Conditions for turning the ex ante risk premium into an ex post redemption for EU government debt

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■ Abstract

Basel III classifies government debt as risk free while actual interest rates in the European Union (EU) show large differences not only because of liquidity but mainly because of the risk of default, as also reflected in credit default swaps. IFRS / IASB insists that there are risks involved indeed and that fair value accounting applies, which causes bank capital to collapse. Speculation sends governments and banks in joint distress. Curiously such debt defaults may not happen so that creditors do not need to cover losses. The risk premium then becomes a reward for taking a risk that does not materialize. Contagious fears create risk premia that destabilize government debts and national economies. A solution is to regard the risk premia as potential redemption that turns into actual redemption when the loan is served to maturity. A EU law may make this mandatory without serious restrictions to the credit market. The rule would be that governments under threat of default would issue only annuity loans with a centrally determined rate of interest. The market sentiment of increased risk then shows up in shorter maturities. Governments that can borrow only at shorter maturities but at higher annual liquidity requirements meet with strong incentives to better manage their economies. The paper investigates the conditions involved. An important distinction appears to exists between the risk free rate, the credit default risk premium, the liquidity premium and a stigma factor. While much of the debate in the EU seems to be about reducing the risk premium, the distinction between ex ante risk and ex post redemption allows to identify that true EU policy costs concern irrational stigma factors. Notably, aversion against Southern European debt, that differs from the risk free rate and the default risk and liquidity premiums, has no rational base but can persist because it is rewarded.

Introduction

When there is a climate of fear that a particular government may default on its debt then this affects all debt of that government, but it becomes important to make a clear distinction between the stock of debt (solvability) and the new issue of debt in the running year (liquidity). All debt seems the same but there can be a window of opportunity if the country hasn't actually defaulted yet. The country may try to honour old debt and try to find ways to deal with the new issue of debt. Inclusion of the market sentiment on the risk of default may still generate new loans instead of blocking them. A rising rate of interest may actually help to reduce such fears. The key point is this: if one manages to maintain the risk free rate then the higher risk premium might also be used as redemption.

Basel III still classifies government debt as risk free. Elementary finance textbooks decompose the rate of interest into a risk free part and the risk premium, at least in the Capital Asset Pricing Model (CAPM), see Bodie & Merton (1998) or Luenberger (1998). In CAPM, government debt is regarded as risk free.

Actual interest rates in the EU show large differences not only because of liquidity but mainly because of the risk of default, as also reflected in credit default swaps (CDS). The IFRS / IASB disagrees with Basel III, imposes fair value accounting, see Selling (2011). The lower value of government debt causes bank capital to collapse. The credit rating agencies have become very active in downgrading government debt. Some institutes like pension funds can be required to sell if debt is no longer AAA. The banking sector appears to speculate on default risks, and destabilizes itself in that manner.

For example, October 2011 gives a 10 year bond rate of 2% for Germany and 18% for Greece so that the liquidity and risk premium for Greece is 16%. Greece had a haircut indeed. For Portugal the rate of interest is 11.7% and for Italy it is 6%: but will they actually default ? The EU is working hard to prevent this. Such defaults happen only rarely so that creditors do not need to cover losses. The risk premium then becomes a reward for taking a risk that does not materialize. Contagious fears currently create risk premia that destabilize government debts and national economies, while they increase private profits where those are not urgently needed. Credit default swaps have been invented by markets to both serve customers and own profits but the emphasis seems to be on the latter. We should rather be looking for credit non-default swaps (CNDS) as this is the most frequent situation for government debt.

A solution is to regard the risk premia on new debt as potential redemption that turns into actual redemption when the loan is served to maturity when the risk thus does not materialize. A EU law may make this mandatory without serious restrictions to the credit market. The idea can be implemented with standard annuities rather than complex instruments. Creditors can still insure themselves against actual default but will do so by using both shorter duration and redemption in the annual payment.

Delbecque (2011) also distinguishes the stock of debt and the issue of new debt, and also proposes to cap the rate of interest on only the latter. This can be enhanced by turning

the ex ante risk premium into ex post redemption. We can also identify a stigma factor that is implicit in many discussions.

We first look at the principle and then at the economic conditions that would be required to make it work. The idea will be grasped immediately by finance experts but the exposition below targets first year students and might perhaps also serve Members of Parliament. For this reason we first restate the simple financial mathematics of a bond issue with a fixed rate of interest. Colignatus (2011c) is an even lower level explanation for a general public that has some acquaintance with mortgage or car loan annuities.

The discussion can best be seen in the context of Colignatus (2011ab) "An economic plan for Europe", see also Stavrou (2011). This plan is special compared to other plans in that it is based upon innovations in economic theory. The prime problems in this crisis concern governance, investment and employment. Europe is fortunate, with the German anchor, that inflation is not in that list. As explained there, part of the old Greek and Italian debt can be regarded as problematic for monetary stability and thus those can be absorbed within the monetary system, provided that those governments provide some collateral to satisfy the no-bailout condition. This present discussion on new bond issue is of secondary importance but helps to clarify some points.

Some authors propose Eurozone bonds to equalize rates of interest and diversify risks of defaults. In my analysis it is better to use market signals on the performance and risk of individual governments. There is also the issue of the short versus the long term. The October 26-27 plan to have a 50% haircut on Greek debt held by private agents seems unwise. The Treaty on the euro excludes bailouts and actually does not clearly deal with defaults. There have been serious policy errors made in the past. There is an alternative to that October 26-27 approach. See that "economic plan for Europe" for measures on short notice. For the longer term the Treaty can be amended for defaults. The present discussion is intended for that amendment. Generally a potential default will not concern the whole debt but only a percentage - the haircut. When the haircut is applied to a bullet bond it can also be treated as an annuity - which then would have been the better instrument in the first place. The new Treaty could include a "ladder" with increasingly stricter conditions for bonds with interest rates that rise above the norm.

We use Cool (1999) "The Economics Pack. Applications of *Mathematica*" for our formulas.

Data

The ECB (2011a) gives "the latest available harmonised long-term interest rates for assessing convergence among the EU Member States. The rates are secondary market yields of government bonds with a remaining maturity close to ten years." See **Appendix A.** The ECB calculation just gives the internal rate of return on observed market values, and thus does not estimate expectations on a haircut, the yield-to-maturity ISMA formula 6.3, see ECB (2003:10). Government debt of different countries may have different risk free values because of the liquidity premium that comes from having

a smaller or less transparant market. As said, October 2011 gives an annual rate of 2% for Germany. The overall liquidity premium may be estimated as the difference in October 2010 between Germany 2.35% and Holland 2.58% or Finland 2.63% and thus as 0.25%. It does not seem correct to use other countries since then this would be part of a risk premium again. Hence we will use the overall risk free rate of 2.25%. Greece with 18% has become a complex example since there is an actual haircut. Italy is a more pressing example since it has not defaulted yet and it has a window of opportunity. For Italy the rate in October is 6% and thus the risk premium is 3.75%.

Our main interests are Germany and the Eurozone average. See **Appendix B** for the euro yield curve. Judging by the euro yield curve the average rate of interest for 10 year Eurozone debt still is fair at 2.72% on average, ECB (2011b) and Eurostat (2011). The increased sense of risk with respect to Southern Europe apparently has a limited impact on the average. The rate of interest for German government debt at 2% is so low (the same as the inflation target, though I would advise 0% inflation, see elsewhere) because risk averse creditors flee from Southern Europe. Southern Europe still attracts funds, so it mainly is a redistribution. The apparent average of 2.72% is 0.5% higher than the 2.25%. Given the limited impact of current fears it seems fair to take the regulatory target rate indeed as 2.25% (Germany + 0.25%) rather than 2.75% (Germany + 0.25% + 0.5%).

Debt and redemption

Notation

The assumption of a flat (constant) rate of interest suffices to explain the mechanism.

We assume a sequence of equal periods with a well defined periodical payment and a final payment at maturity, with all payments at the end of the period. We use the following symbols:

- r rate of interest per period (coupon rate i)
- m maturity (number of periods)
- p instalment or periodical payment
- w payment at maturity (principal, worth)
- v present value (capital equivalent at the beginning)

Cashflow object

The basic object is a cash flow of p per period, for m periods, and a final payment of w. In effect, someone has borrowed w, pays periodic interest p at the coupon interest rate $i = p / w$, and returns the loan at maturity m.

```
example = {p → 10 Euro/Year, m → 10 Year, w → 100 Euro};
```

CashFlow[p, m, w] /. example

$$\text{CashFlow}\left(\frac{10\ \text{Euro}}{\text{Year}},\ 10\ \text{Year},\ 100\ \text{Euro}\right)$$

A bullet (bullit) loan has annual interest payment at rate i without redemption, and at maturity the redemption of the principal.

Bullit[i / Year, m, w] /. example

$$\text{CashFlow}\left(\frac{100\ \text{Euro}\ i}{\text{Year}},\ 10\ \text{Year},\ 100\ \text{Euro}\right)$$

Present value

The Present Value differs from the principal if the coupon rate i differs from the market rate r. With a cash flow of p[t] per period, we can discount each payment with a discount factor $\frac{1}{(1+\text{r})^{\text{t}}}$. Since we assume equal payments, p[t] = p, we can add all discount factors:

total[r_, m_] = Sum[1 / (1+r)^t, {t, m}]

$$\frac{(r+1)^{-m}\left((r+1)^{m}-1\right)}{r}$$

capital == PV[Bullit[i, m, w], r]

$$\text{capital} = \frac{i\,w\,(1-(r+1)^{-m})}{r} + w\,(r+1)^{-m}$$

Greek debt example

The 18% rate for Greece mentioned in the introduction need not actually be paid by Greece in an actual new loan now, but has been calculated by the ECB from debt values on the secondary market. For example, Greece 5 years ago in 2006 may have had a bond issue with a maturity of 15 years at 4% (ECB website). This bond now has a maturity of 10 years and is sold on the secondary markets. If there is no default or haircut, this bond would trade above its principal value of 100 since the coupon rate of 4% is above the current risk free rate of 2.25%.

value[0, NoDefault] == PV[Bullit[.04, 10, 100], .0225]

value(0, NoDefault) = 115.516

The calculated yield of 18% for the old bonds implies that the ECB apparently observes market values of 37% of the principal of 100. The ECB calculates the internal rate of return, and from that we recover the apparently observed market value. The calculation of the implied 18% does not include an estimate on a haircut (and a premature end of the loan).

value[0] == PV[Bullit[.04, 10, 100], .18]

value(0) = 37.0828

Annuity table

Suppose you borrow capital *v* now. Without intermediate interest payments, you would have to repay *f v* with factor $f = (1 + r)^m$ at maturity. Suppose that you only pay *w* at maturity. Then the remainder *f v - w* must be paid as interest or redemption in the period before. If the periodical payment is constant then it is called an annuity. A table contains payments of interest and amortisation, and remaining debt.

Suppose that a person is willing to pay an annuity of 30 per year for a period of 3 years, and an additional final sum of 100 at the end of those 3 years as well. When the rate of interest is 10% then the present value is almost 150.

Present value = 149.737

period	payment	interest	redemption	debt
1	30.00	14.97	15.03	134.71
2	30.00	13.47	16.53	118.18
3	30.00	11.82	18.18	100.00

Haircut on a bullet loan

This is the formula for the remaining debt in an annuity scheme with annual payment *p*, number of paid payments *n,* principal *w* and rate of interest *r*, say for *n* = 3:

$$\text{remainder} = \frac{p}{r} - (r+1)^3 \left(\frac{p}{r} - w\right)$$

The formula can be understood as borrowing a perpetuity value *p / r* and putting a part *p / r - w* into an account earning interest.

Consider a bullet loan that after three years is hit by a haircut *h* on the principal *w*:

$$\frac{\mathbf{p}}{\mathbf{r}+1} + \frac{\mathbf{p}}{(\mathbf{r}+1)^2} + \frac{\mathbf{p} + (1-\mathbf{h})\,\mathbf{w}}{(\mathbf{r}+1)^3}$$

The haircut in year 3 can be seen as generating a remainder of an annuity scheme after 3 years:

$$(1-h)\,w = \frac{p}{r} - (r+1)^3 \left(\frac{p}{r} - w\right)$$

For example, a principal of *w* = 100, *r* = 2.25% and a payment of 18%:

$$\left\{\left\{h \to -\frac{\left(r^2+3r+3\right)(rw-p)}{w}\right\}\right\}$$

```
Result /. {w → 100, p → 18, r → .0225}
```

{{*h* → 0.483211}}

We check that this haircut on the bullet loan gives the proper present value (at 2.25% instead of 18%):

$$\frac{p}{r+1}+\frac{p}{(r+1)^2}+\frac{p+(1-h)\,w}{(r+1)^3}\ /.\ \text{Result}[[1]]\ /.\ \{w\to 100,\ p\to 18,\ r\to .0225\}$$

100.

Example for Greek debt

Existing Greek debt from 5 years ago that gives 4% apparently has an implied haircut of around 70% when we assume that this takes place at year 2 or 3:

$$\text{Solve}\left[37.0828 == \frac{p}{r+1}+\frac{p+(1-h)\,w}{(r+1)^2}\ /.\ \{w\to 100,\ p\to 4,\ r\to .0225\},\ h\right]$$

$\{\{h \to 0.693197\}\}$

$$\text{Solve}\left[37.0828 == \frac{p}{r+1}+\frac{p}{(r+1)^2}+\frac{p+(1-h)\,w}{(r+1)^3}\ /.\ \{w\to 100,\ p\to 4,\ r\to .0225\},\ h\right]$$

$\{\{h \to 0.726294\}\}$

The new mechanism

We assume the situation that old debt is redeemed in full, but that the country has to deal with fears about default, that it meets when issueing new debt. Greece crossed the line but Italy still has a window of opportunity. We can use the current Greek data (18%) as theoretical values and the Italian data (6%) as practical values.

The new mechanism is to turn an ex ante risk premium into an ex post redemption if the risk does not materialize. Alternatively put: the debtor pays the high annual payment but if one succeeds in repaying the loan then one gets a refund.

In effect, the original bullet bond can be recalculated as an annuity bond. The new EU law then would be that governments under threat of default would issue only annuity loans. While creditor and debtor can in principle bargain on the rates of interest and risk, a regulator may cap the rate of interest to eliminate one degree of freedom. This regulation may be a mere law with no strings attached. See the section below on regulation.

Assume a 5 year loan of 100 (million or billion) at 2.25% interest for risk free governments. Let the risk premium be 15.75% for a government at risk, in total 18%. These Greek values are purely theoretical since Greek will not be able to issue a loan like this.

Viewpoint 1: The rate of interest consists of “risk free rate plus risk premium”. The bullet bond would be like this, and the present value is determined with 18%.

Present value = 100.

period	payment	interest	redemption	debt
1	18.00	18.00	0.00	100.00
2	18.00	18.00	0.00	100.00
3	18.00	18.00	0.00	100.00
4	18.00	18.00	0.00	100.00
5	18.00	18.00	0.00	100.00

Viewpoint 2: When discounted with the risk free rate of 2.25% the present value is 174. For example, if the creditor lives in a country where 2.25% is the norm then the extraction of a bond with 18% translates into an immediate profit of 74 (million or billion). The profit of course is balanced with the risk of default.

```
PV[CashFlow[18, 5, 100], 0.0225]
```

173.701

What about that risk of default ? After 5 years roughly 80% of the loan will be repaid. If the loan is served to maturity then the risk does not materialize. Under the new mechanism the risk premium payments can be counted as redemption. Effectively the calculation gives an annuity table. At maturity a remaining debt of 17.63 has to be redeemed instead of the bullet value of 100. The present value is now determined using the risk free rate of 2.25%. Note that the 51.68 value in the third year is consistent with the haircut of 0.4832 that we calculated above in the formula section.

Present value = 100.

period	payment	interest	redemption	debt
1	18.00	2.25	15.75	84.25
2	18.00	1.90	16.10	68.15
3	18.00	1.53	16.47	51.68
4	18.00	1.16	16.84	34.84
5	18.00	0.78	17.22	17.63

Compare the two payment tables. At the end of year 2 almost 30% has been repaid and at the end of year 3 almost 50% has been repaid. Suppose there is a default around year 3 in the bullet bond. The risk premium will be based upon fears about both the size of the potential haircut and the moment when it might occur. In this case, an implied haircut of 80% over 5 years puts a ceiling on the expectations. NB. The haircut applies to the bullet format and not to the annuity format - see the section on regulation below.

Thus, when the risk free rate is given, the risk premium affects maturity. If the risk of default is judged to be large, the creditor will agree only with shorter maturities. At renewal of the loan, the risk can be smaller, resulting in a longer maturity, or the risk can be higher, resulting in an even shorter maturity.

The proposed scheme limits the scope for creditors to diversify risks. In the present situation a creditor might collect risk premia from say 10 customers to cover the actual default of 1 of them. Good customers effectively pay the redemption of the failing customer. Customers can have different rates of interest including risk premia depending upon risk status. A bit irrational: a customer with high risk may pay a higher premium, enlarging the risk, and, when the risk does not materialize, this weaker customer contributes most to the redemption of the customer who fails. In the new situation the rates of interest and risk are (in principle) both negotiated between creditor and debtor

on an individual basis. If the risk materializes then there might be a subsequent negotiation on the size of the haircut, while the creditor could still recover possible losses from overall proceeds from various customers.

The creditor can still diversify the risk of default by taking a portfolio of different maturities. Here it is important that the loans start in different years so that redemption is collected over different periods. In the example above, suppose that 1/5th is kept of each of these lines. The first redemption cashed in the first tranche is balanced by a much larger redemption cashed over time in the last tranche. On average a “risk premium” of about 40% is cashed and thus a haircut of about 40% can be carried on similar bullet bonds. With such a haircut on a bullet the creditor still enjoys the normal risk free earnings on interest. (Let us call this the “non-losing haircut”.)

The debtor can negotiate for a lower rate of interest or a longer period by offering collateral. Credit default swaps should rather be forbidden since they create the sense of security associated with money, which is the monopoly of the Central Bank.

This example used figures taken from Greece, though it is a complexer example since it already took a haircut on existing debt. It is more practical to look at Italy that still honours its stock of debt.

Application to Germany and Italy

Suppose that Italy takes a loan of 10,000 million euro for 10 years. Markets in October demanded 6%. The present value taken at the risk free German rate of 2% plus the liquidity premium of 0.25% amounts to 13.3 billion. Italy thus pays a risk premium of 3.3 billion, or 33% in total, above the annual reward of 2.25%.

```
PV[CashFlow[600, 10, 10000], 0.0225]
```

13 324.8

If the bullet loan were discounted at 6% then of course the present value again is 10,000. Creditors will like us to think that we have to use 6% instead of 2.25%.

Present value = 10 000.

period	payment	interest	redemption	debt
1	600.00	600.00	0.00	10000.00
2	600.00	600.00	0.00	10000.00
3	600.00	600.00	0.00	10000.00
4	600.00	600.00	0.00	10000.00
5	600.00	600.00	0.00	10000.00
6	600.00	600.00	0.00	10000.00
7	600.00	600.00	0.00	10000.00
8	600.00	600.00	0.00	10000.00
9	600.00	600.00	0.00	10000.00
10	600.00	600.00	0.00	10000.00

The ex ante risk premium for Italy can be regarded as ex post redemption, if the loan is served to maturity. The annuity scheme uses 2.25% and the final future value is 5846, so that halfway about 2000 is redeemed. For a portfolio of different maturities the non-

losing haircut would still be 20%.

Present value = 10 000.

period	payment	interest	redemption	debt
1	600.00	225.00	375.00	9625.00
2	600.00	216.56	383.44	9241.56
3	600.00	207.94	392.06	8849.50
4	600.00	199.11	400.89	8448.61
5	600.00	190.09	409.91	8038.71
6	600.00	180.87	419.13	7619.58
7	600.00	171.44	428.56	7191.02
8	600.00	161.80	438.20	6752.81
9	600.00	151.94	448.06	6304.75
10	600.00	141.86	458.14	5846.61

Thus there are two properties: (1) With a proper monetary and financial management, that risk need not materialize, and creditors cash a 33% surplus profit. (2) If the risk of default would materialize in a haircut of 20% then creditors do not actually lose anything either since they are compensated as in an annuity scheme, and also rewarded with the German risk free rate plus the liquidity premium.

This scheme of translating premium into redemption looks decidedly simpler than what the Eurozone has concocted till now, see the critical Cabral (2011) and Hau (2011).

The problem is not just Italy but also the Treaty on the euro. Elementary finance textbooks assume that debt can be discounted with an overall (world) market risk free rate but somehow in the Eurozone its governments have lost the ability to impose this. See the section below on regulation.

If the risk free rate would be imposed, fears on defaulting translate into shorter maturity and higher redemption. A higher annuity causes more distress for a government that is already short in funds. The advantage however is that the horizon becomes shorter, while the effective rate of interest is under regulation from a central regulator. This current rate of 6% seems rather excessive and it derives mainly from the present crisis, while a revised Treaty on the euro will have more balancing rules in an earlier stage. The regulator in a revised Treaty (see below) would start with such 2.25% but when it appears that new loans are made to cover payments on older loans, then it could raise that rate. The regulated rate namely controls the real losses suffered by the regulated government.

Stigma

The proposed scheme relies on the strict difference between the market risk free rate and the risk premium, as used in finance textbooks and CAPM. We allowed for a third aspect of market liquidity, meaning that German bonds may sell easier because of a better developed market. There may also be a fourth factor, call it stigma, or bear market sentiment or country aversion, so that a country may fall prey to speculations on such sentiments. Such a stigma effect can be the only explanation why investors might require a rate of interest for Italy that is higher than 2.25% even when the risk of default does

not materialize.

Assume an Italian market stigma of 2%. Then the Italian interest rate rises to 4.25% and the scheme to turn the ex ante risk premium into ex post redemption becomes as follows. Italy has to pay 7874 at maturity, and thus loses about 2,000 million in future value (compared to the scheme above) because investors have lost trust and speculators fuel that. This is an irrational sentiment in the market but it becomes rational again because it is rewarded by higher proceeds.

Present value = 10 000.

period	payment	interest	redemption	debt
1	600.00	425.00	175.00	9825.00
2	600.00	417.56	182.44	9642.56
3	600.00	409.81	190.19	9452.37
4	600.00	401.73	198.27	9254.10
5	600.00	393.30	206.70	9047.40
6	600.00	384.51	215.49	8831.91
7	600.00	375.36	224.64	8607.27
8	600.00	365.81	234.19	8373.08
9	600.00	355.86	244.14	8128.93
10	600.00	345.48	254.52	7874.41

Suppose that Italy would be able to reduce stigma to 1%. Then the 6% annuity might reduce to 4% and the interest rate would reduce to 3.25%. Italy saves on liquidity 200 per annum but has a future final payment of 9130 that is higher than the 7874. Overall it saves the 1%.

Present value = 10 000.

period	payment	interest	redemption	debt
1	400.00	325.00	75.00	9925.00
2	400.00	322.56	77.44	9847.56
3	400.00	320.05	79.95	9767.61
4	400.00	317.45	82.55	9685.06
5	400.00	314.76	85.24	9599.82
6	400.00	311.99	88.01	9511.81
7	400.00	309.13	90.87	9420.95
8	400.00	306.18	93.82	9327.13
9	400.00	303.13	96.87	9230.26
10	400.00	299.98	100.02	9130.24

Summary on the kind of submarkets

Thus we have these submarkets:

(1) The risk free rate including liquidity premium.

(2) Perceived but false default risk for government debt, that can be handled by annuity schemes. Haircuts on bullets are paid via redemption in annuities.

(3) Stigma (a) that contributes to (2), and (b) that raises the discount rate in the annuity scheme in (1). If stigma is not clearly recognised then it may cause that the rate of (2) is used in (1) too.

(4) True risk premium as normally for companies in the CAPM but now also for government debt that can default in full (also in annuity form). This risk is covered by portfolios (but not in discounting with (1)).

Texts from the realm of (4) apparently have confused discussions about (1) and (2), causing (3) as well. Markets apparently benefit from that confusion.

In October Portugal's 10 year rate was 11.7%. On November 24 Fitch reduced it to junk status, with a further rise to 12.1%. It does not imply that a default is in scope. On November 29 the Italian rate was 7.56%, and now indeed on new loans and not merely inferred from old debt. It could switch to annuities and fully redeem debts, but with shorter maturities (and likely liquidity assistance).

Contagion to bank capital

The case of Greece helps to highlight another effect. The rise to 18% restricts Greece from issueing new debt. It cannot impose the risk free rate used in the annuity scheme, as explained above. Instead, it has to rely on funds from the EU and the IMF, who require austerity. This is one effect. The other effect is dat banks holding Greek debt lose value. The rise of rates and the actual Greek default have consequences for bank capital.

Let us review what we determined in the section on formulas above. The 18% rate for Greece need not actually be paid by Greece now, in an actual new loan, but has been calculated by the ECB from the value of debt on the secondary market. As said, Greece 5 years ago in 2006 may have had a bond issue with a maturity of 15 years at 4%. This bond now has a maturity of 10 years and is sold on the secondary markets. If there is no default or haircut, this bond would trade above its principal value of 100 since the coupon rate of 4% is above the current 2.25%.

```
value[0, NoDefault] == PV[Bullit[.04, 10, 100], .0225]
```

value(0, NoDefault) = 115.516

The ECB calculated a yield of 18% for the old bonds, which implies that the traded value must be 37% of the principal of 100.

```
value[0] == PV[Bullit[.04, 10, 100], .18]
```

value(0) = 37.0828

Last year this same bond traded at a higher value. We take the ECB 10 year rate of October last year of 9.57%, again assuming no haircut in the estimate. Apparently the bond traded at 63% of principal.

```
value[-1] == PV[Bullit[.04, 11, 100], .0957]
```

value(−1) = 63.0951

The IFRS / IASB rules require fair value accounting by banks. When banks holding Greek debt lose value on it, say from 63.1 to 37.1, they have to account for it. This debt

is a liability to them, and the loss directly translates in their capital and equity value. Other agents are affected that hold paper from such banks. The government debt crisis becomes a bank crisis (again).

The markets have different agents. The seller takes a loss in the hope to avert a bigger loss, the buyer hopes to make a profit on a lesser haircut. Some pension funds may be forced to sell because of regulations that they use only debt with a certain credit rating. A speculator who buys above bond at 37.1 from a pension fund in distress, and sees a lesser haircut, gains. Apparently fair value accounting does not allow to specify such speculative expectations, possibly since that speculator is in the shadow banking system.

Earlier, we concluded that the 18% would be a surplus profit due to speculation. Now it appears a loss to banks, due to expectations on default. What is it, a profit or a loss ? Clearly it is confusing as well that the ECB publishes a rate of interest of which we may assume that it does not include a haircut while market sentiments can include a haircut.

The point remains that Greece is stuck. If it issues a bond at the current 18% in the bullet format and works hard to prevent a default, then creditors would make a huge profit. Greece can only arrive at a decent rate by conforming to market sentiments and actually default on that bullet - which is what governments are supposed not to do. It is rather perverse that a speculator could buy at 37.1 and insist that Greece works hard to not default, after which the speculator gets 115.5.

In fact, Greece should buy back its own bonds and make that profit itself. Hufbauer & Kirkegaard (2011) explain that angle. The problem is that Greece doesn't have the funds for that buyback. Haufler et al. (2011) state the viewpoint by German economists: other states should not help Greece in this bailout. Currently Greece is being bailed out partly nevertheless. Suppose that it wants to do more, on itself. One option is to guarantee precedence to buyers of new bonds over holders of older debt. This however will not really work since these will be the same creditors. It is better to honour old debt and then use the new debt creatively.

A response by Greece could be to actually conform to such market expectations on defaulting, by issueing a bond that has a probability of defaulting. For example, in year 2 part of the issue is recalled with probability Pr and fully redeemed, and the remainder is recalled in year 3 and given a haircut. If the 18% reflects market sentiments then it can become the coupon rate, while the present value at the risk free rate of 2.25% gives the announced haircut value of 81%, if Pr = 50% and using a random generator from some independent regulator.

$$w == \text{Pr}\left(\frac{p}{r+1} + \frac{p+w}{(r+1)^2}\right) + (1 - \text{Pr})\left(\frac{p}{r+1} + \frac{p}{(r+1)^2} + \frac{p+(1-h)\,w}{(r+1)^3}\right) /.$$

$$\{w \to 100,\ p \to 18,\ r \to .0225\}$$

$$100 = (0.935427\,(100\,(1-h)+18)+34.8205)\,(1-\text{Pr}) + 130.468\,\text{Pr}$$

```
Solve[Result /. Pr → 0.5, h]
```

$$\{\{h \to 0.808922\}\}$$

One would not suggest such a scheme for Italy since the implied risk of default is still

low. But for Greece it might be considered. If a haircut is expected, the auction master can make the expectations explicit, and separate those fears from the risk free rate.

Thus there are various subtle effects, but overall the conclusion is warranted that current procedures allow too much scope for some actors in the financial world to make surplus profit.

Stigma may consist to some extent out of the contagion discussed here. That is, creditors may require 18% not only to cover the direct default risk but also the indirect effects on other paper that they have, e.g. on shares of banks holding Greek debt or shares of companies in Greece. I tend to think that this need not be so. Supposedly it could be possible to separate the direct and indirect effects.

It may be that the IFRS / IASB rules do not fully account for the pecularities of the Eurozone. Since IFRS / IASB allow model exercises, it might be looked into that banks report on their estimate of an actual government debt default. The difference between this and the estimate of the market value of the debt would given a value for stigma. Perhaps this already happens ?

To regulate or not to regulate

For new regulation the important issue is the cost at the EU level. There are three kinds of regulated markets that all assume no-bailouts, such that the member state faces issues of haircuts itself, and there is a fourth one with a bailout.

(1) The EU-costless but uncapped market. The new law only states that unmaterialized risk is translated into an annuity. Creditor and debtor negotiate in advance about the split in risk free rate and risk premium. Stigma effects cannot be avoided. In the current situation it must be doubted however whether the Greek stigma really causes a true total rate of interest of 18%. Stigma may be lower at 3% so that the rest is redemption.

(2) The EU-costless but capped market. The new law also instructs the regulator to cap the rate of interest, either with rules or discretion. The cap would consist of the risk free rate (Germany) plus the liquidity premium plus a tolerable level of stigma, say 2% as when entering the Eurozone. Long government debt is a prime method to bring stability to pension funds, and a somewhat higher rate of interest is merely another way of providing for pensions and thus need not be a cause for alarm. It would be interesting to see what the maturity would be if stigma is set at zero, and whether Greece would be able to raise sufficient funds. Without learning, the cap would be exactly at the market value (case 1) to generate sufficient funds. But there may also be learning effects that allow a lower stigma to sink in. The country itself may make costs to achieve a lower stigma but it would be EU-costless.

In this way there would be scope for a EU regulator to oversee the rate of interest for a member government that threatens to become in default. The 10 year German rate of 2% would not be affected by this since Germany does not accept more risk in this scheme,

and since the problem country remains responsible for its own debt. The problem country pays a price since the 10 year German rate may become its own 6 year rate. There is benefit in regulation and capping that rate, since it blocks somewhat irrational effects of private profit taking in current financial markets.

(3) The EU-costly and capped market. Regulation would likely become costly if there is a common policy to drive down stigma. Suppose that the regulator caps stigma to 1% while the market rate would be 3%. It depends upon the supply schedule but say that Greece then only covers 30% of its demand for funds. It would need 70% of funds from non-market sources. Here ideas on adaptation of the European Central Bank (ECB), the introduction of Eurozone bonds, or the extension of the European Financial Stability Fund (EFSF) enter the discussion. Those ideas can be confusing when also bailouts are covered that actually belong to the following.

(4) The EU-costly and capped market with bailout. The notion of a bailout causes more integration than only regulation of trade flows. The prime example is the Eurozone bond backed by the whole Eurozone. It presumes some fiscal union, since otherwise the fund would be powerless if some country would default.

With these 4 possibilities we can imagine a "regulation ladder" with regime switches, first how to get to a stable situation, and secondly how that stable situation looks like. See the next section.

With this analysis it appears that much debate in the EU seemed to be about regulating default risk while it actually was about regulating irrational market stigma that fuels on itself since it is rewarded. Of course, some were discussing the fiscal union, but many of those discussants may have lacked a clear view on stigma.

It is a bit sobering that all this discussion in the EU about the Greek haircut, first of 21% in July (now adopted by Parliaments) and then of 50% last October 2011 (still pending), essentially boils down to swap a bullet into an annuity scheme, plus the willingness to cap the effective rate of interest to the market risk free rate. That is, the discussion in 2011 about Greece concerned a haircut on old debt, but this situation could have been avoided if one had discussed this swap some years earlier. The lesson is useful for the treatment of other countries in Southern Europe.

The literature shows the awareness of herd behaviour (indeed bears and bulls in general) yet the matter becomes a bit clearer when it is seen in the context of turning ex ante risk into ex post redemption. It allows us to better evaluate the role of the ECB. The ECB decided to buy Southern European debt on the secondary market. The given argument of supporting the financial stability of the South and the system as a whole is vague when there would be no fundamental risk for default - it should have sufficed to point to the fundamental factors. The traditional notion of a liquidity crisis now becomes clearer. The proper motivation rather lies in the desire to fight suddenly high market stigma when the fundamental belief is that there is no cause for default. We now understand that the ECB actually wanted to cap the risk free rate in the annuity scheme. It currently lacks that option and the market operation was a second best, i.e. the traditional way to bring down the rate of interest. This method suits a monetary and fiscal union but is inadequate for the Eurozone setting. Adaptation of the ECB and the Treaty on the euro

seems wise. Countries can do a lot themselves about reducing stigma but joining a monetary union eliminates an instrument (primarily printing money, but perhaps also the exchange rate but that generates another risk factor) to handle stigma and thus there is some responsibility for the union to assist.

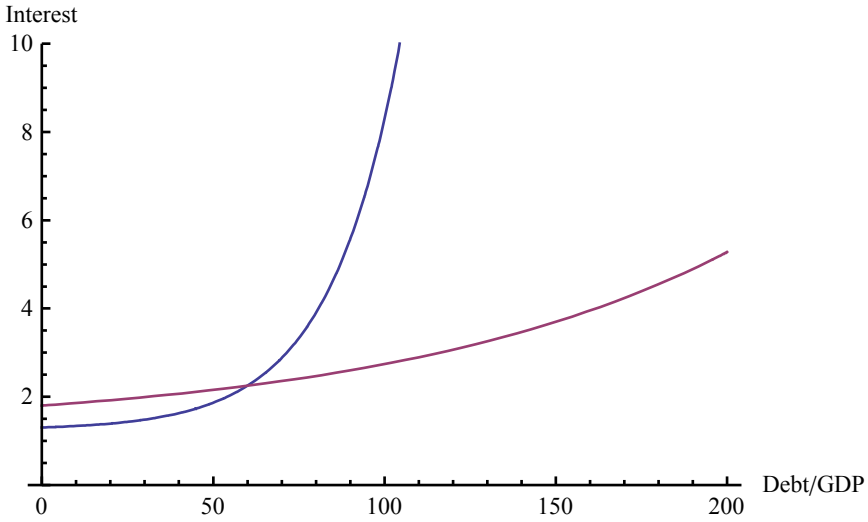
A regulation ladder

We get a ladder with a yardstick, and distinguish the end result and the process how to get there.

PM. It is a curious system that private banks can borrow from the ECB at 1%, use a multiplier, and loan to governments at 18%. In normal situations we would like to see governments benefitting from seigniorage, see Colignatus (2005), and banks having to compete for funds in the market place, rather than the other way around. The target rate of interest would be about the same as the nominal GDP growth, thus $r \approx g$, since then income and wealth would be balanced. With the long term rate anchored in that manner, the weight for inflation policy falls on the short term rate of interest, hence the term structure, influencing bank profits based upon their channelling of short term deposits into long term loans.

A yardstick

The regulator can let itself be guided by a formula to establish the rate of interest to be used in the annuity scheme of a government at risk of default. With d the Debt / GDP ratio the rate could be $r = 1.25 + c^{(d-60)}$, both in percentages, with coefficient c. At $d = 60$ we have $r = 2.25$. The coefficient 1.25 could change if the fundamental (German) rate of 2 rises. We can distinguish operations in the normal state around $d = 60$, with coefficient $c = 1.05$, and the current period of crisis with coefficient $c = 1.01$. The latter form can provide stability for the adjustment in the next decade. Once debt values are sustainable then the regime switch from recovery to normality takes place.



The long term situation

In the long term countries would be in these states:

(1) Stability around $d = 60$ and the deficit at most 3%.

(2) Warning phase, when $d \geq 80$ and possibly $r \geq 3.9$.

```
1.25 + 1.05 ^ (80 − 60)
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```
3.9033
```

The country is obliged to use annuity schemes so that market sentiments translate into maturity. The regulator assists in capping the rate of interest. It can use discretion. If the country is cooperative then the cap could be at 2.25 but otherwise it might rise with d according to above formula or worse.

The cap can be implemented in various ways. The most natural seems to be the following. The annuity bond of principal P can be backed by αP by the regulator and $(1 - \alpha) P$ by the country, say for $\alpha = 30\%$ during 30% of the start of its life. No doubt market parties will design schemes to split the insurances, if needed, but this is OK since it will provide information about the perceived risks.

Countries can apply for this phase voluntarily at lower debt levels too. For example, at a debt level of 75% the markets might cause a rate of interest of say 5.5% and there would be a perverse temptation for the country to let debt rise to 80%. Presumably though instruments are developed to better identify stigma and true fears about defaults.

(3) Danger zone, for $d \geq 85$ and $r \geq 4.6$.

```
1.25 + 1.05 ^ (85 − 60)
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4.63635
```

Market perceptions threaten to develop into high stigma and perceived risks on defaulting even on the annuity payments. The regulator may still cap the rate of interest to only 2.25% if the country behaves but may also choose for example 5% if it doesn't. The formula is only indicative. It may be necessary that the loans run fully via the regulator (not only $\alpha = 1$ but also the annual payments) who then recovers the sums from the country. The regulator may use 25 year loans in these bilateral dealings with the country. Collateral will be involved as well.

(4) No more support, for $d \geq 90$ and $r \geq 5.5$.

```
1.25 + 1.05 ^ (90 − 60)
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```
5.57194
```

The regulator has been signalling to the market via the earlier steps that debt from this country is getting risky. Market parties have been able to sell their holdings. The low price of the debt causes an ever shorter maturity of its annuity loans. Beyond 90% of GDP it is over. The regulator starts selling its own debt to recover part of it, while maintaining a claim on the country for the remainder.

The country is still in the Eurozone. Though it no longer gets financial support from the regulator, it still has some minimal advantages of the whole system on liquidity. In phase

(3) one cannot use bonds that explicitly state a probability of default but now one is obliged to do so (see the example above).

(5) Exit, for $d \geq X$.

It is a matter of taste whether one wishes to specify an exit rule. If a large group wishes to impose an exit of a single member then it could always enforce it. Thus there does not seem to be a need to do so.

How to get there

The process on getting there can be described as stage (3) above but now with $c = 1.01$, and Greece perhaps now at 180% debt of GDP. Greece would be allowed to use bonds that specify a probability of defaulting, using a random generator of a trusted source. If Greece succeeds in reducing its debt then the rate could be 2.25% but it can be higher if the regulator thinks so. If the debt has been reduced to 85% then c flips to 1.05.

```
1.25 + 1.01 ^ (180 − 60)
```

```
4.55039
```

The approach suggested here can already be started. Apparently the regulator is not the ECB but the EFSF. See Delbecque (2011) for a proposal how the EFSF could cap the rate of interest on new debt, and a short exchange of views with De Grauwe on the stock versus new debt. This does not yet identify stigma and the option to turn ex ante risk premium into ex post redemption via annuities. The EFSF runs to 2013 and is supposed to be replaced by a permanent ESM. It seems wiser to make the ECB a full lender of last resort without discussion about legality.

Again, this discussion can best be seen in the context of Colignatus (2011ab). Stress tests would enhance our information about the system performance. There should be provisions to change the ladder in a stress situation for example due to climate change.

Other literature on stigma

Armentier et al. (2011) discuss Discount Window stigma (DW-stigma) when banks prefer not to borrow cheaper at the US FED for fear that it signals to others that they are vulnerable. IMF (2011) accounts for that kind of stigma too. When the ECB buys debt from specific countries it has a similar signalling effect, such that rate of interest need not reduced as much as hoped for. This is just one kind of stigma and not the only kind. Efrat (2005) indeed gives another example, and discusses how bankruptcy used to affect enterpreneurs in the past more than nowadays. Erb et al. (1997) discuss country risk in global financial management. Apparently stigma must be implied but they do not specify stigma in the terms discussed here.

In the literature on Eurozone bonds there are ample references to speculation but not using the label “stigma”. That literature tends to carry a confusion of stigma with the

real risk of default. Eurozone bonds destroy the information about individual performance, which information is useful to generate shorter maturities for governments under distress. Some comments on such bonds can be made here. There are various models for such bonds. If all countries use only Eurozone bonds then Germany would see a rise of its rate from 2% to say the 2.75% average. The liquidity premium of 0.25% would disappear, but the extra risk factor has to be included that there no longer is a safe haven in Germany since it has taken along the load of other nations. Though one might argue that it already has taken on that load anyway. Countries may also only partly use Eurozone bonds, e.g. the first 60% of debt. The German Five Wise (Bofinger et al. (2011)) propose a once-only redemption for debt above 60%, financed by a Eurozone instrument. Overall, a partial application is better than a full one. However, setting up a temporary and/or partial system for Eurozone bonds has the risk that the mechanism gets known and becomes permanent.

The slides by Bini Smaghi (2011) are informative about the issues in the Eurozone. He is aware of speculation but does not formulate the issue in terms of stigma, and does not sharply formulate a stand against surplus profits made when defaults do not materialize. He glosses over the issue of inflation, and does not see these two points: (a) Liquidity support for Eurozone government debt need not fuel inflation. (b) The critical overhang of Greece and Italy can be neutralised within the monetary system.

Teulings et al. (2011), in a book on the current crisis for the general public by the director and some colleagues of the Dutch Central Planning Bureau (CPB), implicitly discuss stigma processes though they do not use the term. Their discussion can be seen as traditional. There is the distinction between liquidity and solvency crises. In a liquidity crisis the EU and ECB could support the affected government since the no-bailout condition is satisfied, though there are restrictions in the Treaty. The higher rates of interest still would have to be paid to the creditors, and thus not just the overall risk free rate of 2.25%. In a solvency crisis the debt must be restructured with a haircut for creditors. In the latter case there is a bailout and the Eurozone would surely need a new Treaty and have to turn into a fiscal union. The latter would overall be useful to prevent that a liquidity crisis turns into a solvency crisis. There is also the problem of contagion that bad government debt affects the capital base of banks, so that oversight of banks at the EU level is required as well. This traditional view neglects that a fiscal union is only a sufficient but not a necessary condition. Necessary is only that exchange rate changes are replaced by another control mechanism on trade flows, not necessarily on other issues than trade flows. The CPB is a strong supporter of the aggressive Dutch export policy but it neglects that this is part of the problem, see Colignatus (2011d) on the ghost of the Berlin Wall. The view neither criticizes the surplus profits made from high rates of interest due to stigma, i.e. “risk premia” for risks that do not materialize. It does neither recognize that a restructuring of the Greek and Italian debt can be absorbed in the monetary system, as suggested in Colignatus (2011ab). The CPB is also silent on the following. The Dutch minister of Finance, De Jager, called for a Greek haircut, with the argument that the banking sector should carry part of the burden. This worsened the situation in the EU because of the higher rates and the contagion towards bank capital. He actually called for a “bank run”, and encouraged stigma by confirming the reaction pattern of the markets instead of discouraging it. Instead, Colignatus (2011ab) contains

additional bank capital, using public funds, which both enhances solvency and implies that the banking sector carries part of the burden because of the loss of equity value.

Papademos (2011), before becoming prime minister of Greece, presents the traditional view too.

Mosler (2011) formalizes the common notion that debt is only delayed taxation but then radically interpretes debt as money too: "The new bond issue includes an addition to the default provisions that eliminates the risk of loss to investors. The language added to the default provisions states that while in default, and only in the case of default, these transferable securities can be used directly, by the bearer on demand, at face value plus accrued interest, for payment of any debts, including taxes, owed to the Greek government. By eliminating the risk of loss, Greece will be able to independently fund all required financial obligations in the market place for the foreseeable future. The immediate benefits are both reduced interest costs that substantially contribute to deficit reduction, and the elimination of the need for the funding assistance from the European Union and the IMF." In current practice, debt has a structure such that debt cannot be used to pay for taxes, and creditors are paid for not doing so. If there is a true default, then such debt would not be accepted as payment for taxes either, since the country would be in dire straits and need all cash it can get. The latter however would not change whatever the default provision text says, even though Mosler hopes to the contrary. There is also the Eurozone setting. It is unlikely that Greece can print 100% of GDP of these bonds, and then default, such that such bonds turn into money useful to pay Greek taxes, without the ECB protesting that it is creating money outside of the agreed system parameters. For Mosler there is no difference between money and debt but in some minds there still is, and likely also in the minds of a defaulting government. Mosler implicitly wants to reduce the stigma effect and the ex ante expectation of default that does not materialize (otherwise the scheme would not work).

The Shadow Financial Regulatory Committees (2011) run the risk of being as shadow-confused as the Eurozone itself, though in the comfort zone of having no responsibility in this (other than educating students). That is, one does not read anything here that for example Kanzler Merkel hasn't heard from her advisors either. In that respect it can be read as a summary of various challenges for policy making, but it is vague, unspecific, focusses on the impossibilities and leaves out important options. The exception may be the proposal on page 3 on a new rule: "including a simple, but ample, minimum required leverage ratio – shareholders' equity divided by total assets" but this causes all kinds of questions. Perhaps one becomes a "shadow regulator" by developing views on the "capital requirement ratio" (while the main problem are shadow-banks). The chairman Benink (2011) in a Dutch text holds that ECB activities require capital, and that losses are at the cost of governments and taxpayers. He then refers to current rules and forgets to add that monetary economics advises a change of the Treaty.

A note on CAPM

One way how the rate of interest can rise for a country in distress is by shortselling. Colignatus (1999) contains a note on shortselling in the CAPM. In an email of August

13 1999 Zvi Bodie reacted: “The point you are making is quite correct. It was first made years ago by Robert C. Merton in his pathbreaking work on the intertemporal capital asset pricing model. You can find all the relevant articles reproduced in Merton’s book “Continuous time finance”.” Note that Bodie may have reacted only to the summary and need not have studied my full paper. I have not pursued the issue further. The interested reader has two references now.

Conclusion

It is useful to see the issue at the level of the EU and not just the Eurozone. We can identify perverse processes that put governments into costs with perceived profits for banks but also with bank capital losses. Perhaps the bank problem requires special new regulation but at least we have succeeded in better understanding stigma and haircuts. The proposed scheme has these features:

(1) We can identify a regulatory ladder with different phases, and distinguish the end result and the process how to get there.

(2) In the “normal” situation around the Debt / GDP norm of 60% countries pursue their own debt policies.

(3) If a country comes from the normal situation of Debt / GDP around 60% into another situation higher than say 80%, it can be declared under threat of stigma or default. It then issues new debt in annuity forms where the rate of interest is establised by the regulator.

(4) In the current situation, where various EU member states have high government debt and are perceived to be under threat of default, already (3) applies. An interest rate cap is required to allow recovery from the rather severe crisis we are in. Healthy people can sustain brisk measures but patients in hospitals need careful treatment. The EU-costless scheme is to require a lower rate by law. This does not put a burden on safe countries. It only regulates the interaction of markets and problem countries, by reducing irrational and counterproductive feedback loops. Creditors like pension funds can be educated on this. Other creditors may resist such law however, remain stuck in stigma, refuse to lend, so that liquidity support is needed.

(5) The identification of the stigma effect and counterproductive market processes requires reevaluation of the Treaty on the euro. Regulation with EU-costs may actually be desirable to block rather than only reduce such counterproductive processes. This view supports the earlier conclusion in Colignatus (2011ab) that it would be better that the EU as a whole gets a proper system of central banks without issues of legitimacy.

Our discussion overlaps much of what already has been said about the distinction between liquidity and solvency crises. Our discussion however helped to better identify the stigma effect and the counterproductive market processes, and we suggested the regulation ladder to deal with these.

Appendix A: EU 10 Year Interest Rates

ECB (2011a), "Long-term interest rate statistics for EU Member States", http://www.ecb.int/stats/money/long/html/index.en.html

Table 1 last update: 11/11/2011

Harmonised long term interest rates for convergence assessment purposes (1)

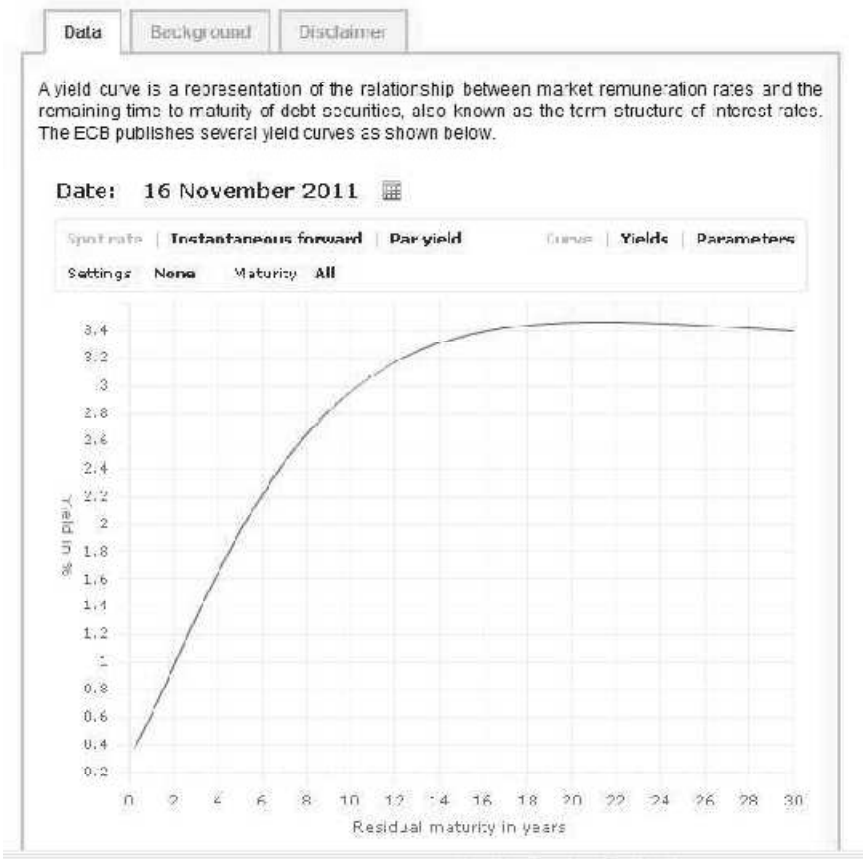
(percentages per annum; period averages secondary market yields of government bonds with maturities of close to ten years (2))

Countries	Oct. 10	Nov. 10	Dec. 10	Jan. 11	Feb. 11	Mar. 11	Apr. 11	May 11	June 11	July 11	Aug. 11	Sep. 11	Oct. 11
Euro area													
Belgium	3.21	3.48	3.99	4.14	4.21	4.21	4.29	4.2[illegible]	4.14	4.22	4.11	3.88	4.20
Germany	2.35	2.53	2.91	3.02	3.20	3.21	3.34	3.06	2.89	2.74	2.21	1.83	2.00
Ireland	6.42	8.22	8.45	8.75	9.10	9.67	9.79	10.04	11.40	12.45	9.57	8.51	9.10
Greece	9.57	11.52	12.01	11.73	11.40	12.44	13.86	15.94	16.69	16.15	15.90	17.78	18.04
Spain	4.04	4.69	5.38	5.38	5.26	5.25	5.33	5.32	5.48	5.83	5.25	5.20	5.26
France	2.72	3.00	3.04	3.44	3.60	3.61	3.68	3.49	3.40	3.40	2.90	2.64	2.99
Italy	5.80	6.18	6.60	6.73	6.74	6.86	6.84	6.76	6.62	6.46	5.27	5.75	5.97
Cyprus	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.78	6.25	6.42	7.00	7.00
Luxembourg (3)	2.73	2.94	3.32	3.30	3.45	3.47	3.58	3.29	3.15	3.03	2.50	2.27	2.37
Malta	3.90	4.12	4.42	4.51	4.60	4.68	4.73	4.63	4.63	4.59	4.32	4.14	4.26
Netherlands	2.53	2.79	3.16	3.23	3.41	3.42	3.65	3.40	3.28	3.17	2.68	2.34	2.46
Austria	2.82	3.01	3.43	3.54	3.68	3.68	3.76	3.53	3.43	3.35	2.84	2.64	2.82
Portugal	6.05	6.91	6.53	6.95	7.34	7.80	9.19	9.63	10.87	12.15	10.93	11.34	11.72
Slovenia	3.56	3.77	4.11	4.29	4.26	4.30	4.53	4.43	4.58	4.89	4.99	4.86	5.16
Slovakia	3.67	3.80	4.06	4.16	4.24	4.32	4.33	4.33	4.39	4.55	4.55	4.25	4.33
Finland	2.63	2.82	3.19	3.27	3.41	3.45	3.57	3.32	3.29	3.16	2.68	2.35	2.51
Non-euro area													
Bulgaria	5.02	5.74	5.70	5.56	5.40	5.30	5.30	5.39	5.39	5.30	5.02	5.30	5.27
Czech Republic	3.43	3.59	3.89	3.98	4.05	4.05	4.05	3.89	3.77	3.79	3.40	3.00	3.14
Denmark	2.46	2.65	3.01	3.05	3.23	3.29	3.42	3.13	2.96	3.02	2.49	2.07	2.23
Latvia	9.24	8.99	7.55	5.38	6.17	6.49	6.47	6.36	5.67	5.67	5.60	5.60	5.62
Lithuania	5.15	5.15	5.15	5.15	5.15	5.15	5.12	5.05	5.05	5.05	5.05	5.09	5.06
Hungary	6.87	7.38	7.92	7.70	7.39	7.29	7.05	7.11	7.22	7.35	7.49	7.64	7.68
Poland	5.53	5.82	5.98	6.28	6.28	6.27	6.14	6.06	5.88	5.81	5.70	5.74	5.71
Romania	7.02	7.04	7.09	6.66	7.03	7.31	7.30	7.26	7.09	7.30	7.38	7.43	7.48
Sweden	2.64	2.86	3.21	3.28	3.41	3.35	3.30	3.01	2.89	2.75	2.17	1.83	1.90
United Kingdom	2.80	3.03	3.34	3.62	4.00	3.78	3.78	3.49	3.09	2.88	2.37	2.41	2.52

Sources: ECB and European Commission.

Appendix B: Euro Yield Curve

ECB (2011b), “Euro yield curve”, http://www.ecb.de/stats/money/yc/html/index.en.html



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