Memoire de Stage

Government bond yield, fiscal policy and tax compliance.

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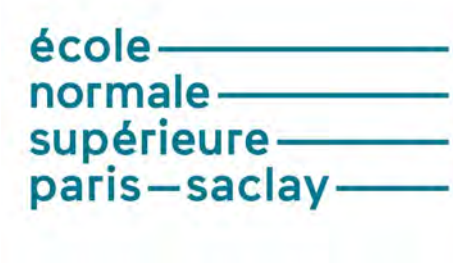
The views expressed are those of the authors and do not necessarily reflect the position of the Banque de France or the Eurosystem.



Abstract

This paper investigates the determinants of the government bond yield spreads. It focuses on the elements related to fiscal policy. It also takes into account the tax compliance through an interaction term between the primary balance accounting for the fiscal policy and the elasticity of tax compliance to tax rate. As expected, we find that the effect of fiscal consolidation is weakenned when the country has a low tax compliance. This effect is robust to a change in fiscal policy proxy. The specification of the model enables us to distangle the effect of the fiscal consolidation and that of the tax compliance. Finally we compute partial elasticity of government bond yield spread to fiscal consolidation.

Remerciements

Je remercie Francesco Pappadà et son co-auteur Yanos Zylberberg, en tant qu'encadrants, ils ont su me guider dans mon travail et m'aider à trouver des solutions pour avancer.

Je remercie également l'ensemble des membres du SEMSI pour leur accueil chaleureux et la bonne ambiance de travail.

Contents

Introduction

For the last decade, countries reached the highest levels of indebtness and some countries faced very high interest rate which turned their debt into an unsustainable one. The sovereign debt crisis has revealed the dire straits of some economies, like that of Greece. This crisis comes from a confidence crisis and an increase of the default risk of these countries. Countries were weankenned by the previous crisis (the subprime crisis) and they had to counter its effects.

First they tried to run counter cyclycal policy so as to limit the subprime crisis effects. But their budget position strongly deteriorated: deficit and debt reached unbearble levels triggering the sovereign debt crisis. Thus governments quickly changed their policy. They run tight fiscal policies so as to restore the soundness of public finance and the financial market confidence. In the long run tight fiscal policies should reduce the sovereign interest rate and the amount of sovereign debt, thus relieves the economy.

A fiscal policy has two main constraints: the *external constraint* and the *internal constraint*. The *internal constraint* concerns the capacity of a country to generate fiscal surpluses. It means the ability of raising taxes but also of reducing spendings. Reducing spendings might be more efficient as a high level of tax spurs agents to evade or to avoid taxes. Then an increase today of taxes implies a smaller capacity of running surpluses in the future. Given this internal constraint the price of debt is determined. A high interest rate deters governments to run unsustainable fiscal policy as debt will be very costly. This is the *external constraint*: the government is limited by the cost of debt that is defined on the financial market with respect to the country's feautures and fiscal plan horizons.

How does the internal constraint affect the external constraint of a country? What is the link between tax compliance and the spread that countries are facing? The question of the definition of the sovereign debt price or its yield has often been explored. Most of the economists agree that a part of the debt price is made of financial elements like the liquidity of the bond or the inverstors' risk aversion. They also acknowledge that observing fiscal policy is relevant to explain the government bond yield. Nevertheless concerning the way fiscal policy impacts the sovereign debt price, economists are not unanimous. Some authors underline that the fiscal policy composition determines its success, while others underline its timing... But until today none of them have focused on the internal constraint. This is what this work is about: we want to explore whether the tax compliance of a country's population matters in defining the government bond yield.

Hence, we define tax compliance as the degree to which taxpayers comply with the tax rule of his country. We use the elasticity of tax compliance to the tax rate as a proxy of tax compliance. We specify an empirical model that enables us to take into account simultaneously fiscal policy and tax compliance. We find that a high elasticity of tax compliance to tax rate tends to reduce the effect of a primary balance improvement on the 10-year government bond yield.

First we review the main works on the topic. Section 2 presents descriptive statistics of the data used. Section 3 justifies the specification of the econometrical model. Before concluding,

section 4 summarizes and discusses the empirical results.

1 Literature review

Government bond spreads are compound of several elements. Here we review the different works that have explained the fluctuation of government bond yields.

Codogno et al. (2003) work on yield differentials concerning the Euro area and focus on their determinants. First, they review the evolution of yield spreads in Europe: thanks to the EMU, government bonds converged steadily. The four main components of the yield spreads are: first the expected rate movements and the exchange rate risk; second the difference of capital controls between countries. The third is the liquidity of the government bonds which is defined as the "ability of a bond to be traded fast at a low transaction cost and with a minimum change of price". And the fourth is the default risk which "depends on the current and future declared and hidden debt that rely on sustainability which also relies on the expected budget deficit". They focus on the liquidity and default premiums. As they study the spread of EMU countries before and after the implementation of euro, they neutralize the exchange rate risk by subtracting the interest rate swap differential in national currency to the government bond yield spread. They first realize a SURE estimation on monthly data. They find that differences in debt to GDP ratio are not always significant, while credit risk is one of the best explanations of the spread. They distinguish two groups of countries: Italy and Spain for which the yield spread is mostly explained by the default risk premium; the other group is made of Belgium, France, Finland, Ireland, Netherlands and Portugal for which the spread changes because of the international risk. The results concerning Italy and Spain are confirmed by the evolution of CDS spread. They also check their results by looking at the daily data. They found similar outcomes, and notice that the trading volumes are the most relevant variable concerning liquidity.

Bernoth and Erdogan (2012) also study the determinants of sovereign bond yield spreads but only of 10 EMU countries. They use a different method: a semi-parametric time varying coefficient model to determine which factor more influences the spread in each period. Similarly to Codogno et al. (2003), they focus on four main factors: the credit risk, liquidity risk, macroeconomics factors and the general risk aversion of investors. The credit risk is modeled through the debt to GDP ratio and the 12 month projected deficit. The market liquidity is observed thanks to the bid-ask spread of each country relative to the German benchmark. The proxy used for the general investor's risk aversion is the corporate bond yield spread: the spread between low grade corporate bonds (Meryll Lynch BBB) and government bonds of the USA. All variables except the last are used in terms of spread with German benchmark. The semi-parametric time varying coefficient model enables the authors to determine clearly whether the market change or the macroeconomic situation of a country is responsible for the government bond yield spread variation. During the whole studied period, the global risk aversion played a big and positive role. In the first period (before the financial crisis), the credit risk did not play a big role. Then during the financial crisis its impact reached 40 basis points. Liquidity never played a significant role in explaining

the government bond spread. These results are much more accurate than a simple OLS regression and explain 95% of the government bond yield spreads while an OLS regression explains only 70%. Globally the semi parametric regression shows that the increase of the spread during the crisis is mostly due to an increase in risk pricing: the degree of market uncertainty and the fiscal situation of a country matter much more than before.

Sgherri and Zoli (2009) focus more on the financial crisis period in Europe. They look at the changes of sovereign risk premium before and after the crisis. They notice that first, the sovereign risk premium does not vary a lot and is mainly driven by the global risk pricing. But after the crisis, other factors impact the risk premium: the frailty of the financial sector and the debt growth. They remind also that the liquidity plays a significant role in the pricing of government bonds. They study changes of sovereign risk premium through a multivariate autoregressive conditional heteroskedasticity framework. By conducting a regression of inflation Euribor spread, stability of the German market and the volatility of the G7 currencies over the long run government bond spreads, they notice a significant influence of political events. Their study also reveals that major changes in sovereign spreads are related to a decline of interbank rates and disinflationary risks. The risk aversion tends to increase when an economic down turn looms, the inflation rate may account for it. They end their article by concluding that the financial market is more severe with European countries than before the crisis. So fiscal and financial policies are even more relevant to keep a sovereign risk premium sustainable.

Manganelli and Wolswijk (2009) study what defines government bond spreads in the Euro area. Contrary to the previous authors, they are interested in the role of the central bank. They find that the short term interest rate defined by the European central bank has a significant positive impact. Then, they also pay attention to the market liquidity risk and credit risks. They define the liquidity risk premium as "the extra interest rate an investor requires to be compensated for bearing the risk of having to liquidate the security at a lower price with respect to the benchmark". A high liquidity risk premium calls for more integration in the bond market and more harmonization. Instead a high credit risk premium "measures the financial compensation investors demand to cover the risk that a government defaults". These definitions are similar to those of Codogno et al. (2003) but have a slightly different point of view. Their study reveals a relationship between short term interest rate and the government bond spreads. It also underlines that the rating of a government bond is related to the yield. They conclude that the role of liquidity premium is bigger than the other risks. The liquidity risk is correlated with the short term interest rate (MRO): when it is low, liquidity are abundant, so the related risk is lower. Therefore it implies a lower government bond spread. In a situation of high MRO, the liquidity risk is able to explain more than a half of the spread level.

Still focusing on the Euro zone, Afonso and Strauch (2007) look at the effectiveness of the Stability and Growth Pact in Europe. Therefore, they focus on the spread between the swap and the yield of countries. The US interest swap is used to account for the liquidity of bond markets. They also take into account the bid ask spread, the average volatility implied of the put and call on the Eurostoxx index and the slope of the US yield curve. Dummies are used to see the

consequences of fiscal policy events. They find little relevance for these dummies. This might be explained by the divergent views of individuals which cancelled out the effects on the spread. However, political elements seem to impact government spreads. For example, the rumor of a potential warning to Portugal by the SGP induced a decrease of its spread. But the effect is not persistent. It might be interesting to look at the impact of the political cycle.

By looking at the changes of government bond spreads (with a German benchmark), Haugh et al. (2009) test the impact of fiscal elements (debt service, tax receipts and fiscal deficit). Therefore they realize a two stage least squared regression with the fiscal variables, proxies for liquidity risk and investors' risk aversion. The instrumental variable is the US corporate bond spread; it enables to erase the potential endogeneity with the risk aversion term. The results highlight that an impact of the debt service and also of the expected deficit on the government bond yield. Some countries are more sensitive to some elements. For example Ireland is more sensitive to the expected future deficit. Future pension liabilities may also explain why some countries do not face the same spread while they have similar characteristics, for instance the spread of Greece and Italy differs by 30 basis points. Thus, in addition to investors' risk aversion, fiscal elements have a relevant impact on government bond spreads.

To completely study the changes of government bond yield spread it is absolutely required to take into account three elements: liquidity, credit risks and investors' risk aversion. Then, fiscal policy components seem also to have an impact according to Haugh & Al. Now we review the works that focus on fiscal policy.

Kumar and Baldacci (2010) realize a study about the relationship between long term yields and debt level. They test for non-linear effects of fiscal deterioration, the importance of economy based on bank financing, the impact of capital inflows and spillovers from sovereign bond market. They notice that some countries' characteristics might worsen the consequences of deficits on interest rate. A country with weak initial fiscal conditions, weak institutions, low domestic savings and limited access to capital market will be more vulnerable on financial markets. To observe such effects and explain the level of long term interest rate, they focus on the primary balance,the overall balance and the public debt. The results of this study are as expected: when deficit increase or fiscal balance deteriorates, the interest rate increases. Higher inflation rates or expected rates tend also to raise the interest rate. Then, the relevance of studying countries' characteristics is confirmed by the results. Countries with basic high deficit suffer indeed of higher increase of government bond yields, so do countries with high debt level. Then good institutions give more credibility to fiscal policy which improve the market's confidence and tend to lower the interest rate.

Nickel et al. (2011) are interested in the consequences of fiscal policy on Eastern European countries that have been faster developing in the last decade. As they realized their study on a short period, the level of the debt is not significant to explain the yield spread of the country. Thus they focus on the effect of the fiscal balance. They first run a regression with the OLS method. They find as expected a positive impact of the projected fiscal deficit ratio and that the European Union membership reduces the government spread bond yields. The results concerning

GDP growth and inflation are not very significant. This model does not fit for all countries; that's why they use the method of SURE. They conclude that fiscal behavior of a country might be tolerated by financial market in a country but not in another.

So fiscal policy is more or less relevant to explaining government bond yield spreads. We explore now which elements of fiscal policy change significantly the interest rate faced by a country.

As the fiscal policy is not always effective, Alesina and Perotti (1996) try to determine which key elements make a fiscal adjustment successful. First they remind that the composition of fiscal changes is significant through three effects: the *expected effect*, the *political credibility effect* and the *labor market effect*. The first effect highlights the fact that some spending cuts are more long lasting than others, for example a reduction of public investment will not last as we need to maintain public goods. The second is about the capacity of the government to tackle budget parts that will be unpopular like social security spendings. The last effect has been underlined by Lane et al. (1996): a cut in government employment improves the profitability of employment since it induces a decrease of unit labor cost. Second to compute the probability of success Alesina and Perotti (1996) use the Blanchard's method to compute discretionary fiscal impulse. It consists in erasing the consequences of unemployment change on public spendings. A successful policy is when "3 years later the primary budget in term of GDP has decreased by 2 points or the debt to GDP ratio has declined by 5% according to the level before the tight fiscal policy". They found that successful discretionary fiscal policies are compound of 70% of spending cuts on transfer and government wages. For the remaining 30%, these policies are made of business and indirect tax increases. Concerning the macroeconomic situation of a country after a period of fiscal adjustment, we observe improvements when the fiscal policy is successful. The nominal interest rate tends to decrease after a successful episode of fiscal policy and to increase when it is a failure.

Faini (2006) looks at the effect of fiscal policies on the government bond spread in the European area. He chooses as fiscal indicators both the public deficit and the level of public debt; current deficits have not the same consequences for a country with a high debt level. Then to observe the impact of these fiscal elements, he regresses the real interest rate on the expected inflation rate, the profitability of investment, the output gap, the level of deficit and of public debt. Since an increase in output gap boosts both investment and savings, the sign of this element is ambiguous and so does the sign of the expected inflation. Faini (2006) also takes into account global elements: the EMU global variables. He finds a statistically significant negative effect of primary surplus on the interest rate. And the EMU fiscal balance increases the real interest rate by 41 basis points, when it changes by one percent. Inflation raises precautionary savings and decreases interest rates. He confirms that an increase in deficit increases the concern of financial market when the debt level is already high. He concludes that there is a spillover effect of a country's behavior on the global level of EMU interest rate. But it does not necessarily induce that high indebted countries have negative consequences on the European interest rate.

Baldacci et al. (2008) do not focus on European countries but on emerging countries. They

acknowledge that the composition of the fiscal policy matters. In emerging countries, developing public investment is very efficient if it does not worsen the public deficit. Their study also reveals that a fiscal consolidation tends to better work in countries that default once. They build a theoretical framework assuming that the State has a utility function relying on the quantity of money that it can borrow, the level of output per capita and the cost of defaulting. Then, their empirical specification consists in a panel data regression. They control for solvency by introducing the level of external reserve as % of GDP. They also take into account current balance, growth rate and inflation. The global financial conditions are taken into account through the US interest rate policy. They are interested in the fiscal balance and public investments. Concerning political elements they build an index made of elements of the World Bank governance index. The results support the positive effect of fiscal surplus: an increase of 1% of fiscal surplus, the spread reduces by 30 basis points. The authors find that a country that has already experienced default has a much more sensitive interest rate to the fiscal balance: a one percent increase of fiscal deficit induces an increase of 80 basis points of the interest rate spread.

Alesina et al. (2016) realize a study on fiscal consolidation through a Narrative approach in 16 OECD countries. They divide fiscal plans in three categories: the unexpected measures that are implemented now; the announced measures that are written in the legislation [1]. A fiscal plan typically contains three parts: a shift of unexpected variables that is announced and implemented at time t [2]; a shift implemented at time t but which had been announced in previous years; a shift announced at time t and that will be implemented in the following years. They assume that a fiscal consolidation last at most 2 years. Then, they compare the share of tax hikes and spending cuts by adding the three components. If the sum of the three components related to taxes is higher than that of the elements related to spendings, they conclude that it is a tax based fiscal consolidation. After defining fiscal plan, they realize a VAR estimation. They find that a tax based fiscal policy that started during a recession is more dangerous for countries that have constrained monetary policy. The composition of the fiscal consolidation does not affect much the fiscal multiplier in a recession or an expansion. But a spending based fiscal consolidation has a much lower cost than a tax based one.

Gruber and Kamin (2012) study the impact of fiscal position through the observation of primary balance changes on the 10-year government bond spread. Therefore, they use the data from the OECD. They focus on the four most relevant reasons that explain the negative impact of government deficit. The first is the crowding out effect that occurs through a growing pressure on the financial market: the demand for funds increases, so does the interest rate. Second the interest rate may also increase so as to induce investors to accept a larger share of the public debt in their portfolio. Third, observing a growing public debt, the central bank may be ready to create inflation so as to reduce the debt level; then financial markets fear this phenomenon and increase the interest rate to balance the potential losses. The fourth reason is simply the default risk. Then, to observe whether these four phenomena are true they use a panel data regression.

[1] They occur now when it was written in the legislation or it can occur later.

[2] It also includes revisions of the plan.

They control for the influence of short term interest rate, the economic cycle through the two year projected GDP and the projected CPI inflation rate. The fiscal variable chosen is the primary balance. They find the expected result: concerning the G-7 countries, an increase of one point of the fiscal balance induces an increase of 15 basis points of the yield spread. Their model is quite robust. They also study the effect of foreign policy but do not find a relevant effect. Then, they realize a simulation by using the coefficient obtained thanks to their model and obtain pretty good results. This paper will be a basis for our work.

Then Heylen and Everaert (2000) review all common hypotheses about fiscal consolidation, and test them altogether using a multivariate regression. The first assumption is that on which Alesina and Perotti (1996) focused on: the composition of the fiscal consolidation matters. The second is that a persistent and large fiscal consolidation is more likely to succeed whatever its composition is. The situation of the country also matters for the fiscal policy: if there is an emergency concerning the level of the sovereign debt or its growth rate, the policy should reach its aims easier. In fact agents will better understand this fiscal consolidation and therefore be more comprehensive. Not only the national economy matters for the success of the fiscal policy, but also the international situation. A favorable international dynamic (economic growth and low interest rates) tends to limit the potential negative effects of fiscal consolidations. The level of the national currency also has consequences on the fiscal policy. If the government implements a strong consolidation, devaluation before this consolidation creates favorable conditions through a support to supply and demand. But this devaluation may be reverse if the consolidation is not strong enough, this may create a negative dynamic: one may expect further devaluation, then financial markets will raise the interest rate. By conducting a multivariate regression Heylen and Everaert (2000) found that there is a negative effect of cutting government wages contrary to Alesina and Perotti (1996). Except this unexpected result all other hypotheses were confirmed simultaneously.

Now, taking all these empirical and theoretical results into account, we develop our own model. We check whether we find similar results.

2 Descriptive Statistics

2.1 Data sources

Government bond yield spread:

$$Yield_t^i - Yield_t^{DEU}$$

The government bond yield spread is the difference between the 10-year government bond yield of a country i and the 10-year German government bond yield. The data that we use is the result of a merger between two data bases: that of Bloomberg and that of Datastream. For each country we took the best series (in terms of years covered by the series).

Primary balance: The primary balance used come from the dataset of G.Gauthier, it is the difference between the total government revenues and expenditures expressed in % of the GDP.

Fiscal consolidation: We use the fiscal plan dataset from the narrative study of Alesina et al. (2016). They define *fiscal plan* as "a sequence of actions, some to be implemented at the time the legislation is adopted, some to be implemented in the following periods. Plans are also a mix of measures, some affecting government expenditures, others affecting revenues". They assume that a fiscal consolidation last at most 2 years. Then, they compare the share of tax hikes and spending cuts by adding the components of a fiscal plan. We do not use the details about whether it is a tax based or spending based consolidation, we summarize it by a dummy denoting whether a fiscal plan was implemented. There are 178 fiscal plans recorded covering 16 countries from 1979 to 2014.

Debt to GDP ratio: It is also a combination of datasets, and we use the same method to combine them. The two basic datasets are: from Datastream and from the Fed of St. Louis. In our model the debt level is not necesserarly related to the credit risk[3], but it may accounts for it.

Elasticity of tax compliance to tax rate:

$$\varepsilon_{Trate}^{TC} = \frac{\Delta TC}{\Delta Trate}$$

These data are the result of the work of Gauthier (2016). He computes the elasticity of tax compliance to tax rate thanks to a regression of the tax compliance [4], the HP filtered real GDP and some controls variables.[5] He estimates the average elasticity over the period for 38 countries. We take the absolute value of this variable in order to easily comment the results.

Liquidity risk

$$Bid_t^i - Ask_t^i$$

It is the difference between the bid and the ask price of 10-year government bonds. The data are provided by Bloomberg. This measure is a proxy for the liquidity of government bonds. The *liquidity risk* concerns the "ability of a bond to be traded fast at a low transaction cost and with a minimum change of price". (Codogno et al. (2003)) A big difference between the Bid and Ask price induces a bad liquidity of the bond. If the bid price is higher than the ask price, nobody buys the bond so the government bond yield should increase as the liquidity of the bond is low. In opposite, if the bid ask is lower than the ask price, all available bonds will be bought, thus the bond is very liquid and its yield should decrease. So, we should observe a positive link between the government bond yield and the bid-ask spread.

[3]The credit risk "measures the financial compensation that investors demand to cover the risk of default"(Manganelli and Wolswijk (2009)).

[4]The tax compliance is computed thanks to the method of Pappadà and Zylberberg (2015).

[5]For more details see Gauthier (2016)).

Risk aversion:

$$BBBcorpo_t^{US} - Yield_t^{US}$$

The measure of risk aversion is similar to that of Bernoth and Erdogan (2012). They observe it through the corporate bond yield spread. This spread is the difference between the yield on US 10-year BBB corporate bonds and 10-year US treasury benchmark bonds. This is a common measure of risk aversion. The BBB corporate bond yield comes from Bloomberg (Merril Lynch). When uncertainty increases, the spread widdens: investors prefer safer government bonds rather than riskier corporate bonds. Thus, we should observe a positive link between the government bond yield and the risk aversion proxy.

Our dataset is an unballanced panel, since there are data gaps even for some of the 23 countries included in the sample. It covers a period of 26 years : from 1990-2016. The complete list of countries and descriptive statistics are displayed in appendix A.

2.2 Stylized facts

First we focus on three countries (France, Germany and Italy) to understand what the effects of fiscal consolidations are.

On figure 1 we observe that fiscal consolidations tend to be pro-cyclical: they occur when the gross debt is increasing and the primary balance deteriorates. Nevertheless, fiscal consolidations slow down the evolution of the debt, improve the primary balance and stabilize or sometimes decrease the sovereign government bond yield. If we compare the evolution of the primary balance and the government bond yield, we may observe a lag between them. When the primary balance worsens, the government bond yield increases only one or two years later [6] .

The global evolution of the primary balance, the gross debt and the government bond yield of Germany, France and Italy are quite similar. We observe an upward trend of the gross debt and a downward trend of the government bond yield. Concerning the primary balance, the global trend is not clear, but we observe that it strongly deteriorates during the subprime crisis.

But if we compare the government bond yields of Italy and France through the government bond yield spread with a German benchmark (figure 2), we notice that during this period, there is a gap between these two countries. The Italian spread was huge before the Euro and strongly worsens during the subprime crisis.

By comparing more carefullly the evolution of the gross debt of Italy, France and Germany, we observe that for all this period the Italian debt was clearly above that of France and Germany (figure 3). From 1992 until today, the gross debt of Italy is over 100% of GDP. Then by comparing the primary balance (figure 4) we notice that the shape of the Italian primary balance is very similar and sometimes better than thzt of France. We may deduce that the financial market is more strict with countries that have a high debt level, even if they try hard to improve their financial situation. Besides if we focus the number of fiscal consolidations realized between 1990

[6] It is circle in red on the figure 1.

to 2016, we note that Italy tends to have done more efforts than France (17 fiscal consolidations vs. 13, figure 6).

So it seems that the financial market is less sensitive to Italian fiscal plans. The Italian debt level is high, which makes Italian bonds riskier assets. By looking at the elasticity of tax compliance to tax rate, the Italian one is high (figure 5): its commitment to reimburse is weaker since its capacity to raise taxes is lower. These facts may explain why the governement bond yield spread has been bigger for Italy rather than for France. This is what we investigate in this work.

Observing all these facts we deduce that the effects of the primary balance's evolution on the government bond yield spread may differ because of a different level of gross debt and/or different capacity of raising taxes.

3 The model

In this section we specify our model, and explain how we introduce the tax compliance effect that may induce a change in government bond yield spread.

3.1 What affects governemnt bond yields?

From the literature, we know that several elements affect government bond yield. There are mainly three elements related to the financial market:

- The *risk aversion of investors*: it is a measure of the global atmosphere of the market. It describes whether investors are more or less willing to take risks. According to Sgherri and Zoli (2009), the investors'risk aversion is increasing when there is a looming downturn in the economy.

- The *liquidity risk* : "ability of a bond to be traded fast at a low transaction cost and with a minimum change of price" (Codogno et al. (2003)). Some authors (e.g. Manganelli and Wolswijk (2009) or Sgherri and Zoli (2009)) underline the strong explicative power of this variable while others like Bernoth and Erdogan (2012) found it negligible compared to the credit risk. The liquidity risk is related to the bond issuance policy. A low liquid bond indicates a lack of bond market integration, further harmonization of the market is required.

- The *credit default risk*: "measures the financial compensation that investors demand to cover the risk of default" (Manganelli and Wolswijk (2009)). Codogno et al. (2003) found that it is one of the best explanation of the spread. An increase in credit default risk should increase the government bond yield so as to cover the potential losses. The credit risk is related to the disciplinary feature of financial market: the credit default premium calls for an improvement of the sustainability of public finances.

The credit default risk is related to the fiscal policy. Indeed an unsustainable fiscal policy weakens the capacity of the Governement to reimburse the debt. In the opposite, a well managed

fiscal consolidation may send a positive signal to the financial market and reduce the credit risk premium of the sovereign bonds.

The simpler element to observe the fiscal policy is the primary balance which is the difference between the government revenues and the government spendings. Gruber and Kamin (2012) found that if the primary balance increases by one point, it induces a decrease of the government bond yield of 15 basis points for the G7 countries.

While observing fiscal consolidation, we should take into account the debt level. It is often reviewed as not having a direct significant impact on the government bond yield, but a high level of debt is likely to amplify the consequences of other fiscal elements like the effect of the primary balance.

The stylized facts gave us small insights of other elements that can impact the government bond yield spread through the credit risk premium : the level of tax compliance. It may be called *the internal constraint*[7]: in the sense that the capacity of a country to generate fiscal surpluses tends to decrease each time a fiscal policy increases the tax level. So our study explore whether the level of saturation of the internal constraint has an impact on the government bond yield spread.

A binding internal constraint, which is associated with a high elasticity of tax compliance has two main drawbacks. First, for a given improvement of the primary balance, a low tax compliance country should rise taxes to a higher level (or moditfy the tax base) than a high tax compliance country. Second, the capacity of reimburse of a low tax compliance country is smaller than a country with a high tax compliance: the possibility of making fiscal surpluses through an increase of taxes no more exists in such countries. Even if a high elasticity country[8] makes strong efforts to get a sustainable fiscal policy, his commitment to repay his debt is lower as its tax revenue is more volatile. Because of these two elements we should observe a bigger governement bond yield spread for high elasticity countries. Improving the primary balance is more difficult for these countries and realizing fiscal consolidation is likely to stongly reduce their future capacity to reimburse their debt. So, the financial market might increase the default risk premium of high elasticity countries.

3.2 The specification of the model

Since we want to observe by how much a country is penalized by an unsustainable fiscal policy, we use the government bond yield spread with a German benchmark ($Sprd_t^i$): German bonds are considered as safe assets and thus face smaller sovereign interest rates. By implementing such a method, we can determine by how much the risk premium of a country varies with respect to its fiscal policy.

[7]By opposition to the external constraint which is the interest rate faced by government. The interest rate faced by a country depends on its level of debt, but also of its capacity to raise fiscal surpluses since it implies that the country will be able to do what is needed to reimburse in the future.

[8]Each time that we refer to elasticity without more details, we refer to the elasticity of tax compliance to the tax rate ($\varepsilon_{Trate}^{TC,i}$).

We use the primary balance as a proxy for fiscal consolidation. An improvement of the primary balance is associated to either an increase of revenues (like taxes) or a cut in spendings. This is a positive signal for the financial market. So, we expect a negative relationship between the government bond and the primary balance.

Since a fiscal policy might be less effective if it is a tax based policy in a high elasticity country, we introduce an interaction term between the elasticity and the primary balance ($PB^i_{t,t-1} \times \varepsilon^{TC,i}_{Trate}$). The elasticity of tax compliance to tax rate enables us to know what will be the consequences of a tax hike. An absolute high level of elasticity implies that there is no potential gain of increasing taxes in order to generate a fiscal surplus. Thus, a higher level of elasticity of tax compliance to tax rate accounts for a binding internal constraint, thus a lower tax compliance.

The risk aversion of investors and the liquidity risks are summarized in the variable $Market^i_t$. The credit default risk is partly controlled through the debt level. By incorporating these elements we neutralize them. Hence we can more precisely observe the effect of the fiscal policy.

Finally, we want to estimate the elasticity of government bond yield spread to fiscal consolidation, we express all the variables in variation: in log-difference[9] for governemnt bond yield spread, and in difference[10] for all other variables.

$$\Delta Sprd^i_{t,t-1} = \alpha + \beta diffPB^i_{t,t-1} + \delta debt^i_t + \varphi diffPB^i_{t,t-1} \times \varepsilon^{TC,i}_{Trate} + \gamma diffMarket^i_{t,t-1} + u^i_t \quad (1)$$

The regression should enable us to compute the elasticity of government bond yield spread to fiscal consolidation ($\xi^{FC,i}_{Sprd}$). It quantifies by how much a fiscal consolidation can reduce the government bond yield spread. We want to estimate it by country or at least by group of countries. We expect the elasticity to have the following shape:

$$\xi^{FC,i}_{Sprd} = \frac{dSprd}{dFC} \quad (2)$$

with

$$\frac{dSprd}{dFC} = \beta + \varphi \varepsilon^{TC,i}_{Trate} \quad (3)$$

With $\beta < 0$ and $\varphi > 0$: it means that the elasticity ($\xi^{FC,i}_{Sprd}$) should be smaller for countries with high elasticity of tax compliance to tax rate ($\varepsilon^{TC,i}_{Trate}$) ; meaning that fiscal consolidation is less efficient to reduce the spread for countries that have already overused tax hikes.

4 Empirical evidences

4.1 Explaining the variation of the government bond yield spread

We run the following regression with random effects[11]:

$$\Delta Sprd^i_{t,t-1} = \alpha + \beta diffPB^i_{t,t-1} + \delta debt^i_t + \varphi diffPB^i_{t,t-1} \times \varepsilon^{TC,i}_{Trate} + \gamma diffMarket^i_{t,t-1} + a_t + e^i_t \quad (4)$$

[9] $\Delta X_{t,t-1} = log(X_t) - log(X_{t-1})$

[10] $diffX_{t,t-1} = X_t - X_{t-1}$

[11] We checked the necessity of random effects rather than a fixed effects regression thanks to a Haussman test.

a_t is the random effect, and e_t^i is the error term.

	(1)	(2)	(3)
$diffPB_{t,t-1}^i$	-0.0480***	-0.344***	-0.323***
	(0.0129)	(0.115)	(0.121)
$debt_t^i$	0.000628	0.000787	0.00124
	(0.000947)	(0.00103)	(0.00119)
$diffPB_{t,t-1}^i \times \varepsilon_{Trate}^{TC,i}$		0.0328***	0.0297**
		(0.0127)	(0.0134)
$diffLiquidity_{t,t-1}^i$			0.178***
			(0.0684)
α	-0.0553	-0.0639	-0.0602
	(0.0645)	(0.0723)	(0.0864)
Observations	472	433	326

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Table 1: The results of the regression in variation.

Here we only display the results with the control for liquidity: it is for us the most relevent as it changes β by 2 basis points without reducing its level of significance and it is the most significant element among the control variables. The results of the same regression with different combinations of controls are displayed in appendix B.

We observe that the variation of the primary balance is always strongly significant and has the expected sign (negative). The control for the debt level is surprisingly never significant. It supports the idea that the level of debt does not directly impact the spread. The interaction term is relevant to explain the variation of the yield and also has the expected sign. His effect is estimated to reduce the effect of the primary balance by 3 basis points. Then, we also notice that in the absence of the interaction term, β is divided by about 10. It means that it incorporates partly the phenomenon that we observed through the interaction term[12].

The liquidity effect is quite strong: an improvement of the bond's liquidity by one point induces a decrease of 17 basis points of the governement bond yield spread. It reminds the relavance of the market liquidity underlined by Manganelli and Wolswijk (2009).

[12]For example, if we assume that $\varepsilon_{Trate}^{TC,i} = 9$, with the coefficients of column (2), we get $0.344 + 9 \times 0.032 = 0.056$ which is near the β of the first column (-0.048) . This fact supports the results of the column (2) and (3).

4.2 Deriving the elasticity of government bond yield spread to fiscal consolidation.

Now that we found an appropriate way to explain the government bond yield spread variations, we can compute the elasticity[13] of government bond yield spread to fiscal consolidation.

We distinguish two types of countries: countries with a high elasticity of tax compliance to tax rate(ε^{TC}_{Trate}) (above the mean's sample) and others. The two groups of country are made of:

Low ε^{TC}_{Trate}	High ε^{TC}_{Trate}
AUT	BEL
CAN	CHE
ESP	CHL
GRC	DNK
PRT	FIN
SWE	FRA
	HUN
	IRL
	ITA
	JPN
	NLD
	NOR
	NZL
	POL
	ZAF

Table 2: The country grouping with respect to their elasticity of tax compliance to tax rate.

To derive the final elasticity ($\xi^{FC,i}_{Sprd}$), we run the following equation:

$$\Delta Sprd^i_{t,t-1} = \alpha + \beta diff PB^i_{t,t-1} + \delta debt^i_t + \varphi diff PB^i_{t,t-1} \times HIGH\varepsilon^{TC}_{Trate} + \gamma diff Liquidity^i_{t,t-1} + a_t + e^i_t \quad (5)$$

a_t is the random effect, and e^i_t is the error term. $HIGH\varepsilon^{TC}_{Trate}$ is a dummy variable that equals one when $\varepsilon^{TC,i}_{Trate}$ is over the mean's sample.

[13]This is in fact a partial elasticity as we cannot express all variables in log since some observations are negative.

$\Delta Sprd^i_{t,t-1}$	(1)	(2)
$diffPB^i_{t,t-1}$	-0.120***	-0.118***
	(0.0309)	(0.0324)
$debt^i_t$	0.000792	0.00128
	(0.00103)	(0.00119)
$diffPB^i_{t,t-1} \times HIGH\varepsilon^{TC,i}_{Trate}$	0.0843**	0.0752**
	(0.0341)	(0.0360)
$diffLiquidity^i_{t,t-1}$		0.174**
		(0.0686)
α	-0.0606	-0.0598
	(0.0724)	(0.0865)
Observations	433	326

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Table 3: The result of the regression with the two types of country.

The formula used to compute the elasticity is the following:

$$\frac{dSprd}{dFC} = \begin{cases} \beta + \varphi & \text{if } HIGH\varepsilon^{TC,i}_{Trate} = 1 \\ \beta & \text{if } HIGH\varepsilon^{TC,i}_{Trate} = 0 \end{cases} \tag{6}$$

The results obtained with the regression (2) are:

Country	$\xi^{Sprd,i}_{FC}$	mean spread
High ε^{TC}_{Trate}	-.043%	1.220
Low ε^{TC}_{Trate}	-.118%	1.128

Table 4: The elasticity of government bond yield spread to fiscal consolidation.

We decuce that for high elasticity countries, an increase of one point of primary balance decreases the government bond yield spread by 4.3 basis points, while for low elasticity country it decreases by 11.8 basis points.

More precisely, when the government manage to improve the primary balance by 0.06% of GDP[14].We assume that it is a tax based fiscal plan. For high elasticity countries, the government loses 46 basis points of their revenues but gains 0.25 basis points on their interest rate payment. With this regression we do not have much details about the losses made by low elasticity countries.

[14]This is approximately the mean of the primary balance variation

We observe a difference of the effectiveness of fiscal consolidations between the two country types.

- Example:

Assume that a government realises a tax-based fiscal consolidation. The country has the following features:

GDP	1,030,876 million $
debt ratio	62% of GDP
Variation of tax rate	+0.06% of GDP
ε^{TC}_{Trate}	8.81%
$\xi^{FC,i}_{Sprd}$	-6.1%
Initial spread	1.2%

Table 5: Characteristic of the country (example).

We can compute what would be the cost of such a fiscal consolidation. The cost of a tax hike is given by:

$$(\varepsilon^{TC,i}_{Trate})\Delta TaxRate^{i}_{t+1,t} \times RevenueDeclared^{i}_{t+1} \tag{7}$$

So in such a country a tax hike of 0.06% of GDP would induces a loss of tax revenue of 54.5 million dollars. A tax hike reduces tax compliance, which impacts negatively the total tax revenue.

In terms of yield, this fiscal policy would enable the country to reduce its government bond yield spread by 0.0036%:

$$(\xi^{FC,i}_{Sprd}) \times \Delta TaxRevenue^{i}_{t+1,t} \tag{8}$$

This reduction cuts its tax service by:

- if we consider that the effect on the spread will last, the spread is relatively stable, the gain related to the debt service is: 3770.6 million dollars;
- if we consider that the effect on the spread will last only 2 years, the gain related to the debt service is: 565.6 million dollars.

4.3 Discussion

Finally we got the expected result: an improve of the primary balance is less efficient for countries with a high elasticity of tax compliance to tax rate. So, the ability of a country to levy taxes seems to be taken into account by the financial market. The market is more lenient with a high tax compliance country.

We also find a strong relationship between the liquidity of a government bond and its yield: a one point increase of the Bid-Ask spread induces a rise of 17 basis points of the government bond yield spread. This result aknowledges the result of Manganelli and Wolswijk (2009))according to whom the liguidity factor is priced by investors calling for ever more market integration.

The use of the primary balance as an independant variable enables us to avoid reverse causality. No reverse causality might be found as the primary balance, by definition, does not take into account the debt interest payment.

Concerning the control variables, we run several specifications. We notice that the lagged GDP is not significant, but it reduces a bit the effect of the primary balance. The control for investors' risk aversion has a similar effect. Then, the liquidity control is strongly significant, and also slightly reduces the impact of the primary balance. Controlling for these elements at the same time is not very effective as we loose in significance. Even if we change a bit the specification, we always get a significant effect of the primary balance and its interaction with the elasticity. Gruber and Kamin (2012) by checking the robustness of their model, also found a significant effect of the current fiscal position on the governement bond yield, while the current effect of debt has no impact. We observe the same fact concerning the current debt level.

Nevertheless, our model is unable to compute a real elasticity, we can only get a partial elasticity of spread to primary balance since the primary balance cannot be expressed in log-difference. Then, studying the primary balance to observe fiscal consolidation and tax compliance is inaccurate.

The primary balance was used as a proxy for fiscal plan. But we want to capture more precisely the effect of a low tax compliance on fiscal plans. Focusing on tax compliance induces also focusing on tax based fiscal plans. So, to be more accurate we should use another proxy than the primary balance. To check whether our results are still true, we replace the primary balance by the total tax revenue[15] in the specification (4). This proxy gives us significant results[16]. The total tax revenue has a negative effect on the government bond yield spread. This negative effect is weakenned for high elasticity of tax compliance to tax rate countries when we take into account the interaction term ($diffTotalTaxRevenue^{i}_{t,t-1} \times \varepsilon^{TC,i}_{Trate}$). Thus, we find similar results to the one obtained with the primary balance. And with the total tax revenue we are able to compute the real elasticity: our two variables of interest (the yield spread and the total tax revenue) can be expressed in log-difference.

Conclusion

This work investigated the interaction between fiscal policy and tax compliance and its impact on the government bond yield spread. We showed that the level of tax compliance changes the effect of a fiscal consolidation. We observe a reduction of the effect of the primary balance, when there is a high elasticity of tax compliance to the tax rate. This result is supported when we replace the primary balance by the total tax revenue. Then, we manage to partly reproduce the litterature results concerning the financial markets features. So, the tax compliance seems to matter in the success of a fiscal policy.

[15]The data come from the World Bank, it is expressed in percent of GDP.

[16]The results are displayed in appendix C.

We computed partial elasticity of governement bond yield spread to fiscal consolidation, but we are unable to say clearly what is the relationship between the internal constraint (related to the tax compliance) and the external constraint (related to the government bond yield).

A better measure of fiscal consolidation would enable us to improve our results. Then other paths have to be explored: a low tax compliance may change the maturity of the sovereign debt or the share of the external debt holders[17].

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[17] An insight of this relationship is given in appendix.

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A Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Unit
$Sprd^i_{t,t-1}$	472	-.006	.663	-2.565	3.912	%
$diffPB^i_{t,t-1}$	631	.033	2.333	-18.393	19.766	% of GDP
$debt^i_t$	653	65.773	38.59	3.88	250.35	% of GDP
$\varepsilon^{TC,i}_{Trate}$	594	8.847	1.049	4.841	9.73	%
$diffLiquidity^i_{t,t-1}$	475	.004	.448	-6.127	6.543	$
$diffRA^i_{t,t-1}$	513	.054	.893	-2.51	2.22	%
GDP^i_{t-1}	686	1160294	2385712	48262.8	1.80e+07	millons of $

Table 6: Data description

Country (ISO-3 code)
AUT
BEL
CAN
CHE
CHL
DNK
ESP
FIN
FRA
GRC
HUN
IRL
ITA
JPN
NLD
NOR
NZL
PRT
POL
SWE
ZAF

Table 7: List of countries used in the panel.

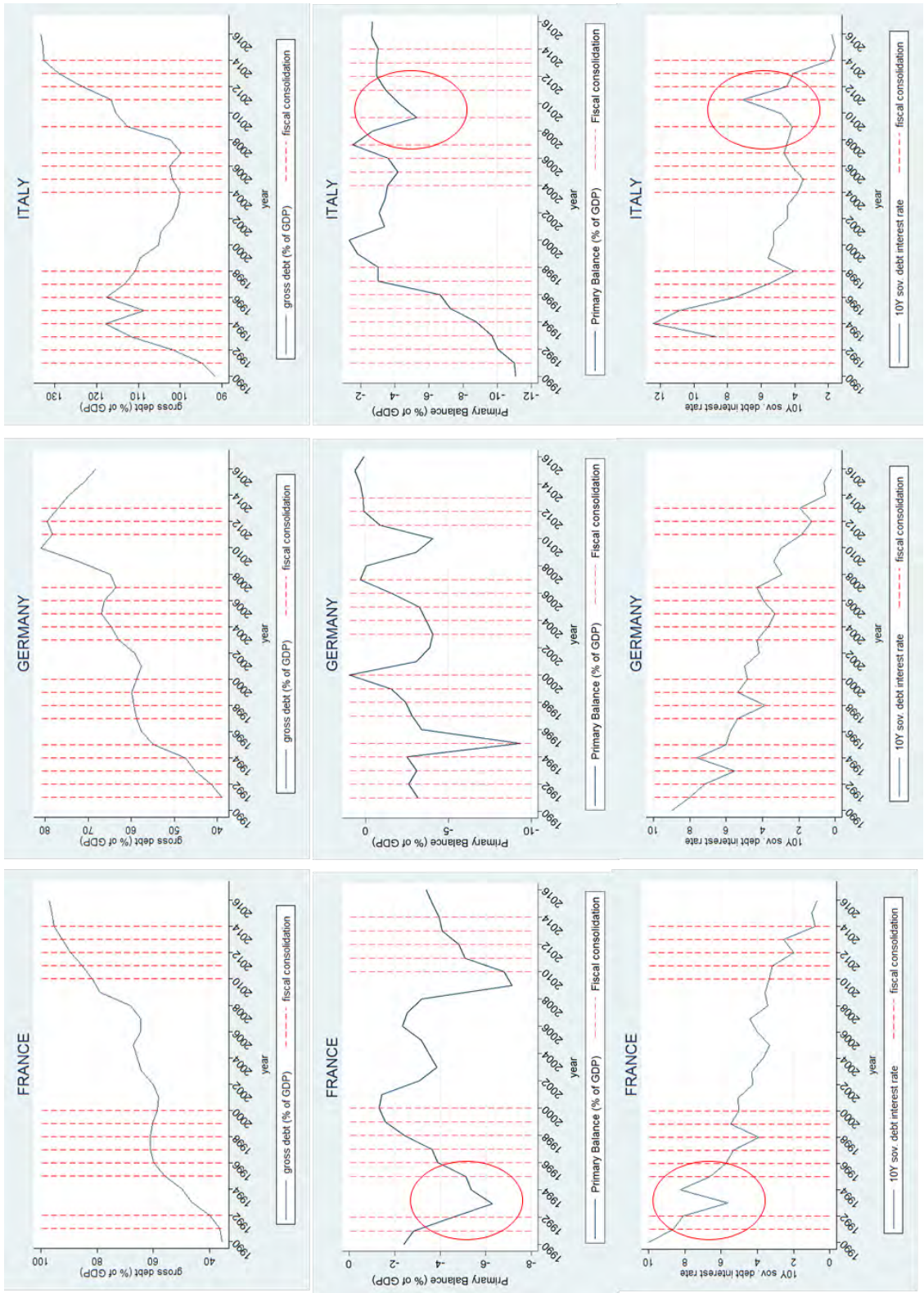

Figure 1: Gross debt, primary balance and government bond yield of France, Germany and Italy.

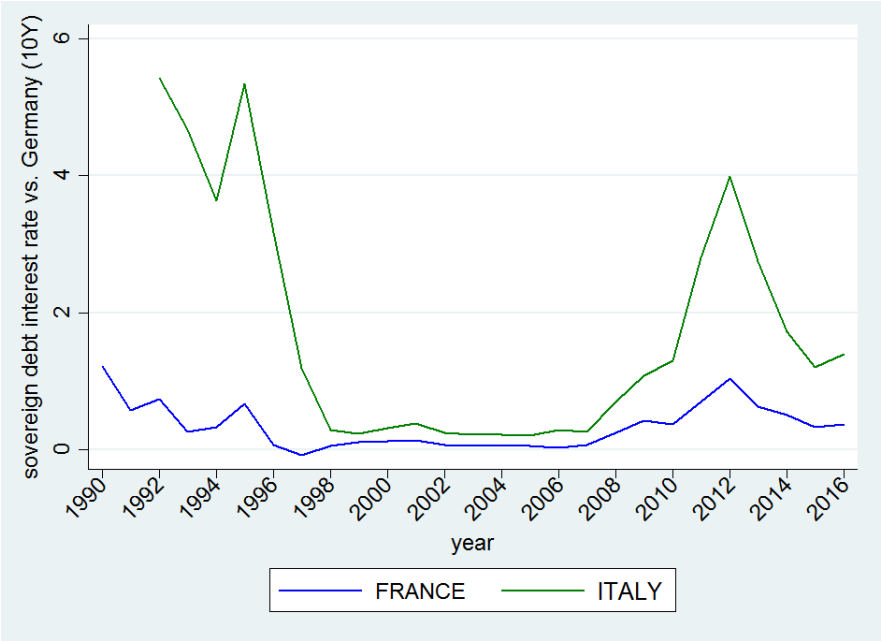

Figure 2: Government bond yield spreads with a German benchmark

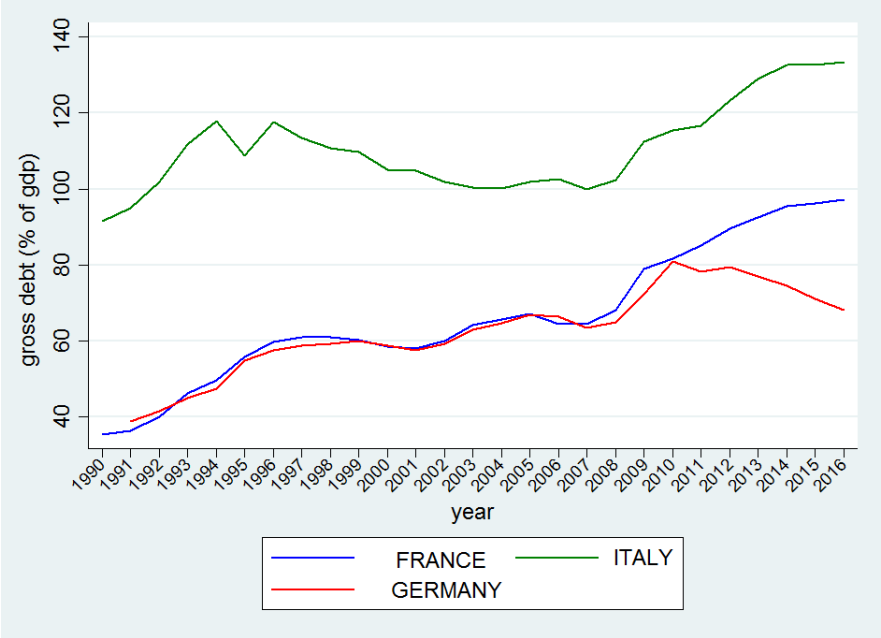

Figure 3: Gross debt of France, Germany and Italy.

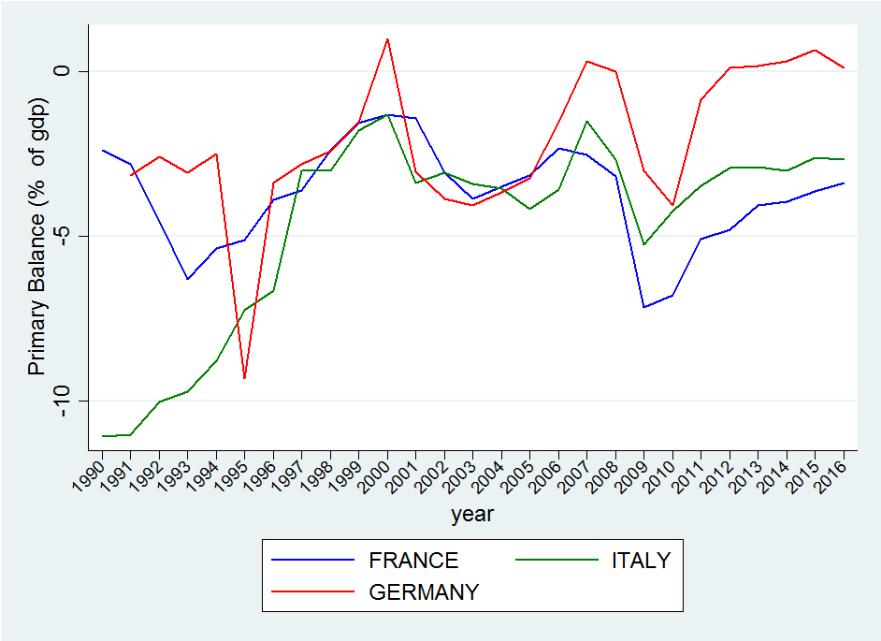

Figure 4: Primary balance of France, Germany and Italy.

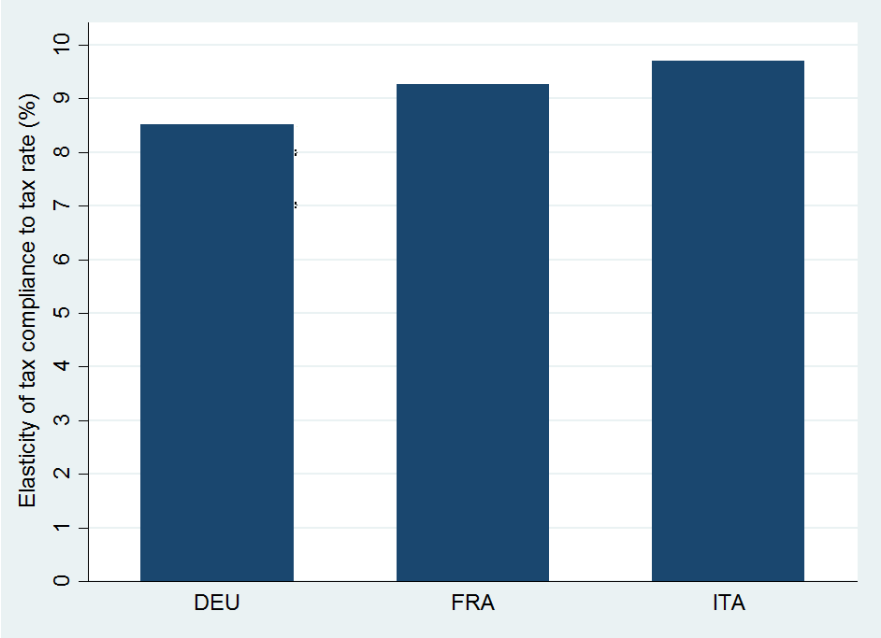

Figure 5: Elasticity of tax compliance to tax rate of France, Germany and Italy.

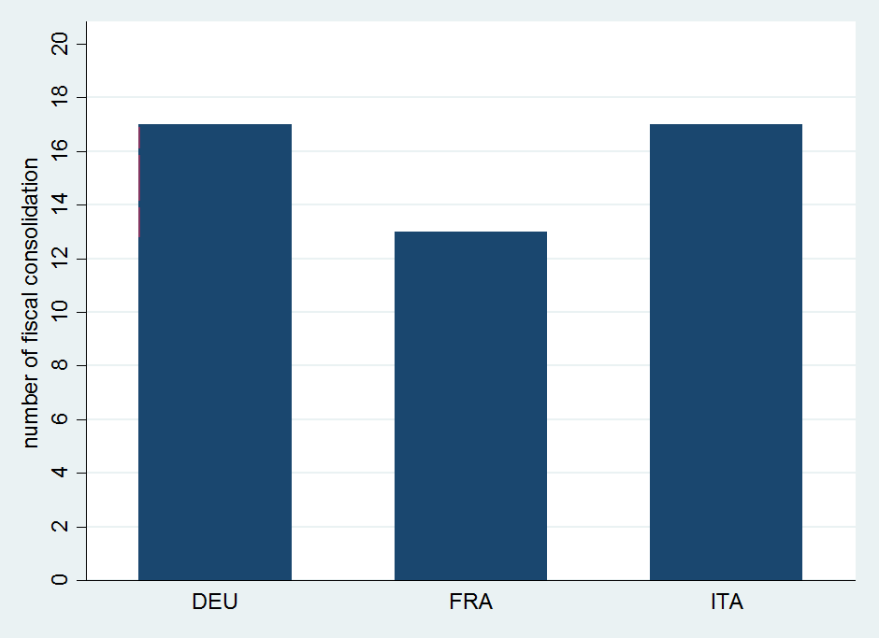

Figure 6: Number of fiscal consolidation from 1990 to 2014.

B The model

$$Sprd_t^i = \alpha + \mu Sprd_{t-1}^i + \beta PB_t^i + \delta debt_t^i + \varphi PB_t^i \times \varepsilon_{Trate}^{TC,i} + \gamma Market_t^i + c^i + e_t^i$$

$\Delta Sprd_{t,t-1}^i$	(1)	(2)	(3)	(4)	(5)	(6)
$diffPB_{t,t-1}^i$	-0.344***	-0.323***	-0.338***	-0.336***	-0.309**	-0.303**
	(0.115)	(0.121)	(0.115)	(0.121)	(0.121)	(0.121)
$debt_t^i$	0.000787	0.00124	0.000454	0.00111	0.00100	0.000658
	(0.00103)	(0.00119)	(0.00107)	(0.00110)	(0.00119)	(0.00127)
$diffPB_{t,t-1}^i \times \varepsilon_{Trate}^{TC,i}$	0.0328***	0.0297**	0.0322**	0.0316**	0.0284**	0.0278**
	(0.0127)	(0.0134)	(0.0127)	(0.0134)	(0.0134)	(0.0134)
$diffLiquidity_{t,t-1}^i$		0.178***			0.178***	0.178***
		(0.0684)			(0.0669)	(0.0670)
GDP_{t-1}^i			5.46e-08			5.02e-08
			(5.25e-08)			(6.49e-08)
$diffRiskAversion_{t,t-1}^i$				0.0407	0.0706*	0.0707*
				(0.0393)	(0.0418)	(0.0418)
α	-0.0639	-0.0602	-0.0770	-0.0289	-0.0158	-0.0245
	(0.0723)	(0.0864)	(0.0734)	(0.0774)	(0.0873)	(0.0881)
Observations	433	326	433	348	293	293

* p<0.10, ** p<0.05, *** p<0.010 Standard errors in parentheses

$\Delta Sprd^i_{t,t-1}$	(1)	(2)
$diffPB^i_{t,t-1}$	-0.288***	-0.272**
	(0.111)	(0.119)
$debt^i_t$	0.000514	0.000957
	(0.00110)	(0.00131)
$diffPB^i_{t,t-1} \times \varepsilon^{TC,i}_{Trate}$	0.0256**	0.0242*
	(0.0124)	(0.0133)
$diffLiquidity^i_{t,t-1}$		0.167**
		(0.0688)
GDP^i_{t-1}		3.31e-08
		(6.44e-08)
$diffRiskAversion^i_{t,t-1}$		0.113***
		(0.0434)
$diffIRS^i_{t,t-1}$	0.363***	0.419***
	(0.0547)	(0.0929)
α	-0.00613	-0.0257
	(0.0820)	(0.0941)
Observations	351	266

* p<0.10, ** p<0.05, *** p<0.010 Standard errors in parentheses

Table 8: Results of the regression with all controls.

The control concerning the relative asset swap spread ($diffIRS^i_{t,t-1}$) accounts for the exchange rate factor. This control is not always reviewed in the literature, but Codogno et al. (2003) showed that it strongly affected the European countries before the EMU.

B.1 The marginal effect of fiscal policy

To see how strong is the link between the elements we just review, we first realize a simple regression with all variables expressed in level. This specification permits only to observe the marginal effects of the different elements. We use a country fixed effect regression for the following estimation:

$$Sprd^i_t = \alpha + \mu Sprd^i_{t-1} + \beta PB^i_t + \delta debt^i_t + \varphi PB^i_t \times \varepsilon^{TC,i}_{Trate} + \gamma Market^i_t + c^i + e^i_t \qquad (9)$$

c^i is the country fixed effect, and e^i_t is the error term.

$Sprd_t^i$	(1)	(2)	(3)
$Sprd_{t-1}^i$	0.504***	0.501***	0.318***
	(0.0341)	(0.0354)	(0.0245)
PB_t^i	-0.0516***	-0.396***	-0.278***
	(0.0180)	(0.137)	(0.0883)
$debt_t^i$	0.0152***	0.0152***	0.0156***
	(0.00314)	(0.00323)	(0.00217)
$PB_t^i \times \varepsilon_{Trate}^{TC,i}$		0.0386**	0.0259***
		(0.0154)	(0.00989)
$Liquidity_t^i$			3.648***
			(0.122)
α	0.406	1.592***	-4.440***
	(0.271)	(0.422)	(0.409)
Observations	594	555	434

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Table 9: The regression's results with variables expressed in level

A one point decrease of the primary balance reduces the government bond yield spread by 50 basis points (column (1)). When we add the interaction variable with the elasticity of tax compliance to the tax rate, the effect of the primary balance is lowered by $0.038 \times \varepsilon_{Trate}^{TC,i}$. So the coefficients are of the expected sign, and everything is significant. If we add the variable accounting for the liquidity of the bond (column (3)), the effect of the primary balance is weankened. It reminds that we should not ignore the influence of the financial market.

This model indicates a strong relationship between the variables of interest and the government bond yield spread, but it provides us only the marginal effects of these elements on the spread. That's why we slightly change the model and express all variables in variation.

C Discussion

$$\Delta Sprd_{t,t-1}^i = \alpha + \beta \Delta TotalTaxR_{t,t-1}^i + \delta debt_t^i + \varphi \Delta TotalTaxR_{t,t-1}^i \times \varepsilon_{Trate}^{TC,i} + \gamma diffLiquidity_{t,t-1}^i + a_t + e_t^i \quad (10)$$

$\Delta Sprd^i_{t,t-1}$	(1)	(2)
$\Delta TotalTaxR^i_{t,t-1}$	-19.51**	-18.04**
	(7.639)	(8.261)
$debt^i_t$	0.000436	0.00117
	(0.00105)	(0.00126)
$\Delta TotalTaxR^i_{t,t-1} \times \varepsilon^{TC,i}_{Trate}$	1.896**	1.606*
	(0.860)	(0.939)
$diffLiquidity^i_{t,t-1}$		0.205***
		(0.0710)
α	-0.0483	-0.0660
	(0.0733)	(0.0914)
Observations	429	310

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.010

Table 10: The regression's results with total tax revenue instead of the primary balance.