Fiscal space in the euro zone

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Using data from 1995 to 2008, this paper[1] derives debt limits in the European Union from the reaction of budget on debt before the crisis. Based on work of IMF (Ostry, 2010) we suggest our approach and estimate the fiscal reaction functions and the implied critical debt levels of EU governments. Since many countries did not take advantage of the boom years for consolidation, the fiscal space – availability of debt financing – in the euro zone has shrunk, especially in countries where the response to rising debt levels was weak in the past. We conclude by stressing a need for structural changes in budget policy (upper shift in the reaction on debt) or risk a default in the case when fiscal space was negative or has been squeezed.

Introduction

When prompted by leaders, voters, or market forces, governments try to respond to rising debt levels through various policy measures to ensure that total public debt is kept under control. We can label actions aimed at debt stabilization or debt reduction as government's consolidation measures.

The reaction of the government to a particular debt level can be expressed through a government reaction function which captures the relationship between primary balance and total debt. As we explain in more detail later, it is reasonable to expect that the reaction function is non-linear: if total debt rises too far, the attempts to cut the primary deficit may become "hopeless".

This paper is motivated by the recent financial crisis, which has brought up several interdependent questions:

- How governments of the EU respond to their existing debts? What is the shape of the reaction to specific debt level? What factors cause the difference in the reaction of individual country?
- At what level of debt (if this level exists) does increasing government reaction compensate for interest payments so that the level of debt[2] is stabilized? This threshold of indebtedness will be called the sustainable debt level.
- At what level of public debt does the risk of default emerge? As cost of debt increases, it may get out of control and become unmanageable. Primary balance that would compensate for rising interest cost is becoming economically and/or politically impossible. The threshold beyond which the government is unable to reduce the level of its debt will be labeled a critical debt level[3].
- Given a specific size of debt, how much room do governments have to raise further funds? The difference between the critical debt level and current debt level will be referred to as fiscal space.

As the debt approaches the critical threshold, the investors´ trust is shaken, leading to higher borrowing cost, and eventually a total loss of confidence. Any government that approaches its critical debt limit must decide whether to take (potentially drastic) fiscal consolidation measures, or whether to declare that is unable to meet its prior obligations. (In the latter case, it must restructure its debt, and pay high economic and reputational costs.)

In this paper we estimate reaction functions of governments in the European Union before current crisis has started (before 2009) as well as critical debt levels and the amount of fiscal space that governments had in 2009, based on this estimates. As a framework to evaluate solvency of a sovereign, we follow the "model-based sustainability" (MBS) test, which asks whether the government's primary fiscal balance responds sufficiently to increases in public debt.

Debt dynamics

Analysis of development of government debt can be based on a standard debt dynamics equation. The following relationship holds for the evolution of debt[4]:

$$\Delta d_t = (i_t - g_t) * d_{t-1} - PB_t - A_t \qquad (1)$$

where

d_t denotes the change of debt in percent of the nominal GDP

Δd_t denotes the change of debt

PB_t is the primary balance at time t in percent of the nominal GDP

i_t is the average (implicit[5]) interest rate on debt

g_t denotes the growth rate of the nominal GDP

A_t captures changes in the valuation of the debt due to, for example, a one-time sale of state-owned assets, exchange rate movements, debt write-offs

According to expression (1), ignoring A_t term whose sign and magnitude is difficult to predict, total debt to GDP increases when cost of debt adjusted for the nominal GDP growth – *the snow-ball effect* – exceeds primary balance.

There are many ways how to understand that the debt level of a country is sustainable[6]. The

1 Here we present shortened version of the original WP (Hajnovic, Zeman (2012).
2 Share of gross debt on nominal GDP.
3 It is rather an upper bound of the debt default level.
4 This relationship is discussed in the context of budget consolidation in Strachotova, 2010.
5 Here "implicit" stands for average interest – defined as 100*interest cost / volume of debt at the end of the previous period
6 One reasonably reliable characteristic of the sustainability of public debt development is a country's fiscal history, which reflects the behavior and the reaction to earlier fiscal problems of previous governments.

7 Alesina et al. (2011) asserts that fiscal consolidation need not be politically damaging.
8 Here we follow standard example – not considering so called expansionary consolidations.
9 Apart from the argument about high nonlinearity of the reaction function discussed in the previous paragraph, the choice of the 4th degree polynomial is justified by statistical properties of our estimates.

notion of sustainability is usually related to the stable or stabilized debt development in a given horizon (short term, medium term, long term). From the formal point of view the government can declare any debt level to be "sustainable", as it autonomously sets tax rates and determines the size of pubic expenditure: in other words, it sets the primary balance.

But the level of the primary balance is constrained by both economic and political factors. For the economic and the political reasons, it is costly to increase taxes, or to otherwise increase government revenues, because of a potential detrimental effect such measures can have on economic activity, demand and living standards. Reducing public expenditures can also be economically and politically costly, because it reduces demand and because the beneficiaries of public programs can punish elected officials in the next election.[7]

At low levels of debt the government's response is largely benevolent, the primary balance does not compensate for the snow-ball effect, nor does it compensate for current income and/or expenditure shocks. Debt gradually moves towards its sustainable level and the reaction becomes stronger. If the level of debt exceeds this point, the governments generally behave more responsibly because they do not want to risk problems with repaying debt. Strengthened consolidation effort sets the primary balance to the level that exceeds the snow-ball effect and causes debt level to move back to its sustainable level. However, there are factors, namely shocks to the budget, cyclical factors and structural deficiencies of the budget, that may alter this direction.

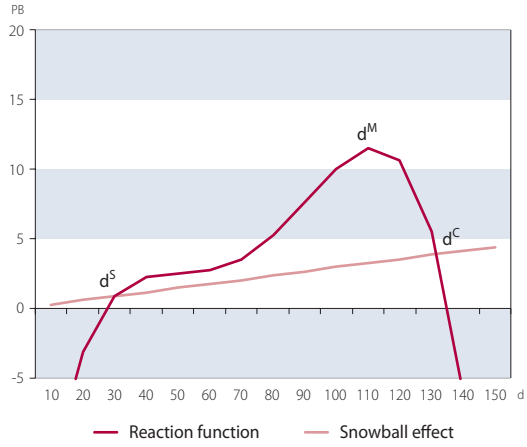
Reaction on the increasing debt level has its limits, however. If the level of debt is too high, the primary balance, which would eliminate snow-ball effect, is economically and/or politically impassable, the government gives up the consolidation fight and declares default. This level of debt is called critical.

Model

The following sequence of events indicates that the government response to debt increases is likely to be highly nonlinear:

1. Markets react to increasing (or higher) debt by increasing credit risk premium on government bonds. This premium is likely to rise in a nonlinear manner for high debt level.
2. Then cost of debt increases (is higher).
3. Higher costs of debt force the government to adopt restrictive debt consolidation measures comprising of tax increases and/or expenditure reductions.
4. Austerity measures have negative impact on domestic demand and economic activity.[8] The stricter the austerity measures are, the more negative (stronger) impact on the demand and the economic activity results in.
5. Slowdown or decrease of GDP growth nonlinearly increases the proportion of debt to GDP.

Figure 1 The government's reaction function and snowball effect



Source: Authors' drawing.
Notes: If the level of debt is lower than d^S, consolidation efforts are weak and do not fully cover the adjusted interest rate costs of debt (the snow-ball effect), represented by the linear function of debt level. If the level of debt is above d^S but lower than d^C the primary balance compensates for the snow-ball effect. The magnitude d^S represents, other things being equal, stabilizing debt situation, because the reaction on debt is stronger when debt exceeds d^S. The situation is different in the proximity of d^M. If debt oversteps d^M the reaction will weaken (government gives up) and, other things being equal, debt exceeding d^C infers that the primary balance does not compensate for the snow-ball effect and debt rises in an unlimited manner. We refer to d^C as the critical debt level.

The degree of nonlinearity of the reaction function is potentially increasing in every step of that sequence and can be thus approximated by a polynomial of higher degree.

We assume that the reaction is up to the fourth degree polynomial.[9] We also assume that beyond reacting to total debt, primary balance is also influenced by cyclical factors, namely the GDP gap and the cyclical component of government expenditure. Reactions are different for individual countries. Following Ostry et al. (2010), we assume that the "shape" of the reaction function is the same for all countries, but the magnitude of the reactions for individual countries differs.

The model to be estimated is

$$\Delta PB_t = b_1 * GDP_{gap_t} + b_2 * GOV_{gap_t} + \\ + k * \left[PB_{t-1} - \left(\frac{c_0}{(-k)} + \frac{c_1}{(-k)} * d_{t-1} + \frac{c_2}{(-k)} * d_{t-1}^2 + \\ + \frac{c_3}{(-k)} * d_{t-1}^3 + \frac{c_4}{(-k)} * d_{t-1}^4 \right) \right] \qquad (2)$$

It consists of two parts:

1. the short-term impulses – emerging through cyclical variables – the GDP gap as a proxy for cyclical budget revenues and the GOV gap, that denotes the gap between the actual government consumption and its trend,
2. the long-term or equilibrium component which represents a long-term or equilibrium reaction to debt in the past.

Values $a_j = c_j/(-k)$, $j = 1,..4$ are coefficients of the reaction function.

In general, there are no "prescribed" signs of coefficients a_j except for the coefficient of the polynomial of the highest degree – a_4 which must be negative to express basic assumption of the approach – government gives up reaction for high level of debt.

It is reasonable to expect that second higher coefficient have positive sign, to express that consolidation effort – the reaction on debt is increasing below the "give up" level (d_m).

Positive sign of coefficient a_1 would express increasing or stronger reaction on growing or higher debt at the lower part of debt spectrum. Negative sign of coefficient a_2 then expresses easing or looser reaction on growing or higher debt in the low to medium part of debt spectrum.

For coefficients b_1 and b_2 we expect:

- Coefficient b_1 will be positive: in a boom period (positive output gap) the government is able to improve its fiscal position and raise the primary balance.
- Coefficient b_2 will be negative: A cyclical increase in government consumption causes a deterioration of its budget.

Estimated reaction function

The main results – estimated coefficients of reaction function – are reported in Table 1, and the fixed effects (shifts away of individual countries from the overall EU reaction) are reported in Table 2. Coefficients are normalized by appropriate power of 10 (debt level is measured in %).

Coefficient a_3 is positive and its value is 1,48/0,65 = 2,28: further debt increases in the medium to high part of the debt spectrum are associated with increasing primary balance – tighter fiscal policy or stronger reaction on debt. Coefficient a_4 is negative: for high levels of debt, primary balance deteriorates, reaction of debt and consolidation efforts are weakened. Coefficient b_1 is positive, as expected: higher GDP gap allows the government to behave more prudently. A one percentage point increase in GDP gap is associated with higher (better) primary balance by 0,15 percentage points. Coefficient b_2 is naturally negative: above-trend expenditures imply more lenient fiscal policy and lower (worse) primary balance. Parameter is (-0,28).

The only specific factor differentiating reactions of individual countries is fixed (shift) factor. It comprises many structural and other factors, which define budget policy of a given country in the long term. Thus the typical position of the reaction function of a country represents the structure of its budget policy – budget policy of a developed slowly growing country must be structurally different from the budget policy of a fast growing catching up country. The other possible interpretation is that when a country expects economic slowdown it has to adopt structural budgetary measures to prevent accumulation of its debt.

The reaction of some countries are located mainly in the range of positive primary balances. This is typical for countries with low growth. Reaction of others are negative for low and moderate debt levels (for example, less than 60% of GDP) and positive for high debt levels. Yet for some countries reaction function is almost entirely negative – this is typical for countries, with rapid nominal GDP growth exceeding interest rate (they grow out of their debt).

We will illustrate results of the estimation of reaction functions for Finland, Italy, Greece and Slovakia.

Finland, as a country with responsible fiscal policy, has the reaction function – in accordance with expectations – shifted upwards by 2.87/0.65 = 4.4% (of its nominal GDP). This means that the reaction of Finland on debt is 4.4% of GDP stronger than the response of the EU as a whole. On the other hand, Greece and Italy react to debt less than the EU as a whole. Greece's reaction function compared to the EU average is shifted downwards by 6.99/0.65 = 10.8% of GDP and reaction of Italy is weaker by 4.44/0.65 = 6.8% of GDP than the EU average. The response to debt of Slovakia is weaker than the response of the EU by 2.3/0.65 = 3.5% of GDP.

Table 1 Estimated model, main results

Panel regression with fixed effects					
		1995-2008		2000-2008	
Dependent var.		ΔPB		ΔPB	
		Coefficient	Prob.	Coefficient	Prob.
Explanatory var.					
C	C_0	-7.69	0.00	-15.78	0.00
d_{t-1}	C_1	0.55	0.00	1.15	0.00
$10^{-2}*d^2_{t-1}$	C_2	-1.37	0.00	-2.80	0.00
$10^{-4}*d^3_{t-1}$	C_3	1.48	0.00	2.89	0.00
$10^{-7}*d^4_{t-1}$	C_4	-5.31	0.00	-10.23	0.01
GDPgap?	b_1	0.15	0.00	0.20	0.00
GOVgap?	b_2	-0.28	0.00	-0.33	0.00
PB?(-1)	k	-0.65	0.00	-0.59	0.00

Source: Authors' calculation.

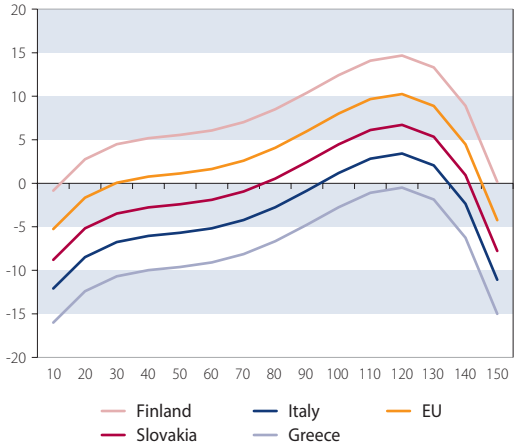
Table 2 Estimated model, main results

	1995-2008	2000-2008
Belgium	-2.57	-2.66
Bulgaria	1.82	1.92
Czech Republic	-0.48	-0.84
Denmark	2.59	1.62
Germany	-0.59	-1.35
Estonia	4.96	10.56
Ireland	0.97	0.29
Greece	-6.99	-7.05
Spain	-0.05	-0.73
France	-1.13	-1.85
Italy	-4.44	-4.82
Cyprus	-0.89	-1.06
Latvia	2.21	4.53
Lithuania	0.12	1.17

	1995-2008	2000-2008
Luxembourg	6.39	10.87
Hungary	-1.86	-2.64
Malta	-2.22	-2.40
Netherlands	0.40	-0.55
Austria	-0.52	-0.97
Poland	-1.89	-2.48
Portugal	-1.52	-2.09
Romania	1.04	1.43
Slovenia	0.29	-0.33
Slovakia	-2.30	-2.41
Finland	2.87	2.03
Sweden	1.40	0.48
UK	-0.27	-1.55

Source: Authors' calculation.

Figure 2 Reaction to debt



Source: Authors' calculation.

If the economy moves at its potential and government spending follows long-term trend, then debt dynamics depends on the interaction between the response to the debt and the adjusted cost of debt – *(i – g) * d*. To determine a critical level of debt, we need to estimate future development of adjusted cost of debt. As already mentioned, one way how to determine the level of interest rate and GDP growth rate is finding an average of these variables for an appropriately chosen period. If a country's debt is sufficiently far from a critical level, interest rate – growth rate differential is assumed to be exogenous and then snowball effect grows linearly with the level of debt.

Critical level of debt and fiscal space

In determining a critical level of debt, besides the knowledge of the reaction function it is also important to know other factors effecting debt dynamics, namely, the rates at which the debt is financed, the nominal growth rate of output and the actual level of debt. These factors together determine whether the budget reaction (the primary balance) is sufficient to compensate for snow-bal effect. Such an assessment is not correct in a short term, because growth rate can be influenced by the budget reaction. We instead use long term approach – our reaction function is estimated from longer time period. Then the interpretation of the assessment is different and can be expressed as: "Is the reaction, as observed (estimated) in the long-term sufficient to cover snow-ball effect (adjusted interest cost of debt)?" From the formal point of view we can then take different assumptions about snow-ball effect – for instance different backward time horizons as the basis for assessing snow ball effect empirically. But selecting specific time period changes the interpretation.

Critical level of debt will be illustrated for countries – Finland, Italy, Greece and Slovakia. For each country (except from Greece[10]) two periods are considered – the whole period 1995-2008 and its sub-period 2000-2008.

The slope of snow-ball effect line for selected period is the period average of the difference between (implicit) interest rate and growth rate of nominal GDP. Values for individual countries are reported in Table 3. While Greece and, even

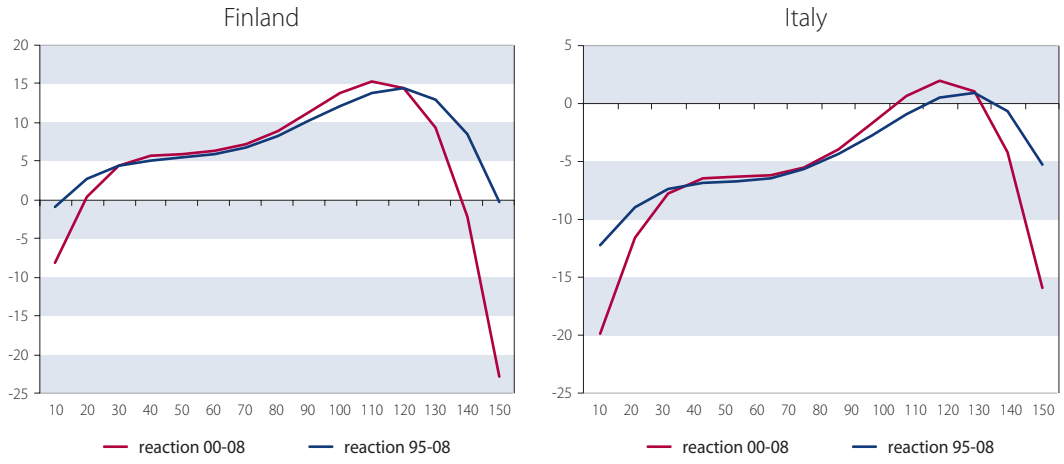
Table 3 Slope of snow-ball effect line

	1995-2008	2000-2008
Country		
Italy	2.07	1.24
Finland	0.23	-0.26
Greece	NA	-1.96
Slovakia	-3.22	-4.01

Source: Authors' calculation.

10 *Data before the 2000 were not available for Greece.*

Figure 3 Fiscal space



Source: Authors' calculation.

more Slovakia, grew up off the debt, snow-ball effect was relevant for Italy. For Finland, snow-ball effect was negligible.

In 2009, Finland owed 43.3% of its GDP to creditors. From Figure 3, it is evident that Finland still has a very large space for debt financing. Given its reaction function, its critical debt level is estimated to be in the neighborhood of 145% of GDP[11] (135% when taking 2000-2008 reaction). (When interest rates fell in Finland after 2000, available fiscal space increased in Finland, but it behaved responsibly nonetheless.)

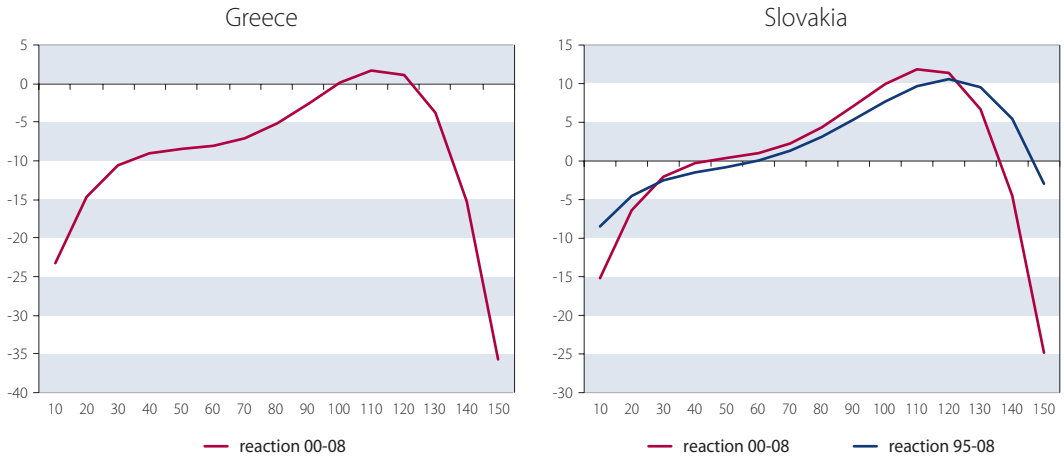
In Italy, total debt was 115.5% of GDP in 2009. Already in 1995, its debt was three times higher than Finland's total debt. Figure 3 shows that Italy does not react to debt sufficiently. Given its policy it has now joined the ranks of countries with very limited fiscal space. It has been worryingly close to its critical level, which we estimate to be between 127% and 130% of GDP). Debt of Italy at the end of 2009 amounted to 129.3% of GDP.

Greece's response to debt was not sufficient (reaction on debt was negative at all levels of debt, Figure 4). Given that the nominal GDP in Greece in the past was growing rapidly and, later on, the debt cost was significantly reduced by low interest rate, the weak reaction was not a critical problem. The current situation is different. Main problem is that prospect of growth get worse (not only for Greece, but for the whole euro zone), stripping it of the last factor in stabilizing the debt. Combined with the growing distrust of Greece's ability to repay their government debt, lack of trust in truthfulness of the information, high level of debt, which is closer to the critical level (estimated at about 128% of GDP) caused distrust of the financial markets and caused the rapid growth of interest in (re) financing government debt.

Considering Slovakia in 2009, its total public debt was 35% of GDP, among the lowest is the region. Based on the adjusted reaction (derived from 2000-2008 time period), 35% represent sustainable debt level (45% if 1995-2008 period is used for estimation). Estimated critical debt level is in the range of 131% – 142% of GDP. Its debt level rose to 41% of GDP in 2010, close to its sustainable level.

11 *Figures 3 and 4 depict the difference between reaction function and snow-ball effect. If the difference is above zero, reaction to debt exceeds snow-ball effect and debt decreases. Fiscal space in these figures is any level of debt lying between current level of debt and critical level (the second zero intercept) of debt.*

Figure 4 Fiscal space



Source: Authors' calculation.

Conclusion

The paper presents an approach on determining critical level of debt. The approach, originally suggested by Ostry et al., (Ostry, 2010), has been adjusted, reflecting mainly the fact that our paper deals with a different set of countries (EU) than original one (developed OECD countries). We assume that a government response to debt in EU countries has a shape of the polynomial of the fourth degree (it was 3rd degree in the original paper) and that problem of autocorrelation can be devised by reaction function determined as a "long term" part of the error-correction model. We are aware that a number of econometric and interpretive problems have not yet been satisfactorily resolved in the paper.

An important result is, that the EU as a whole had rather large fiscal space – a critical level of debt is significantly higher than the actual debt (2009). Several individual EU countries had also sufficient fiscal space, among others Finland, that is used as an example of a disciplined country in the paper. Some countries, by contrast, were already close to the critical level of debt (Italy, Greece) in 2009 and their fiscal space have been virtually exhausted. We also address the issues of stability and robustness of reaction function and examine the impact of crisis on the snow-ball effect in determining the critical level of debt. In the analyzed period, dynamics of debt differed significantly in individual EU countries. Some countries maintained a surplus in primary balance. Other countries were able to contain debt mainly due to a rapid growth of (nominal) GDP. Virtually all countries might be motivated to behave less prudently by low interest rates.

Slovakia belongs to rather more prudent country in managing its public debt. Until the outbreak of the crisis it systematically consolidated its public debt towards the level of 27% of GDP. Consolidation was enabled mainly by a combination of high GDP growth and decreasing interest rates on debt, but also by one-off payments acquired by privatization. But the fact that during the whole consolidation period, the primary balance remained in deficit, although relatively low, sounds less optimistic. The crisis has slowed down GDP growth, reversed the process of consolidation and debt in the short time climbed up to the proximity of 50% of GDP.

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Ponuka podujatí Inštitútu bankového vzdelávania NBS, n. o., na marec 2013

INŠTITÚT BANKOVÉHO VZDELÁVANIA NBS, n.o.

Názov vzdelávacieho podujatia	Dátum konania
Boj proti legalizácii príjmu z trestnej činnosti a financovaniu terorizmu – online kurz	priebežne počas celého roka
Riadenie likvidity	4. 3. 2013
Dostatočný kapitál, finančné riziká banky ich riadenie v podmienkach Bazileja II a III – cyklus 4-dňových seminárov	5. 3. 2013 / 26. 3. 2013
Funds Transfer Pricing – Liquidity Pricing	5. 3. 2013
Školenie pre používateľov IS SEPA SIPS	7. 3. 2013
Skúšky sprostredkovateľov – stredný stupeň	7. 3. 2013
Ochrana osobných údajov pre banky a finančné inštitúcie	8. 3. 2013
Základy bankovníctva a poisťovníctva pre zamestnancov s neekonomickým vzdelaním – cyklus 6-dňových seminárov	12. 3. 2013 / 27. 3. 2013
SWIFT I	12. 3. 2013
Hodnotenie kvality interného auditu	14. 3. 2013
Školenie ICM TARGET 2	14. 3. 2013
Practical Legal English	15. 3. 2013
Back Office (Treasury Back Office)	18. 3. 2013
SEPA – SEPA prevody a SEPA inkasá, SEPA end-date	19. 3. 2013
Právo Európskej únie	20. 3. 2013
Zákon o verejnom obstarávaní v intenciách ostatnej novely	20. 3. 2013
Bankové záruky a medzinárodné finančné podvody v oblasti bankových záruk	20. 3. 2013
Skúšky sprostredkovateľov – stredný stupeň	21. 3. 2013