DEFAULT RISK PREMIUM AND THE YIELD CURVE

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13/11/2023

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1 Introduction

The goal of this assignment is to examine the effects of certain macro-variables on the default risk premium and the term structure of Greece during the period of 2013-2024. Most existing literature, when coming to default risk distinguishes between crisis and non-crisis periods, following suit we also estimate our model over two separate time frames to account for the effects arising from financial turmoil. We validate the results of previous literature confirming the overall as well as the regime dependent effects of our variables of interest on Greece's estimated default risk premium. In estimating our term structure model we draw inspiration from the framework of the three latent factors of the yield curve, using the same macro determinants highlighted **Evans and Marshall (2007)** and **Paccagnini (2016)** which are usually associated with level, slope and curvature of the yield curve. It should be noted that in our model we don't extract those factors from the Yield curve directly, since our proxy for it consist of only two maturities making it linear, but rather we take the macro factors as is and then regress them upon the term premium.

The structure of the assignment is as follows: first we begin with a brief, or rather not so brief, review of existing literature, next we present the data used as well as the logic behind the construction of certain key variables followed by the mathematical presentation of our models. In the fifth section we present the estimated results produced by our models and finally we finish off with some concluding remarks.

2 Literature review

In this section I will briefly present the findings as well as other relevant information, revealed by the literature taken into consideration for the completion of this assignment.

Alessandria, Yan and Deng (2020) investigated the impact of default risk and migration on the persistence of sovereign debt crises, using Spain's 2008 economic downfall as a case study. Sovereign debt crises often go hand in hand with economic downturn, rising sovereign spreads (and subsequently default risk), as well as significant capital and labour outflows. During it's 2008 debt crisis Spain experienced severe declines in immigration and capital flow and increase in sovereign spread. The paper examines the interconnectedness of default risk, capital flows and migration by incorporating migration and capital accumulation into a standard sovereign default model, under the assumption that the economy's production is based on capital, labor, a continuoum of workers and a central government. The analysis concludes that migration plays a substantial role in the persistence of economic decline in such crises, as is measured by the default risk.

Chatterjee and Eyigungor (2012) advances the understanding of of quantitative sovereign debt models by incorporating long-term debt. The authors demonstrate that long-term debt introduces a downward sloping equilibrium price function, maintaining the core feature of the Eaton-Gersovitz framework where higher interest rates lead to increased credit supply. The model is calibrated using Argentina's economic data, and manages to accurately capture high debt to output ratios, average debt spreads and spread volatility while simultaneously providing a more nuanced understanding of Argentina's other cyclical factors. A key finding of the paper is the influence of debt maturity on default risk. While long term debt is initially more expensive due to the higher interest rates associated with it, the model proves that, in comparison to short term debt, it lowers the risk of default. This association is attributed to the fact that long term debt reduces the probability of self-fulfilling rollover crises, which is when lenders lose confidence in a county's ability to repay it's debt leading them to stop lending and forcing the country to default, even though had the lending continued it would eventually be able to repay it. Long-term debt mitigates this risk since it does not need to be refinanced as often as short term debt hence reducing the chances of sudden loss of confidence. This approach highlights the advantages of long term debt in managing default risk and stabilizing debt maturity yields.

Rho and Saenz (2021) delves into whether, and to what extend financial stress, both at international and at local level, amplifies the effect of certain macroeconomic fundamentals and fiscal vulnerabilities on the risk of sovereign default. By analyzing data from 113 market access countries, including both advanced as well as emerging financial markets, over the extensive period of 1990-2014 it is revealed that indeed financial stress significantly enhances the effects of certain debt indicators. Specifically, using a country's 10 year sovereign bond spread (with respect to the US 10 year treasury bond spread) and the default probability as measures of overall sovereign risk it is found that, during financial crises, the impact of public debt on the risk of default significantly enhances. Furthermore, other fundamentals such as GDP per capita and international reserves also have a stronger effect on default risk, especially at the local level. The findings underscore the importance of accounting for macroeconomic fundamentals and financial stress when assessing a sovereignty's default risk, in the sense of them, to a remarkable degree, defining the accuracy of the sovereign risk evaluation. Failing to take these factors into consideration could lead to underestimation of a country's default risk.

Similarly, **Naifar(2011)** analyzes the sensitivity of default risk premium changes to stock market conditions as well as other macroeconomic variables during financial crises. Using iTraxx credit default swaps (CDS) index spreads from the Japanese market over the period of 2006-2009, as proxys of default risk premium, the author employs a time varying dynamic factor model with a two-state Markov switching, accounting for regime shifts (crisis and non-crisis) to analyze the probability changes, in the explanatory variables for default risk premium, going hand in hand with regime changes. The findings indicate that the relationship between default risk premium changes, stock market conditions(as measured by the Japanese stock market return index), CPI and PPI is regime dependent. Specifically during a crisis regime, defined by rising loan defaults in the subprime mortgage market, CDS indices demonstrate wider spread and became highly sensitive to stock market index return volatility and to production price index fluctuations, contrary to the non-crisis model where those parameters either did not hold any statistical significance or affected the default risk premium to a lesser extend. The study furthers our understanding of the determinants of default risk premium and showcases that depending on the overall economic climate those determinants tend to change.

Interestingly, **De Pooter, Ravazzolo and van Dijk (2010)** uncovered that when forecasting the term structure of US interest rates, the accuracy of different forecast models depends on the overall economic climate, as measured by the increase/decrease in interest volatilities. It was established that models incorporating macroeconomic factors performed better during periods of recession (high volatility) while models without macro factors excelled during low volatility periods. These differences in model performance highlights the issue of model uncertainty, something which can be mitigated by combing different models as each is more effective depending on the subperiod under examination. This complex modeling approach lead to improved predictability, especially for longer-term maturities, and seemed to be persistent over time.

Kozicki and Tinsley (2001), **Kozicki and Tinsley (2002)**, established, in their works the relation between long-horizon forecasts of short-term nominal rates, in expectations based models of the term structure, and the long term policy target of inflation, or in other words the so called "endpoint" of the long term market expectations for inflation data. The authors suggest that there is a linear dependency between the "endpoint" of the short-term nominal rates and the "endpoint" of the market expectations of inflation, something which contrast previous models assumption of mean-reversion and hence fixed short-term rate "endpoint". Since, in expectations theory long term interest rates are a product of short-term rates and since long term rates are embedded in the yield curve, the finding imply a link between long term expectations of inflation and term structure. Building on this approach **Dewachter and Lyrio (2006)** extend the model by simultaneously modeling long-run inflation expectations and the term structure in a unified framework allowing for a more consistent representation of the interplay between those factors. Furthermore the paper introduces time-varying prices of risk into the model, allowing for the prices of risk to be dynamic and influenced by macroeconomic variables, namely actual inflation rates, actual interest rates and business cycle conditions. This macro economic decomposition allows for the interpretation of latent factors of the yield curve, specifically the level factor, which is linked to long-run inflation expectations, the slope factor, linked to business cycle conditions and the curvature factor, linked to monetary policy(actual inflation/interest rates) hence bridging the gap between macroeconomic theory in finance. The model is empirically validated using US data.

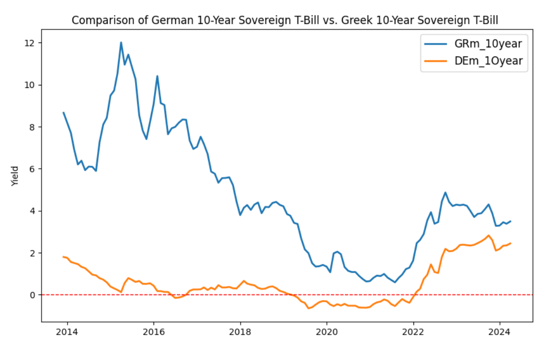
Nelson and Siegel (1987) introduce a simple parsimonious model fro yield curves that has the ability to represent all shapes generally associated with the yield curve(monotonic, humbed, S shaped). The model, in its simplest form, is comprised of three components: a long-term component($\beta 0$) serving as the base line or asymptote of the yield curve, and representing the long term average interest rates, a short-term component($\beta 1 * \exp(m/\tau)$) reflecting short term interest rates and a medium term($\beta 2 * (\tau/m)\exp(m/\tau)$). The exponential components ensure that the medium and short-term components decay faster as the time to maturity components increases, the medium-terms exponential decay is scaled allowing for more flexibility in capturing complex shapes of the yield curve. The model is tested on the US treasury bill data over the period of 1981-83, and it is found that when properly weighing each "time" component, the model is able to explain to 96% of the variations on maturity across maturities. Extending or rather simplifying this model **Siegel and Nelson (1988)** suggest a functional form for modeling yield curves with a focus on long-term behaviour, specifically since forward interest rates behave as a function of maturity it is implied that the yield curve approaches an asympote at a rate of decay equivalent to the reciprocal of maturity. This implication leads the authors to conclude that a simpler model may occur when modeling discount rates in accordance to the reciprocal of maturity since at the long-term yield curve, the relationship between the two becomes linearized.

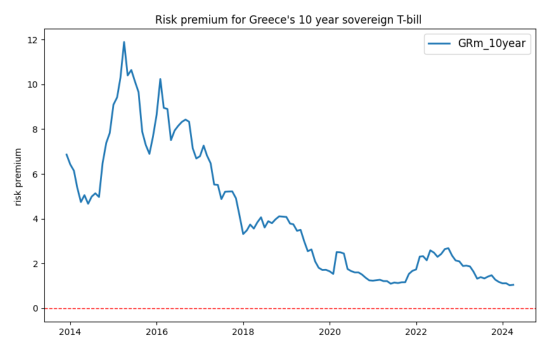
Leveraging the aforementioned model and in a similar fashion to previous literature on the subject, **Paccagnini (2016)**, investigates the impact of macroeconomic determinants on the US term structure of interest rates during the Great Moderation period of 1984-2007. To do so the author use the Nelson-Siegel model to extract three latent factors of the yield curve(level, slope, curvature), each accounting for different macroeconomic factors, , which were selected following the framework of **Evans and Marshall (2007)** who also investigated the effects of macroeconomic shocks to nominal treasury yields, namely inflation, industrial productivity, federal funds and consumption. By doing so the author is able to further our understanding of how certain macroeconomic shocks affect the shape of the yield curve and further emphasizes the importance of considering those effects in planning economic policies.

3 Data & Methodology

3.1 Data

The analysis relies on extensive datasets on sovereign bond yield, as well as other macroeconomic indicators, for Greece over the period of 2013-2024. Our first variable of interest in the market default risk premium for Greece's 10 year sovereign T-bill. As a proxy for this we use the spread between the yields of Greece's 10 year sovereign T-bill and Germany's 10 year sovereign T-bill, which is considered a "safe heaven" for investment. Note that any other "safe heaven" country like the US for example could be used as a referendum for the calculation of the default risk premium producing slightly different but still reliable results, yet it was decided to use Germany due to it's economy being more similar to Greece's in the sense that they both use the same currency, so immediately bias arising from exchange rates is accounted for, and furthermore over the early 2000's the countries sovereign bonds moved very close to each other. The following graphs visualize the spread between the two countries long-term sovereign bonds3.1 and the risk premium for Greek bonds3.1.





Note: The graph depicts the historical data of both countries sovereign bond yields. The higher the yield the greater the risk that goes hand in hand with holding on/obtaining the particular bond. Notably Germany's bond yield drops below zero during certain periods indicating negative yields, meaning that one had to pay to hold on to the bonds, due to the fact that it was estimated to have a "negative" risk factor, even though that is not technically possible it further showcases how safe German bonds were considered.The gap between the two time series is considered as the default risk premium.(Graphs created using python.)

Figure 1: Summary statistics of economic variables

Variable	Count	Mean	Std	Range
GR GDP	125	100.106	1.903	91.637 – 101.816
US GDP Growth	125	2.269	9.921	-69.047 – 45.954
CPI	125	1.167	3.393	-2.836 – 12.093
PPI	125	0.102	0.299	-0.898 – 1.508
Net migration	125	-1.574	0.648	-3.004 – -0.543
risk premium	125	4.173	2.842	1.030 – 11.888

	GR GDP	US GDP Growth	CPI	PPI	Net migration
GR GDP	1				
US DP Growth	-0.101	1			
CPI	0.472	-0.0409	1		
PPI	0.237	-0.032	0.612	1	
Net migration	0.081	-0.004	0.599	0.388	1

Figure 2: Correlation matrix

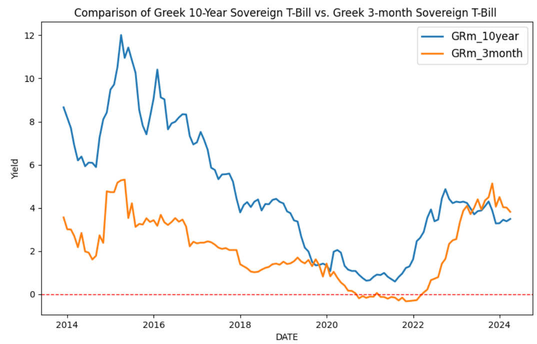
Note: All adjacent data sets were sourced, on a monthly basis, from the FRED database, with the exception of the Net migration variable, the data for which was source from the OECD homepage. Furthermore any missing values were linearly interpolated.

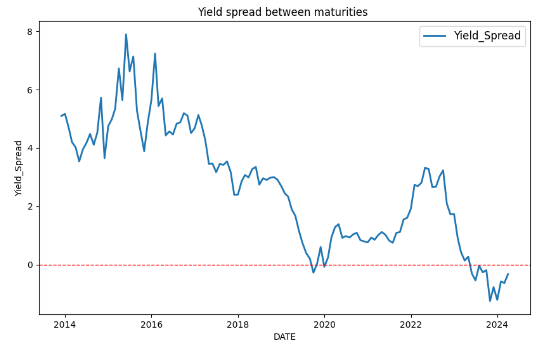
In selecting key macroeconomic variables we are heavily inspired by **Alessandria, Yan and Deng (2020)** who examined the effect of migration on the persistence of financial crisis, as measured by the changes in default risk premium, using Spain as a case study. We include in our model the net migration for Greece, we further include the real GDP for Greece as a proxy for country specific effects, the consumer price index (CPI) and producer price index (PPI) as proxies for the price levels and finally the U.S. GDP growth rate to account for global economic dynamics. Some basic descriptive statistics as well as the correlation matrix, of the independent variables, are presented in the table 1.

Interestingly one can observe the fact that net migration stays negative throughout the entire sample period, meaning that during that time frame the people that emigrated from Greece always outnumbered those that immigrated to it. Furthermore the risk premium always stays positive and above zero, something which indicates that at no point in time during the sample period did Greece's bonds reach the status of a risk free investment, though it should be noted that the minimum value of 1.03 could be deemed satisfactory.

Moving on to the term structure, we simply defined it as the differences in yield between Greece's 10year and 3month sovereign T-bills. The course of the two maturities3.1 over the sample period as well as the spread between 3.1 them are presented in the graphs below.

In selecting macroeconomic variables we follow **Evans and Marshall (2007)** and **Paccagnini (2016)**. Namely we use the Industrial Production Index (IP), the changes in Consumer Price Index (CPI) as a proxy for inflation and finally the Personal Consumption Expenditures (PCE) as a proxy for consumption. Some basic descriptive statistics as well as the correlation matrix between those variables are presented as follows.





Note: The graphs depict the yields for both the 10year as well as 3 month sovereign T-bill for Greece as well as the spread between the two over time. We can observe that at certain points the yield of the 3month T-bill is equal to or even greater than that of the long-run T-bill, something which is reflected in the yield spread between the two as during those points in time it drops to or below zero. This can be interpreted in the sense that, for those specific points in time, investors expected interest rates to fall (due to changes in monetary policy, inflation rates, economic turmoil etc.) in the future and hence preferred more liquid short-term investments, while in stable periods the would seek higher yields from long term bonds. Furthermore it should be noted that the spread between the two maturities can be viewed as the term premium. (gaphs created using python)

Figure 3: Summary Statistics

Variable	Count	Mean	Std	Min	Max
IP	125	109.371	8.580	95.276	128.163
CPI	125	1.168	3.393	-2.837	12.093
PCE	125	9.453e+09	7.764e+08	8.090e+09	1.137e+10
Yield Spread	125	2.669	2.055	-1.253	7.9

Figure 4: Correlation Matrix

	IP	CPI	PCE
IP	1		
CPI Growth	0.723	1	
PCE	0.685	0.606	1

Note: All data sets were sourced, on a monthly basis, from the FRED database. Any missing values where linearly interpolated. It is noteworthy the minimum of both the yield spread and the CPI is negative, this indicates that during the sample period there were probably times of economic turmoil.

3.2 Methodology

In assessing the effect of each of our macro variables on both the default risk premium as well as term structure a simple linear regression using Ordinary least squares (OLS) was implemented. Since, as already established the default risk premium was modeled like:

$$\text{Risk Premium}_t = \text{GR}_{10\text{year}t} - \text{DE}_{10\text{year}t}$$

(1)

Where $\mathrm{GR}_{10\mathrm{year}}$ and $\mathrm{DE}_{10\mathrm{year}}$ denote the yield of 10-year sovereign T-bills for Greece and Germany respectively, our final model for estimating the default risk premium can be expressed as :

$$\begin{aligned} \text{Risk Premium}_t = a &+ b_1 \cdot \mathrm{GDP}_{\mathrm{GR}t} + b_2 \cdot \text{GDP growth}_{\mathrm{US}t} \\ &+ b_3 \cdot \mathrm{CPI}_t + b_4 \cdot \mathrm{PPI}_t + b_5 \cdot \text{Net migration}_t + \epsilon_t \end{aligned} \tag{2}$$

Where CPI and PPI denote the Consumer Price Index and the Producer Price Index respectively. In similar manner, the term structure or rather the term premium is denoted as:

$$\text{Term Structure}_t = \mathrm{GR}_{10\mathrm{year}t} - \mathrm{GR}_{3\mathrm{month}t}$$

(3)

Where $\mathrm{GR}_{10\mathrm{year}}$ and $\mathrm{GR}_{3\mathrm{month}}$ denote the yields of the 10year and 3month sovereign T-bill of Greece respectively. Hence our final model for estimating the term structure can be expressed as :

$$\text{Term Structure}_t = a + b_1 \cdot \mathrm{IP}_t + b_2 \cdot \mathrm{CPI}_t + b_3 \cdot \mathrm{PCE}_t + \epsilon_t \tag{4}$$

Where IP and PCE denote the Industrial Production index and the Personal Consumption Expenditure respectively.

4 Empirical Findings & Interpretation

In this section of the assignment we will present the results of the OLS regressions on both the default risk premium and the term structure, as well as interpret the findings of the effects of the independent variables both from a quantitative as well as a financial perspective.

Starting with our model on default risk premium, to further our understanding of the nature of the influence of our independent variables we estimate a second, comparison, model with the same variables but this time over a 'crisis' period. Crisis period is defined as a period of economic turmoil characterized by rising yield spreads. We set this period to be from the 12/03/2013 to the 4/01/2017. During this time frame one can observe extreme high yield spread between Greece and Germany's long term T-bills, stemming mainly from rises in the yield of the Greek sovereign bond, indicating during that period of time speculation for Greece's probability of default were especially high further hinting at the notion that the market perceived the country's economy to be fragile.

The following table presents the results of the regression of risk premium on our independent variables, both in the crisis as well as the non-crisis periods.

Table 1: Comparison of Regression Results: Crisis vs Non-Crisis Periods

	Crisis	**Non-Crisis**
const	-161.7468***	-25.571**
	(70.324)	(8.44)
GDP_{GR}	1.78**	0.239***
	(0.693)	(0.086)
US GDP Growth	-0.2580***	-0.007
	(0.082)	(0.014)
CPI	-1.4290***	-0.031
	(0.209)	(0.068)
PPI	0.5652	0.399
	(0.694)	(0.580)
Net migration	4.1365 ***	-3.693***
	(0.788)	(0.275)

Note: Robust standard errors in parentheses. Statistical significance is denoted as ***: p <0.01, **: p <0.05, *: p <0.1. Crisis dataset contains 40 observations while Non-crisis contains 125.

The results indicate that there is indeed a difference in the way our macroeconomic factors affect default risk premium depending on whether or not the economy is experiencing periods of turmoil. Specifically, we first take a look at the effect of the U.S. GDP growth, whose coefficient during stable, non-crisis, periods is not statistically significant. This leads us to conclude that U.S. GDP growth, a proxy for global financial conditions, does not have any significant effect on default risk during ”normal” periods. On the other hand when looking at the crisis model we can see the U.S. GDP growth does have a statistically significant, negative effect on default risk. This aligns with **Rho and Saenz (2021)** whose findings already established that the effects of global macro conditions on default risk are enhanced during times of financial distress, especially when ”crisis” occurs at local level. The negative correlation between those two variables can be attributed to a multitude of reasons, since the U.S. is a major driven of global economic activity, a strong U.S. economic growth can lead to increase demand for goods and services globally leading to positive spillover effects through bilateral trade and investments. Furthermore higher U.S. growth can lead to more favorable global liquidity conditions, with more capital flowing internationally, cost of capital falls and hence accessibility to founds becomes easier, thus reducing the likelihood of default. From an investors perspective positive performance of the U.S. economy can boost confidence in investing in riskier assets, like Greece's sovereign bonds. Increased investment, and hence again increased capital flows, reduce the probability of default.

Greece's GDP has, during both periods, a statistically significant positive effect. Notably the effect seems to be stronger during Non-crisis periods something which contrasts most literature. This phenomenon can be attributed to the fact that Greece's GDP experienced more intense, negative, fluctuations during our non-crisis sample period. This is further made evident when looking at the yield spread between different maturities for the same period, short-term yield more than once outperformed or were equal to long term ones, something which indicates that although there are is a slight rising trend in Greek GDP, the market perceives it as unsustainable or driven by external factors, such as debt financing, which may lead to concern about future economic ability.

Moving on to our proxies for price levels, CPI and PPI. While the PPI does not achieve statistical significance in either of the sample periods, CPI, in accordance to **Naifar's(2011)** findings, experiences regime dependent effects on default risk premium. Specifically, during the crisis period the index demonstrated negative effects on our estimated model. When looking at the data for the CPI during this period we can observe that the indicator is mostly negative, signaling deflation, but yet having a rising trend, with certain fluctuations though but still rising. This positive trend, and hence the improvements in inflation conditions it signifies, were viewed positively by the investors. Since it suggests that as deflation pressures ease, the economy is stabilizing, leading to lower risk of default. On the other hand, the lack of statistical significance during the non-crisis period, suggests that during this time, were inflation was moderate(with fluctuations), price levels were not of primary concern to investors since the price levels were overall stable and other factors had more substantial effect on default risk.

Last but certainly not least, we look at net migration. During both periods the variable demonstrates statistically significant coefficients, the interesting part is that during the Crisis period the coefficient is positive whilst during the non-crisis period it is negative. The net migration was negative throughout the entire sample period with a gradually ascending trend, yet it is important to note that during the crisis period the ascending trend was at a lesser rate than it was compared to the non-crisis period. Taking this into consideration we can interpret the results in the context of the findings of **Alessandria, Yan and Deng (2020)** i.e. the fact that the net migration was negative and declining at a relatively slow rate during the crisis period lead to a positive coefficient since, as already established by the relevant literature, net migration tends to play a significant role in the persistence of economic crises, as measured by default risk. This is due to the fact that the economy heavily relies on a positive stream of labor to not only overcome financial distressed but to also sustain itself in the bigger picture. Since net migration is negative this means that the continuum of workers required is not met leaving the required work force in a deficit and hence hindering the recovery process of the economy, increasing the risk of default. In accordance to this positioning the negative coefficient in the non-crisis period is the result of the ever faster ascending rate of net migration over time which seems to lower the risk of default since as the work force increases, labour increases, production increases and hence overall financial position and health increase.

Next, we look at the term structure of Greece during our period of interest. As already mentioned, inspired by a multitude of prevailing literature, we will estimate our model based on three dominant macro factors usually associated with the latent factors (level, slope, curvature) of the yield curve. Namely those factors industrial productivity(proxy for which is the Industrial Productivity index),inflation (the proxy for which is the CPI), and consumption (proxy for which is the Personal Consumption Expenditure) respectively. It should be noted that contrary to most literature, where the latent factors are extracted from the yield curve directly and then matched with their respective macro variable before being regressed upon the term structure using a Nielsen-Siegel Model(NSM), we simply regress our estimate of the term premium (proxy of term structure) on said macro variables. This may lead to distortion in results and hence a differentiation from the results most prior studies have produced. This done due to the fact that for our model of the yield curve we only use two different maturities resulting in a linear yield curve, as is shown below.

That being said, we will now move on to presenting the estimated coefficients of our

Figure 5: Yield Curve Comparison: 3-Month vs 10-Year

Note: Graphical representation of the average yield of 3-Month vs 10-month sovereign T-bills fro Greece (2013-2024). Graph created using python.

model in the table below.

Table 2: Regression Results of Term Structure

	coef
const	31.9278***
	(2.299)
IP	-0.2245***
	(0.022)
CPI	0.3245***
	(0.051)
PCE	-5.379e-10**
	(2.11e-10)

Note: Robust standard errors in parentheses. Statistical significance is denoted as ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Starting with industrial production(IP) we can see that it has negative statistically significant coefficient. When looking at the data for IP index we can see that overall, while having some fluctuations, it has a rising trend. During the beginning of our sample period the IP was at it's lowest and the yield spread between the maturities was high (yet both long-term and short term yield were following the same overall trend), the spread observed in typically the case since long-term maturities usually earn higher yields due to the increased risk associated with long-term future investments. Moving on in time as production increases, paired with rises in inflation, which we have already established in the sense of a rising observed trend in CPI, short-term interest rates tend to rise due to multitude of different reasons. First, in order to control inflation central banks might tighten monetary policies, this expectation may lead investors to demand higher interest rates for short-term investments to compensate both for the effect of inflation as well as for the added risk going hand in hand with aforementioned policy expectations. Second, a rising PI, and hence an improving economy, might make investors more risk seeking as the shift heir investments from safer long-term government bonds to riskier assets, pushing prices and yields of long-term bonds downwards. Third, if the market perceives the economic improvements not to be permanent this might lower the risk associated with long-term bonds pushing their yields down even further and increase the risk of short term bonds having the opposite effects on their perceived risk and yields. A combination of all these factors may lead to a decrease in yield spread between the two different maturities.

Moving on to our inflation proxy, the CPI. It demonstrates a statistically significant positive coefficient. This can be attributed to the fact that rising inflation may result in the diminishing of the risk, and the yields, of long term bonds since they are often intrumentalized in order to hedge against the risk of inflation and inflation expectations. On the other hand, as already pointed out when analyzing the effects of IP, short-term yields might spike up during periods of increased inflation since short-term bonds are at a greater risk of losing their value or part of their value, until their date of maturity during these points in time. While the positive coefficient does not seem to stem from the pre 2018 period where interest rates moved ”normally”, but rather can be attributed to the late 2019-early 2020 as well as the late 2013-early 2024 intervals where not only did inflation peek but short-term yield surpassed or were equal to long-term ones.

Finally we take a look at our proxy for consumption, the Personal Consumption Expenditure (PCE). It exhibits a statistically significant positive coefficient in our model. Similarly to the PI, an increase in PCE, which is observed, signals stronger economic growth and potentially higher inflation expectation as demand increases. This seems to be the case in our model since both CPI and PCE have a rising trend, leading to widening of the yield spread as short-term rates hike up in response to inflation, and hence long-term rates, being an inflation risk hedge, go down. The widening effect can once again be attributed to the fact that at some point short-term rates surpass long-term ones. Furthermore this effect might be amplified by the markets perception that the current economic growth can not be sustained in the future, hence making short-term investments riskier and long-term ones safer, pushing their yields up and downwards respectively.

All in all through this analysis the interconnectedness of those three macro variables is made evident. When consumption rise’s production has to follow suit and rise as well to be able to satisfy the ever growing demand. This leads to ever growing economic expenditure and hence a rise in inflation. Inflation hikes up yields of short-term rates and pushes down yields of long term ones. Yet the exact effect can vary depending on the markets perception of future monetary policies and moreover, on whether or not it is believed that the economic growth can be sustained in the long-run.

5 Conclusion

In this assignment we studies the the factors that may affect the default risk premium and the term structure of Greece during the 2013-2024 period. To do so we regressed certain macroeconomic variables on the default risk premium, as proxied by the yield spread between Greece’s and Germany’s 10 year sovereign T-bills. To gain a deeper understanding of the effect of these variables, and inspired by previous research on the subject, we estimated our model over two distinct time frames one ”crisis” and one ”non-crisis” state. Interestingly we uncovered that the effect of our chosen macro variables was indeed affected by the time frame they were estimated in, specifically the US GDP growth and CPI exhibited regime dependent effects, not achieving statistical significance during the "non-crisis" state. Furthermore the Greek GDP's and the net migrations effects were altered depending on time frame they were estimated in with net migration negative effects in the "non-crisis" time frame and positive ones during the "crisis" period. Our results showcase the effect of the factors on default risk as well as how their role pivots depending on overall financial conditions.

Additionally, we estimated a model for the term structure (term premium) using three key macro economic variables(production, inflation, consumption) usually associated with the latent factors of the yield curve (level, slope, curvature). Our results highlight the effect these factors had even, on our simplistic approach of the term structure, further confirming the findings of existing literature.

These results provide pivotal information to policymakers and investors alike about which, and through what avenues macro economic shocks and determinants influence not only a sovereignty's risk of default but also the behaviour of long and short term rates over time.

6 References

- Alessandria, G., Bai, Y., & Deng, M. (2020). Migration and sovereign default risk. Journal of Monetary Economics, 113, 1-22.
- Chatterjee, S., & Eyigungor, B. (2012). Maturity, indebtedness, and default risk. American Economic Review, 102(6), 2674-2699.
- De Pooter, M., Ravazzolo, F., & Van Dijk, D. J. (2010). Term structure forecasting using macro factors and forecast combination. FRB International Finance Discussion Paper, (993).
- Dewachter, H., & Lyrio, M. (2006). Macro factors and the term structure of interest rates. Journal of Money, Credit and Banking, 119-140.
- Evans, C.L., Marshall, D., 2007. Economic determinants of the nominal treasury yield curve. J. Monet. Econ. 54, 1986–2003.
- Kozicki, Sharon, and Peter A. Tinsley (2001). "Shifting Endpoints in the Term Structure of Interest Rates." Journal of Monetary Economics 47, 613-652.
- Kozicki, Sharon, and Peter A. Tinsley (2002). "Dynamic Specifications in Optimizing Trend- Deviation Macro Models." Journal of Economic Dynamics and Control 26, 1585-1611.
- Naifra, N., (2011). What explains default risk premium during the financial crisis? Evidence from Japan. J. Econ. Bus.63 (5), 412-430.
- Nelson, C.R., Siegel, A.F., 1987. Parsimonious modeling of yield curves. J. Bus. 60 (4), 473–489.
- Paccagnini, A. (2016). The macroeconomic determinants of the US term structure during the Great Moderation. Economic Modelling, 52, 216-225.

- Siegel, A.F., Nelson, C.R., 1988. Long-term behavior of yield curves. J. Financ. Quant. Anal. 23, 105–110
- Rho, C., & Saenz, M. (2021). Financial stress and the probability of sovereign default. Journal of International Money and Finance, 110, 102305.