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THE YIELD CURVE AS A LEADING INDICATOR ACROSS COUNTRIES AND TIME: THE EUROPEAN CASE

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THE YIELD CURVE AS A LEADING INDICATOR ACROSS COUNTRIES AND TIME: THE EUROPEAN CASE

By

Tuan Minh Nguyen

Abstract

With the increasing demand for a better understanding about the relationship between yield curve and economic activities, this paper analyzes the data sets of seven countries in the European Union: Germany, France, Belgium, Spain, the United Kingdom, Sweden and Poland using quantitative analytical method. Based on previous literature, the expected hypothesis is: there is a strong relationship between the yield curve and the chance of an incoming economic contraction. The inverted yield curve, or the negative yield curve spread is considered as the tool to forecast the incoming contraction. Having been used as a rule of thumb for future reference of a contraction, whether yield curve and interest rates can be an accurate tool to predict the movement of business cycles should be studied more thoroughly, which will help not only the governments to reduce the loss from recession, but also equip financial sector valuable information to adjust itself before a contraction takes place. Further findings in this paper present a comparison between a group of Eurozone members and a group of non-Eurozone members. The similarities and differences give a broad idea of how the creation of the Eurozone has affected the area in the last decade.

Table of Contents

I.   Introduction

After the catastrophic damage of the Great Depression, economists have always tried to develop the most accurate and comprehensive tools to forecast when a recession will happen. Even though having well forecasting tools cannot prevent recessions from taking place in the future, a necessary forecasting tool will help the governments and especially policy-makers reduce the loss caused by the recessions. Moreover, predicting an incoming recession can also help the financial market, which consists of thousands of investors, portfolio managers and other financial agents, benefit from the awareness of the information in advance to make the right decisions and actions in time.

In the recent decades, in addition to several predicting tools of the economy, the inverted yield curve has been studied as a leading indicator of the economy, particularly, forecasting the movements of business cycles. The yield curve is defined as a curve, which plots the interest rates, at a set point in time, of bonds having equal credit quality, but differing maturity dates. The shape of the yield curve can give an idea about the future interest rates based on expectation hypothesis, which posits that long-term interest rates are averages of expected short-term interest rates. Because the movement of interest rates is closely related to the strength of economic activities, the yield curve can be used as a tool to present the performance of an economy, taking into account numerous linked variables.

While there have been already a large number of studies on the relationship between yield curve and business cycles, most of them used the United States as the subject. Only a few attempted to link the yield curve with the performance of the economy in other countries. One of the reasons was that the relationship can only occur if the level of

development of an economy is high enough to offer a robust and liquid financial market. However, as other countries, besides the United States, start to develop rapidly, and the globalization of the financial sector emerges, there is an increasing demand for the study of the relationship between yield curve and the performance of the economy in many other countries.

In the last half of the 20th century and the first decade of the 21st century, the European Union has become one of the biggest economic blocs in the world. The high level of development of the European Union provides a strong and high-functioning financial market, creating chances for further study of the effect of the yield curve on economic activities. In order to get a better understanding of the mechanism of the relationship between yield curve and business cycles, this paper aims to test the relationship of the yield curve and the business cycles in a group, consisting members of the European Union, and, using the result of that relationship, to draw the comparison of the power of the relationship between members that join the Eurozone and members that are no in the Eurozone.

II.   Literature Review

Interest rates have always been an important subject of economists in explaining the mechanism of the economy since the beginning of the 20th century. As mention above, most of the studies focuses on the United States' economy. Study on the behavior of interest rates of different maturities over the business cycle goes back at least to Mitchell (1913). However, Kessel (1965) is considered to be the first to make specific reference to the behavior of term spreads. In his work, he showed that various spreads between long- and short-term rates tend to be low at the start of recessions and high, as expansions get under way. In 1978, Butler made a connection between the yield curve as a predictor of short-term interest rates and the implications of declining short-term rates for contemporaneous economic activity. In the late 1980s, there were several attempts in research on the yield curve as a leading indicator by Laurent (1988, 1989), Harvey (1988) and Furlong (1989). Estrella and Hardouvelis in the beginning of 1990s, show empirically that the yield curve may be used to predict real growth in consumption, investment and aggregate GNP[1].

Since the relationship between the yield curve and economic activity was studied at least from 1913, the data used dated back to 1875 by Bordo and Haubrich (2004). However, most of studies use data since 1950s, which are more accurate and reliable to calculate the model. The most recent data suggest some structural changes, particularly with regard to parameter values in the relationship. The predictive power may still be there, but the values of the parameters that record the sensitivity to movements in the term spread changed from earlier periods.

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[1] "The Yield Curve as a Leading Indicator." *Federal Reserve Bank of New York.* 9th May 2014.

In global context, however, evidence shows that not all the countries in the world can use term structure of interest rate as a leading indicator. Mishkin (1990) concludes that term spread is not significant in a big part of OECD countries, except the UK, France and Germany. Schich (2000) finds in G-7 countries, US, Germany, UK and Canada yield spreads are significant for output forecasting. Bonser & Morley (1997) show evidence that UK Canada and Germany can use yield spread as a leading indicator, but weak evidence is shown in Japan and Switzerland.

III. Methodology

The results of this paper are based on the analyses collected from data on the set of countries, which includes: Germany, France, Belgium, Spain, the United Kingdom, Sweden and Poland. The choice of countries is based on 3 criteria. The first criterion is the availability of the country's consistent and accurate data on interest rates and economic indicators. Out of 7 countries, the data sets of Germany, France, Belgium and the United Kingdom are the best provided. Data on these countries collected are from 1970 to 2014. This range of time is large enough to provide accepted results, as well as to serve as the threshold marking the period of the creation of the European Union (the first core body). The data sets of Spain, Sweden and Poland are from 1980 to 2014, 1986 to 2014 and 2001 to 2014 respectively.

The second criterion is the level of robustness and liquidity of the financial markets, to ensure the interest rates represent accurately market-determined rates. In this case, all seven countries are members of the Organization for Economic Co-operation and Development (OECD), giving a standard level of development of each country's economy. The third criterion is these countries are the best representatives of two groups of countries in Eurozone and non-Eurozone (but in European Union). Germany, France, Spain and Belgium represent 4 of the leading economies in the Eurozone, while the United Kingdom, Sweden and Poland represent the 3 most important non-Eurozone members of the European Union.

The data of each country consists of three indicators: long-term interest rates, short-term interest rates and historical economic contraction periods (recession). Even though to

calculate the spread of the yield curve in the past many types of interest rates have been studied, in this paper, to achieve the best results with the most consistent data, 10-year government bonds and 3-month market rates are used. Since the bigger the data pool is, the better the result will be, data of each country is monthly data, which also best represents the changes in interest rates as well as the changes in contraction periods. In this paper, the definition of contraction is taken from the National Bureau of Economic Research (NBER). According to the NBER, contraction is a period in which the economic activities fall from the peak of the business cycle to the trough of the business cycle. It is important to note that by using this definition, contraction period is not only a period of negative GDP growth rates in two or more consecutive quarters, but it is also a decline in economic activities in a range of other indicators as well[2].

To retrieve the relationship between the spread of the yield curve and contraction period, the spread of the yield curve is determined as the difference between long-term and short-term interest rates. The peak of the spread of the yield curve is defined as the beginning of a negative period of spread and the trough is the end of a negative period of spread of the yield curve. After retrieving data, one model is applied to all countries for consistency and comparison purposes.

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[2] "Business Cycles Frequently Asked Questions." *National Bureau of Economic Research.* 1st Dec 2014

IV.   Findings and Implications

1.   Data Sources

The data using in this paper is retrieved from two sources. The first source is the online database of the OECD. Two sets of data are provided by this database: long-term and short term interest rates of seven countries: Germany, France, Belgium, Spain, the U.K, Sweden and Poland. According to the OECD database, long-term interest rate is the long term (in most cases 10 year) government bonds that are the instrument whose yield is used as the representative 'interest rate' for this area. Generally the yield is calculated at the pre-tax level and before deductions for brokerage costs and commissions and is derived from the relationship between the present market value of the bond and that at maturity, taking into account also interest payments paid through to maturity[3]. Short-term interest rates, on the other hand, are usually either the three month interbank offer rate attaching to loans given and taken amongst banks for any excess or shortage of liquidity over several months or the rate associated with Treasury bills, Certificates of Deposit or comparable instruments, each of three month maturity. For Eurozone countries, the 3-month "European Interbank Offered Rate" is used from the date the country joined the euro[4]. The third set of data is the data on the time periods of the business cycles (contraction periods) also retrieved from OECD database of economic indicators[5].

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[3] "Monthly Monetary and Financial Statistics." *OECD Database.* 1st Dec 2014.
[4] *OECD Database.*
[5] "OECD Composite Leading Indicators: Turning points of Reference Series and Component Series." *OECD Database.* 1st Dec 2014.

2. Predicting Ability

For each country, data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Historical Contractions and Yield Spread Figures* from Appendix 1 to Appendix 7. The line graphs represent the yield spread (percentage) and the shaded columns represent the contraction periods (month). The first goal of this paper is to test whether an inverted yield curve (negative yield spread) can predict an incoming economic contraction; therefore, only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Tables of Historical Contractions and Yield Curve Time Gaps* from Appendix 1 to Appendix 7. In these tables, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1 shows the overall results retrieved from analyzing data from 7 countries, summarized from the results of Appendix 1 to Appendix 7. Out of 45 periods of negative yield spreads, 33 of them precede an economic contraction, which accounts for 73.3%, representing the predicting power of the spread of the yield curve over contractions. This is a relatively high value in total, implying that the forecasting power of the spread of the

yield curve is actually valid in those 7 countries. Looking more closely to each country, Germany, France and the U.K show the highest percentage values of the predicting power of the yield curve, over 80%. This finding corresponds very well the fact that these 3 countries are the most developed countries financially out of the seven countries, which show more robustness and liquidity in financial markets, improving the relationship between interest rates and the economy. On the contrary, countries with less developed financial markets like Spain, Sweden and Poland have only 50% of predicting power with the spreads of the yield curve.

Germany and France, according to Table 1, have very similar results. The leading time from the beginning of the inverted yield curve to the start of the contraction is only from 4.2 to 6.9 months, which are approximately 2 economic quarters. This result is very different with the result from Belgium, the U.K, Spain or Sweden, which is around 10 and 11 months, (3 to 4 quarters).

Poland shows the most different result from the other 6 countries, firstly, due to the fact that data on Poland is limited (only from 2001 to 2014). Moreover, Poland's economy is every different with the other six countries because of its period under the communist regime before 1992.

The number of false signals collected in Table 1 is very important in drawing the conclusion. There is 13% that a false signal will appear without leading to a contraction. Likewise the number of contractions that are not preceded by a period of negative yield spread indicates the likelihood of the contractions which will cannot be predicted by the yield curve.

The leading time periods vary from 4.2 months to 20.5 months from peak to peak, and from -3.4 to 17.5 months from trough to trough. These are large variance values, making it hard to conclude anything about the leading time of the contractions studied.

Table 1: Summary of overall research results from 7 countries

Country/ Area	Germany	France	Belgium	Spain	Eurozone *	U.K	Sweden	Poland	Non-Eurozone **
Number of Contractions	10	10	11	7	9.5	9	5	3	5.7
Number of Negative Yield Spreads	7	9	9	8	8.3	6	2	4	4
Number of Contractions Preceded by a Negative Yield Spread	6	8	7	4	6.3	5	1	2	2.7
Number of Contractions Not Preceded by a Negative Yield Spread	4	2	4	3	3.3	4	4	1	3
Number of False Negative Yield Spread Signals	1	1	1	2	1.3	0	0	0	0
Number of Negative Yield Spreads After a Contraction	0	0	1	2	0.8	1	1	2	1.3
Average Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	-4.2	-6.4	-10.6	-11.3	-8.1	-10.4	-11	-20.5	-14
Average Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough	-13.8	-14.9	-15.3	-8.5	-13.1	-3.4	1	-17.5	-6.6
Average Negative Spread Duration (months	19	12.9	17	24.5	18.4	32.2	50	19.5	33.9
Average Contraction Duration (month)	28.7	21.1	21.1	18.8	22.4	24.6	38	17	26.5
Negative Yield Spreads Precedes a Contraction Over Total Number of Negative Yield Spread (%)	85.7%	88.9%	77.8%	50%	75.8%	83.3%	50%	50%	66.7%

Notes: *The average value of Germany, France, Belgium and Spain

**The average value of the U.K, Sweden and Poland

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3. Differences between Eurozone and Non-Eurozone Countries

The access the difference between countries which are members of the Eurozone and countries which are in the European Union but not in the Euro-zone, it is important to consider data from 1999 to 2014 only (from the establishment of the Eurozone in 1999 to present). Table 2 shows the results retrieved from analyzing data of 7 countries from 1999 to 2014. One interesting result is that the percentage of the accurate prediction of the negative spread of the yield curve in the group of countries that are members of the Eurozone, is 100%. This result shows that the prediction power of the yield spread after the creation of the Eurozone in countries that are members, is very significant. On the other hand, only the U.K in the group of countries that are not in the Eurozone has 100% of predicting ability. Sweden and Poland have very low percentage values, which are 0% and 50% respectively. Furthermore, countries in the Eurozone group have almost identical results according to Table 2. The leading time from the beginning of the negative yield spread to the beginning of the contraction in this group is approximately 5.9 months, with very little deviation. On the contrary, there are mixed results retrieved from the non-Eurozone group, showing inconsistency among those countries. This result implies that with the creation of the Eurozone, all of the countries which are members of the Eurozone, have become more similar in their economic activities, improving the solidarity of the region economically. Having closely connected and similar economies, the Eurozone can provide better tools for the economy of each member states and itself. In contrast, countries which are non-Eurozone members, have to provide specific policies fitting each individual country, causing an unbalance among economies.

Table 2: Summary of research results from 7 countries from 1999 to 2014

Country/ Area	Germany	France	Belgium	Spain	Eurozone *	U.K	Sweden	Poland	Non-Eurozone **
Number of Contractions	3	3	3	3	3	4	3	3	3.1
Number of Negative Yield Spread	2	1	1	1	1.3	2	1	4	2.3
Number of Contractions Preceded by a Negative Yield Spread	2	1	1	1	1.3	2	0	2	1.3
Number of Contractions Not Preceded by a Negative Yield Spread	1	2	2	2	1.8	2	3	1	2
Number of False Negative Yield Spread Signals	0	0	0	0	0	0	0	0	0
Number of Negative Yield Spreads After a Contraction	0	0	0	0	0	0	1	2	1
Average Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	-5.5	-5	-7	-6	-5.9	-21.5	N/A	-20.5	-21
Average Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough	-26.5	-7	-5	-9	-11.9	-9	N/A	-17.5	-13.3
Average Negative Spread Duration (months)	9.5	15	15	15	13.6	34	N/A	19.5	26.8
Average Contraction Duration (months)	30.5	17	13	18	19.6	20.5	N/A	17	18.8
Number of Negative Yield Spreads Precedes a Contraction Over Total Number of Negative Yield Spread (%)	100%	100%	100%	100%	100%	100%	0%	50%	57.1%

Notes: *The average value of Germany, France, Belgium and Spain

**The average value of the U.K, Sweden and Poland

V.   Conclusion

Based on the results evaluated from the research, it is clear that the forecasting power of the yield curve over the economic activities, in this case, incoming contraction can be applied across countries outside the United States. The predicting ability of the spread of the yield curve is significant in the economies of Germany, France and the U.K, while it is insignificant in Belgium, Spain, Sweden and Poland. However, the insignificance of the yield curve spread in the 4 countries above can be caused by the limitation of the data. The data sets from Spain, Sweden and Poland are not large enough in order to accessing a better result of the predicting power of the yield curve on the business cycles. Likewise, the difference between Eurozone and non-Eurozone countries are significant; however, it is based on a very small data pool. The period of time from the beginning of the Eurozone to present is too short for a valid conclusion on whether the establishment Eurozone can cause a change in the relationship between the yield curve and the predicting of economic contractions.

The second issue is about the value of parameters used in creating the model for predicting the future economic activity. As mentioned above, there are changes in the values of parameters due to the development of the economy and the complexity of the market. Even though we know that there will be a contraction after a period of negative spread in interest rate, it is hard to come up with the exact number of months between the negative spread and the start of a recession. Because interest rates are directly related to monetary policy, there might be some effects that are applied into the market, which can create a more complicated result afterward. The third issue about the predicting ability is

the counter-effect of the market onto the yield curve. Most of the literature in the field deals with the yield curves as a predictor of future activity, but does not deal with the opposite direction that economic activity can also affects yield curve. In this case, Diebold, Rudebusch and Aruoba (2004) found that the influence in the direction from activity to the term structure is even stronger than the predictive relationships. In general, theory and evidence are both supportive of a bidirectional relationship, which consequently complicates the story even more[6].

Does the relationship between the yield curve and economic activity still hold? Yes, even though there are critical changes and development in considering the yield curve as a leading indicator. The simple rule of thumb is still reliable, and useful in giving an idea about the mechanism of the economy.

Giving the limitation of the paper mentioned above, in the future, further studies should be conducted using a larger pool of data sets to get better results. With the complexity of the relationship of the economy in general and the yield curve and the contractions, other factors should be revised and included in the model. A more quantitative model using regression analyses is also recommended to achieve accurate findings.

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[6] Diebold, Francis X., Glenn D. Rudebusch and S. Boragan Aruba (2004). "The Macroeconomy and the Yield Curve: A Dynamic Latent Factor Approach." *Journal of Econometrics*.
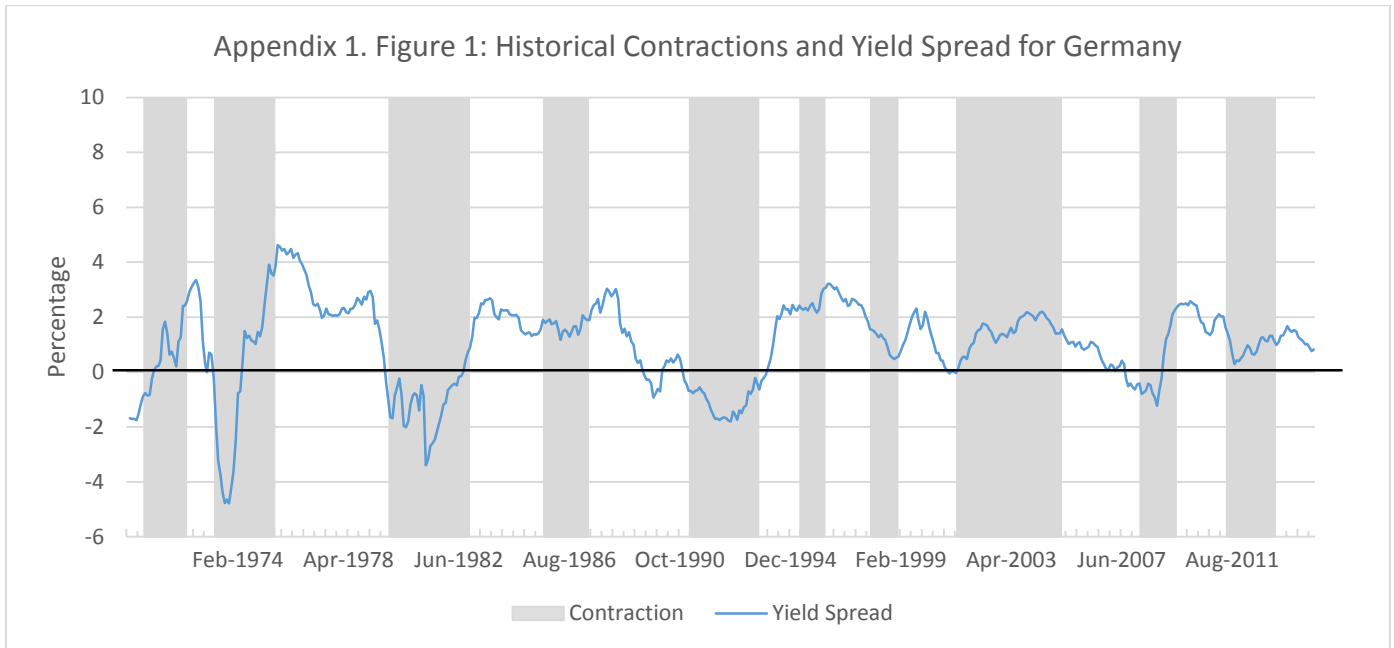
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Data Sources:

1. "Monthly Monetary and Financial Statistics." *OECD Database.* 1st Dec 2014. http://stats.oecd.org/

2. "OECD Composite Leading Indicators: Turning points of Reference Series and Component Series." *OECD Database.* 1st Dec 2014. http://stats.oecd.org/

Appendix 1: Germany

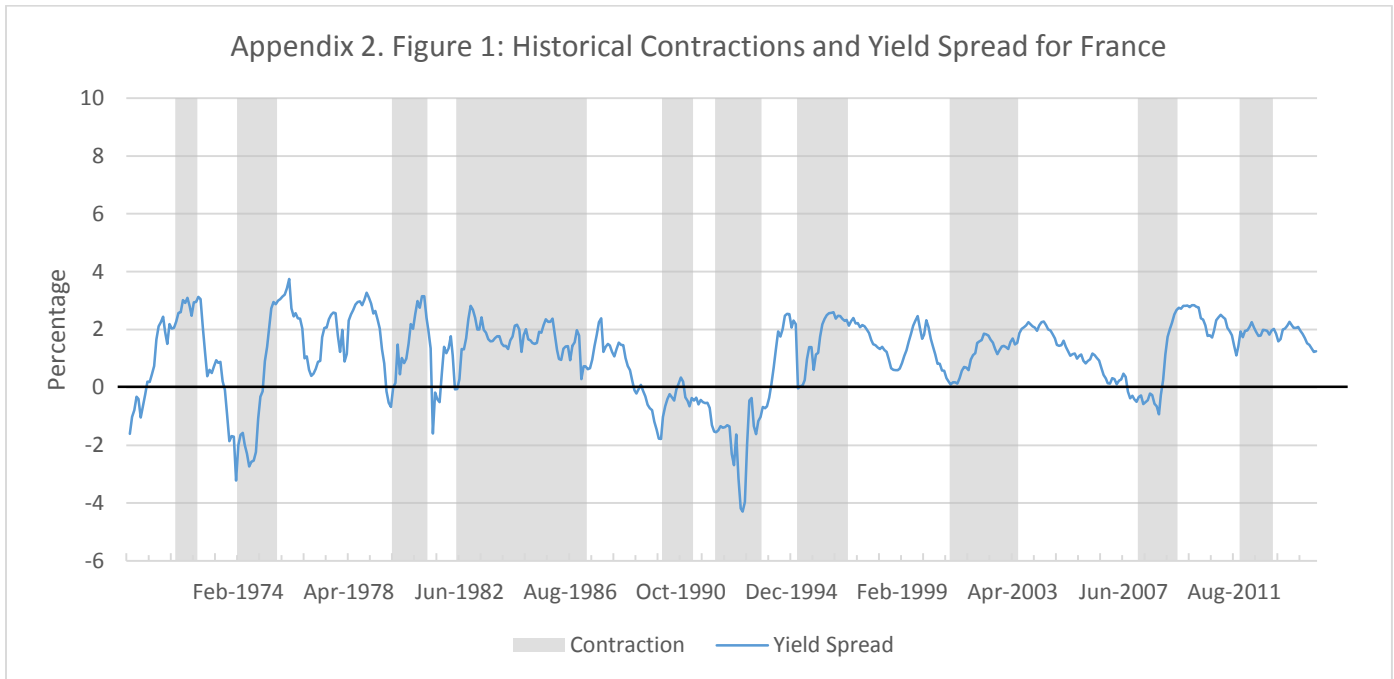Appendix 1. Figure 1: Historical Contractions and Yield Spread for Germany

Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for Germany

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Jan 1970	Nov 1970	10	Aug 1970	Feb 1972	18	-7	-15
Mar 1973	Mar 1974	12	Apr 1973	Jun 1975	27	-1	-16
Sep 1979	Aug 1982	36	Nov 1979	Oct 1982	36	-3	-3
Dec 1990	Jan 1994	37	Mar 1991	Sep 1993	30	-3	4
Dec 2000	Mar 2001	3	Apr 2001	Feb 2005	46	-4	-47
Aug 2007	Dec 2008	16	Mar 2008	Jun 2009	15	-7	-6
Average (month)		**19**			**28.67**	**-4.17**	**-13.83**
Average (month) *		**9.5**			**30.5**	**-5.5**	**-26.5**

Notes: * Applied for data from 1999 to 2014

Appendix 2: France

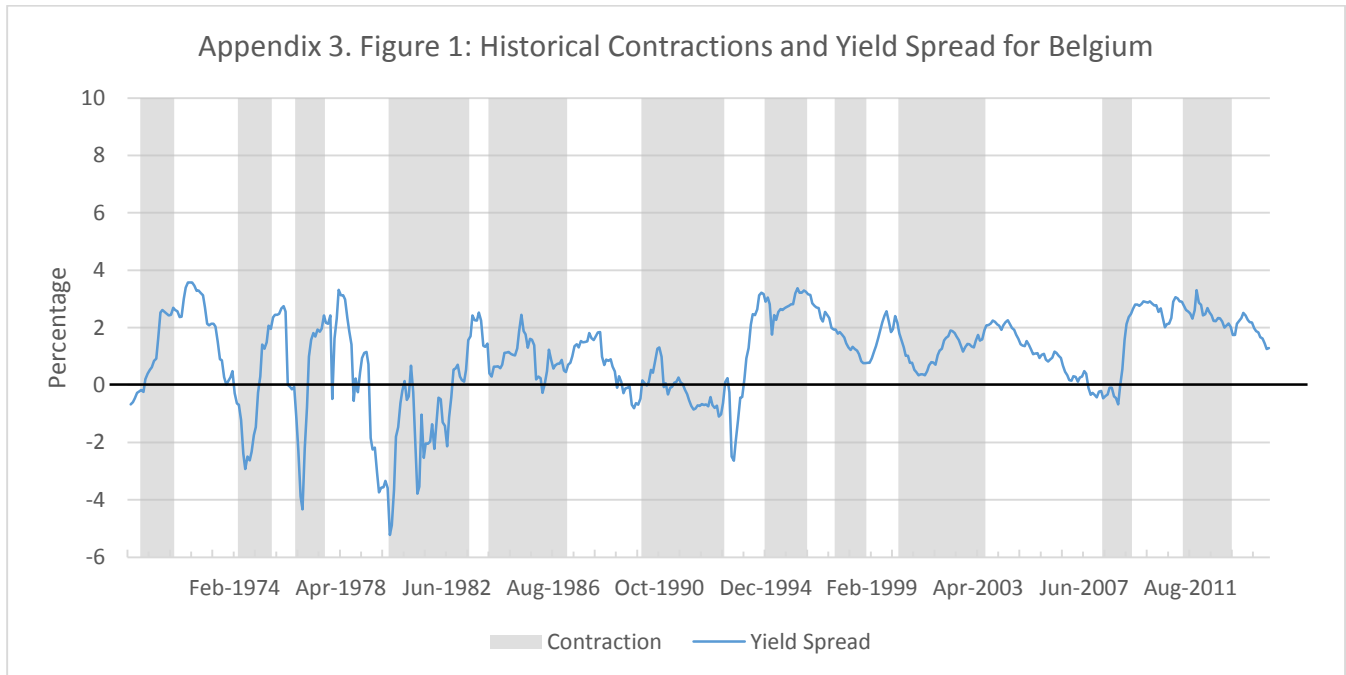Appendix 2. Figure 1: Historical Contractions and Yield Spread for France

Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for France

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Jan 1970	Aug 1970	7	Oct 1970	Jul 1972	21	-9	-23
Aug 1973	Jan 1975	17	Feb 1974	Jul 1975	15	-6	-6
Sep 1979	Dec 1979	3	Dec 1979	Mar 1981	3	-3	-3
Apr 1982	May 1982	1	May 1982	Mar 1987	58	-1	-58
Jan 1989	Aug 1990	19	Feb 1990	Mar 1991	13	-13	-7
Dec 1990	Feb 1994	38	Feb 1992	Oct 1993	20	-14	4
Mar 1995	Jun 1995	3	Mar 1995	Jan 1997	22	0	-19
Aug 2007	Nov 2008	15	Jan 2008	Jun 2009	17	-5	-7
Average (month)		**12.88**			**21.13**	**-6.38**	**-14.88**
Average (month)*		**15**			**17**	**-5**	**-7**

Notes: * Applied for data from 1999 to 2014

Appendix 3: Belgium

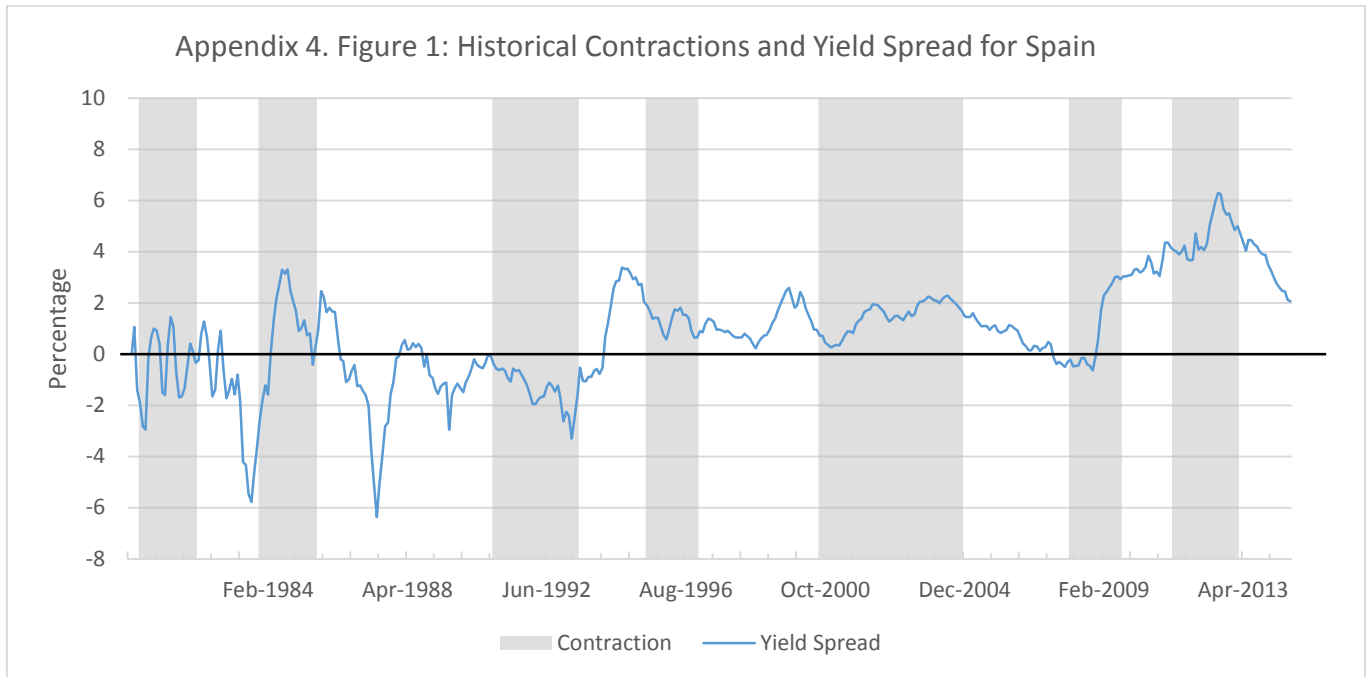Appendix 3. Figure 1: Historical Contractions and Yield Spread for Belgium

Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for Belgium

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Jan 1970	Jul 1970	6	Jun 1970	Sep 1971	15	-5	-14
Feb 1974	Jan 1975	11	Apr 1974	Jul 1975	14	-2	-6
Mar 1976	Dec 1976	9	Jul 1976	Aug 1977	13	-4	-8
Jun 1979	Aug 1982	43	Mar 1980	Apr 1983	37	-9	-8
May 1989	Jan 1990	8	Feb 1990	Apr 1993	38	-9	-37
Oct 1991	Jan 1994	27	Dec 1994	Jul 1996	18	-38	-29
Aug 2007	Nov 2008	15	Mar 2008	Apr 2009	13	-7	-5
Average (month)		**17**			**21.14**	**-10.6**	**-15.3**
Average (month)*		**15**			**13**	**-7**	**-5**

Notes: * Applied for data from 1999 to 2014

Appendix 4: Spain

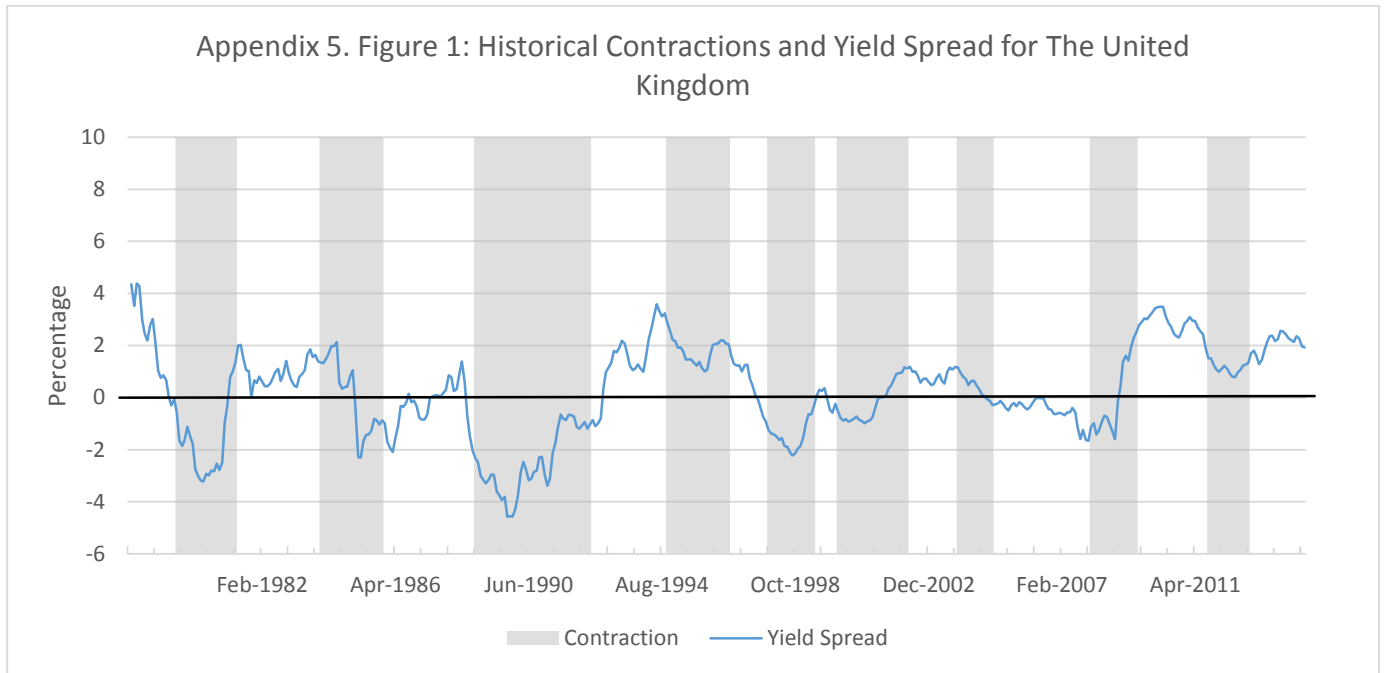Appendix 4. Figure 1: Historical Contractions and Yield Spread for Spain

Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for Spain

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Mar 1980	Jul 1980	4	Apr 1980	Dec 1981	20	-1	-17
Oct 1982	Feb 1984	16	Dec 1983	Jul 1985	19	-14	-17
Nov 1988	Feb 1994	63	Nov 1990	May 1993	18	-24	9
Aug 2007	Nov 2008	15	Feb 2008	Aug 2009	18	-6	-9
Average (month)		**24.5**			**18.8**	**-11.3**	**-8.5**
Average (month)*		**15**			**18**	**-6**	**-9**

Notes: * Applied for data from 1999 to 2014

Appendix 5: The United Kingdom

Appendix 5. Figure 1: Historical Contractions and Yield Spread for The United Kingdom
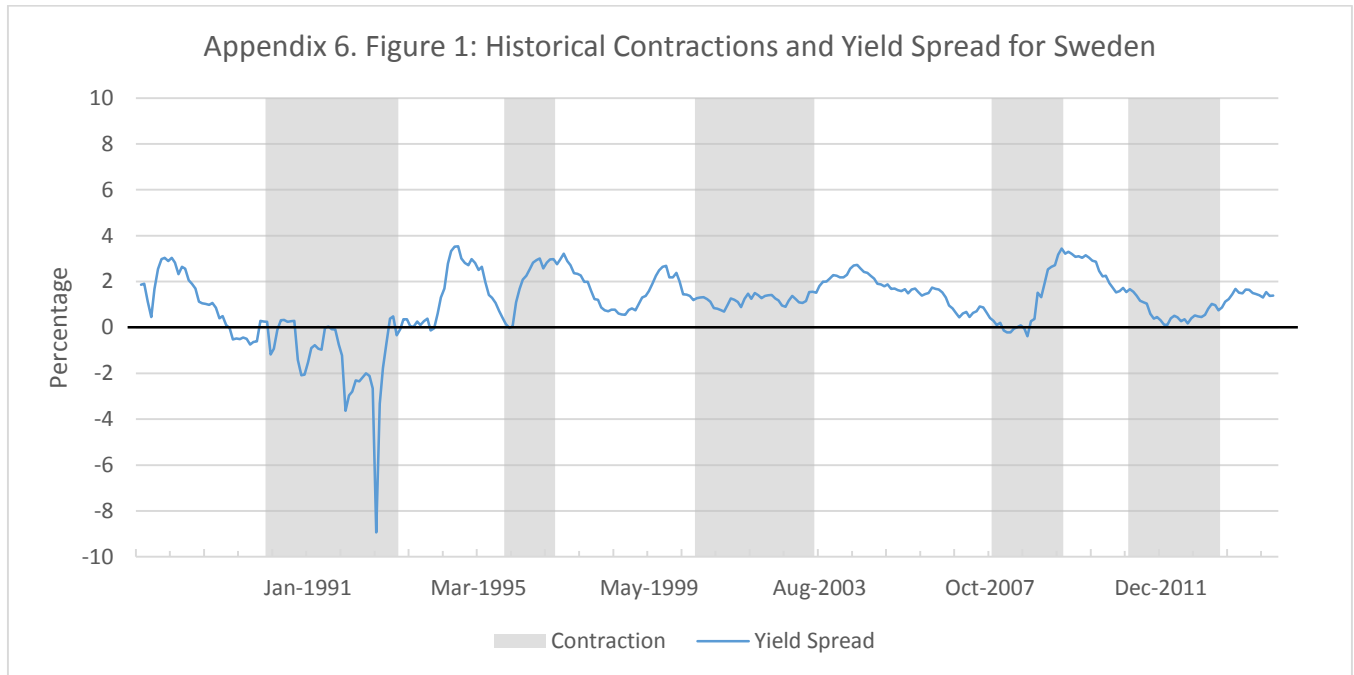
Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for the United Kingdom

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Apr 1979	Jan 1981	21	Jun 1979	Apr 1981	22	-2	-3
Jul 1988	Sep 1992	50	Oct 1988	May 1992	43	-3	4
Aug 1997	May 1999	22	Dec 1997	May 1999	17	-4	0
Oct 1999	May 2001	19	Feb 2000	Apr 2002	24	-4	-11
Oct 2004	Nov 2008	49	Jan 2008	Jun 2009	17	-39	-7
Average (month)		**32.2**			**24.6**	**-10.4**	**-3.4**
Average (month)*		**34**			**20.5**	**-21.5**	**-9**

Notes: * Applied for data from 1999 to 2014

Appendix 6: Sweden

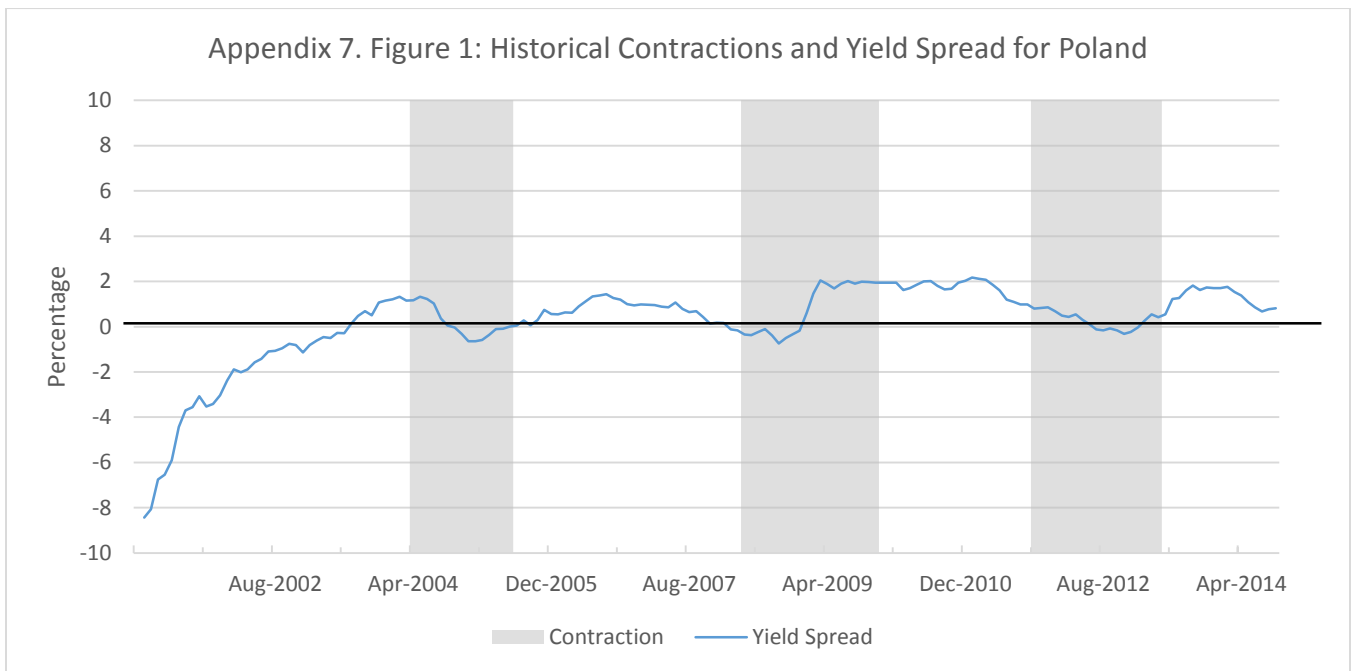Appendix 6. Figure 1: Historical Contractions and Yield Spread for Sweden

Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last row calculates the average (in month) of each durations presented above. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for Sweden

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Feb 1989	Apr 1993	50	Jan 1990	Mar 1993	38	-11	1
Average (month)		**50**			**38**	**-11**	**1**

Appendix 7: Poland

Appendix 7. Figure 1: Historical Contractions and Yield Spread for Poland

Data sets of the yield spread and the time periods of contractions are constructed and presented visually by the *Figure 1: Historical Contractions and Yield Spread.* The line graph represents the yield spread (percentage) and the shaded columns represent the contraction periods (month). Only contractions that are preceded by a period of negative yield spread are analyzed further. Specific data on business contractions that are preceded by a period of negative yield curve spread is presented in the *Table 1*: *Historical Contractions and Yield Curve Time Gaps.* In these table, the dates (in month) of the peaks and troughs of the negative yield spread periods and the contractions are recorded. The durations from the peak to the trough of each indicators are calculated in the third and fifth columns. The last two columns represent the time periods from peak to peak and trough to trough of each contraction. The last two rows calculate the average (in month) of each durations presented above. It is important to note that the last row is used to draw comparison between two groups of countries, since the year 1999 is the year when the Eurozone was established. Negative values describe time leading periods and positive values represent time lagged periods.

Table 1: Historical Contractions and Yield Curve Time Gaps for Poland

Negative Yield Curve Spread		Negative Spread Duration (month)	Business Cycle Contraction		Contraction Duration (month)	Months of Yield Spread Peak Before (-) or After (+) Business Cycle Peak	Months of Yield Spread Trough Before (-) or After (+) Business Cycle Trough
Peak	Trough		Peak	Trough			
Jan 2001	Jun 2003	29	Apr 2004	Jun 2005	14	-39	-24
Feb 2008	Dec 2008	10	Apr 2008	Nov 2009	20	-2	-11
Average (month)		**19.5**			**17**	**-20.5**	**-17.5**
Average (month)*		**19.5**			**17**	**-20.5**	**-17.5**

Notes: * Applied for data from 1999 to 2014