0,49	-0,52	1,00							
deposits	0,54	0,14	-0,48	-0,05	-0,11	0,04	-0,08	-0,03	1,00						
Private debt	0,06	-0,10	-0,02	-0,18	0,17	0,64	-0,42	0,43	0,05	1,00					
law	0,06	0,01	-0,40	0,03	-0,59	0,05	-0,53	0,33	-0,11	-0,05	1,00				
shortspread	-0,19	-0,05	0,18	0,35	-0,30	-0,27	-0,08	-0,22	-0,22	-0,39	0,05	1,00			
intratechange	0,27	-0,10	-0,17	0,06	0,06	0,10	0,00	0,10	0,16	0,20	-0,02	-0,15	1,00		
longshort	0,16	0,19	0,09	-0,31	-0,06	0,13	-0,14	0,13	0,08	0,07	0,13	-0,22	-0,41	1,00	
income	-0,05	0,02	-0,41	-0,03	-0,10	-0,03	-0,02	0,30	0,03	0,02	0,52	-0,20	0,10	0,01	1,00

TABLE 4 – REGRESSIONS AV. MAT. DOMESTIC DEBT

dependent	*difavmatdom*	*Avmatdom*	*difavmatdom*	*Avmatdom*	*difavmatdom*	*Avmatdom*
lags	-	*0*	-	*1*	-	*0*
	RE with Driscoll-Kraay SE	*RE with Driscoll-Kraay SE*	*RE with Driscoll-Kraay SE*	*RE with Driscoll-Kraay SE*	*RE with Driscoll-Kraay SE*	*RE with Driscoll-Kraay SE*
$Intercept$	-0.116	9.669***	-0.291	9.012***	-0.379	10.389***
$debt_{t-1}$	-0.004*	0.012**	-0.013***	-0.015	-0.009*	-0.018
$dumdebt * debt_{t-1}$	0.002**	-	0.007***	-	0.005*	-
$govexp_{t-1}$	0.006	-0.086***	0.016*	-0.018	0.012	0.015
$inflation_{t-1}$	0.034**	-0.146**	0.067***	0.275***	0.062***	0.222**
age_{t-1}	-	-	-0.024***	-0.472***	-0.004	-0.333***
$corruption$	-	-	-	0.236**	-	-0.041
$DBspend$	-	-	-	0.063***	-	0.033
$deposits_t$	-	-	-0.000	0.014***	-0.000	0.022***
$pensionfunds_t$	-	-	-0.198***	0.029	-	-
$privatedebt_t$	-	-	0.002***	-0.003	0.001***	-0.002
law	-	-	-	-1.881***	-	-0.751***
$shortspread_{t-1}$	-0.010	-0.197***	-0.046***	-0.219***	-0.028	-0.382***
$long - short_t$	0.006	-0.106**	0.014	0.112*	0.002	-0.125
$intratechange_t$	0.159**	-	0.359***	-	0.266**	-
Duminc1	-	-	-	-	-	-2.394***
Duminc2	-	-	-	1.996***	-	-
Duminc3	-	-	-	2.350***	-	0.677***
Duminc4	-	-	-	3.372***	-	0.915***
No. of countries	29	29	22	22	22	22
$No. of\ obs.$	368	383	171	140	226	195
R^2	0.023	0.142	0.086	0.436	0.054	0.406
Wooldridge test	-	1.553	-	18.542***	-	0.058

This table presents the results of the random-effects regression model with two different dependent variables: the change in the average maturity of domestic debt and the value of the average maturity of domestic debt. The number of lags indicates, whether the regression is corrected for autocorrelation. Wooldridge test, with H0: there is no autocorrelation of order 1, is presented at the bottom.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

Average maturity for external debt

The Pearson correlation matrix shows that most of the variables are strongly correlated with the average maturity for external debt. Long-term spread has a correlation coefficient of 0.34, while short-term spread only 0.16. Moreover, the correlation between the dependent variable and rating is negative (-0.42). Rating is also negatively correlated with interest rate spreads (short-term -0.5, and long-term -0.61). This confirms that more developed countries, with higher rating grades, have lower interest-rate spreads. Interestingly, the foreign currency debt has a positive correlation with the dummy for lowest GDP quantile, while negative for the highest. This also suggests that indeed less developed and poorer countries need to rely on the foreign currency debt more.

The results of the regressions show that the rise in the exchange rate is associated with the increase in the average maturity for external debt. 1% rise in the exchange rate is associated with maturities longer by 0.246 months (12*2.05/100). This effect is significant at 1% level in all regressions.

Moreover, the short-term spread has a negative coefficient, showing that the rise in the short-term spread by 1% causes the average maturity to decrease by 1.416 months (0.118/12). This confirms that as the risk-premium rises, the investors are more reluctant to borrow long-term. Thus, the change in the exchange rate which can be associated with the greater volatility of the exchange rate, or simply the depreciation of the currency makes the governments to choose more long-term debt as an insurance against worsening economic conditions.

What is interesting, higher rating in the previous year is associated with the shorter maturities next year. This is surprising, since higher rating is a sign of credibility of a given country. However, since governments prefer to borrow domestically than externally, the good rating grade can induce governments to get rid of external debt and to decrease its maturity.

From the second regression it is possible to see which factors can explain the average maturity of external debt. Countries characterized by higher short-term spread actually have maturities longer by 1.188 months on average (0.099*12). Furthermore, the average maturity is higher when also the country's foreign currency debt level is bigger. Rating has also the negative effect on the nominal value of average maturity, same as the effect on the change in the average maturity but slightly bigger (coefficient of -0.224 versus -0.115).

What is also worth mentioning is that the size of the economy (measured as the GDP) is related to the average maturity of the external debt. The countries that are belonging to the smallest-size group have maturities longer by 0.121 years compared to the middle-size group (11.366-11.245). The biggest countries have maturities longer by even 2.379 years (13.624-11.245) compared to middle-size group and longer by 2.258 (13.624-11.366) compared to the smallest-size group .This confirms that bigger countries are more credible from the external creditor perspective and they borrow more long-term than small economies. Smaller economies have also less credible currencies, and borrowing externally in domestic currency is regarded as more risky in case of countries belonging to the middle-size group. However, the findings from Cestau (2010) find a support in this analysis, as it can be seen that it is the middle-income countries that borrow most short-term.

The coefficient of corruption in two regressions is significant at 1% level and takes the negative value, suggesting that countries that are less corrupt tend to have shorter maturities of external debt, quite the opposite

compared to the relation with the average maturity of the domestic debt. It may be that countries that are less corrupt can borrow domestically without the need to turn to external markets.

In results of the last two regressions it is visible that the long-term spread has significant coefficient only when the difference in the average maturity is taken as a dependent variable. The coefficient has the same sign as the coefficient of the short-term spread, however it is slightly more negative now (-0.210). Nevertheless, the coefficient in the last regression, though negative, is insignificant at all significant levels (1%, 5% and 10%).

What is important to bear in mind, the analysis of the average maturity of external debt included only up to 201 observations. The reason is that some governments do not hold external debt, while for some there was less information. Such a small sample may bias the results, although this analysis included up to 25 countries, therefore it still gives robust results. Moreover, the sample consists Scandinavian countries that hold very little amounts of short-term debt, however the foreign-currency debt variable, significant at 1% captures this effect.

Similarly to the previous case of domestic debt, R-squared is much higher in the second and fourth regression. However, the number of variables used in findings determinants of the change in average maturity and just nominal value of the average maturity does not differ too much, which suggests that these models have strong explanatory power.

No. of obs. = 151	**TABLE 5 – PERASON CORRELATION 2**									
	Av. foreign maturity	*xrate change*	*shortspread*	*longspread*	*Fordebt*	*rating*	*GDP1*	*GDP2*	*GDP 3*	*corruption*
Av. Foreign maturity	1,00									
xratechange	-0,01	1,00								
shortspread	0,16	0,16	1,00							
longspread	0,34	0,21	0,85	1,00						
Fordebt	-0,13	0,20	-0,02	0,05	1,00					
rating	-0,42	-0,07	-0,50	-0,61	0,14	1,00				
GDP1	-0,17	0,09	0,11	-0,05	0,38	-0,03	1,00			
GDP2	-0,34	-0,11	-0,33	-0,25	-0,09	0,18	-0,62	1,00		
GDP3	0,59	0,03	0,27	0,35	-0,32	-0,18	-0,40	-0,47	1,00	
corruption	-0,65	0,07	-0,36	-0,47	0,36	0,77	0,14	0,26	-0,45	1,00

TABLE 6 – REGRESSIONS AV. MAT. EXTERNAL DEBT

dependent	*difavmatfor*	*Avmatfor*	*difavmatfor*	*Avmatfor*
lags	-	*0*	-	*0*
	RE with Driscoll-Kraay SE	*RE with Driscoll-Kraay SE*	*RE with Driscoll-Kraay SE*	*RE with Driscoll-Kraay SE*
$Intercept$	2.033***	-	2.607***	-
xratechange	2.805**	-	2.473***	-
$shortspread_{t-1}$	-0.118***	0.099**	-	-
$longspread_{t-1}$	-	-	-0.210**	-0.017
$fordebt_{t-1}$	0.104	6.394***	0.867	7.754***
$rating_{t-1}$	-0.115***	-0.224***	-0.146***	-0.160*
GDP1	-	11.366***	-	11.359***
GDP2	-	11.245***	-	10.961***
GDP3	-	13.624***	-	13.328***
corruption	-	-0.508***	-	-0.632***
No. of countries	25	19	15	19
$No. of\ obs.$	130	201	114	180
R^2	0.052	0.585	0.040	0.542
Wooldridge test	-	0.005	-	0.097

This table presents the results of the random-effects regression model with two different dependent variables: the change in the average maturity of external debt and the value of the average maturity of external debt. The number of lags indicates, whether the regression is corrected for autocorrelation. Wooldridge test, with H0: there is no autocorrelation of order 1, is presented at the bottom.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

7. Robustness Check

In order to check the robustness of the findings presented above, the logit regressions were ran to find whether certain variables increase the probability of the dependent variable. Two logistic regressions were created for each type of debt: one with the dependent dummy variable taking value of 1 when the increase in the average maturity was bigger than 1, and the dependent dummy variable that was taking value of 1 if the average maturity was below 5 years (slightly below the mean value of 5.42 and 5.28 for the domestic and foreign debt respectively). The increase in the average maturity is driven by different time-variant factors, while the value of the average maturity being lower than 5 is driven by the differences in the country-specific factors.

The first model was a Conditional Logit model, which uses within-individual differences, therefore treating each country homogeneously. This approach is better suited for checking the probability of the increase in the average maturity, since the between-country effects should not affect the change in time but rather the difference in the maturity between these countries. The second model was standard logit model for binary response, which allows for the between-countries differences to be the independent variables in the regression.

The results of the first two regressions show that actually the rise in debt increases the probability of the increase in the average maturity of the domestic debt, however not much (odds ratio of 1.058, which means: chance of having the rise in the maturity if the debt rises divided by the chance of having the rise in the maturity if the debt does not rise = 1.058, thus the probability of the rise in the average of the maturity increases with the rise in the debt level). Similarly, the increase in inflation greatly increases the probability that there will be actual increase in the average maturity by more than 1 year (odds ratio 1.546). Similarly, the rise in the short-term spread and the rise in the interest rates is associated with the greater probability that the average maturity will in fact increase.

The second regression shows that the size of the deposits decreases the probability that the country will have the average maturity below 5 years. Similarly, bigger private debt market makes it slightly less probable that the country will be forced to borrow short-term. Moreover, the common law system in fact decreases greatly (odds ratio 0.053) the probability that the country will borrow mostly short-term.

It is however very probably that the country that belongs to the lowest GDP quantile group will actually have average maturity below 5 years.

When analyzing the average maturity of the foreign debt, surprisingly the exchange rate change and long-term spread had no significant coefficient in the first logistic regression. However, the higher levels of foreign currency debt greatly reduce the probability (almost to 0%) that there will be an increase in the average maturity. Moreover, the higher rating also decreases the chance that the average maturity will rise by more than 1 year.

At the same time, higher rating makes it much more probable that the average maturity of the foreign debt will be below 5 years. Similarly, the corruption level has the same impact on the probability of the below-mean average maturity.

What is interesting, the low-GDP groups have big chance of having the average maturity below 5, however still smaller than the middle-size group. This is surprising, given that the small economies usually have harder times borrowing abroad at longer maturities.

TABLE 7 – LOGISTIC REGRESSIONS AV. MAT. DOMESTIC DEBT		
dependent	*Increaseavmatdom*	*dumavmatdom*
	>1 year	*<5*
	Odds ratio	*Odds ratio*
$Intercept$	0.000***	39.106
$debt_{t-1}$	1.058***	-
$dumdebt * debt_{t-1}$	0.984	-
$govexp_{t-1}$	1.055	-
$inflation_{t-1}$	1.546***	-
$corruption$	-	1.179
$DBspend$	-	0.780*
$deposits_t$	-	0.975***
$pensionfunds_t$	-	1.373
$privatedebt_t$	-	0.979***
law	-	0.053***
$shortspread_{t-1}$	1.325**	-
$long - short$	1.202	-
$intrateshock$	3.437***	-
Duminc1	-	5.595***
Duminc2	-	2.853
Duminc3	-	0.808
Duminc4	-	-
No. of countries	29	-
$No. of\ obs.$	436	157
Log-Likelihood	-143.890	-71.286

This table presents the results of the logistic fixed-effects regression, and standard logistic regression with binary outcome with two different dependent variables: one that takes the value of 1 if there is an increase in the average maturity above 1 year, and the second that takes value of 1 if the average maturity is below 5 years. The coefficients already represent the odds ratio.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

TABLE 8 – LOGISTIC REGRESSIONS AV. MAT. EXTERNAL DEBT		
dependent	*increaseavmatfor*	*dumavmatfor*
	>1 year	*<5*
	Odds ratio	*Odds ratio*
$Intercept$	7.332	0.001***
xratechange	4.306	-
$longspread_{t-1}$	0.953	-
$fordebt_{t-1}$	0.000**	-
rating	0.841**	1.199**
GDP1	-	2.356***
GDP2	-	3.231***
GDP3	-	-
corruption	-	1.513***
No. of countries	15	-
$No. of\ obs.$	113	223
Log-Likelihood	-45.742	-109.257

This table presents the results of the logistic fixed-effects regression, and standard logistic regression with binary outcome with two different dependent variables: one that takes the value of 1 if there is an increase in the average maturity above 1 year, and the second that takes value of 1 if the average maturity is below 5 years. The coefficients already represent the odds ratio.
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

8. Discussion of the Results

The results of the empirical research provide some new information regarding the determinants of the average maturity of both domestic and external debt. Whereas there is no evidence to reject any of the hypotheses, the results are not always in line with the findings found in the already-existing literature. This section will briefly compare this paper with what other authors claim.

First of all, the empirical studies show that countries follow the objective of minimizing the cost of servicing debt. The rises in the inflation, as well as interest rates are associated with the increase in the average maturity. This is true in this analysis, confirming that countries follow the first objective of debt management described by Goudswaard (1990). The results suggest also that governments choose to borrow long-term to insure against the interest rate shocks, or have an incentive to inflate away their long-term debt. It goes in line with Missale (2012) who argued that governments postpone servicing their debt during uncertain times. However, the flattening of the yield curve does not seem to have an impact on the government choice of the maturity of the newly issued debt. The coefficient was significant 5% level only in the second regression, while in the other was not significant at any desired level, or only at 10%.

The findings of Missale and Blanchard (1991) are somewhat confirmed in this paper. High debt levels have a considerable effect on the maturity of the government debt, however in this paper the rise in the debt is associated with extending the maturities. Moreover, in the second regression the coefficient of inflation was negative, which contradicted the findings of Missale and Blanchard (1991). Still, other regressions confirm the positive relation between inflation and average maturity of the domestic debt proposed by these authors, as well as by Abbas et. Al. (2014). Moreover, the proposition of Calvo and Guidotti (1992) stating that the optimal maturity structure is negatively related to government expenditure, thus the rises in the government expenditure should decrease the average maturity, was not observed in this analysis. This may be due to the fact that governments are stricken to a great extent by more factors and cannot simply decrease the maturity when the government expenditures rise.

This paper also confirms the finding of Guibaud et. al. (2013) and Campbell and Viceira (1999), where the ageing society puts a pressure on the debt market, as the decrease in the amount of the younger cohorts shifts the demand on the government bonds to more long-term papers.

This paper introduced the preference of the capital suppliers to the determination of the maturity of government bonds. Most important potential determinants were the size of banking sector, size of the pension funds and the national dependence on the DB pension system. Moreover, the private debt size was investigated as a proxy for the development of the debt market in the given country. This research found a considerable support for the impact of the capital suppliers on the choice of the maturity of the debt by governments. Still, DB spending was significant only when analyzed alongside with pension funds. The latter variable was also significant only in one regression, where the change in the size of the pension funds' assets decrease the average maturity, however do not affect significantly the nominal value of the average maturity. Moreover, the deposits had a positive effect, contrary to the proposition by Fan, Twite and Titman (2012) who claimed that banks demand more short-term bonds and cause governments to act in their favour. However, as Guscina and Jeanne (2009) claim, strong

banking sector makes borrowing domestically easier and this could explain the positive coefficient in the regressions.

On the other hand, as determined by Fan, Twite and Titman (2012) from their observations of private debt market, the effect of corruption on the maturity of government debt was confirmed, however only in one regression and at 5% level. Surprisingly though, the common law system, which is claimed to favor the creditors, was actually associated with shorter maturities (between 1.881 and 0.751 years, ceteris paribus). However, the robustness check showed that common law system greatly reduces the probability that the average maturity will be below 5 years, and this is significant at 1% level.

Interestingly, the model of Arellano & Ramanarayanan (2010), as well as the empirical findings of Larrain et. al. (1997) were not fully confirmed in this study. The interest rate spread was negatively related to the average maturity, while the interest rate change was positively related. This suggests that governments may try to insure their debt and borrow more long-term when they experience shocks or rises in the interest rates, however the rise in the interest rates that would be higher relatively to the risk-free rate has the opposite effect. Perhaps the governments have limited power here, as the risk-averse demand side tries to avoid borrowing long-term.

Finally, the analysis of the average maturity of the government debt confirmed partly the empirical studies of Cestau (2010). Income is related to the average maturity, however Cestau (2010) claimed that high-income countries would borrow short-term, and longer maturity is preferred in the middle-income countries. This study found that the richer the country, the longer are the maturities of the government debt, where the poorest countries have average maturities significantly smaller than average, while the richer countries have values higher than average.

However, the size of the economy had the relation consistent with Cestau (2010) in case of the average maturity of the foreign debt. Moreover, regarding the analysis of the average maturity of foreign debt, the results show that developing countries, with more unstable economies (measured through interest-rate spread) turn more to borrowing short-term. This goes in line with Guscina and Jeanne (2006). The long-term spread was though not statistically significant, which suggests that short-term interest rate changes relative to the risk-free rates, which are more sensitive to the current economic conditions, are a better predictor than the long-term interest changes. The latter do not change that much, which can be seen when looking at the standard deviation of the long-term spread used in this paper.

Surprisingly, the rating was negatively related to the average maturity of external debt. As noted before, rating should convey all the information regarding the risk of investing in a given country. This would imply (after Larrain et. al. 1997) that more credible countries with ratings closer to AAA should be able to borrow more long-term. This empirical study suggests the opposite. What is more, the robustness check showed that the drop in the rise in the rating decreases the probability that the maturity will rise. Still, the rise in the rating may be associated with better country's economic condition and their ability to turn more to domestic market and service external debt quicker.

The problem of original sin was incorporated in this study. The findings show that higher foreign currency debt is associated with the higher average maturity. This could be explained by the fact that countries unable to

borrow long-term domestically will try to borrow in foreign currency and retain the privilege of borrowing long-term. Moreover, the size of the economy determines also the possibilities of the country to borrow externally at short-, medium-, or long times to repayment. The countries that were in the highest GDP group could borrow significantly more long-term than the countries belonging to the lowest and middle GDP group. The results of the regression analysis showed that it is the middle-size countries that borrow most short term. On the other hand, robustness check showed though that it is more probable to have average maturity of below 5 years when the country is in the middle group, rather than the lowest one. Still the size dummies had coefficients significant at 1% level, which supports the findings of Husmann & Panizza (2003).

Moreover, the corruption has a significant effect on the ability to borrow externally at different maturities. Countries that were further away in the Corruption Index, hence having higher corruption, were borrowing at longer maturities. This extension from the Fan, Twite and Titman (2012) is a new factor not analyzed before in the topic of maturity of external debt. It seems that countries that have bigger corruption are borrowing more long term. This may be due to the fact that domestic investors do not trust governments enough, and the latter have to turn to external markets to borrow at the desired maturity.

Overall, this study confirmed most of the previous findings. The strength of this research is that all factors were analyzed jointly which gave a detailed picture of what affect the average maturity to what degree.

9. Conclusion

This research aimed at investigating different determinants of the maturity of both domestic and external debt. The sample taken were 30 OECD countries analyzed throughout the 20 years' time span, from 1990 till 2010. The results confirm the previous findings in this topic, however only to the limited extent. Macroeconomic factors, as well as the socio-legal setting and the preference of the capital suppliers do indeed have an impact on the maturity of the government debt, however to a different degree, and not all factors had the effect similar to the theoretical predictions. Moreover, this research found that differences between the countries significantly affect to what extent countries can and do borrow long-term or short-term.

Still, this research has its limitations. For instance, it does not provide the universal answers, since the sample were only the most developed OECD countries. Extending this to the poor and developing countries would help find universal determinants. However, this would be at cost of omitting other significant variables that did not need to be included when analyzing only OECD group. The countries belonging to this prestigious set are to a great extent homogeneous and mostly European. To ensure that all socio-legal factors are present when other countries are included as well, one would have to assess for instance the quality of institutions in the poorer post-colonial countries or account for the government instability in for example Somalia. The analysis of the OECD countries has also an advantage that it shows how subtle changes (due to the homogeneity of the countries) in the studied factors affect the average maturity.

What is more, the data gathered for the maturity of the government debt did not distinguish between inflation-linked and nominal bonds. These two are different regarding the risks they bear, and the sensitivity to the

demand from the investors. If these differences are captured, the more precise determination of the drivers of maturity would be possible. This requires creating new models for analyzing the average maturity in a given time period, based on the information about issuance of new bonds by countries. Such a database can be collected from Datastream, however only from a certain time period, and the information on the average maturity and the size of the debt before is needed to create the moving-average model. However, this can be a promising extension of this research. Also, the emerging economies use often different types of bonds, compared to the developed ones (Guscina and Jeanne, 2006).

The further research should focus also on investigating in more detail the relation between the maturity of the public debt and the pension systems in the countries. The findings in this paper show that this is an important topic. Moreover, extending the research to account for the more complex socio-legal issues may yield better results. Countries differ also among each other regarding for instance the strength of the credit market, the trust in the government actions, or the demographic structure of the society. These social and economic factors may also influence the choices of the governments regarding the time of the repayment of their debt.

What is more, the recent crisis provides good insight how certain shocks change the debt management actions. Robustness checks showed that certain determinants may not be worthy after 2000. The sovereign crisis in Europe is one of its kind and the maturities of certain countries changed dramatically. The focus on the risk perceived by the investors in these times should be included. Moreover, the European Union system should be analyzed in detail, since the interrelation between these countries, as well as European Monetary Union affect the debt management choices of all European countries which is more than 50% of OECD countries. Finally, the external credit environment could also be studied in more detail to reflect how investors choose whether to lend long or short to certain governments.

Nevertheless, this research shows mainly that the between-country differences are important and should not be omitted in the theory. The observations presented by Fan et. al (2013) for the private debt market can be extended to the government bonds and used to determine why certain countries have longer, while some shorter average maturities of their public debt. Regarding the question asked: “Which factors determine the maturity structure of the government debt?” the answer is: the combination of the macroeconomic as well as the country-specific legal and social environment.

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11. Appendix

List of the sources from which the data was gathered:

Variable	***Measure***	***Source***
Average maturity of the domestic public debt	Weighted average	OECD Central Government Debt Statistical Yearbook
Average maturity of the external public debt	Weighted average	OECD Central Government Debt Statistical Yearbook
Average maturity of the total public debt	Weighted average	OECD Central Government Debt Statistical Yearbook
Debt level	Total central government debt level as a percentage of the GDP.	IMF World Development Outlook
government expenditure	Central government, as a percentage of GDP.	World Bank WDI
Inflation level	Annual change in the consumer prices.	IMF World Development Outlook
GDP	Measured in US $	OECD database
exchange rate	exchange rate between domestic currency and US $ on a year-to-year basis.	Datastream
Level of debt issued in foreign currency	Central government debt level in a foreign currency.	OECD database
Average rating on the country	Moody's rating. Numerical, 20=AAA.	Datastream
Short-term interest rate	interest on 3-month bonds in the country.	OECD database
Long-term interest rate	interest on 10-year bonds in the country.	OECD database
age of the society	As a percentage of people aged 65+ to total population.	IMF World Development Outlook
national income	national income denominated in US $.	World Bank WDI
Amount of deposits	Amount of private deposits in banks.	OECD database
defined-benefit pension spending	Spending as a percentage of GDP in 2010.	BIS
Pension funds' size	Assets of autonomous pension funds.	OECD database
corruption	Corruption index value as of 2010	Transparency International Corruption Index 2010
Law system	Dummy taking value 1, if the country has a common law system.	Treisman (200)
Private sector debt	Private debt as a % of total marketable debt.	OECD database