The Impact of Structured Eurobonds on Exchange Rates

Marc-Patrick Adolph*

University of Trier

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*University of Trier, Universitätsring 15, 54286 Trier, Germany, adolph@uni-trier.de

Abstract

In this paper, we want to discuss the impact of introducing structured Eurobonds on the foreign exchange market. It is mainly concentrated on the connection between four currency pairs (Euro vs. US-Dollar, Swiss Franc, British Pound, and Chinese Renminbi). It can be done for every other counter currency compared to Euro as well. The impact is analyzed in a context where Eurobonds are issued through an asset-backed security (ABS) approach. Within this structure, we assume that a new yield curve for the European Monetary Union (EMU) is about to occur. Previous research results have shown a link between the relative shape of yield curves to each other and exchange rate evolution. These results are transferred to and evaluated for the actual connection between the European yield curve, several counterparts, and exchange rate development. After the introduction of structured Eurobonds and emergence of a new yield curve, the relative shape would suddenly change. Finally, the effect of this abrupt change in yield curves on the exchange rate is a depreciation of the Euro against the US-Dollar in a range of 1.70% to 3.56% in the following 12 months. In contrast, the Euro will appreciate against the other three counter currencies, ranging from 0.75% for Chinese Renminbi to 5.17% for British Pound. This is dependent on the structure of issuance as well as the time of issuance.

1 Introduction

Since the start of the European Monetary Union (EMU) the discussion on deepening sovereign bond markets is vivid. Many different possibilities have been debated to achieve this. One of these is the common issuance of bonds for all countries in the EMU, the so-called Eurobonds.

First ideas have been published by the Giovannini Group (2000) and have been evolved since today. The different approaches reach from issuing a part of the needed debt to a whole refinancing through Eurobonds with different strength of liabilities.[1]

[1] For a deeper insight in the different possibilities, see Claessens et al. (2012).

Besides strengthening the connection between member countries, the bonds can help reducing interest expenses of countries as well as deepening the market of sovereign bonds. On the other hand, there are some disadvantages. One of them which is really prominent in political and scientific discussions is "moral hazard". There is a controversial debate whether common issuance will set negative incentives for countries which have had refinancing problems through the financial crisis. Another problematic issue is the question of liability in case of default. More stable countries, e.g. Germany, fear a situation in which they have to pay for other countries who use Eurobonds as a cross-financing instrument. In the actual Reflection Paper on the Deepening of the Economic and Monetary Union of the European Commission (2018), the necessity of common issuance to deepen the bond market in the EMU is highlighted. Another purpose is to build an equivalent to the US-American T-Bill market.

New approaches for Eurobonds have been developed by Hild et al. (2014) and Brunnermeier et al. (2016) to reduce the above-mentioned disadvantages. They use structured products - especially asset-backed securities (ABS) - to construct Eurobonds. In the Reflection Paper of the European Commission, they also prefer structured products to introduce Eurobonds. The ABS-approach of both articles have some similarities but crucial differences in relevant configurations. To construct an ABS a Special Purpose Vehicle (SPV) has to buy a portfolio of bonds of all participating countries. It is relevant to say that the portfolio is filled with physical bonds and not through a synthetic contract, e.g. a credit default swap. After this pooling of assets, tranches with different risk, seniority, and interest payments are emitted. One of the main differences between both approaches is that Brunnermeier et al. (2016) have two tranches, the "European Safe Bonds" (ESBies) and "European Junior Bonds" (EJBies). Hild et al. (2014) don't have a specific number of tranches. The advantages of both ABS-approaches are a reduction of the negative aspects that are the reasons for moral hazard. Liquidity will be improved due to the different tranches. The liability is also reduced due to the structure of ABS.

Some authors have remarked that the role of the Euro as an international reserve currency will be strengthened after the introduction of Eurobonds.[2] The aim is to have a closer look at the resulting influence concerning the exchange rate between Euro and a few relevant counter currencies.

To calculate the effect we will start by assuming an issuance of structured Eurobonds in the manner of Hild et al. We consider the current European yield curve to reflect the actual link. This is based on the method used by Chen and Tsang (2013) who have examined the US-Dollar against Japanese Yen, Canadian Dollar and British Pound with the Nelson-Siegel model which is a non-linear model to describe yield curves. The Nelson-Siegel model delivers three different factors - level, slope, and curvature. The actual yield curve of the Euro Area is calculated and published by the European Central Bank. Yields of bonds emitted by member countries are weighted relative to their capital commitment at the ECB to construct the actual European yield curve. Using this data from the European Central Bank we find a significant link for different factors, mainly slope and level, and exchange rate development. The slope factor is the most robust of the three factors for the Euro against the US-Dollar because it is significant for every time horizon above 1 month whereas for other countries the level and curvature are the main factors. After this, the tranches of Hild et al. are used to create a new yield curve for the European Monetary Union which is influenced by the choice of issuance date. The impact of an introduction of Eurobonds on the exchange rate also varies through the choice of structure in the ABS-model. In a conservative setting, the appreciation of the Euro is 0.75% and ranges to 5.17% in a progressive choice of structure in the following 12 months after introduction against British Pound, Swiss Franc, and Chinese Renminbi. Against US-Dollar the Euro will face a depreciation of about 1.70% to 3.56% in the following 12 months after issuance, again dependent on the structure and issuance date.

The next sections are structured as follows. The next section provides a the-

[2]See for example the Green paper on stability bonds of the European Commission (2011).

oretical background. Section 3 describes the data, shows the actual link between the yield curves and the exchange rate and will describe the new yield curve after issuance of structured Eurobonds combined with the influence of the new yield curve on the progress of the exchange rate. In section 4 we will perform robustness checks. Section 5 concludes the findings.

2 Theoretical Background

2.1 Structured Eurobonds

Eurobonds are chosen as one part to solve the debt crisis by the European Commission. They shall also be necessary to prevent a new adverse situation in the European Monetary Union. The idea of a coordinated debt issuance was first established by the Giovannini Group (2000) who mentioned different hypothesis for elaboration. The concepts got more specified by Boonstra (2005, 2010) who introduced the possibility to use a fund for issuance. A much-noticed approach has been given by Delpla and von Weizsäcker (2010). They proposed a system with two different types of Eurobonds. Every debt needed up to a threshold of 60% of the individual national GDP can be issued together through so-called "blue-bonds". The threshold has its origin in the Stability and Growth Pact (SGP) of the EMU. Every debt needed above 60% will be issued by every country on its own. They are called "red-bonds". The specialty of this construction is the joint liability, higher liquidity, and seniority of blue-bonds against red-bonds. Due to the features of blue-bonds, participating countries have significantly lower interest payments on the debt. Delpla and von Weizsäcker assume that such a construction will gain positive incentives on discipline because red-bonds will admonish countries to get under the threshold. A greater problem in this construction is the "no-bailout" clause of the Maastricht Treaty which will be violated in case of default. A reverse method was discussed by the German Council of Economic Experts (2011). They introduced a system where sovereign debt above a threshold of 60% is transferred into a special debt redemption fund with joint liability. The threshold is also chosen with respect to the SGP. The debt will be transferred in a multi-annual process. Every country has to pay a part of its transferred volume to the fund year by year. This ensures that the fund can be closed after a fixed time horizon, the aim is 25 years. Every country will be below or just at a 60% debt-to-GDP ratio after the closing of this fund.

One way to deal with this issues and still reach the benefits of common issuance is to create "Structured Eurobonds". They have the same aim like the above-mentioned Eurobonds, e.g. to reduce interest burden and stabilize bond markets, but they diminish the negative aspects dramatically. Two methods have been developed by Hild et al. (2014) and Brunnermeier et al. (2016). Essentially they use similar techniques with slight but nonetheless fundamental differences. Both use an Asset-Backed Security (ABS) approach to creating a new bond. The outstanding and newly raised debt of every country is pooled together by a Special Purpose Vehicle (SPV), e.g. a fund. This SPV restructures the pooled bonds into new tranches with other ratings than the original bond ratings. This effect is attributed to a correlation less than 1 between the countries of the EMU. For the sake of abbreviation to explain this effect we have a look at two different countries, country A and B. Both are emitting bonds on their own and every bond is characterized by an implied default probability dependent on the riskiness of default of the emitting country and seniority. After buying these bonds, restructuring them through a SPV and emitting in different tranches, the risk of the SPV has to be calculated. We denote the risk of country A by σ_A and the ratio at the whole portfolio with x_A. Analogously is the definition of the two variables named for country B. In addition, ρ_{AB} describes the correlation coefficient between this two countries. The variance of our SPV portfolio is $\sigma_{AB}^2 = x_A^2\sigma_A^2 + x_B^2\sigma_B^2 + 2\rho x_A x_B \sigma_A \sigma_B$ and the risk is calculated by taking the square root: $\sigma_{AB} = \sqrt{x_A^2\sigma_A^2 + x_B^2\sigma_B^2 + 2\rho x_A x_B \sigma_A \sigma_B}$. Since $-1 \leq \rho \leq 1$ is valid for our correlation coefficient, the risk of the SPV portfolio is lower than or equal to the aggregated risk $x_A\sigma_A + x_B\sigma_B$ of our two countries. As countries in the

EMU are not perfectly correlated, ρ would not attain a value of 1. In this boundary case with a value of 1, a diversification would not deliver better results because the risk is the same as in the aggregated case. For our special case, the diversification will reduce risks due to lower correlation.

The new emitted tranches have a lower implied default probability than the weighted average of the actual default probability of participating countries. Since coupon rates on the nominal value of bonds are driven by ratings, this advantage can also be gained with structured Eurobonds. One main difference between the two approaches can be found in the number of tranches. While Brunnermeier et al. (2016) present a model restricted to two tranches, European Safe Bonds (ESBies) and European Junior Bonds (EJBies), Hild et al. (2014) have some more possibilities, ranging from two to even more tranches. They use a reserve fund to absorb first losses in case of default. This fund has a size of 10% of the nominal volume of emitted debt. The trust fund bear interest and if a country the defaults the recovered value is transferred to the trust fund. Losses that extend the size of the trust fund will cause depreciation of the junior tranches. Due to this construction with an ABS product the above mentioned negative aspect of Eurobonds concerning "moral hazard" and joint liability can be prevented.

2.2 Nelson-Siegel Model

The yield curve links the yield of bonds to their maturity for similar bond contracts. Diverse work has shown that information about future macroeconomic conditions can be derived from this curve. The yield curves of the US and the EMU with End of February 2018 data can be seen in figure 1. The actual US yield curve is above the EMU curve due to a higher interest rate level in the US which is a non-neglecting driver of the level.

Since this curve has a non-linear character, different models have been designed to fit the yields. The model developed by Nelson and Siegel (1987) is a prominent method to describe yield curves. Their model has an exponential character and is of the following form,

$$y(m) = L_t + S_t \left(\frac{1 - e^{-\lambda m}}{\lambda m} \right) + C_t \left(\frac{1 - e^{-\lambda m}}{\lambda m} - e^{-\lambda m} \right), \tag{1}$$

where $y(m)$ describes the yield to maturity or the continuously compounded zero-coupon nominal yield of a bond with m months to maturity. The variables L_t, S_t and C_t represent level, slope and curvature of the yield curve at an observation time t. The parameter λ is crucial to the strength of exponential decay in S_t and C_t. λ is set to 0.0609 as a standard value in the literature.[3] The impact of a changing value will be discussed in an upcoming chapter about the robustness check. It can be seen from the equation that the components have a different impact over time. While the level is a constant linear part, the slope is more relevant in the short term and decays rapidly whereas curvature gets more relevant in the midterm and decays to zero in the long term. The choice of $\lambda = 0.0609$ implies a maximum impact of the curvature factor at 30 months.

An advantage of this model is the possibility to fit it to yield data by using a relatively simple non-linear least square model. Another benefit is the feasibility to describe different kinds of yield curves, ranging from normal over humped to inverted curves.

Chen and Tsang (2013) have found a link between the exchange rate predictability and the relative shape of associated yield curves. They used the Nelson - Siegel model with a small alteration,

$$y(m) - y^*(m) = L_t^R + S_t^R \left(\frac{1 - e^{-\lambda m}}{\lambda m} \right) + C_t^R \left(\frac{1 - e^{-\lambda m}}{\lambda m} - e^{-\lambda m} \right) + \epsilon_t, \tag{2}$$

where $y(m)$ describes the home yield, in this framework the European yield, and

[3] A discussion on the choice of λ can be found in Diebold and Li (2006).

$y^*(m)$ the foreign yield. L_t^R, S_t^R and C_t^R are the relative Nelson-Siegel factors and ϵ_t is the fitting error resulting from the non-linear least square model.

3 Data and Methodology

3.1 Data

To fit the above mentioned relative Nelson-Siegel model we need yield data of the associated currencies respectively countries. We also need the exchange rate between the base currency (Euro) and different counter currencies (US-Dollar, British Pound, Chinese Renminbi and Swiss Franc) measured as counter currency price per unit of Euro. Our sample consists of end-of-month data from September 2004 to February 2018 resulting in 162 observations. The zero-coupon yields with maturities 3, 6, 12, 24, 36, 60, 84, 120, 240 and 360 months of the United States and China as well as the exchange rate are downloaded from Reuters Datastream. For Switzerland and the United Kingdom, the yield data consists of the same maturities extended by 48, 72, 96, 108 and 180 months and is also downloaded from Reuters Datastream. Yield data for the same maturities of the EMU are downloaded from the European Central Bank (ECB) statistical database. The yield data for every member country of the EMU is downloaded from Reuters Datastream. This data is used for the construction of the yield curves of the EMU after issuance of structured Eurobonds. Figure 2 shows different yield curves from EMU member countries and it can be seen that the yield curve of the EMU lies between the French and Spanish one, but is closer to the Spanish. It is representing a nearly AA yield curve. The German yields are the lowest since they have the best possible rating from rating agencies and highest liquidity.

For further steps, we also need some macroeconomic data. The GDP and debt statistics of every country in the EMU are taken from Eurostat, a European statistic institute. At least we need the ratio of commitment which every country of the EMU has at the capital stock of the ECB. The value is also available from the ECB. This ratio is calculated by the ECB and uses two key figures, one is the ratio of GDP of every country and the other one is the ratio of population.

At first, we estimate the relative Nelson-Siegel factors with equation (2) for every observation. Figure 3 illustrates the evolution of the EUR/USD exchange rate against the relative Nelson-Siegel factors. As we can see in this figure the level and slope factor are sparsely varying over time whereas the curvature factor has a higher volatility. Two interesting breaks can be seen here. The slope factor drops in 2009 which can be explained with the financial crisis as the slope is an indicator of economic growth. Afterward, it is slowly increasing due to the recovery in the USA. Another break can be seen at the end of the year 2011 for the level factor. There was one of the peaks of the European debt crisis where a higher level is characteristic. Since the US yield curve is subtracted from the EMU curve, the resulting relative factor has a quick growth. However, our attention is not on an actual link but rather on the influence to future exchange rate changes.

In the first step, we want to have a closer look at the link between the relative factors and exchange rate evolution. To find this we use the same linear regression like Chen and Tsang (2013),

$$\Delta s_{t+m} = \beta_{m,0} + \beta_{m,1} L_t^R + \beta_{m,2} S_t^R + \beta_{m,3} C_t^R + u_{t+m}, \tag{3}$$

where Δs_{t+m} is the annualized relative difference of the exchange rate at time t looking m months in the future. Due to overlapping data when $m > 1$, the solutions will be biased. To filter this moving average process we use the Newey-West covariance estimator. Although there are some other possibilities to handle this challenge, e.g. Monte-Carlo simulation or rescaled t-statistic, we use the Newey-West estimator as a conservative approach.[4] Table 1 shows diverse descriptive statistics on the different relative Nelson-Siegel factors for all counter currencies. It is noticeable that the standard deviation grows from level to curvature. This can be explained by the long yield horizon which is relevant for the level factor. On the other hand slope and

[4] A discussion on this challenge can be found by Chen and Tsang (2013)

curvature are more influenced by short or medium term changes.

The results for all currency pairs differ in the significant relative Nelson-Siegel factor as well as the predicted time horizon which is displayed in tables 2 and 3. We can find a significant connection between the relative slope factor and future change of Euro/US-Dollar in panel A. This connection can be found for every viewed future period beside the one-month horizon. This can be explained with some response time on macroeconomic evolution in the yield curve as well as the exchange rate. The level is only significant in a 3 and 18 months horizon with significance level 10%, the curvature is not significant for any horizon. Since the level is only significant for two time horizons, we neglect this in future considerations due to missing explanation power. The results can be interpreted as follows: A one percentage point higher relative slope factor predicts a 3.39% annualized depreciation of the Euro in the following 24 months. This is equivalent to a steeper US yield curve relative to the European curve. In this case, the growth expectations of the United States are getting higher. The annualized effect of this factor decreases over time. This can be explained by the declining effect of current expectations and information as well as new effects occurring in longer horizons. For British Pound (panel B) the only factor that is significant at a higher level for different time horizons is the relative level factor. The slope factor is also significant but only for 3, 6 and 12 months and the curvature is only significant on a 10% level in a 3-month horizon. In this case a one percentage point higher relative level factor predicts a 9.92% annualized appreciation of the Pound in the following 12 months. In this case, the whole yield curve of the European Monetary Union shifts up 1 percentage point relative to the UK one. Due to a consistent significance of the slope factor for three consequent viewed time horizons, it will not be left out in the calculation of the 12-month prediction. The results for Chinese Renminbi (panel A in table 3) show only a significance in the relative curvature factor and this shows up for time horizons of six months and one year, whereas it is significant with 10% level for 6 months and 5% at a one-year horizon. At least the Swiss Franc (panel B in table 3) is also significant only for longer time horizons. Here the relative curvature factor is the main driver of exchange rate evolution and the other two factors only show up for a horizon of 24 months. A one percentage point rise in the relative curvature factor will lead to a 2.13% rise in the exchange rate which is equivalent to an appreciation of the Euro against the Swiss Franc.

We also look at non-overlapping Data to show the robustness of this regression with the Newey-West estimator. They are constructed for 3 and 6 months in the future by only looking at end of quarter and semi-annual data. They are as well displayed in table 2 in panel C but only for a three and six-month horizon and US-Dollar as counter currency. If longer horizons are examined we will have problems with the number of observations. We have 54 respectively 27 observations for quarterly and semi-annual data. For longer horizons with one year or more, we only have 13 or fewer observations left. This will reduce the explanatory power of the test. The relative slope factor delivers values close to the shown values panel A. The two other factors which are not significant in the non-overlapping dataset have larger differences. The other currencies are displaying the same picture and are therefore not included in the table.[5]

3.2 Estimation of New Yield Curves

The next step to find the impact of structured Eurobonds on exchange rates is to estimate the shape of the yield curve after the introduction of a new bond system through an ABS-approach. We look at three different structuring methods which are taken from Hild et al. (2014) and build new yield curves for every method. As the ratings of every tranche, as well as the thickness, are fixed, the yield curve is calculated using macroeconomic data. The countries who have the same rating are weighted by this macroeconomic indicators to build a benchmark curve. For every tranche, we use the rating to find the corresponding benchmark in the EMU. The different curves in the whole structured product will be weighted by the thickness

[5]The results are available on request.

of the represented tranche and construct a new yield curve.

To estimate this we use three different calculation methods respective macroeconomic indicators and show that they deliver similar results. The first method is inspired by the actual way to calculate the European yield curve using the commitment of every country at the capital stock of the ECB. The AAA tranche is built using the yield curves of the respective countries. Their weighting in the ECB capital stock is scaled up until their sum reaches 100%. With this scaling, we get their weighting in the benchmark curve for the AAA tranche. This method is also used for every other rating as well as macroeconomic indicator. The second indicator is the ratio of every single country GDP at the GDP of the whole EMU. At last, we will use the rate of debt of every country at the whole debt of the EMU. An advantage of the second and third estimator is that they can be adjusted every quarter through the release of new datasets whereas the capital commitment is only calculated every 5 years or after the accession of a new country in the European Union. The yields for every maturity of a benchmark curve can be calculated using the following formula:

$$y_R(m) = \sum_{i=1}^{n} \frac{IND_i}{\sum_{j=1}^{n} IND_j} \cdot y_i(m), \tag{4}$$

where n is dependent of the number of countries with the same rating. IND_i is the value of the chosen macroeconomic indicator for country i, so $\frac{IND_i}{\sum_{j=1}^{n} IND_j}$ describes a weighting of country i in the benchmark curve. At least $y_i(m)$ is the yield of the appropriate country and $y_R(m)$ finally describes the yield with m months to maturity and a rating R. Using this method we can build a benchmark curve for every rating.

The resulting yield curve from a special structure is built by a weighted sum of benchmark curves:

$$y(m) = \sum_{k=1}^{l} T_R \cdot y_R(m), \tag{5}$$

where l is the number of tranches with different rating and T_R the thickness of the representative tranche.

3.3 Impact on Exchange Rate

3.3.1 Conservative Structure

Hild et al. (2014) have built structures with different correlations between countries and the structures can be seen in table 4. The conservative structure can be seen in panel A. In this table two other structures are displayed which will be evaluated in the next chapters.

This tranching implicates a yield curve which is different from the actual one but great swings are not expected. This assumption can also be validated in figure 4, which shows the actual yield curve and a new one build by the method of ECB-commitment for February 2018. In the short term both curves are close to each other but in the long term with maturities above 8 years, the values are diverging even more. A consequence will be a relatively higher slope and lower level factor which is supported by the upcoming calculation results.

Using the three indicators (ECB-commitment, GDP and debt) and equations (4), (5), we get slightly different yield curves which cannot be visualized in an appropriate way. It can only be seen in the Nelson-Siegel factors and the calculation results. In the graphic, we can see that the new yield curve is flatter than the actual one. It was thematized in the previous chapter that a consequence of a steeper yield curve would be an appreciation of the Euro against the US-Dollar. Since it is flatter in this case, we will face a depreciation of the Euro which will be underpinned by the following calculation results. Additionally, the long-term level is lower which delivers a lower relative Nelson-Siegel level. As we have mentioned before, a lower relative Nelson-Siegel level delivers a depreciation of the British Pound. This will be seen in the following calculations.

We use equation (2) to calculate the relative Nelson-Siegel factors using the new yield curve and the US yield curve. In the next step, we compare the relative factors of the new curve with the relative factors of the actual curve for January and February 2018 using the three methods of construction. This is presented in tables 5 and 6.

The first column of the table is listing the different Nelson-Siegel factors and in brackets the method of calculation for the currency pair EUR/USD. The following column presents the calculated values with the actual EMU yield curve from the ECB, followed by the values with our recent created yield curve as a result of the structure. At last, the difference between both values is highlighted. Panel A shows the results for January and panel B for February 2018. As it can be seen in the calculation results, the difference between the three methods of construction is marginal. Only the curvature factor shows higher, but not really huge, differences than the others. The same can be seen for the three other examined currencies.[6] Due to this fact, we only evaluate the calculation method regarding the ECB-commitment in this and the following chapters, because it is in line with the actual method of calculation. Table 6 displays the other three counter currencies and has the same setup as table 5. As we have mentioned above, the predominantly parameter for US-Dollar is the relative slope factor and curvature is not explaining exchange rate movements for any time horizon. The impact of introducing structured Eurobonds is dependent on the issuing month. With issuing month January the impact on the relative slope factor is about 0.32. This impact can be explained with a lower growth expectation relative to the US economy resulting from the flatter yield curve. As a consequence, the Euro will face a depreciation.

For the following month, the impact on the relative slope factor is greater, it reaches 0.36. Connecting this results to the actual link between the relative Nelson-Siegel factors and the exchange rate in table 5, we can conclude an impact of -1.08% in January and -1.22% in February on the exchange rate for a 2-year horizon. As we have taken the exchange rate in Dollar price per unit, the Euro faces an annualized depreciation of 1.08% respectively 1.22% in the following 24 months. For better comparison between the four different counter currencies, we will focus

[6]The results for the other counter currencies can be presented upon request.

on a twelve month time horizon because it is the only horizon with significant factors for each currency. This delivers an impact of -1.70% to -1.91% on the exchange rate EUR/USD in the following year after the introduction of structured Eurobonds. When facing British Pound we have to evaluate the change of two Nelson-Siegel factors, level and slope. The impact of issuing structured Eurobonds in January will be a rise of 3.01% of the exchange rate in the following 12 months which is equivalent to an appreciation of the Euro. Contrary to the results for the US-Dollar the effect is weaker for February 2018 with an impact of 2.34%. The same direction of impact can be seen for Chinese Renminbi. It is weaker than British Pound with 1.04% for January and drops to 0.75% if structured Eurobonds have been emitted in February 2018. At last, we take a closer look at the impact on Swiss Franc which is only determined by the relative curvature factor. The effect is 2.07% for January and weakens to 1.62% in February.

The Euro would only face a depreciation against the US-Dollar in a conservative structure whereas it would appreciate against the three others. This is a structure with restrictive assumptions. We will have a closer look at less restrictive structures in the following chapters.

3.3.2 Ordinary Structure

This structure is built with less rigorous restrictions on the correlation. Like at the beginning of the previous chapter the structure is presented in table 4 in panel B. Compared with the first structure, the BBB tranche drops and the AAA tranche grows above 85% thickness. Figure 5 presents the yield curve shape in this structure compared to the actual one. Due to the greater thickness of the AAA part, this yield curve has a lower long-term level and while the other yield curves are subtracted from it, the relative level factor will decrease. Observing the short term, we can see that the yield curve of the conservative and ordinary structure are really similar. Following this and a lower long-term level, the slope has to be lower than in the conservative setting and the relative slope factor will grow. The same explanation can be used for the curvature factor. The similar values in the short term can be explained with the expansive monetary policy of the ECB which suppresses individual risk premium. As the level is again lower than the actual yield curve, we expect an appreciation of the Euro against British Pound. Since the level is also lower than for the ordinary structure the effect will be stronger than before. The relative Nelson-Siegel factors are again analyzed for January and February. The results can be seen in table 7.

We can see that the differences in the relative Nelson-Siegel factors are getting greater than using the conservative structure. They range between 0.55 and 0.59 for the relative slope factor with counter currency US-Dollar. Following this result, we can conclude an impact of -2.92% to -3.13% on the exchange rate. Like before this represents a depreciation of the Euro against US-Dollar the following 12 months after introducing structured Eurobonds. As the differences are getting greater, also the impact is growing.

The same can be seen for the other three counter currencies where the direction of impact is the same as before but now the impact is stronger. It grows to 4.65% and 4.09% for British Pound which is more than 1.5 percentage points greater than in the conservative structure. The impact on CNY is rising up to 1.59% in January respectively 1.30% in February which is about 0.5 percentage points higher than for a conservative structure. As before the Euro would face an appreciation. The same picture is drawn for Swiss Franc with impacts of 3.02% and 2.54%. The drop on the impact from January to February which can be seen for every counter currency is due to a change of yields of the constituents of the new yield curve from one month to the other.

3.3.3 Progressive Structure

At last, we want to have a closer look on a structure with even lower correlations than in the ordinary structure shown in the previous section. In this case, the BBB+ tranche drops leaving only three tranches. The AAA tranche grows to a thickness above 95%. We can see the structure in panel C of table 4. Due to the structure of the tranches, the new yield curve will be nearly a AAA yield curve which is close to the actual German one. The newly created yield curve in this structure can be seen in figure 6. We see a flattened yield curve with only small changes in the short horizon in comparison to the previous curves but with a small downward shift for all horizons. This will again have an influence on the different factors and will result in even stronger exchange rate evolutions. This assumption is proved by numerical results which can be seen in table 8. The setup of the table is the same as in the previous chapters. The differences in crucial factors are even rising in absolute values. The shock of introducing structured Eurobonds in January respectively February on the relative slope factor would be 0.62 and 0.67. This delivers an effect of -3.29% to -3.56% on the exchange rate. In this case, the Euro will again face a depreciation of 3.29% to 3.56% the following 12 months after introducing structured Eurobonds.

As before the other counter currencies show an appreciation of the Euro. The effect is stronger than in a scenario with the conservative structure, now ranging from 4.59% to 5.17% for British Pound, 1.45% to 1.76% for Chinese Renminbi and 2.78% to 3.3% for Swiss Franc. In this structure, the effect is the greatest but the jump from the ordinary to this structure is lower than from the conservative to the ordinary. This can be explained by the small shift from the BBB+ tranche to the better ones whereas in the first improvement the AAA tranche grows nearly 30 percentage points.

4 Robustness check

4.1 Modified Lambda

The choice of λ as 0.0609 in the Nelson-Siegel model is inspired by Diebold and Li (2006) and Chen and Tsang (2013). At this value, the maximum impact of λ on the curvature is at 30 months. As we see in the regression results, the curvature factor is not relevant in predicting the exchange rate. Other authors like Afonso and Martins (2012) chose not a global value but a local value for every dataset. This value is a result of the nonlinear least square model. When using this approach for the model from equation (2) with the European and US yield curve, we get a median value for λ of 0.0380. This value implies a maximum loading of the curvature factor at a maturity of 47 months, it is more slowly increasing than in the other case. Also, the loading of the slope factor is less rapidly decreasing which implies a longer effect of this factor. Both factors are getting similar after 80 months in the first case and after 145 months in the second case. This can also be seen in figures 7 and 8. Here the different impact on the Nelson-Siegel model respectively the yield curve of every single factor is presented which was mentioned in a previous chapter.

Now we use the local value of 0.0380 to calculate the three Nelson-Siegel factors for equation (2) with the European and US yield curve. Following this we use linear regression (3) with our new λ and the exchange rate to find a link between the predictability of exchange rates and evolution of the three factors. The results are displayed in table 9. We focus on the examination of US-Dollar as counter currency because the results for other currencies are showing the same characteristics. [7]

Comparing this results with the results from table 2, we can see that the significance in the slope factor is getting weaker for 3 and 6 months, but grows for 18 months. On the other hand, we get a significance level of 10% for the level factor in a time horizon of 12 months and the significance grows for an 18 months horizon. Due to comparison purposes, we will again mainly focus on the slope factor as a predictive instrument. The curvature factor is also significant in a short horizon of 1 month but will not be further investigated. Although the values are changing we can see in the longest horizon that the value for our main significant factor - slope - is really close to the one generated with the original value of λ. Also, the sign of the factor is the same, so a change of the yield curve will have the same effect on the exchange rate as we have examined before. We only look at the conserva-

[7] Results can be delivered upon request.

tive and progressive structure since they are representing two extreme positions in our model. We build the yield curves again using the ECB-indicator to calculate it with the capital commitment. This calculation method ensures consistency and comparability between the computed outcomes.

The nonlinear least square model delivers an optimal value of λ for the composed yield curve in the conservative structure of 0.0431 for January and 0.0462 for February. Results for the conservative structure are presented in panel A of table 10. In the first column, we see the actual values calculated with the optimal values of λ. As above mentioned the value are 0.0431 respectively 0.0462 for this column. After this, the difference between both values is shown and for comparison purposes in the last column the results with the original λ presented in table 5. Comparing the values and differences we can see that the relative factors are changing but the sign of the differences stay the same. At least the shift in the relative slope factor is getting stronger with the modified λ. Since the sign of the shift and regression presented in table 9 are the same, we will also face a depreciation of the Euro against US-Dollar in the following 12 months after the introduction of structured Eurobonds. When we look at the results for a 12-month horizon, the original impact is a 1.70% depreciation for January. With our modified lambda, we will face a 2.65% depreciation only due to the relative slope factor for an introduction in January. The same pattern can be observed for the following introduction month. The difference of the slope factor is greater than in January. As a consequence, the impact will also be higher. The original λ has a depreciation of 1.91% as consequence. With the modified λ, we can conclude a depreciation of 3.07% in the following 12 months. Now we want to examine the progressive structure and test whether the modification has the same effect on exchange rate evolution.

In this case, the non-linear least square model delivers an optimal value of λ for the composed yield curve in the structure of 0.0466 for January and 0.0484 for February. The values for λ change compared to the ordinary structure because we have a new composition of the yield curve and therefore a new shape. The results can now be seen in panel B of table 10. We can see that the resulting differences in the level factor are really close and for the curvature factor are vast when we compare the results for original and modified λ. The difference in the slope factor is our crucial factor. Since the signs are the same we will also face a depreciation of the Euro against US-Dollar. We originally found a depreciation of 3.29% and 3.56% for January respectively February in the following 12 months after introducing structured Eurobonds. In the modified setting our effect is even greater. Here we obtain an impact of 4.76% and 5.02% on the exchange rate which is clearly stronger than the original one.

It can be said that the original choice of λ as 0.0609 delivers more conservative results since the absolute value of annualized depreciation is lower than in the case with a modified λ.

4.2 Uncertainty measure

Besides the impact of the relative yield curve on the exchange rate, we also like to have a view on a global uncertainty measure which can be an additional explanation of exchange rate shift. We use the CBOE Volatility Index (VIX) which is calculated by the Chicago Board Options Exchange on a daily basis. It represents the implied volatility from options on the S&P 500 index. We modify regression (2) by adding the index resulting in

$$y(m) - y^*(m) = L_t^R + S_t^R \left(\frac{1 - e^{-\lambda m}}{\lambda m} \right) + C_t^R \left(\frac{1 - e^{-\lambda m}}{\lambda m} - e^{-\lambda m} \right) + \delta_1 VIX + \epsilon_t. \quad (6)$$

Data for the VIX is taken from Reuters Datastream for the same time horizon as for the yield curves resulting in 162 observations. For the regression month-end data is again used with the original value of λ at 0.0609 for better comparison. This delivers the following connection displayed in table 11. The relative slope factor is now highly significant for every time horizon and the values for this factor are higher than in our original set. Also, the VIX is significant for every time horizon and the level factor grows in significance. The higher significance of both factors can be described by the VIX. As level and slope of a yield curve are explaining long-term interest rate and country growth expectations, an uncertainty measure smooths out these disturbances.

The higher values of the slope factor are a hint that our first evaluation is more conservative because the shocks after introducing structured Eurobonds will stay the same but the connection between the Nelson-Siegel factors and the exchange rate evolution grows. To emphasize this we calculate the exchange rate influence in a conservative structure. The effect on the other two structures is the same. We can see an effect of the slope factor of -6.917 in the regression results displayed in table 11 for a 12-month horizon. Since the change of the EMU yield curve is not influenced by this, we can use table 5 to find the change in the slope factor. The impact on the factor is between 0.32 and 0.36. This leads to an exchange rate trend between -2.21% and -2.49% which is higher than in the setting of the previous chapter. Again, we are facing a depreciation of the Euro against the US-Dollar.

We can follow that the inclusion of this uncertainty measure increases the explanatory power of the regression. In addition, it supports our findings and the direction of the effect on exchange rates. However, the effect is stronger in this scenario which may be explained by the effect of the uncertainty measure on the three Nelson-Siegel factors. For a more conservative estimation, the original setting shall be consulted.

5 Conclusion

An issuance of structured Eurobonds with an ABS-approach would not only influence the European sentiment but also would have a severe impact on capital markets. The fragmentation of sovereign bond markets in the European Monetary Union would vanish and the interest burden of every single country would be reduced. The impact of an introduction on the forex market hasn't yet been examined although the strengthening of the Euro as an implication of a new bond has been mentioned in recent research references.

Using the Nelson-Siegel Model and previous methods established by Chen and Tsang, we can find a significant connection between exchange rate evolution and the relative yield curve of the European Monetary Union and other countries. This connection is significant in all Nelson Siegel factors. When Eurobonds are issued with the ABS-approach an issuance on a country level is not necessary and individual yield curves are no longer existing. A new yield curve on EMU-level replacing the actual one will be the consequence. Dependent on the structure of issuance the shape will be different, ranging from a nearly AAA yield curve to a mixed yield curve near an AA curve, e.g. Belgium. The new yield curve causes a shock by influencing the relative Nelson-Siegel factors. This shift has an impact between -1.70% and -3.56% on the exchange rate of Euro against US-Dollar, dependent on the structure and time of introduction of structured Eurobonds. The impact describes a depreciation of the Euro against US-Dollar in the following 12 months. The other three examined counter currencies - British Pound, Chinese Renminbi and Swiss Franc - will face a depreciation, ergo the Euro will appreciate. The strength of this effect also depends on issuing time and structure. It will reach an impact between 0.75% and 5.17% in the following 12 months after issuance of structured Eurobonds.

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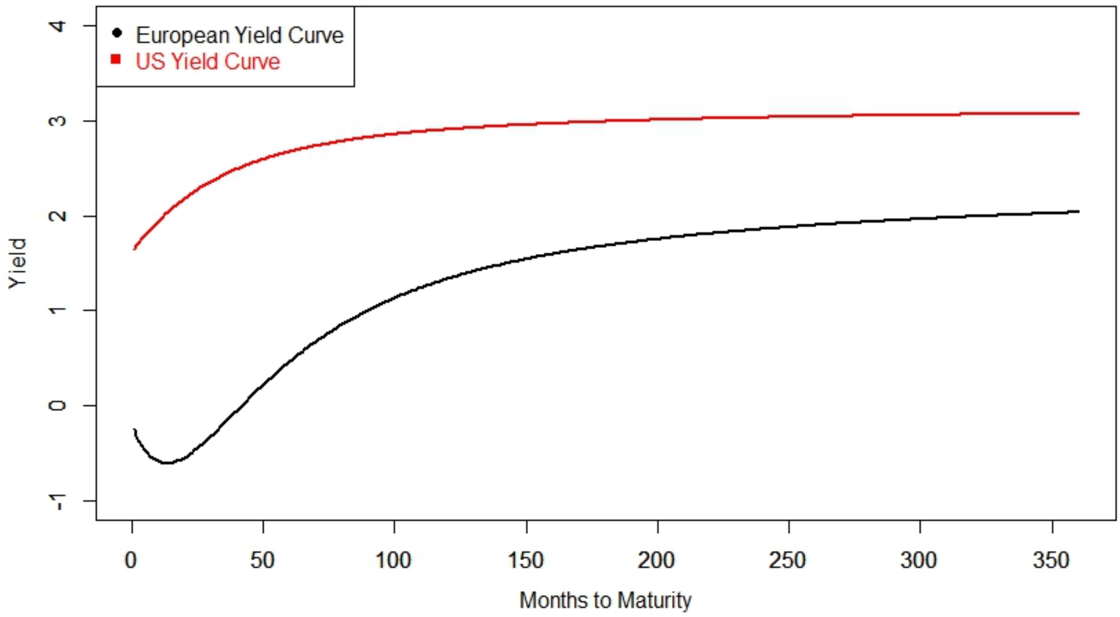

Figure 1: The European and US Yield Curve for End of February Data

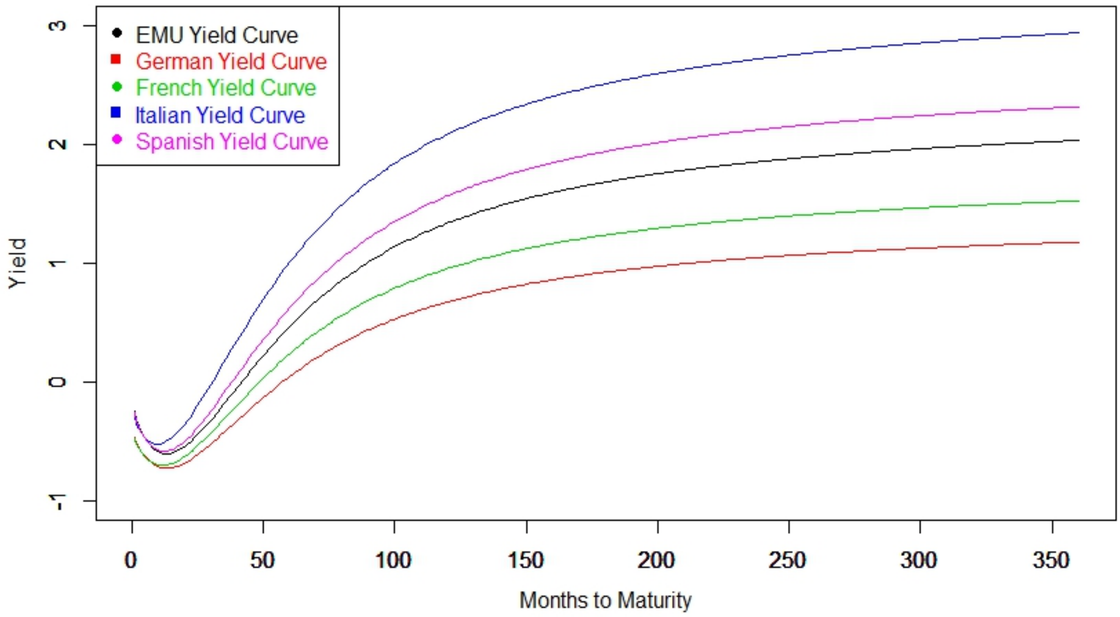

Figure 2: The EMU and member yield curves for End of February Data

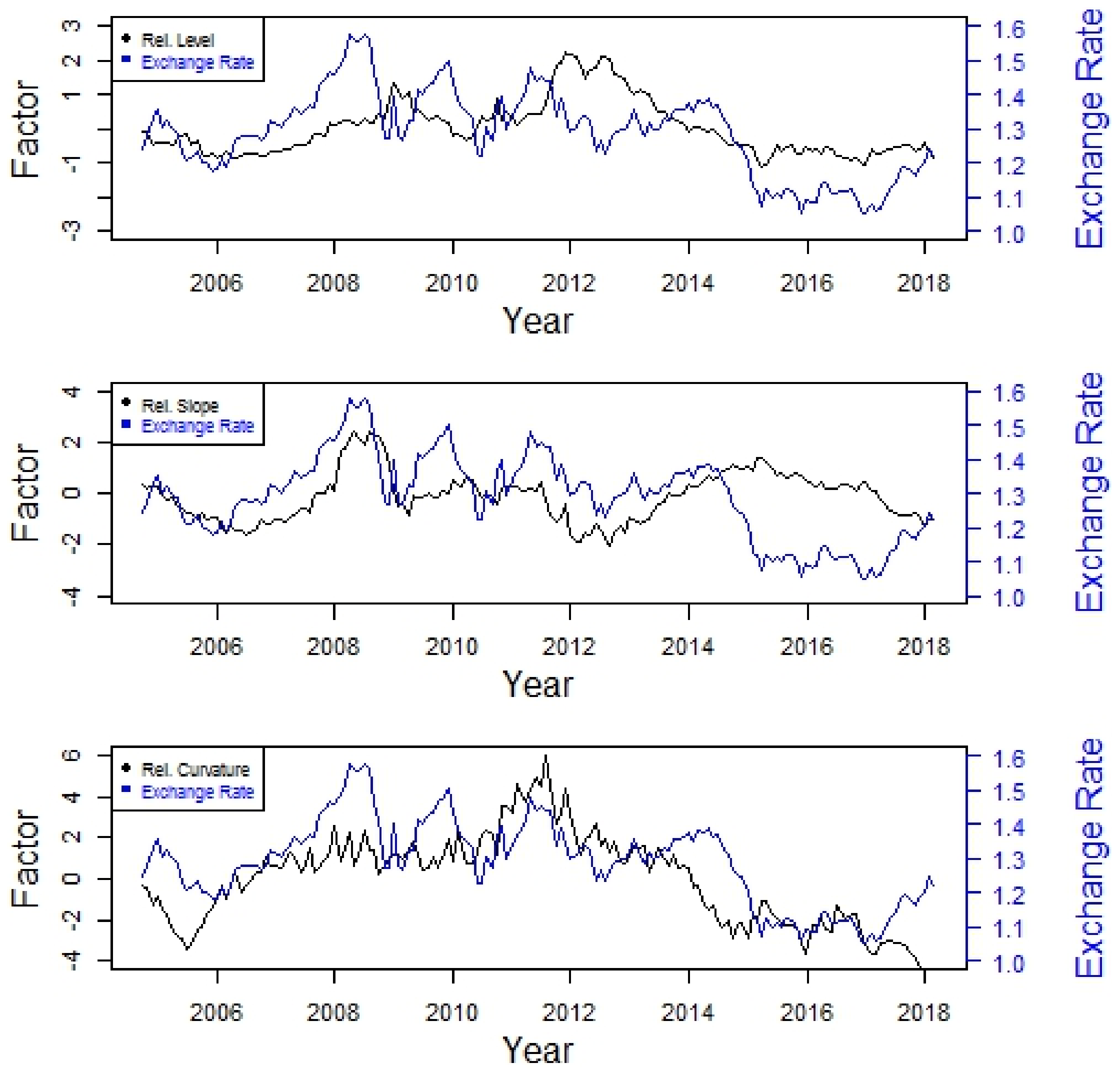

Figure 3: Time series of Nelson Siegel factors and exchange rate

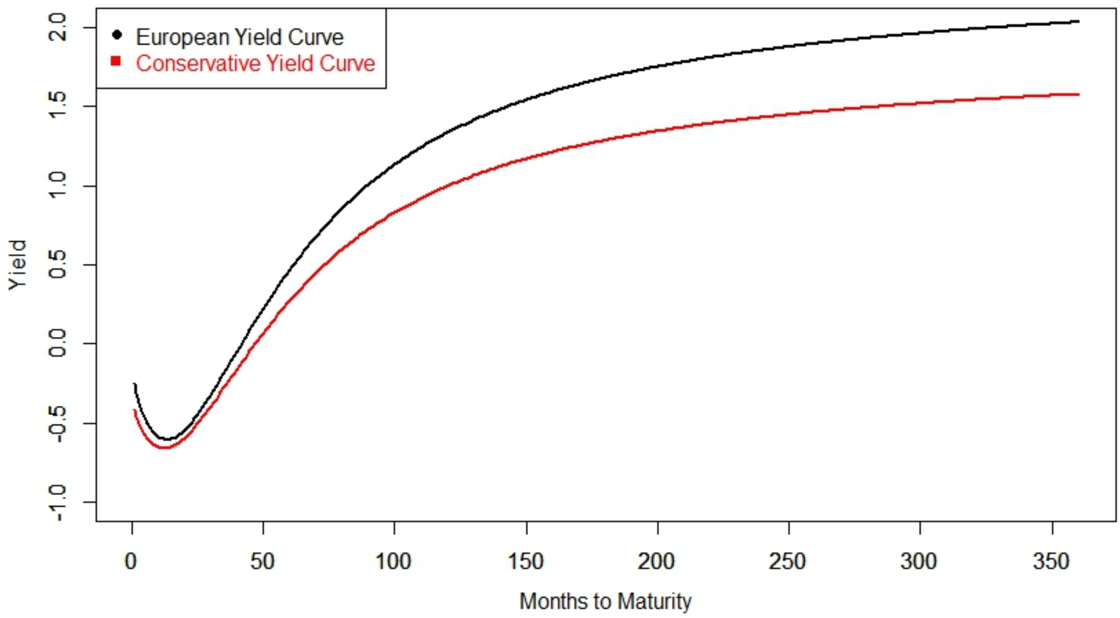

Figure 4: The European and new Yield Curve with a conservative structure for End of February Data

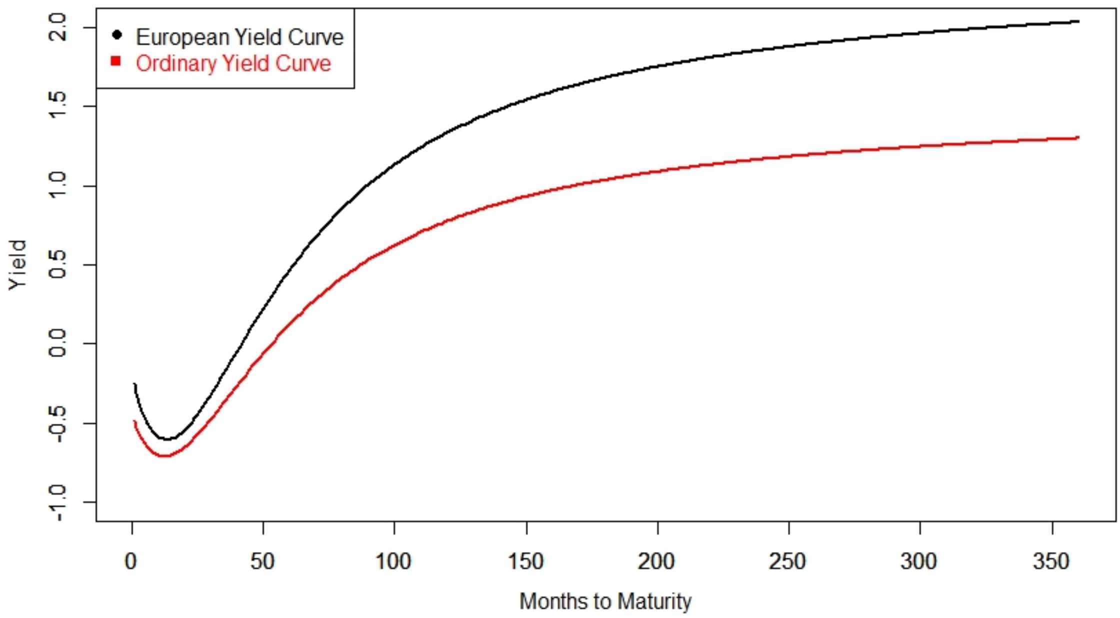

Figure 5: The European and new Yield Curve with an ordinary structure for End of February Data

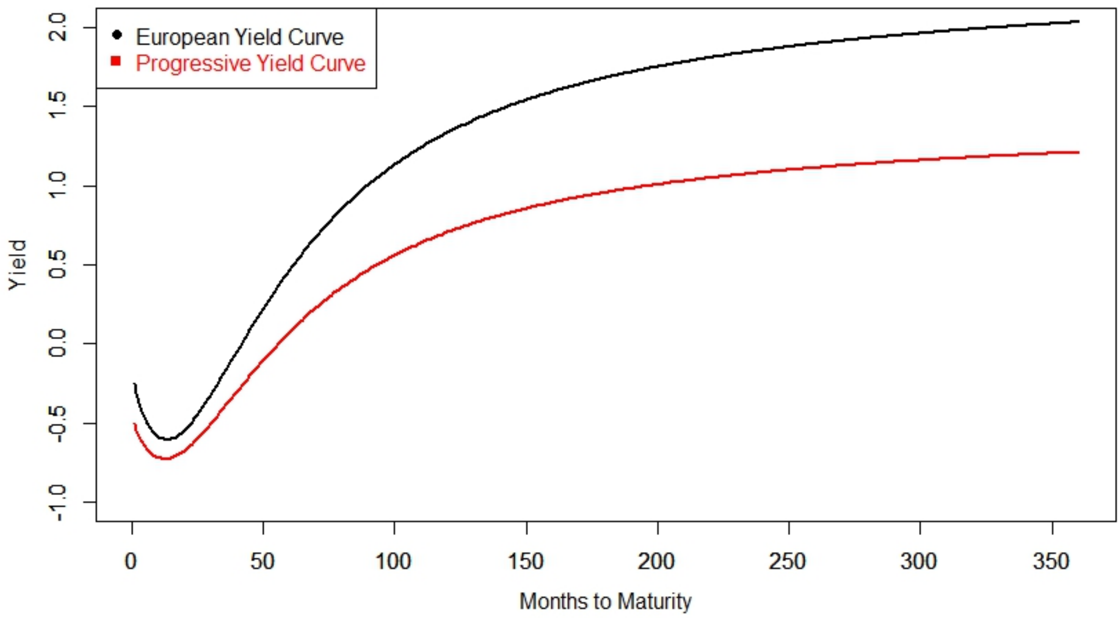

Figure 6: The European and new Yield Curve with a progressive structure for End of February Data

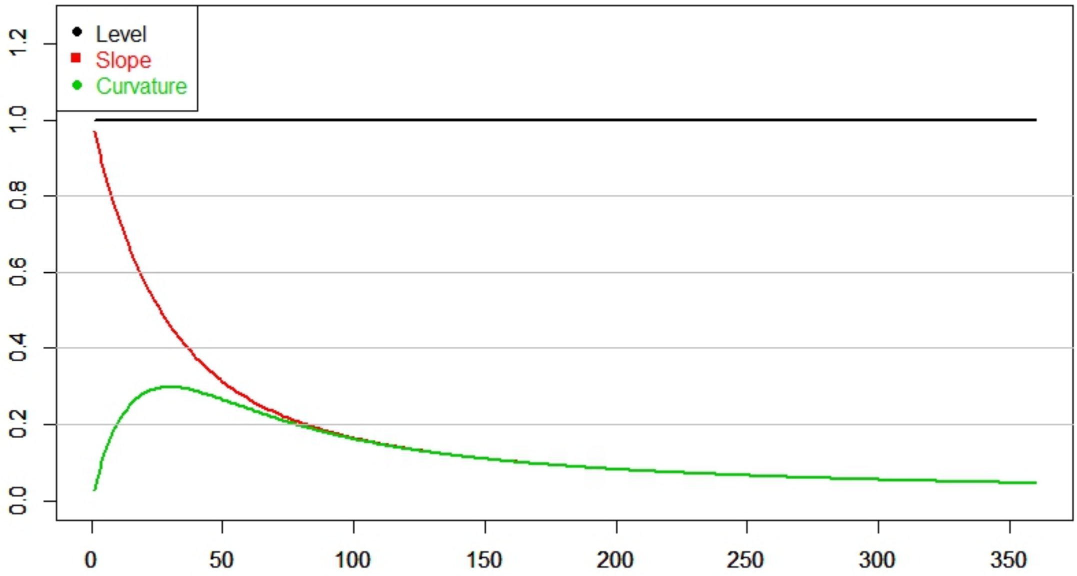

Figure 7: Factor impact with $\lambda = 0.0609$

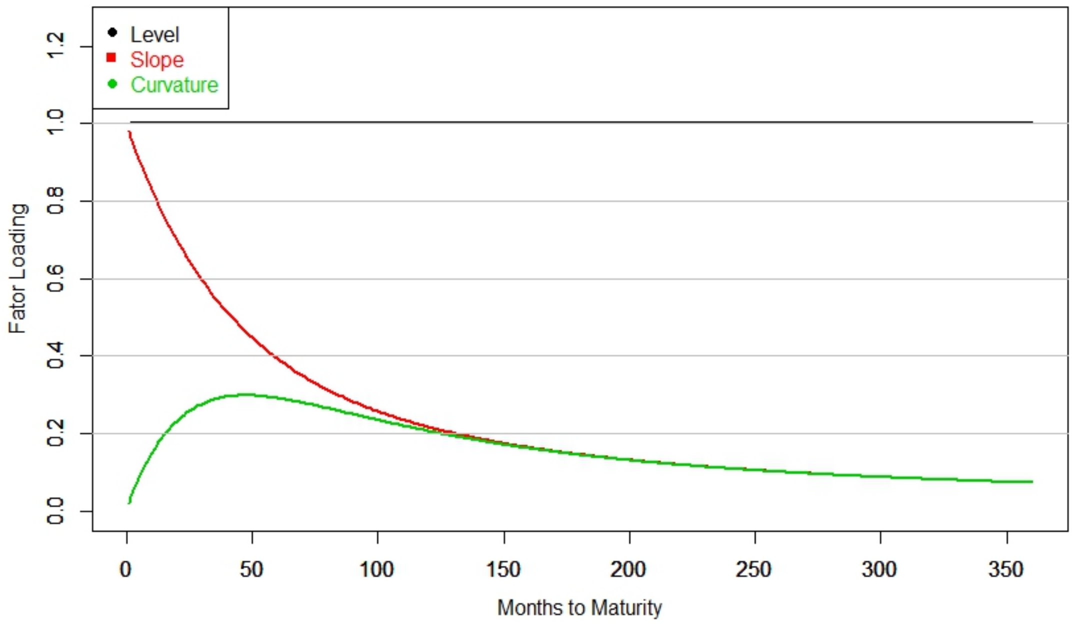

Figure 8: Factor impact with $\lambda = 0.038$

Table 1: Descriptive Statistics for Nelson-Siegel Factors

	Mean	Median	Maximum	Minimum	Std.Dev
Panel A: US-Dollar					
Level	0.019	-0.175	2.236	-1.143	0.808
Slope	-0.126	-0.052	2.431	-2.025	0.955
Curvature	-0.054	0.515	6.031	-4.710	2.246
Panel B: British Pound					
Level	0.204	0.079	2.141	-0.909	0.577
Slope	-0.815	-0.837	0.637	-3.032	0.764
Curvature	-0.461	0.848	5.934	-5.764	2.401
Panel C: Chinese Renminbi					
Level	2.214	2.328	3.547	0.389	0.676
Slope	-1.285	-1.649	1.381	-3.276	1.404
Curvature	-0.288	0.258	2.693	-4.009	1.958
Panel D: Swiss Franc					
Level	1.915	1.532	3.947	0.819	0.739
Slope	-1.043	-0.963	0.45	-3.417	1.003
Curvature	-1.996	-1.926	1.373	-5.576	1.398

Notes: The descriptive statistics for the three different Nelson-Siegel factors out of 162 observations per factor and counter currency.

Table 2: Connection between Nelson-Siegel Factors and Exchange Rates

Panel A: US-Dollar						
Factor \ Horizon	1 Month	3 Months	6 Months	12 Months	18 Months	24 Months
Level	-2.836	-4.824 .	-4.431	-3.818	-3.127.	-2.232
	(-0.552)	(-1.694)	(-1.287)	(-1.484)	(-1.874)	(-1.217)
Slope	-4.462	-6.640**	-6.950**	-5.309*	-4.118*	-3.398**
	(-1.341)	(-2.930)	(-2.831)	(-2.141)	(-2.521)	(-2.619)
Curvature	1.638	1.279	0.751	0.199	0.009	-0.387
	(0.912)	(0.757)	(0.325)	(0.175)	(0.016)	(-0.766)
Panel B: British Pound						
Level	-9.064	-11.436*	-10.917*	-9.915**	-7.572.	-4.429
	(-0.847)	(-2.019)	(-2.238)	(-2.912)	(-1.859)	(-0.833)
Slope	1.390	-7.018*	-6.805.	-5.756.	-4.118	-1.714
	(0.223)	(-2.067)	(-1.921)	(-1.886)	(-1.193)	(-0.176)
Curvature	1.606	1.752.	1.504	1.087	0.348	-0.448
	(0.692)	(1.733)	(1.626)	(1.467)	(0.670)	(-0.435)
Panel C: Non-Overlapping US-Dollar						
Level		-3.626	-4.323			
		(-0.759)	(-0.835)			
Slope		-6.388*	-6.034.			
		(-2.197)	(-1.988)			
Curvature		0.816	0.475			
		(0.493)	(0.264)			

Notes: The connection of different Nelson-Siegel factors and their predictive power for exchange rate evolution with the currency pairs EUR/USD and EUR/GBP. The significance levels are . 10 percent; * 5 percent; ** 1 percent and *** 0.1 percent. In parenthesis below the factor the t-statistic after the use of the Newey-West estimator is displayed.

Table 3: Connection between Nelson-Siegel Factors and Exchange Rates

Factor \ Horizon	1 Month	3 Months	6 Months	12 Months	18 Months	24 Months
Panel A: Chinese Renminbi						
Level	0.529	-0.877	-2.145	-2.265	-1.767	-1.713
	(0.179)	(-0.083)	(-0.841)	(-1.216)	(-1.168)	(-1.435)
Slope	-0.799	-0.506	-0.248	0.423	0.586	0.449
	(-0.494)	(-0.119)	(-0.178)	(0.402)	(0.632)	(0.678)
Curvature	1.005	0.985	1.566 .	1.365*	0.643	0.413
	(0.937)	(0.168)	(1.894)	(2.599)	(1.328)	(1.063)
Panel B: Swiss Franc						
Level	-5.517	0.787	1.687	1.876	2.881	4.418**
	(-1.006)	(0.136)	(0.747)	(0.609)	(1.372)	(2.779)
Slope	-5.520	0.394	1.326	1.128	1.979	3.210*
	(-1.202)	(0.099)	(0.744)	(0.526)	(1.183)	(2.596)
Curvature	1.381	1.313	1.550	2.134**	1.729**	1.064.
	(0.992)	(0.856)	(2.755)	(3.325)	(2.676)	(1.814)

Notes: The connection of different Nelson-Siegel factors and their predictive power for exchange rate evolution with the currency pairs EUR/CNY and EUR/CHF. The significance levels are . 10 percent; * 5 percent; ** 1 percent and *** 0.1 percent. In parenthesis below the factor the t-statistic after the use of the Newey-West estimator is displayed.

Table 4: Different Structures

Panel A: Conservative Structure			
Tranche	Thickness	Rating	Interest Rate
Tranche I	56.63%	AAA	2.9%
Tranche II	9.35%	AA-	3.5%
Tranche III	9.42%	A	4.3%
Tranche IV	20.01%	BBB+	5.3%
Tranche V	4.59%	BBB	6.3%
Panel B: Ordinary Structure			
Tranche I	85.07%	AAA	2.9%
Tranche II	7.38%	AA-	3.5%
Tranche III	2.96%	A	4.3%
Tranche IV	4.59%	BBB+	5.3%
Panel B: Progressive Structure			
Tranche I	95.41%	AAA	2.9%
Tranche II	2.94%	AA	3.5%
Tranche III	1.65%	A	4.3%

Table 5: Change of Nelson-Siegel Factors after introducing structured Eurobonds for USD

Factor	Actual Values	New Values	Difference
Panel A: January 2018			
Level (ECB)	-0.651	-1.125	**-0.474**
Slope (ECB)	-0.991	-0.672	**0.319**
Curvature (ECB)	-4.711	-3.974	**0.737**
Level (GDP)	-0.651	-1.120	**-0.469**
Slope (GDP)	-0.991	-0.673	**0.318**
Curvature (GDP)	-4.711	-4.001	**0.710**
Level (Debt)	-0.651	-1.119	**-0.468**
Slope (Debt)	-0.991	-0.674	**0.317**
Curvature (Debt)	-4.711	-4.005	**0.706**
Panel B: February 2018			
Level (ECB)	-0.836	-1.289	**-0.453**
Slope (ECB)	-1.044	-0.683	**0.361**
Curvature (ECB)	-4.433	-3.864	**0.569**
Level (GDP)	-0.836	-1.285	**-0.449**
Slope (GDP)	-1.044	-0.681	**0.363**
Curvature (GDP)	-4.433	-3.898	**0.535**
Level (Debt)	-0.836	-1.284	**-0.448**
Slope (Debt)	-1.044	-0.683	**0.361**
Curvature (Debt)	-4.433	-3.902	**0.531**

Notes: The effect of introducing structured Eurobonds in a conservative structure on the exchange rate EUR/USD and under different building methods of the new yield curve. The introduction months are January and February 2018.

Table 6: Change of Nelson-Siegel Factors after introducing structured Eurobonds for the other currencies

Panel A: January 2018 Factor	Actual Values	New Values	Difference
Panel A.1: British Pound			
Level	0.221	-0.279	**-0.500**
Slope	-0.930	-0.592	**0.338**
Curvature	-2.471	-1.660	**0.811**
Panel A.2: Chinese Renminbi			
Level	-2.059	-2.545	**-0.486**
Slope	-1.627	-1.298	**0.329**
Curvature	-3.705	-2.941	**0.764**
Panel A.3: Swiss Franc			
Level	1.343	1.099	**-0.244**
Slope	-0.835	-0.815	**0.020**
Curvature	-2.284	-1.314	**0.970**
Panel B: February 2018			
Panel B.1: British Pound			
Level	0.295	-0.150	**-0.445**
Slope	-1.016	-0.656	**0.360**
Curvature	-3.111	-2.588	**0.523**
Panel B.2: Chinese Renminbi			
Level	-1.995	-2.441	**-0.446**
Slope	-1.484	-1.129	**0.355**
Curvature	-3.561	-3.010	**0.551**
Panel B.3: Swiss Franc			
Level	1.268	1.063	**-0.205**
Slope	-0.852	-0.806	**0.046**
Curvature	-1.761	-1.004	**0.757**

Notes: The effect of introducing structured Eurobonds in a conservative structure on the exchange rate EUR/GBP, EUR/CNY and EUR/CHF. The introduction months are January and February 2018.

Table 7: Change of Nelson-Siegel Factors after introducing structured Eurobonds

Panel A: January 2018 Factor	Actual Values	New Values	Difference
Panel A.1: US-Dollar			
Level	-0.651	-1.414	**-0.763**
Slope	-0.991	-0.441	**0.550**
Curvature	-4.711	-3.599	**1.112**
Panel A.2: British Pound			
Level	0.221	-0.576	**-0.797**
Slope	-0.930	-0.365	**0.565**
Curvature	-2.471	-1.216	**1.255**
Panel A.3: Chinese Renminbi			
Level	-2.059	-2.845	**-0.786**
Slope	-1.627	-1.058	**0.569**
Curvature	-3.705	-2.538	**1.167**
Panel A.4: Swiss Franc			
Level	1.343	0.802	**-0.541**
Slope	-0.835	-0.588	**0.247**
Curvature	-2.284	-0.871	**1.413**
Panel B: February 2018			
Panel B.1: US-Dollar			
Level	-0.836	-1.597	**-0.761**
Slope	-1.044	-0.451	**0.593**
Curvature	-4.433	-3.460	**0.973**
Panel B.2: British Pound			
Level	0.295	-0.456	**-0.751**
Slope	-1.016	-0.433	**0.583**
Curvature	-3.111	-2.155	**0.956**
Panel B.3: Chinese Renminbi			
Level	-1.995	-2.749	**-0.754**
Slope	-1.484	-0.897	**0.587**
Curvature	-3.561	-2.607	**0.954**
Panel B.4: Swiss Franc			
Level	1.268	0.757	**-0.511**
Slope	-0.852	-0.582	**0.270**
Curvature	-1.761	-0.571	**1.190**

Notes: The effect of introducing structured Eurobonds in an ordinary structure on the exchange rate EUR/USD, EUR/GBP, EUR/CNY and EUR/CHF. The introduction months are January and February 2018.

Table 8: Change of Nelson-Siegel Factors after introducing structured Eurobonds

Panel A: January 2018 Factor	Actual Values	New Values	Difference
Panel A.1: US-Dollar			
Level	-0.651	-1.507	**-0.856**
Slope	-0.991	-0.367	**0.624**
Curvature	-4.711	-3.482	**1.229**
Panel A.2: British Pound			
Level	0.221	-0.671	**-0.892**
Slope	-0.930	-0.291	**0.639**
Curvature	-2.471	-1.082	**1.389**
Panel A.3: Chinese Renminbi			
Level	-2.059	-2.941	**-0.882**
Slope	-1.627	-0.982	**0.645**
Curvature	-3.705	-2.416	**1.289**
Panel A.4: Swiss Franc			
Level	1.343	0.707	**-0.636**
Slope	-0.835	-0.514	**0.321**
Curvature	-2.284	-0.737	**1.547**
Panel B: February 2018			
Panel B.1: US-Dollar			
Level	-0.836	-1.694	**-0.858**
Slope	-1.044	-0.372	**0.672**
Curvature	-4.433	-3.351	**1.082**
Panel B.2: British Pound			
Level	0.295	-0.551	**-0.846**
Slope	-1.016	-0.357	**0.659**
Curvature	-3.111	-2.044	**1.067**
Panel B.3: Chinese Renminbi			
Level	-1.995	-2.844	**-0.849**
Slope	-1.484	-0.819	**0.665**
Curvature	-3.561	-2.500	**1.061**
Panel B.4: Swiss Franc			
Level	1.268	0.662	**-0.606**
Slope	-0.852	-0.506	**0.346**
Curvature	-1.761	-0.460	**1.301**

Notes: The effect of introducing structured Eurobonds in a progressive structure on the exchange rate EUR/USD, EUR/GBP, EUR/CNY and EUR/CHF. The introduction months are January and February 2018.

Table 9: Connection between Nelson-Siegel Factors and Exchange Rates

US-Dollar						
Factor \ Horizon	1 Month	3 Months	6 Months	12 Months	18 Months	24 Months
Level	-4.712	-5.835.	-5.538	-4.565.	-3.526*	-2.503
Slope	-3.522	-5.779*	-6.328*	-5.016*	-3.977**	-3.482**
Curvature	2.548.	2.055	1.673	0.879	0.474	0.026

Notes: The connection of different Nelson-Siegel factors and their predictive power for exchange rate evolution for EUR/USD. Now there is a new chosen λ=0.0380. The significance levels are . 10 percent; * 5 percent; ** 1 percent and *** 0.1 percent.

Table 10: Change of Nelson-Siegel Factors after introducing structured Eurobonds with modified Lambda

Factor	Actual Values	New Values	**Δ: Mod. λ**	**Δ: $\lambda = 0.0609$**
Panel A: Cons. Structure				
Panel A.1: Jan. 2018				
Level	-0.359	-0.940	**-0.581**	**-0.474**
Slope	-1.569	-1.040	**0.529**	**0.319**
Curv.	-4.064	-3.658	**0.406**	**0.737**
Panel A.1: Feb. 2018				
Level	-0.570	-1.151	**-0.581**	**-0.453**
Slope	-1.581	-0.969	**0.612**	**0.361**
Curv.	-3.741	-3.591	**0.150**	**0.569**
Panel B: Prog. Structure				
Panel B.1: Jan. 2018				
Level	-0.359	-1.286	**-0.927**	**-0.856**
Slope	-1.569	-0.708	**0.861**	**0.624**
Curv.	-4.064	-3.398	**0.666**	**1.229**
Panel B.1: Feb. 2018				
Level	-0.570	-1.495	**-0.925**	**-0.858**
Slope	-1.581	-0.668	**0.913**	**0.672**
Curv.	-3.741	-3.281	**0.460**	**1.082**

Notes: The effect of introducing structured Eurobonds in a conservative and progressive structure on the exchange rate EUR/USD, EUR/GBP, EUR/CNY and EUR/CHF. The introduction months are January and February 2018.

Table 11: Connection between Nelson-Siegel Factors and Exchange Rates under Uncertainty

US-Dollar						
Factor \ Horizon	1 Month	3 Months	6 Months	12 Months	18 Months	24 Months
Level	-10.031.	-8.064*	-8.197*	-6.169**	-4.224.	-3.879.
Slope	-9.391**	-8.893**	-9.561***	-6.917***	-4.865**	-4.531***
Curvature	0.777	0.865	0.276	-0.076	-0.114	-0.568
VIX	1.455***	0.659**	0.751***	0.477*	0.222.	0.336***

Notes: The effect of uncertainty, measured by the index VIX, beside the Nelson-Siegel factors on the exchange rate evolution.