Hungary: Selected Issues Paper

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NON-PERFORMING LOANS: DETERMINANTS AND MACROECONOMIC IMPLICATIONS[1]

This chapter investigates the non-performing loans (NPLs) in Hungary and other Central, Eastern and South-Eastern Europe (CESEE) countries in the period of 1998–2011. It finds that the level of NPLs can be attributed to both macroeconomic conditions and banks' specific factors, though the latter set of factors was found to have a relatively low explanatory power. The examination of the feedback effects broadly confirms the strong macro-financial linkages in the region. While NPLs were found to respond to macroeconomic conditions, such as GDP growth, unemployment, and inflation, the analysis also indicates that there are strong feedback effects from the banking system to the real economy, thus suggesting that the high NPLs that many CESEE countries currently face adversely affect the pace economic recovery.

A. Introduction

1.   The asset quality in the Hungarian banking system worsened significantly in recent years, reflecting in part the sharp contraction in economic activity during the financial crisis (6.7 percent) and the lack of robust economic recovery in the post-crisis period (Figure 1). In the corporate segment, NPLs are largely related to the weakness in the real estate market, which adversely affected construction and real estate companies. In the household segment, the increase in NPLs was aggravated by the poor labor market conditions, and the currency depreciation, particularly against the Swiss Franc, which increased significantly the debt service burden of FX mortgages. The sharp deleveraging, which was driven by persistent contraction of lending also contributed to the rising share of NPLs through its impact on the denominator. These trends are broadly in line with developments in the region (Figure 2).

Figure 1. Hungary: Non-Performing Loans in the Private Sector

Source: MNB.

Figure 2. Non-performing loans in CESEE economies

Source: Global Financial Stability Reports.

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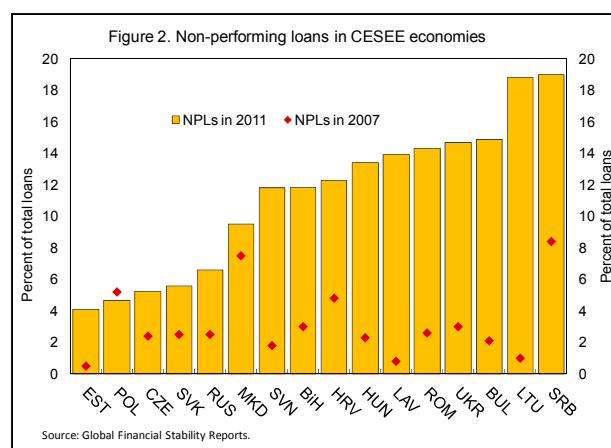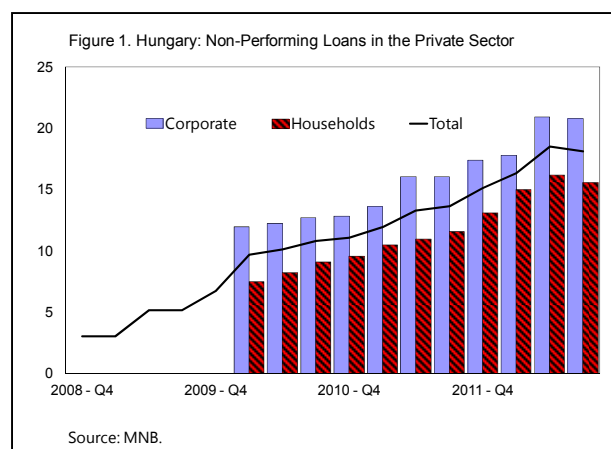
[1] Prepared by Nir Klein.

2.   The high levels of NPLs exert strong pressure on bank balance sheets, with possible effects on bank's lending operations, and exhibit a strong and negative correlation with pace of economic recovery (Figure 3).[2] While, at this juncture, the surge in NPLs is not viewed as an immediate de-stabilizing factor, the feedback effects from the banking system to economic activity may pose significant vulnerabilities going forward. Acknowledging the importance of resolution of the NPLs problem, many policymakers have placed it high in their agenda.[3]

Figure 3. Real GDP growth and the change in NPLS in CESEE economies, 2000-2011

$y = -0.6373x + 3.6186$
$R^2 = 0.2464$

3.   Against this background, the objective of this study is twofold. First, the study aims to evaluate the determinants of non-performing loans in CESEE economies by looking at both bank-level data and macroeconomic indicators over 1998–2011. Such an exercise would be useful not only to evaluate the relative importance of bank-level vs. macroeconomic factors but also to examine how the relative importance has changed since the onset of the financial crisis. The second part of the study evaluates the feedback effects from the banking sector to the real economy through a panel vector auto-regression (VAR) analysis, which includes five endogenous variables (NPLs, real GDP growth, unemployment rate, the change in credit-to-GDP ratio and inflation) in order to assess how the recent increase in NPLs in the CESEE region is likely to affect economic activity in the period ahead.
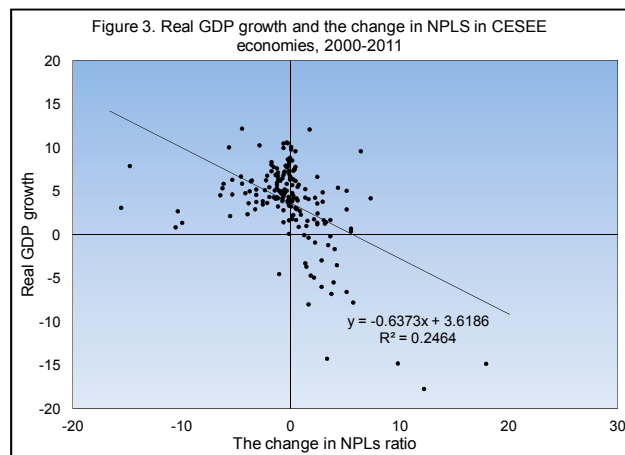
4.   The results suggest that NPLs are indeed affected by both macroeconomic and bank-level factors. Among the macroeconomic determinants, the results suggest that higher unemployment rate, exchange rate depreciation (against the euro) and higher inflation contribute to higher NPLs while higher Euro area's GDP growth results in lower NPLs. Higher global risk aversion (VIX) was also found to increase NPLs. The impact of bank-specific factors is broadly in line with the literature: equity-to-asset ratio and return on equity (ROE) are negatively correlated with NPLs while excessive lending (measured by loan-to-asset ratio and the past growth rate of banks' lending) leads to higher NPLs. Although bank-level factors have a significant impact on NPLs, their overall explanatory power was found to be low.

5.   The panel VAR analysis broadly confirms the existence of strong macro-financial linkages. In particular, the impulse response functions reveal that a positive shock to GDP growth and credit (as a ratio of GDP) contributes to the reduction of NPL while a higher inflation leads to higher NPLs. In addition, other things being equal, a positive shock to NPLs ratio leads to a contraction of credit-to-

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[2] The subdued credit growth in many countries in the region is attributed to both demand and supply factors.

[3] See, for instance, the "European Bank Coordination Vienna Initiative".

GDP ratio and real GDP and to a higher unemployment rate. As a result of an NPL shock, inflation also declines reflecting weaker economic activity.

6.   Building on the feedback effects in CESEE economies, the recent rapid increase in NPLs in Hungary is likely to have an adverse impact on economic activity in the period ahead, including by further credit contraction and moderation of domestic demand. While point estimates needs to be treated with caution given the relatively wide confidence interval, the 3 percentage points increase in NPLs observed in 2012 may shave about ½ –¾ percentage points off real GDP growth in 2013.

7.   The rest of the chapter is structured as follows. Section B provides a brief literature review on both the macroeconomic and bank-level determinants of NPLs, and on empirical evidence related to the feedback effects between NPLs to the real economy. Section C describes the data, presents the empirical model that is used to analyze the NPLs' determinants, and discusses the results; Section D evaluates the feedback effects from the banking sector to the real economy through a panel VAR analysis. Section E concludes and offers some policy implications.

B.   Literature

The Determinants of Non-Performing Loans

8.   The literature identifies two sets of factors to explain the evolution of NPLs over time. One group focuses on external events such as the overall macroeconomic conditions, which are likely to affect the borrowers' capacity to repay their loans, while the second group, which looks more at the variability of NPLs across banks, attributes the level of non-performing loans to bank-level factors. Empirical evidence, however, finds support for both sets of factors.

Bank-level factors

9.   Berger and DeYoung (1997), who studied the links between NPLs, cost efficiency and capitalization in the US commercial banks for the period 1985–94, found a two-way causality between cost efficiency to NPLs. While they explained the causality from NPLs to cost efficiency as "**bad luck,**" driven mainly by deterioration in macroeconomic conditions, they explained this causality from cost efficiency to NPLs through the hypothesis of "**bad management**." In particular, this hypothesis argues that low cost efficiency is a signal of poor management practices, thus implying that as a result of poor loan underwriting, monitoring and control, NPLs are likely to increase. Williams (2004) who focused on the relationship between loan quality and cost efficiency among European savings banks from 1990–1998, Podpiera and Weil (2008), who analyzed the Czech

banks between 1994–2005, and Louzis, Vouldis and Metaxas (2010), who examined the determinants of NPLs in the Greek banking sector, found support for this hypothesis.[4]

10.   An alternative hypothesis ("skimping"), that was also proposed by Berger and DeYoung (1997) suggests a possible positive causality between high cost efficiency and NPLs. In particular, they suggest that high cost efficiency may reflect little resources allocated to monitor lending risks and therefore may result in higher NPLs in the future. This hypothesis is consistent with the findings of Rossi, Schwaiger, and Winkler (2005) who looked at a sample of 278 banks from nine transition countries from 1995 to 2002.

11.   The "moral hazard" hypothesis, which was discussed by Keeton and Morris (1987), argues that banks with relatively low capital respond to moral hazard incentives by increasing the riskiness of their loan portfolio, which in turn results in higher non-performing loans on average in the future. Keeton and Morris (1987) indeed showed that excess loss rates were prominent among banks that had relatively low equity-to-assets ratio. The negative link between the capital ratio and NPLs was also found in Berger and DeYoung (1997), and Salas and Saurina (2002).

12.   More generally, Keeton and Morris (1987) argued that banks that tend to take more risks, including in the form of excess lending eventually absorbed higher losses. Their finding was supported by Salas and Saurina (2002) and Jimenez and Saurina (2005).

Macroeconomic factors

13.   There is significant empirical evidence regarding the anti-cyclical behavior of the NPLs. The general explanation is that higher real GDP growth usually translates into more income which improves the debt servicing capacity of borrowers. Conversely, when there is a slowdown in the economy the level of NPLs is likely to increase as unemployment rises and borrowers face greater difficulties to repay their debt (Salas and Suarina, 2002; Rajan and Dhal, 2003; Fofack, 2005; and Jimenez and Saurina, 2005).

14.   Other macroeconomic variables, which were found to affect banks' asset quality, include the exchange rate, interest rate, and inflation. In this regard, exchange rate depreciation might have a negative impact on asset quality, particularly in countries with a large amount of lending in foreign currency to un-hedged borrowers,[5] and interest rate hikes affect the ability to service the debt, particularly in case of floating rate loans (Louzis, Vouldis and Metaxas, 2010). The impact of inflation, however, may be ambiguous. On one hand, higher inflation can make debt servicing easier by reducing the real value of outstanding loan, but on the other hand, it can also reduce the borrowers'

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[4] These studies used different measures to capture "cost efficiency", including profitability indicators such as return on equity or return on assets (Louize et al, 2010), expenditures-to-assets (Espinosa and Prasad, 2010), or by estimating a "cost frontier" (Podpiera and Weil, 2008).

[5] ECB Financial Stability Review, December 2011.

real income when wages are sticky. In countries where loan rates are variable, higher inflation can also lead to higher rates resulting from the monetary policy actions to combat inflation (Nkusu, 2011). Several studies also found that NPLs are affected by stock prices arguing that a drop in shares prices might lead to more default via wealth effects and decline in the value of collaterals.

Feedback Effects

15.   The literature offers a large number of models and empirical evidence on the feedback effects between the real and financial sectors. The impact of the real economy on NPLs is mainly explained by weakening the borrowers' capacity to repay their debt, while the feedback from NPLs to the real economy is often identified through the credit supply channel. Diawan and Rodrik (1992), for instance, suggested that high NPLs increase the uncertainty regarding the capital position of the banks and therefore limit their access to financing.[6] This in turn increases the banks' lending rates and thus contributes to lower credit growth. Two additional mechanisms that are mentioned in the literature are the high costs associated with managing high NPLs (Mohd et al, 2010), and the lower capital that results from provisioning. Both contribute to lower credit supply, and therefore may have implications for economic activity. A recent paper, which focused on central, eastern and southeastern European countries indeed found causality between NPLs and credit growth.[7]

16.   The feedback effects from NPLs to the real economy may also work through non-credit supply channels. For example, debt overhang can discourage companies from investing in new projects since future profits will be shared with the banks (Myers, 1977). Households may also show little enthusiasm to improve their houses or apartments if they may lose it down the road (Meltzer, 2010).

17.   A number of studies examined the feedback effects from the banking system to the real economy from a cross-country perspective. For instance, Espinosa and Prasad (2010) who looked at a sample of 80 banks of the Gulf Cooperation Council (GCC) region found that an increase in NPLs reduces credit growth and the non-GDP growth. Nkusu (2011), who focused on 26 advanced economies in the period of 1998–2009, found that adverse shocks to asset prices, macroeconomic performance and credit to the private sector lead to a worsening of loan quality. In turn, higher NPLs lead to a decline in house prices, credit-to-GDP ratio, and GDP growth. De Bock and Demyanets (2012), who assessed the vulnerability of emerging markets to financial shocks in the period of 1996-2010, found that economic activity slows down when non-performing loans increase while exchange rate tends to depreciate.

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[6] This channel, of course, highly depends on the banks' level of provisioning as high rates of loan loss provisioning reduce the uncertainty regarding the banks' capital position.

[7] Working group report on NPLs in central, eastern and southeastern Europe, which was done under the umbrella of Vienna Initiative (2012).

C. Data and Empirical Approach

Data

18.   The analysis uses panel data of individual banks' balance sheets from Bankscope as well as macroeconomic indicators from the *Haver and World Economic Outlook (WEO)* datasets. Data is based on annual frequency for 1998–2011, and covers the ten largest banks (commercial, savings, cooperate, and real estate & mortgage) in each of the 16 countries covered in the analysis.[8] While for some banks data is not available for the entire period, the dataset's coverage is relatively large and includes above 60 percent of the banking sector's assets in most of the countries in the sample (Table 1).

Table 1. Coverage of Dataset as a Percent of Total Banking Assets[1]						
	2006	**2011**			**2006**	**2011**
Bosnia and Herzegovina	92.2	83.2	Macedonia		96.4	96.0
Bulgaria	81.9	87.9	Poland		82.7	71.9
Hungary	95.1	89.9	Romania		86.7	85.9
Croatia	92.4	90.2	Russia		48.4	64.1
Czech Rep.	89.6	86.8	Serbia		67.4	80.5
Estonia	100.0	99.8	Slovak Rep.		100.0	93.5
Latvia	78.8	88.1	Slovenia		91.1	86.1
Lithuania	100.0	99.6	Ukraine		64.5	64.7

[1]Figures are expressed as a percent of the available data in each year.

19.   While many variables were considered in the estimation process, the baseline specification includes four explanatory bank-level variables (equity-to-assets ratio, return on equity (*RoE*), Loan-to-Assets ratio, and the Loans growth rate (*D_Loans*)); three country specific variables (inflation, the change in exchange rate vis-à-vis the euro, and the change in unemployment rate); and two "global variables (the Euro zone's GDP growth, and the global risk aversion captured by the implied volatility of the Standard & Poor's 500 stock market index (*VIX*). It is worth mentioning that Bankscope reports the level of "impaired loans," which may be different than the official classification of non-performing loans. "Impaired loans" is an accounting concept, which reflects cases in which it is probable that the creditor will not be able to collect the full amount that it is specified in the loan agreement, while "NPL is a regulatory concept, which primarily reflects loans

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[8] Bosnia and Herzegovina (BiH), Bulgaria (BUL), Croatia (HRV), Czech Rep. (CZE), Estonia (EST), Hungary (HUN), Latvia (LAT), Lithuania (LTU), Macedonia (MKD), Poland (POL), Romania (ROU) Russia (RUS), Serbia (SRB), Slovak Rep. (SVK), Slovenia (SVN), and Ukraine (UKR).

that are more than 90 days past due.[9] Acknowledging these differences, we treat "impaired loans" as NPLs in this analysis.

20.   The correlation matrix (Table 1A in the Appendix) broadly supports the expected signs, although the magnitude of the correlation is not very high. NPLs exhibit a positive correlation with the change in unemployment (*D_unemp*), exchange rate depreciation (*Ex_rate*), and the VIX, while negatively correlated with return on equity (ROE), and the euro area real GDP growth (*D_rgdp_euro*). The negative correlation of NPLs with Loans-to-Assets ratio and loans' growth results from the contemporaneous effect of the volume of loans on the denominator of NPLs. Panel unit root tests (Fischer) reject the null hypothesis of a unit root in all panels (Table 2A in Appendix).

21.   Overall, the data on NPLs includes 976 observations, which are unevenly divided over the sample's period: the first half of the sample (1998–2005) include 330 observations and the second half (2006–2011) include 646 observations. A close look at the evolution of the NPLs ratios indicate that they varied significantly over time, and across countries and banks (Table 2).

Table 2. Summary Statistics, Bank-Level Indicators, 1998–2011					
Variable |	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
NPLs	976	8.25	9.02	0.07	60.82
Equity-to-Assets	1547	12.29	8.18	-19.50	77.70
Return on Equity (RoE)	1538	10.68	35.61	-200.88	570.17
Loans-to-Assets	1529	56.70	15.62	0.544	84.88
D_Loans	1347	24.83	37.05	-60.17	327.77

22.   The Bank-level data also shows that the deterioration in the banks' assets quality since the outbreak of the financial crisis is wide-spread and evident in the balance sheets of most of the banks. Figure 4 indeed shows that following a significant improvement in the banks' NPLs in 2000–07, the median of NPLs climbed sharply from just below 3 percent in the pre-crisis period to about 11 percent in 2011, surpassing the high level that was observed in the late 1990s.

Figure 4. NPLs at bank-level

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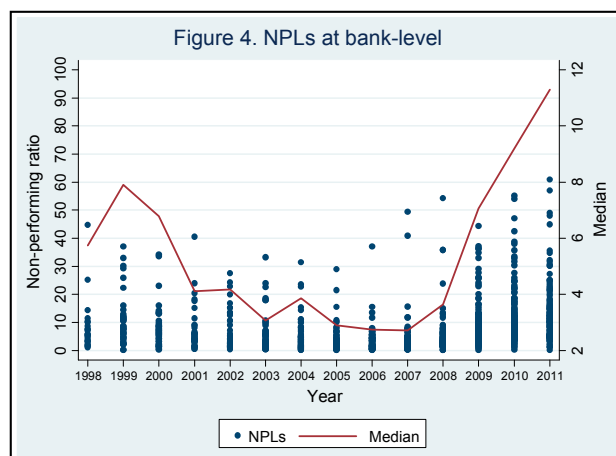
[9] A survey on NPLs definitions and reporting standards reveals that there are substantial differences among countries in the classification of NPLs (see report on NPLs by the European Banking Coordination "Vienna" Initiative (2012).

23.   The country-specific variables also show high variability across time and countries (Table 3). For instance, high double digit levels of inflation were recorded mainly in Russia, Serbia, and Romania in late 1990s and early 2000s while negative rates of inflation were mostly evident in the financial crisis period (Bosnia and Herzegovina, Estonia and Latvia). Exchange rate also moved sharply in some countries such as Ukraine, Russia and Poland, particularly in response to the financial crisis in 2008–09.

Table 3. Summary Statistics, Country-Specific and Global Indicators, 1998–2011					
Variable |	*Obs.*	*Mean*	*Std. Dev.*	*Min*	*Max*
Country-specific					
D_unemp	223	0.04	1.87	-5.61	9.70
Inf	221	8.07	11.63	-1.22	85.74
Ex_rate	206	2.40	9.45	-13.40	63.13
Global variables					
D_rgdp_euro	14	1.60	1.93	-4.39	3.90
Vix	14	22.72	5.98	12.78	32.65

Dynamic panel - econometric specification

24.   We run a dynamic panel regression of the form:

$$y_{i,t} = \alpha y_{i,t-1} + \beta B_{i,t-1} + \gamma C_t + \delta G_t + u_{i,t} \qquad (1)$$

Where $y_{i,t}$ denotes the logit transformation of the NPLs ratio for bank *i* at year *t*. Such transformation ensures that the dependent variable spans over the interval [+∞, -∞] and is distributed symmetrically. The dependent variable is explained by its lag, $y_{i,t-1}$; bank-level variables $(B_{i,t-1})$, country specific variables, (C_t), non-country (global) variables(G_t).

25.   We consider three alternative estimation techniques. The first one is a **fixed effects model**, which allows controlling for unobserved heterogeneity across banks. While this approach is rather simple and intuitive; it may give rise to "dynamic panel bias", which results from the possible endogeneity of the lagged variable and the fixed effects in the error term, $u_{i,t}$. This can be avoided by applying a "**difference GMM**" method of Arellano and Bond (1991), which transforms the data to first differences to remove the fixed effect element and uses the lagged levels of the right hand-side variables as instruments. One drawback of this approach, however, is that, in samples with a limited time dimension (small T) and high persistence, the estimation has low precision (Blundell

and Bond (1998)).[10] Therefore, we also estimate a "**system GMM**" developed Arellano and Bover (1995) and Blundell and Bond (1998), which addresses this concern.[11] Under this approach, the lagged bank level variables were modeled as pre-determined (thus instrumented GMM-style in the same way as the lagged dependent variable) while the country-level variables and the global variables were treated as strictly exogenous (instrumented by itself as "IV style" instrument, see Roodman 2009).[12]

26.   Three major caveats are worth noting. First, the classification of non-performing loans may not be consistent across countries due to differences in accounting approaches and regulations, and consequently national supervisors apply different criteria for "overdue loans".[13] Assuming that classification of NPLs has not changed significantly over time (within countries), this problem is somewhat mitigated by controlling for unobserved fixed effects in the econometric analysis. Second, in some countries, the non-performing loans are masked by sizable amount of restructured and "ever-greened" loans, which are not captured in this analysis. In these countries, the reported figures for NPLs underestimate the true stress in the banking system, and therefore could potentially bias the estimations' results. Lastly, while the determinants of NPLs are likely to be affected by composition of outstanding loans (local vs. foreign currency, corporate vs., retail, and housing vs. consumption) across countries, the analysis does not control for composition impact due to data limitations.

Results

27.   The results presented in Table 4 broadly confirm that both bank-level and macroeconomic factors play a role in affecting the banks' asset quality, although the contribution of bank-level factors is relatively low – their inclusion marginally increases the "within" explanatory power of each group while it significantly reduces the "between" explanatory power (in the fixed effects estimations). The Hansen-test suggests that the instruments used are uncorrelated with the residuals, and the Arellano-Bond tests rejects the hypothesis that the errors are not autocorrelated in the first order (AR(1)), but cannot reject this hypothesis for the second order (AR(2)).[14] Beyond this, the NPLs were found to have high auto-correlation: the coefficient's size of the lagged NPLs

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[10] Blundell and Bond (1998) showed that the performance of the difference GMM estimator is worsened with the degree of persistency of the series because, as persistency increases lagged levels become less correlated with subsequent changes so they turn out to be weak instruments.

[11] This approach involves estimation of two simultaneous equations, one in levels (with lagged first differences as instruments) and the other in first differences (with lagged levels as instruments).

  In this approach we used the forward orthogonalization procedure of Arellano and Bover (1995) to

[12] In this approach we used the forward orthogonalization procedure of Arellano and Bover (1995) to reduce observation losses due to differencing, and the collapsing method of Holz-Elkin, Newely, and Rosen (1988) to limit the number of instruments (see Roodman, 2009).

[13] See Stephan Barisitz (2011).

[14] This is expected since differencing generates autocorrelation of order one.

ranges between 0.6 to 0.93, thus suggesting that a shock to NPLs is likely to have a prolong effect on the banking system.

Table 4. NPLs: Macroeconomic and Bank-Level Determinants, 1998–2011					
	Fixed Effects		Difference GMM		System GMM	
NPLs (-1)	0.664*	0.598*	0.805*	0.798*	0.933*	0.878*
Macroeconomic variables						
D_unemp	0.040**	0.010	0.026	-0.002	0.049*	0.039***
Inf (-1)	0.006	0.026*	0.030*	0.038**	0.012***	
Ex_rate[1]	0.003	0.006	0.012*	0.009**	0.005	0.009**
D_rgdp_euro (-1)	-0.053*	-0.034*	-0.038	-0.028**	-0.030*	-0.017***
Vix	0.028*	0.020*	0.022	0.014**	0.024*	0.022*
Bank-level variables						
Equity-to-Assets (-1)		-0.040*		-0.061*		-0.044**
RoE (-1)		-0.008*		-0.000		-0.005**
Loans-to-Assets (-1)		0.017*		0.032*		
D_loans(-2)		0.000		0.001		0.002***
Country dummies	no	no	no	no	yes	yes
Number of Obs.	764	604	587	464	764	608
R-squared (within)	0.601	0.620				
R-squared (between)	0.830	0.693				
Number of banks	135	120	124	105	135	120
Number of instruments			84	85	44	70
Hansen test p-value					0.624	0.206
A-B AR(1) test p-value					0.000	0.000
A-B AR(2) test p-value					0.289	0.433

Significance level: *significant at 1 percent; ** significant at 5 percent; ***significant at 10 percent.
[1] An increase in exchange rate indicates depreciation.

28.   Starting with the bank-level indicators, the estimations show that higher equity-to-assets ratio leads to lower NPLs, therefore confirming the "moral hazard" effect; and higher profitability (RoE) contributes to lower NPLs and suggests that better managed banks have, on average, better quality of assets (corroborating the "bad management" hypothesis).[15] Excessive lending, as measured by the loans-to-assets ratio, leads to higher NPLs in both fixed effects and difference GMM. The effect of past excess lending is also captured by the lagged lending growth, which results in higher NPLs as well. Unlike in other studies mentioned earlier, other bank-level indicators such as the bank size and expense-to-income ratio were not found to have significant impact.

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[15] The causality between equity-to-assets and NPLs and RoE and NPLs is likely to be two ways, as higher NPLs also worsen the banks' equity position and profitability and, in turn, reduce equity-to-assets and RoE ratios.

29.   On the macroeconomic level, the results show that an increase in unemployment contribute to higher NPLs, thus validating the strong link between the business cycles and the banking sector's resilience. In addition, both higher inflation and the depreciation of currency were found to increase NPLs. As expected, the global environment also contribute to the evolution of NPLs among CESEE banks: Higher volatility index and lower Euro area growth reduce the firms' capacity to repay, perhaps because of higher rates in the international financial markets, which reduce the firms' ability to rollover their debt, and because of lower export revenues. In addition, these two factors may also lead to lower external funding of the banks and therefore may result in negative credit growth (thus affecting NPLs ratio through the denominator).[16]

Robustness

30.   To examine the robustness of the results, and particularly to evaluate the effect of the financial crisis, we split the sample to two sub-samples—the pre-crisis period (1998–2007) and 2008–11 ("post-crisis" hereafter). The results, which are presented in Tables 4A and 5A in the appendix, suggest that inflation and the change in unemployment had larger impact on the level of NPLs during the pre-crisis period. In the post-crisis period, the contribution of the exchange rate was much more prominent while the contribution of inflation was not found to be significant. The bank-level factors seem to play a role in both periods, though their coefficients' significance highly depends on the estimation technique.[17]

D.   The Dynamics of Non-Performing Loans and Their Macroeconomic Effects

31.   This section explores the feedback effects from the banking sector to the real economy. In particular, we are interested in the linkages between NPLs of the banking-system as a whole, credit-to-GDP ratio, GDP growth, unemployment and inflation. The assessment of these linkages—causality, magnitude and duration—may shed some light on the macro-financial vulnerabilities that are associated with the recent surge of NPLs in many CESEE countries.

Methodology

32.   The analysis applies a panel VAR methodology, which serves as a useful tool to evaluate the magnitude and duration of the effects. This technique also combines the traditional VAR approach, which treat all the variables in the system as endogenous, with a panel data approach, which allows for unobserved individual heterogeneity. The advantage of this methodology is that it does not require any a priori assumptions on the direction of the feedback between variables in the model.

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[16] Because of the relatively high contemporaneous correlation between inflation and the change in exchange rate (0.51), and between the VIX and the euro area GDP growth (-0.69), they are introduced with different lags in the regressions.

[17] The results may be also driven by differences in the composition of banks within each sub-sample.

The panel VAR is computed from a program written by Love and Zicchino (2006) and is based on the following model:

$$Y_{i,t} = \Gamma_0 + \sum_{s=1}^{n} \Gamma_s Y_{i,t-s} + f_i + e_{it} \quad , \quad Y_{i,t} = [npl_{i,t}, \Delta credit_{i,t}, unp_{i,t}, \Delta gdp_{i,t}, \Delta cpi_{i,t}] \quad (2)$$

where $Y_{i,t}$ is a vector of five endogenous variables. The variable $npl_{i,t}$, is the ratio of non-performing loans-to-total loans of the overall banking system in country i and year t; $\Delta credit_{i,t}$ is the change in the credit (to the private sector)-to-GDP ratio, $\Delta gdp_{i,t}$ is the real GDP growth, $unp_{i,t}$ is the unemployment rate, and $\Delta cpi_{i,t}$ is the inflation rate. The countries' specifics are captured in this framework in the fixed effect variable, denoted in the model by f_i.[18] Since the fixed effects are correlated with the regressors due to lags of the dependent variable, the analysis uses a forward mean-differencing (Helmert procedure), which removes the mean of all forward future observations available for each country-year (Arellano and Bover, 1995).[19]

33.   The dynamic behavior of the model is assessed using impulse response functions, which describe the reaction of one variable in the system to innovations in another variable in the system while holding all other shocks at zero.[20] The shocks in the VAR were orthogonized using Cholesky decomposition, which implies that variables appearing earlier in the ordering are considered more exogenous, while those appearing later in the ordering are considered more endogenous. In this specification, we follow the presumption that the GDP growth, unemployment, and inflation affect NPLs only with a lag, while NPLs have a contemporaneous effect on economic activity mainly through credit. Therefore, npl appears first in the ordering, and $\Delta credit_{i,t}$, unp Δgdp, and Δcpi appear later (in this order).[21] Qualitatively, the results remain broadly unchanged for alternative ordering.

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[18] One of the caveats in this approach is that it assumes that the country's characteristics are fixed over time.

[19] This transformation preserves the orthogonality between the transformed variables and lagged regressors. The estimation uses lagged regressors as instruments and estimate the coefficient by GMM methodology.

[20] Monte Carlo simulations are used to generate the confidence intervals.

[21] This ordering is close in spirit to De Bock and Demyanets (2012). Marcucci and Qualiariello (2008) propose a related identification scheme where they rank default rates first.

Data

34.   The analysis covers 16 CESEE economies over the period of 1998–2011.[22] Data for GDP growth, unemployment and CPI inflation was obtained from the World Economic Outlook database while the ratio of non-performing loans-to-total loans was taken from financial soundness indicator (FSI) dataset and from GFSR publications. Credit to the private sector was obtained from IFS. Table 6A in the appendix provides summary statistics.

35.   The sample includes 206 annual observations of NPLs, which are mostly clustered in the 0–10 percent segment (Figure 5). The change in NPLs is nicely distributed around zero, though with a relatively high variance. The latter mainly reflects periods such as early 2000s when NPLs fell sharply in few countries such as Czech Rep., and Slovak Rep., and the financial crisis period (2008–09) when NPLs increased rapidly in Lithuania, Latvia and Ukraine. The correlation between the five variables is broadly in line with economic theory: Non-performing loans is negatively correlated with GDP growth, and the change in credit to GDP ratio, and positively correlated with the change of unemployment. Inflation is positively correlated with the change in credit and GDP growth and negatively correlated with unemployment. Interestingly, the contemporaneous correlation of NPLs and inflation is negative (Table 5).

36.   To assess the level of integration we applied Fisher-ADF and Fisher-PP tests, which do not require a balanced sample and allow for data gaps. These tests conduct unit-root tests for each panel individually, and then combine the p-values from these tests to produce an overall test. The results in Table 3A (Appendix) indicate that, at least in one of the tests performed, the five endogenous variables are stationary I (0) as the null hypothesis of a unit root in all panels can be rejected with a confidence of 95 percent or higher.

Results

- *Response of NPLs to shocks in other variables*: An increase of one percentage point in credit-to-GDP ratio and real GDP leads to a cumulative decline of 0.7 percentage point and 0.6 in NPLs, respectively (in the subsequent year, Figure 7). Additionally, an increase of one percentage point in inflation leads to an increase of 0.4 percentage point in NPLs (in the subsequent year). While in this specification a shock to unemployment was not found to have a specific impact on NPLs, in an alternative specification, where NPL and unemployment were introduced in their first difference the impact was found to be significant (see robustness below).

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[22] The composition of countries is the same as in section III.

Figure 5. Distribution of the Level and the Change of NPLs, 1998–2011
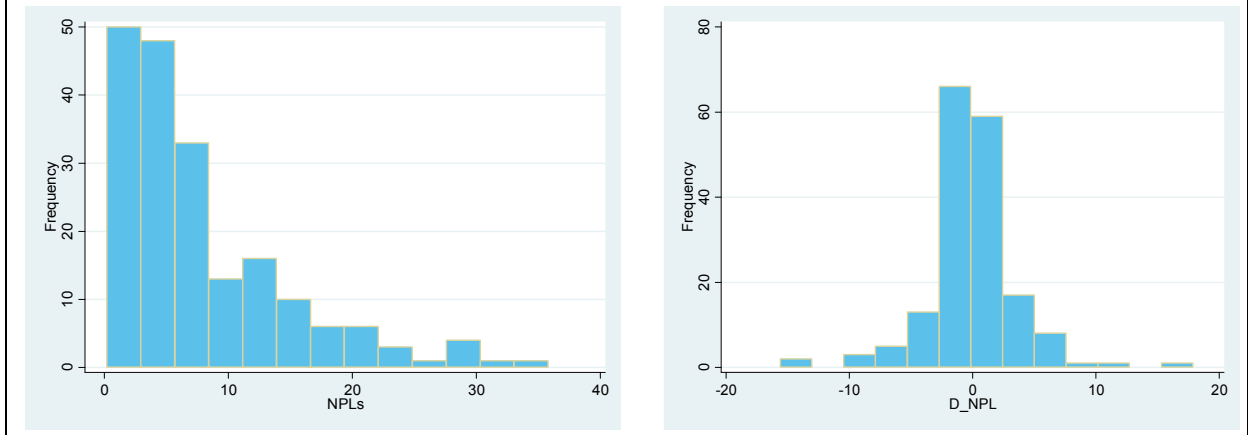
Figure 6. Correlation between the Change in NPLs, Unemployment and GDP Growth
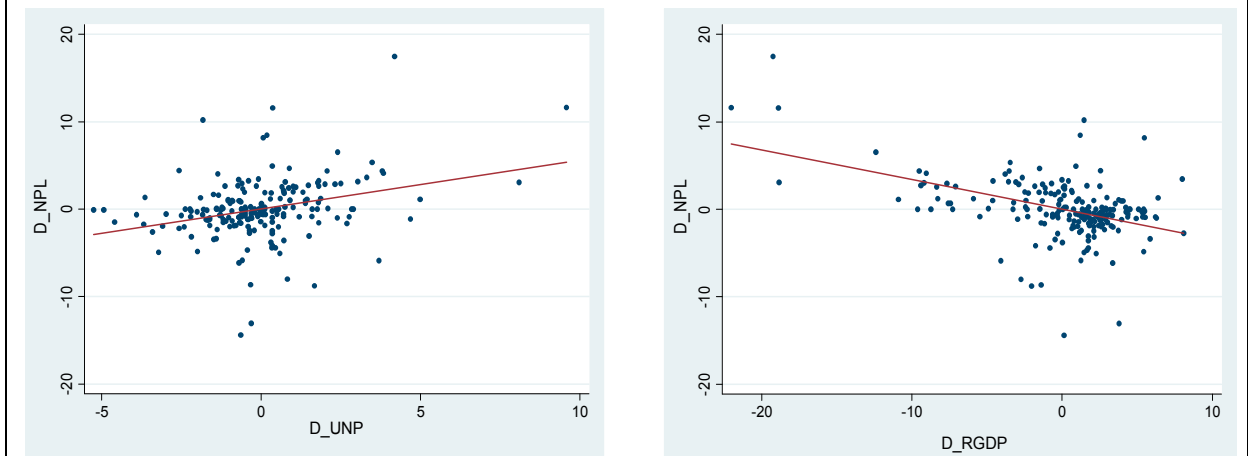
Table 5. Correlation Matrix

	npl	Δcredit	unp	Δgdp	Δcpi
npl	1				
Δcredit	-0.327	1			
unp	0.239	-0.136	1		
Δgdp	-0.290	0.114	-0.072	1	
Δcpi	-0.055	0.099	-0.357	0.056	1

Figure 7. Impulse Response Functions*

Errors are 5 percent on each side generated by Monte-Carlo with 300 reps.

*Shocks are of one standard deviation.
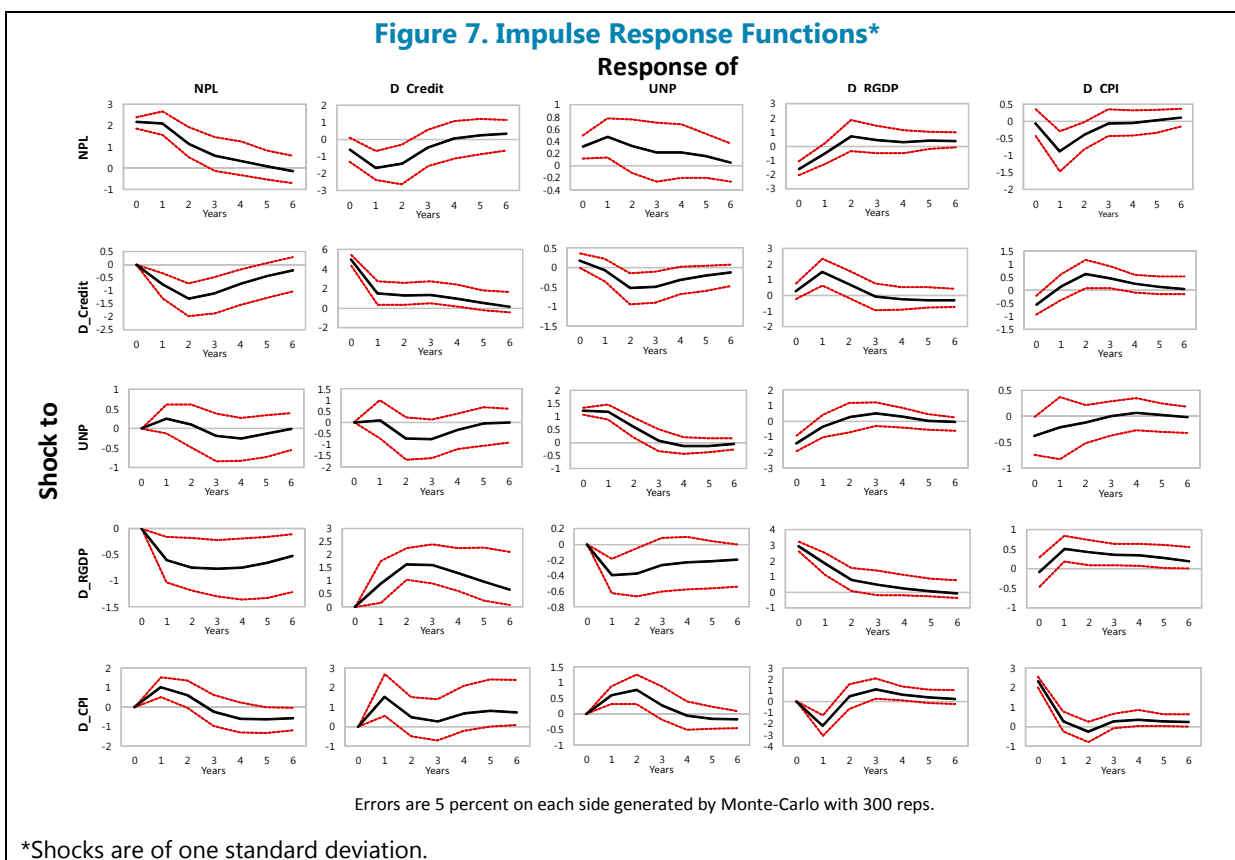
- *Impact of a shock to NPLs:* An increase in NPLs has a negative and significant effect on credit, inflation, and real GDP growth, while contributing to higher unemployment. In this regard, a one percentage point increase in NPLs results in a cumulative decline of 1.7 percentage points in credit-to-GDP ratio and a cumulative increase of 0.5 in unemployment (over three years). Such a shock also results in a cumulative contraction of about one percentage point in real GDP (over two years), and a cumulative decline in inflation of 0.6 percentage points (over three year horizon).

37.   The impact of NPL on credit and GDP growth was found to be rather large compared to previous findings.[23] While point estimates should be treated with caution given the relatively wide confidence intervals, the large effects of NPL in this analysis may reflect the fact that this sample of countries exclusively consists of emerging markets that are in general more reliant on bank lending (compared to advance economies) and where individuals are in general more liquidity-constrained.

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[23] Nkusu (2011), who studied the feedback effects in advanced economies in 1998–2009, found that a one percentage point increase in NPLs leads to a cumulative decline of about 0.6 percentage points in GDP over three years. Espinosa and Prasad (2010), who focused on GCC region in 1995–2008, found that such a shock leads to a decline of 0.4 percentage point in the non-oil GDP in the first year.

Moreover, the results are affected by the massive credit boom in the period that preceded the financial crisis where in some countries (particularly Lithuania and Ukraine) the sharp drop in NPLs was facilitated by rapid expansion of credit and double digit GDP growth (or close to that). Excluding Ukraine and Lithuania, the effect of an NPL shock on GDP growth is significantly more moderate.[24]

Robustness

38.   In light of the different definition of NPLs across countries, the level of NPL may not be comparable. Therefore, for robustness, we apply an alternative estimation that replaces the levels of NPL and unemployment with their change [$\Delta npl_{i,t}, \Delta credit_{i,t}, \Delta unp_{i,t}, \Delta gdp_{i,t}, \Delta cpi_{i,t}$]. The results show that the variables' dynamics are broadly similar to that in the baseline specification, although the magnitude of the effects is slightly different. In particular:

Figure 8. Impulse Response Functions, Alternative Specification*

Errors are 5 percent on each side generated by Monte-Carlo with 300 reps.

*Shocks are of one standard deviation.
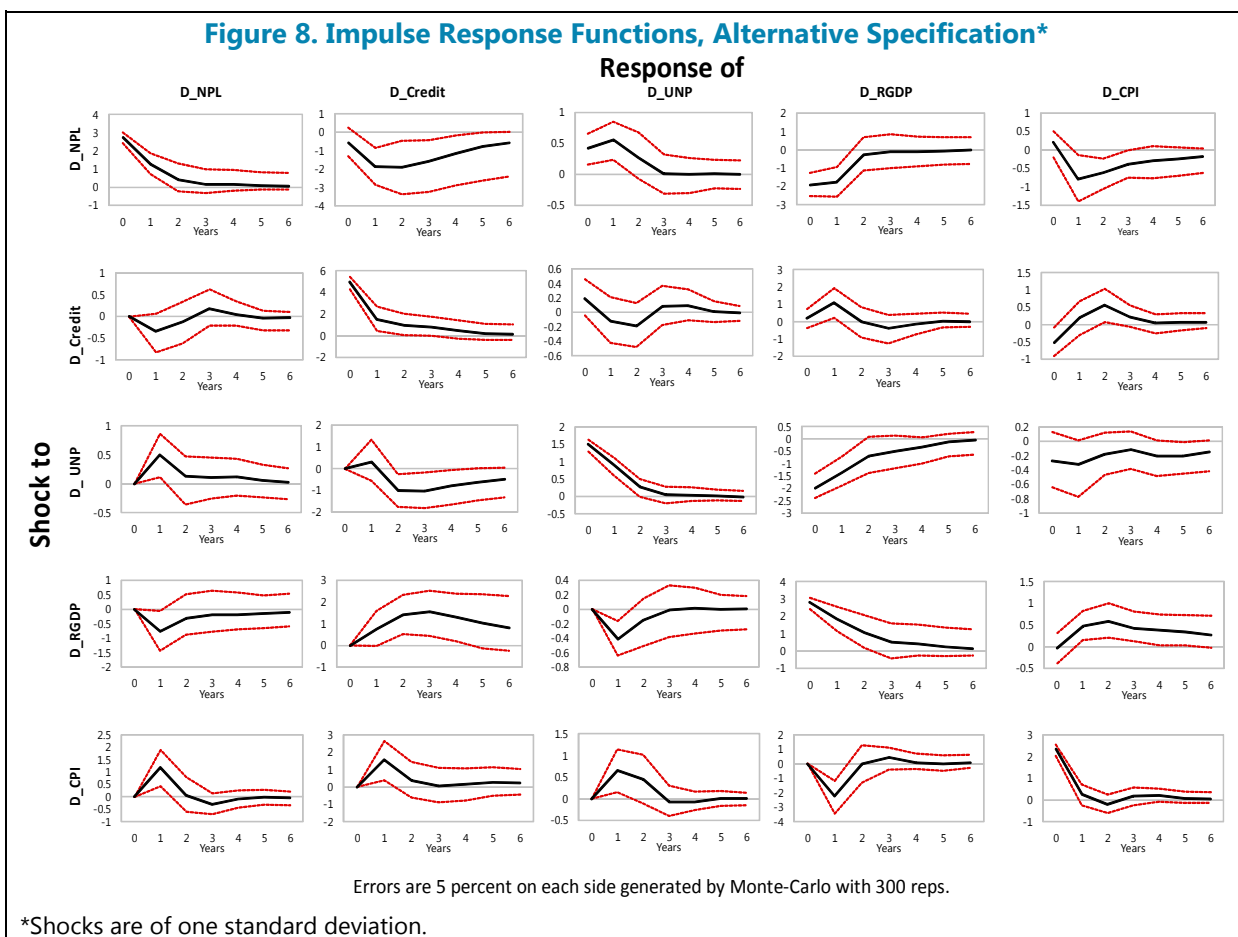
[24] In this sub-sample, a one percentage point increase in NPLs results in a cumulative contraction of 0.7 percentage point in GDP over two years.

- *Response of NPLs to shocks in other variables:* The impulse response functions confirm the effect of economic activity on NPLs (Figure 8). An increase of one percentage point in unemployment and inflation results in an increase of NPLs in the subsequent year by 0.3 percentage point and 0.5 percentage point, respectively. Similarly, an increase of one percentage point in real GDP leads to a decline of 0.8 percentage points in NPLs (including through an expansion of credit) in the subsequent year.

- *Impact of a shock to NPLs:* An increase in NPLs leads to a prolonged period of reduction in credit-to-GDP ratio with repercussions to economic activity. Other things being equal, a one percentage point increase in NPLs results in a cumulative decline of 1.5 percentage point in credit-to-GDP ratio, and a cumulative increase of nearly 0.5 percentage points in unemployment (over a three-year horizon). Additionally, such a shock leads to a cumulative contraction of 1.3 percentage points in real GDP over two years. As a result of weaker economic activity, inflation also declines by a cumulative 0.4 percentage points over three years.

Variance decomposition

39.	The panel VAR dynamics were also assessed by variance decomposition, which shows the extent of which the forecast error variance of one variable in the system is associated with exogenous shock to other endogenous variable (Table 7). The variance decomposition shows that, in a 5-year horizon, NPLs plays an important role in affecting real economic variables as it explains about 10 percent of the forecast error of the rest of the endogenous variables. Among the variables in the system, the change in credit has the most information regarding the variation of NPLs, and then equally important are inflation and real GDP growth. In the alternative specification, the explanatory power of D_NPL regarding the variation of other variables is somewhat higher (10–20 percent), but the explanatory power of other endogenous variables with regards to the variation of D_NPL is on average lower.

	Horizon	NPL	D_CREDIT	UNP	D_RGDP	D_CPI
NPL	5	0.573	0.212	0.009	0.109	0.097
D_CREDIT	5	0.109	0.646	0.025	0.157	0.064
UNP	5	0.088	0.113	0.557	0.071	0.171
D_RGDP	5	0.127	0.101	0.090	0.457	0.225
D_CPI	5	0.109	0.115	0.024	0.082	0.670
		Alternative estimation				
		D_NPL	D_CREDIT	D_UNP	D_RGDP	D_CPI
D_NPL	5	0.689	0.152	0.015	0.072	0.073
D_CREDIT	5	0.129	0.622	0.045	0.140	0.064
D_UNP	5	0.119	0.075	0.642	0.042	0.122
D_RGDP	5	0.189	0.083	0.163	0.362	0.203
D_CPI	5	0.154	0.103	0.022	0.071	0.649

Table 6. Variance Decomposition[1]

[1] Percent of variation in the row variable explained by column variable.

E.   Conclusions and Some Policy Implications

In recent years many banks in Hungary as well as in the CESEE region experienced a rapid deterioration in assets' quality, leading to substantial losses and reduction of capital buffers. The fast increase in NPLs not only increased banks' vulnerability to further shocks but also limited their lending operations with broader repercussions for economic activity. This chapter assesses these feedback effects and identifies the main determinants of the NPLs over time and across sixteen CESEE countries using a variety of panel estimation techniques.

40.   While the chapter's main findings remain robust for alternative specifications and time periods, they should be treated with caution as they are subject to caveats, including those that arise from the NPLs' data quality and differences in the classification of NPLs across countries. With this in mind, the chapter finds that the level of NPLs can be attributed to both macroeconomic conditions and banks' specific factors. In particular, the results confirm that the level of NPLs tends to increase when unemployment rises, exchange rate depreciates, and inflation is high. Beyond the country-specific effects, factors, such as the euro area GDP growth and the global risk aversion, also play an important role in affecting banks' asset quality.

41.   The analysis also finds that NPLs are sensitive to bank-level factors. Higher quality of the bank's management, as measured by the previous period's profitability, leads to lower NPLs, while moral hazard incentives, such as low equity, tend to worsen NPLs. In addition, excessive risk-taking (measured by loans-to-assets ratio and the growth rate of bank's loans) was found to contribute to higher NPLs in the subsequent periods. These bank-level effects were significant during both the pre-crisis and post-crisis periods.

42.   The examination of the feedback effects between the banking system and economic activity broadly confirms the strong macro-financial linkages in the CESEE region. While NPLs were found to respond to macroeconomic conditions, such as GDP growth, the results also indicate that there are feedback effects from the banking system to the real economy. More specifically, the estimations suggest that an increase in NPLs has a significant impact on credit (as a share of GDP), real GDP growth, unemployment, and inflation in the periods ahead, thus validating the notion that a healthy and sustainable growth cannot be achieved without a sound and resilient banking system.

43.   For Hungary, this implies that the recent rapid increase in NPLs in Hungary is likely to have an adverse impact on economic activity in the period ahead, including by further credit contraction and moderation of domestic demand. Given the usual caveats for the use of point estimates, the results suggest that the 3 percentage points increase in NPLs observed in 2012 may shave about ½–¾ percentage points off real GDP growth in 2013.

44.   These findings have some policy implications. First, given the adverse effect of NPLs on the broad economy and also in view of the significant contribution of bank-level factors to NPLs, there is merit to strengthen supervision to prevent a sharp buildup of NPLs in the future, including by ensuring that banks avoid excessive lending, maintaining high credit standards, and limiting foreign currency lending to un-hedge borrowers. Beyond this, the fact that high levels of NPLs continue to

pose a burden on the economy, inter alia through limited bank lending, highlights the need for a swift, but orderly, clean-up of banks' portfolios. While the resolution of NPLs should, in principle, be led by banks in a collective and cooperative fashion that will benefit both the debtors and creditors, policymakers can take a more proactive approach, including by removing tax, legal, and regulatory impediments to help banks accelerate the cleanup process of their portfolios in a non-disruptive manner taking into account banks' ability to absorb losses.

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Appendix

Table A1. Correlation Matrix, 1998–2011

	NPLS	d_unemp	Inf	Ex_rate	d_rgdp_euro	Vix	Equity-to-Assets	RoE	Loans-to-Assets	D_loans
NPLS	1.00									
d_unemp	0.20	1.00								
Inf	-0.10	-0.11	1.00							
Ex. rate	0.04	0.17	0.51	1.00						
d_rgdp_euro	-0.13	-0.42	0.15	-0.26	1.00					
Vix	0.24	0.31	0.09	0.21	-0.69	1.00				
Equity-to-Assets	0.04	0.02	0.17	0.17	0.00	0.03	1.00			
RoE	-0.13	-0.13	0.06	0.02	0.13	-0.12	-0.15	1.00		
Loans-to-Assets	-0.06	0.10	-0.08	-0.02	-0.14	0.09	0.05	-0.05	1.00	
D_loans	-0.44	-0.30	0.13	-0.10	0.28	-0.32	-0.02	0.10	0.03	1.00

Table A2. Panel Unit Root Tests (Fisher), NPLs Determinants

		Fisher-ADF	Fisher-PP
NPLS	level	778*	718*
D_unemp	level	1029*	628*
INF	level	1261*	1465*
Ex_rate	level	1217*	1087*
D_rgdp_euro	level	651*	809*
VIX	level	781*	367*
Equity-to-Assets	level	836*	1022*
RoE	level	1075*	1171*
Loans-to-Assets	level	517*	469*
D_Loans	level	406*	799*

*and ** denote significance at 1 and 5 percent, respectively.

Table A3. Panel Unit Root Tests (Fisher), NPLs determinants

		Fisher-ADF	Fisher-PP
npl	level	46.62**	70.74*
Δnpl	level	42.61	72.87*
Δgdp	level	62.54*	86.11*
unp	level	65.92*	21.95
Δunp	level	113.67*	94.03*
Δcpi	level	124.50*	106.17*
$\Delta credit$	level	38.47	120.22*

*and ** denote significance at 1 and 5 percent, respectively

Table A4. Macroeconomic and Bank-Level Determinants, Pre-Crisis Period (1998–2007)

	Fixed Effects		Difference GMM		System GMM	
NPLs (-1)	0.471*	0.511*	0.163	0.203	0.830*	0.741*
Macroeconomic variables						
D_unemp	0.120*	0.114*	0.093*	0.094**	0.047	0.091***
Inf (-1)	0.015**	0.025*	0.034*	0.038*	0.019**	0.025*
Ex_rate[1]	0.003	0.007	0.011**	0.012**	0.010	0.005
VIX	0.024*	0.032*	0.024*	0.027***	-0.006	0.003
Bank-level variables						
Equity-to-Assets (-1)		-0.014		-0.000		0.009
RoE (-1)		-0.007***		-0.003		-0.003
Loans-to-Assets (-1)		0.019*		0.014*		0.007
Country dummies	no	no	no	no	yes	yes
Number of Obs.	347	344	240	238	347	344
R-squared (within)	0.480	0.518				
R-squared (between)	0.715	0.503				
Number of banks	93	92	72	71	93	92
Number of instruments			41	44	28	55
Hansen test p-value					0.380	0.153
A-B AR(1) test p-value					0.015	0.026
A-B AR(2) test p-value					0.521	0.515

Significance level: *significant at 1 percent; ** significant at 5 percent; ***significant at 10 percent.
[1] An increase in exchange rate reflects depreciation.

Table A5. Macroeconomic and Bank-Level Determinants, Post-Crisis Period (2008–2011)

	Fixed Effects		Difference GMM		System GMM	
NPLs (-1)	0.312*	0.300*	0.480*	0.459*	0.452*	0.513*
Macroeconomic variables						
D_unemp	0.013	0.008	0.028**	0.020***	0.023	0.037**
Inf (-1)	-0.007	-0.006	0.000	-0.000	-0.004	0.012
Ex_rate[1]	0.005*	0.005	0.008**	0.006**	0.007**	0.010**
Bank-level variables						
Equity-to-Assets (-1)		-0.037**		-0.048*		-0.005
RoE (-1)		-0.004*		-0.001		-0.007*
Loans-to-Assets (-1)		0.017*		0.016*		-0.006
Country dummies	no	no	no	no	no	yes
Number of Obs.	337	336	207	206	337	336
R-squared (within)	0.257	0.325				
R-squared (between)	0.821	0.464				
Number of banks	130	130	115	115	130	130
Number of instruments			7	10	22	31
Hansen test p-value					0.018	0.206
A-B AR(1) test p-value					0.675	0.034
A-B AR(2) test p-value					.	.

Significance level: *significant at 1 percent; ** significant at 5 percent; ***significant at 10 percent.
[1] An increase in exchange rate reflects depreciation.

Table A6. Summary Statistics

|	Obs.	Mean	Std. Dev	Min	Max
npl	206	8.757	7.937	0.200	41.300
Δnpl	189	-0.176	3.704	-15.600	17.900
$\Delta credit$	167	3.564	5.752	-16.587	19.262
unp	238	12.626	8.165	1.620	37.250
Δunp	208	0.039	1.936	-5.605	9.700
Δgdp	223	3.570	4.589	-17.729	12.194
Δcpi	235	9.214	13.746	-1.224	85.742

THE COMPOSITION OF FISCAL CONSOLIDATION MATTERS—POLICY SIMULATIONS FOR HUNGARY[1]

This chapter evaluates different policy options to achieve permanent fiscal consolidation in Hungary based on a general equilibrium model. The main finding is that the composition of the consolidation matters for growth, employment, and investment. A consolidation based on cuts on current expenditures yields the smallest GDP contraction in the short-term and can increase output in the long-term by stimulating labor participation and private investment. On the other hand, cuts in government investment and hikes in corporate taxes are the most costly, as disincentives for private investment result in protracted declines in GDP. The long-term GDP losses can exceed considerably the initial size of the consolidation.

A. Introduction

1.   Fiscal consolidation in Hungary is necessary for several reasons. First, in order to reduce risks to fiscal sustainability, particularly as public debt and financing needs are very large (close to 80 percent and 20 percent of GDP, respectively). Second, to meet public debt and deficit targets agreed with the EU and comply with the Hungarian Constitution.[2] Third, to improve conditions for growth by crowding in private sector activity. The latter is particularly important given the large size of government (text chart). Financing it requires a heavy tax burden, resulting in significant allocation inefficiencies, low investment and labor participation, and erosion of competitiveness.

General Government Expenditures
(2000-2007 average; in percent of GDP)
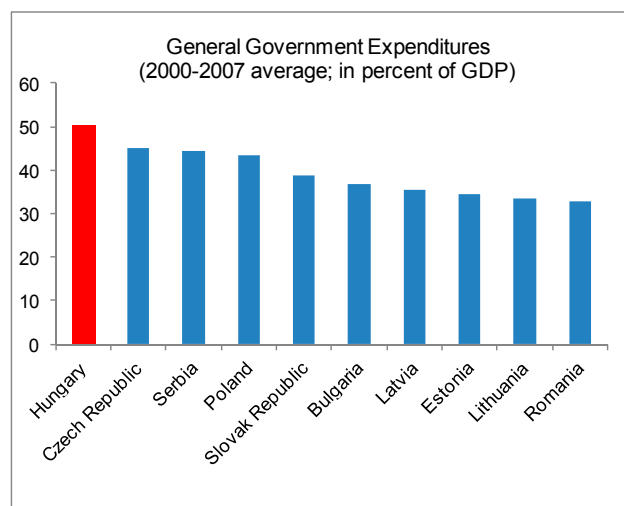
2.   To assess the impact of alternative fiscal consolidation options, a general equilibrium model was calibrated for the Hungarian economy. Policy simulations were based on seven policy instruments including increases in consumption, corporate, and labor income tax rates and reductions in government consumption, government investment, general transfers (lump-sum), and targeted transfers to liquidity-constrained consumers (lump-sum). The results show that the

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[1] Prepared by Alejandro Guerson.

[2] The Hungarian Constitution specifies a public debt upper threshold at 50 percent of GDP.

composition of fiscal consolidation across tax and expenditure categories has a significant impact on growth, both in the short- and long-term. The impact works mainly through the effect of various policies on investment, employment, wages, and competitiveness.

3.   The chapter is structured as follows. Section B summarizes recent fiscal developments, setting up the context to the analysis. Section C describes the model. Section D presents the results of the policy simulations. Section E concludes.

B.   Fiscal Policy Context

4.   Following a significant fiscal loosening in 2010, the government embarked on a sizable fiscal adjustment with the ultimate goal of complying with EU targets and exiting the Excessive Deficit Procedure. During this period, a flat personal income tax system was introduced in 2010,[3] which had as main objective the increase in labor participation. To offset the substantial revenue loss, sector-specific levies on bank, energy and retail sectors were introduced. In addition, under the Convergence Programs of 2011 and 2012, a raft of policy measures sought to reduce spending on health, education, social transfers, pensions, local administrations, and transport.

5.   The consolidation efforts were complicated by deteriorating growth conditions, which slowed revenue performance. In this regard, several fiscal packages were adopted to reduce the budget deficit under 3 percent of GDP. These included an increase in the VAT rate (to the highest rate in Europe at 27 percent), the introduction of multiple small taxes, increase in excises and levies, increase in social security contributions, and introduction of simplified business and personal income tax schemes for small businesses and individuals. For 2013, the budget includes a new tax on financial transactions, and additional sector-specific taxes on insurance, utilities and telecoms. Most special sectoral levies were expanded and have now become permanent.

6.   This multiplicity of fiscal measures provides the motivation to investigate the macroeconomic impact of fiscal policies, with a view to understand their implications and inform future decisions on more growth-friendly policies to achieve the needed fiscal consolidation.

C.   Model Overview

7.   In this chapter, we employ the three-region Global Integrated Monetary and Fiscal general equilibrium model (GIMF) developed by Kumhof, Laxton, Muir and Mursula (2010) (KLMM). The three regions modeled are Hungary (HN), Euro Area (EU), and Rest of the World (RW). Below is a descriptive presentation of the key features of GIMF. More details on the specific equations can be found in KLMM.

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[3] Effectively, the Hungarian personal income tax is a two-rate system given that income is taxed in gross terms (including social security contributions) above a certain threshold.

Key Characteristics of the Model

8.   **Non-Ricardian features.** The model includes several non-Ricardian elements that make revenue and expenditure fiscal measures non-neutral, both in the short and long term. In order of quantitative importance, these include: (i) overlapping generations (OLG) agents with finite lifetimes; (ii) liquidity constraints; and (iii) distortionary taxes on labor income, capital income, consumption and imports.

9.   **Nominal and real rigidities.** Nominal and real rigidities exist in labor markets, intermediate and final goods markets. Real rigidities include habit persistence in consumption; quantity adjustment costs in the retail sector; investment adjustment costs and variable capital utilization; and imports' adjustment costs and productivity spillovers. Nominal rigidities are included as price adjustment costs by firms, and nominal wage rigidities.

10.   **Asset markets.** Asset markets are assumed to be incomplete. There is a home bias in local currency government debt, so that it is all held by domestic investors. Foreign currency bonds are internationally traded. Firms are owned domestically, and households receive lump-sum dividend payments from their shareholding. The commodity sector is owned by both domestic and foreign households.

11.   **Risk premia.** These take the form of a foreign exchange risk premium and a sovereign risk premium. The foreign exchange risk premium is a non-linear function of the current account to GDP ratio, so that the risk premium increases, and at an accelerating rate, as the current account deficit becomes bigger. The sovereign risk premium is set exogenously.

12.   **Monetary policy.** The monetary authority responds to economic developments and seeks to achieve an inflation target. The policy interest rate responds to inflation (concurrent and one-period-ahead forecast), the size of the inflation gap, and lagged interest rates.

13.   **Long-term growth.** Steady-state growth is exogenous with the world economy growing at a constant rate. Population also grows at a constant rate.

Figure 1. Simplified Presentation of GIMF Sectors 1/

1/ Arrows indicate flow exchange of goods and/or services among sectors. These sectors are replicated for each of the three regions. A more detailed diagram representation can be found in KLMM.
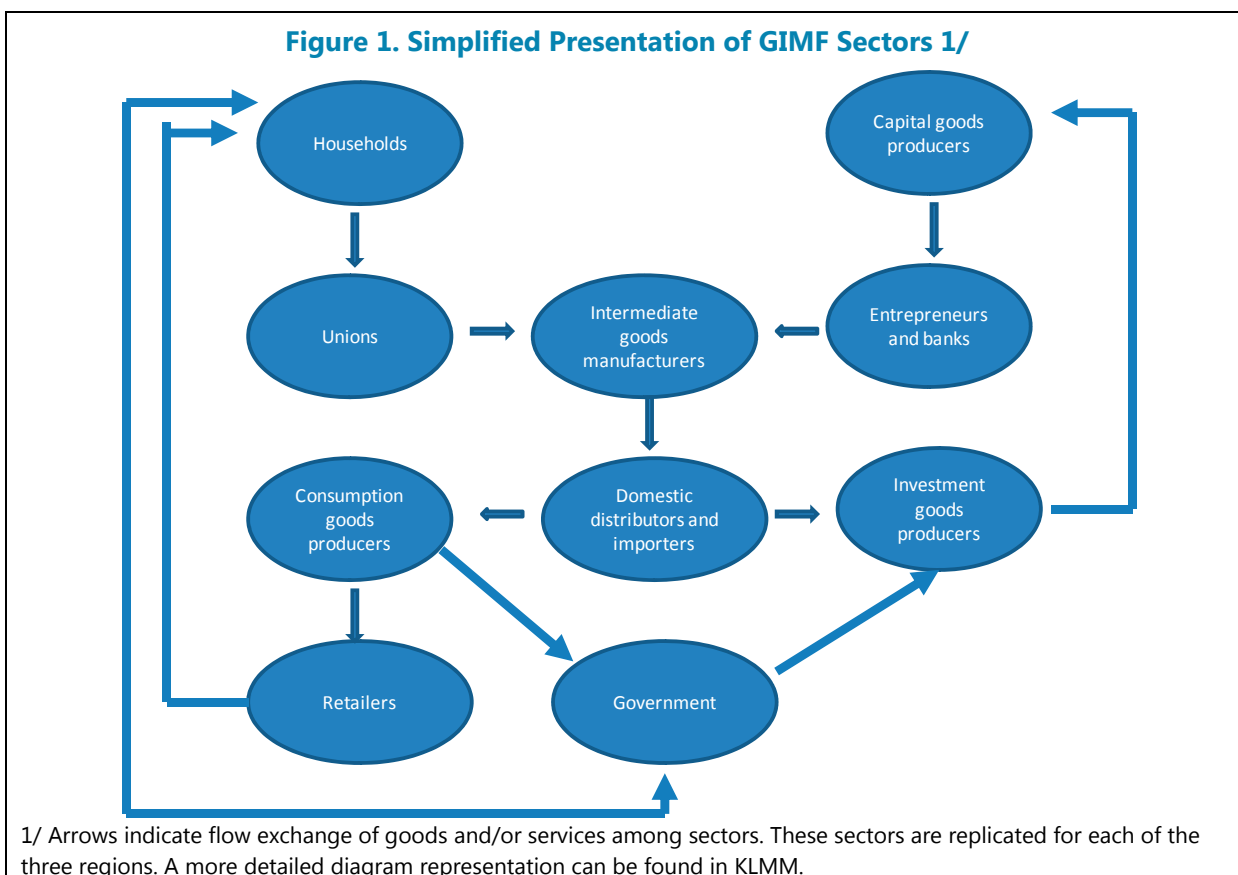
Economic Sectors

In broad terms, the GIMF structure includes the following framework, replicated for all three regions:

14.　　**Households**. There are two types of households: overlapping generations' (OLG) households with finite planning horizons (Blanchard 1985), and liquidity constrained households (LIQ). Households consume final retailed output and supply labor to unions. Both types of households are subject to uniform labor income, consumption and lump-sum taxes. Their income also derives from financial assets (domestic government and corporate bonds in domestic currency), international bonds in foreign currency, and ownership of domestic firms. Households supply labor. OLG households have several investment options: finance entrepreneurs through bond purchase; make bank deposits (non-contingent return) and own firm shares that yield dividends.

15.　　**Firms**. The production structure of the economy includes several stages ranging from primary producers to retail distributors. Each stage includes a combination of frictions in price setting and acquisition of inputs that result in a parsimonious response to shocks and also to changes in economic policy. Primary production is carried out by manufacturers producing tradable and non-tradable goods. For inputs, manufacturers buy capital services from entrepreneurs, labor from monopolistically competitive unions (who buy labor from households and are subject to

nominal wage rigidities), and raw materials from the world raw-materials market. Entrepreneurs receive loans from banks (subject to a zero-profit competitive constraint), which take households' deposits. Entrepreneurs then purchase capital and rent it to manufacturers, and decide the rate of capital utilization, which is subject to increasing utilization costs. Manufacturers are subject to nominal rigidities in price setting, and also to real rigidities in labor hiring and in the use of raw materials. Manufacturers' domestic sales are purchased by distributors while foreign sales are purchased by import agents that are domestically owned but are located in each export destination region (who then sell their product to foreign distributors).

16.   **Distributors**. A distribution sector assembles non-tradable goods along with domestic and foreign tradable goods with imported inputs, with changes in the latter being subject to adjustment costs. This private sector output is then combined with a publicly owned capital stock (infrastructure) and foreign output in order to produce domestic final output which is sold to consumption goods' producers, investment goods producers, and to final goods import agents located at a foreign country. Distributors are subject to nominal rigidities (sticky price setting). Consumption goods output is sold to retailers and the government; investment goods output is sold to domestic capital goods producers and the government.

17.   **Retailers**. A monopolistically competitive retail sector sells the goods to consumers at flexible prices but with adjustment costs associated with changes in sale volumes. This feature contributes to generate inertial consumption dynamics, allowing a smoother path of consumption consistent with time series data. Retailers combine a final consumption good composite from consumption goods and raw materials. They are subject to adjustment costs to changes in raw material inputs. Their price setting is subject to real rigidity by way of costly adjustment of sales to changes in demand.

18.   **Government.** The government utilizes domestic and foreign inputs to produce a government consumption good. In addition, the government spends on public capital (infrastructure), which is used as an input in private production. Finally, the government makes lump-sum transfers to households. Government expenditures are financed with debt issuance and several forms of distortionary taxes plus lump sum taxes. This means that fiscal policy consists of public investment, public consumption, transfers to households, lump sum taxes, consumption taxes, investment income taxes and labor taxes. The production of a government good allows import content in government output (often high content of investment goods and low content of consumption goods). Government allocation of resources plays a key role for the real economy, as government investment augments the stock of infrastructure and results in protracted and long-lasting effects on private investment, and labor supply and demand. Fiscal policy is modeled so that it complies with two objectives: debt sustainability, and cycle smoothing. Non-explosive debt dynamics are ensured by adjusting expenditure to stabilize the overall fiscal balance at a long-run

level chosen by policy (long-run debt ratio target). Stabilization of the business cycle is achieved through a structural balance rule that responds to the size of the output gap.[4]

D. Policy Simulations

19.   The GIMF model was calibrated to fit key features of the Hungarian economy. The main parameters are derived from national accounts, ComTrade and GFS databases. Where no specific data were available, the parameters were kept in line with the literature. Appendix 1 lists the main parameters used in the calibration. The key simulations are presented in Figures 2-4.

Consolidation of government investment

20.   A fiscal consolidation achieved by cutting public investment appears as the least desirable policy option, both in the short and long term. The impact on output is the most severe of all instruments considered (Figure 3). There is a sustained decline in GDP relative to baseline of about one percentage point every five years for every percentage point of fiscal consolidation. GDP is 3 percent lower than in the baseline by 2025, and 5 percent lower by 2050.

21.   Aggregate demand declines immediately by about 0.5 percent of GDP. This reduces firms' demand for both capital and labor in the short term. In addition, as government investment is cut, the stock of public capital declines, gradually reducing productivity and undermining potential output. Overall, the decline in demand for factors of production becomes protracted, and private investment declines by around the same magnitude as the government's. This depresses output, households' incomes, and consumption over time (Figure 3).

22.   The external sector balance improves initially, but it gradually deteriorates as the economy looses competitiveness (Figure 4). Interestingly, real exchange rate appreciates, mainly as the protracted consumption decline is slower than output's, a result driven by habit persistence in consumer preferences.[5]

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[4] The Hungarian authorities expressed commitment to pass legislation for the adoption of a European-style structural balance rule for the general government before the end of 2013.

[5] GIMF assumption on habit persistence is simplified to a weak form of consumption inertia. The Retailers sector (producing a consumption composite good and sells it to households for final consumption) plays a key role to obtain parsimonious consumption dynamics, by way of two assumptions: (a) costs to deliver fast changes in the purchase of raw material inputs and; (b) price setting rigidities that make it costly t accommodate rapid changes in demand. This setup permits realistic consumption dynamics within an OLG agents framework while also avoiding problems of aggregation.

Figure 2: Permanent Fiscal Consolidation Using Alternative Fiscal Instruments
(Differences relative to baseline, in percent of GDP)
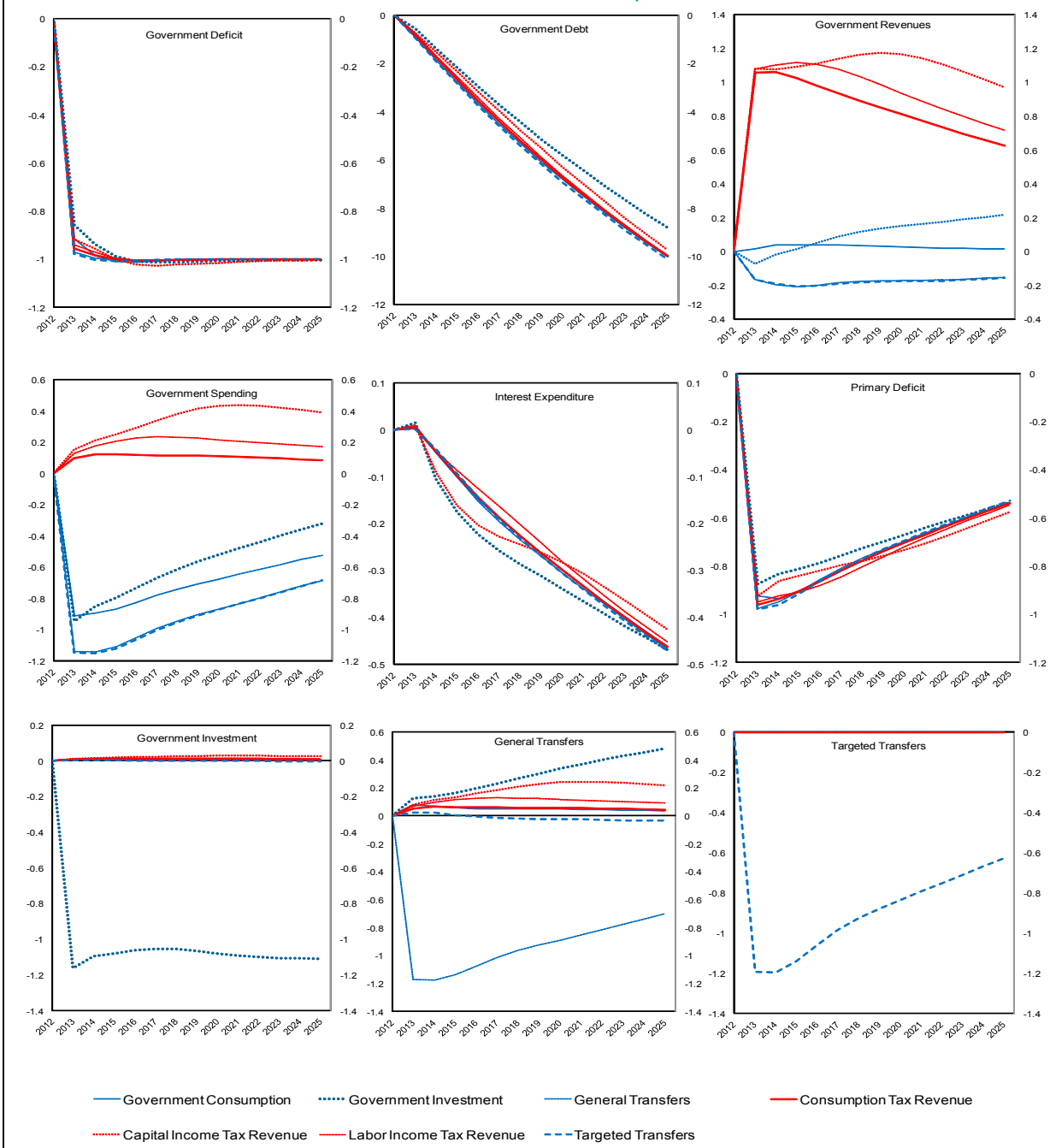
Figure 3: Impact of 1 percent of GDP Permanent Fiscal Consolidation on National Accounts
(Differences relative to the case of no consolidation, in percent)
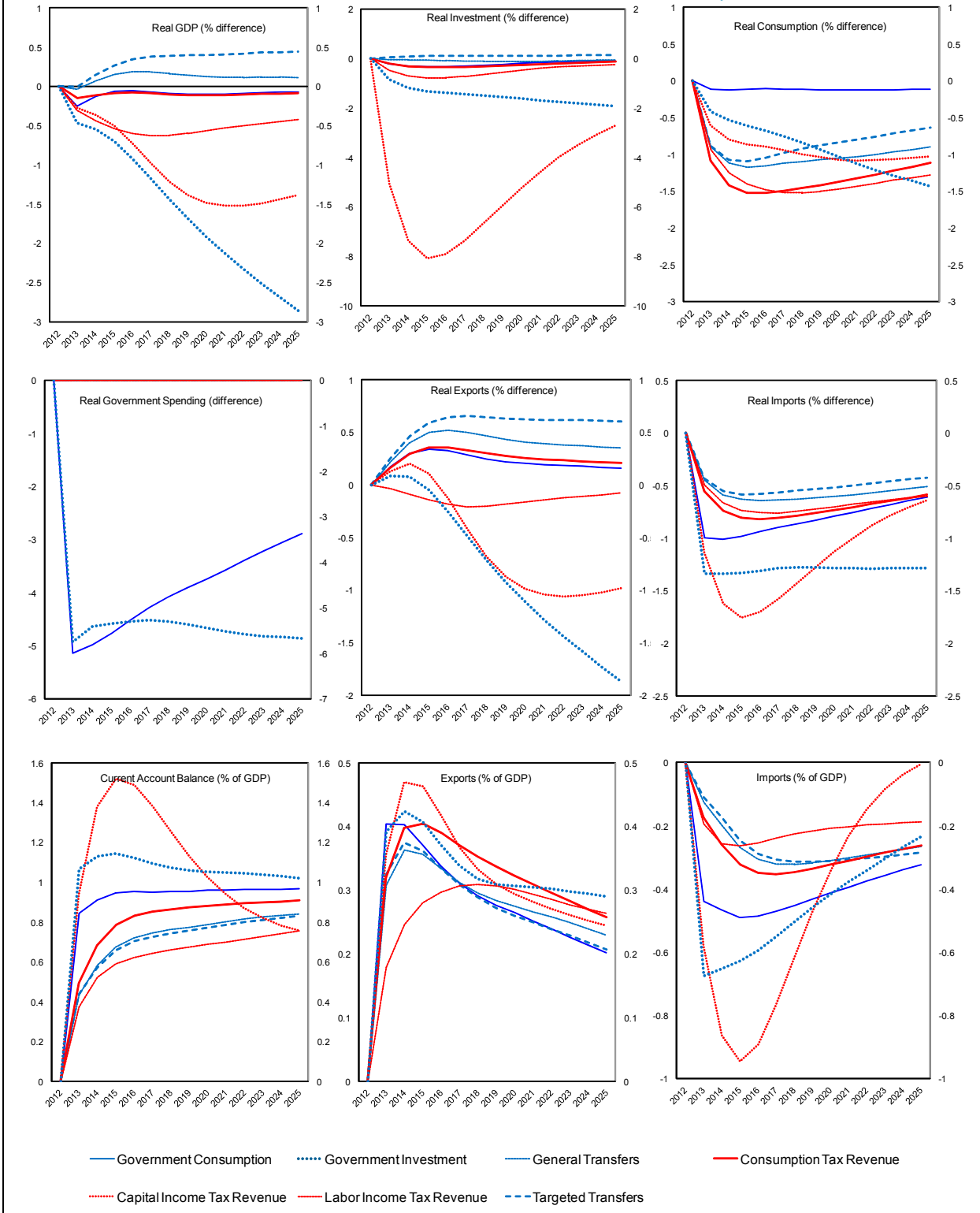
Figure 4: Impact of 1 percent of GDP Permanent Fiscal Consolidation on Inflation, Exchange Rates, and Interest Rates
(Differences relative to the case of no consolidation, in percent)
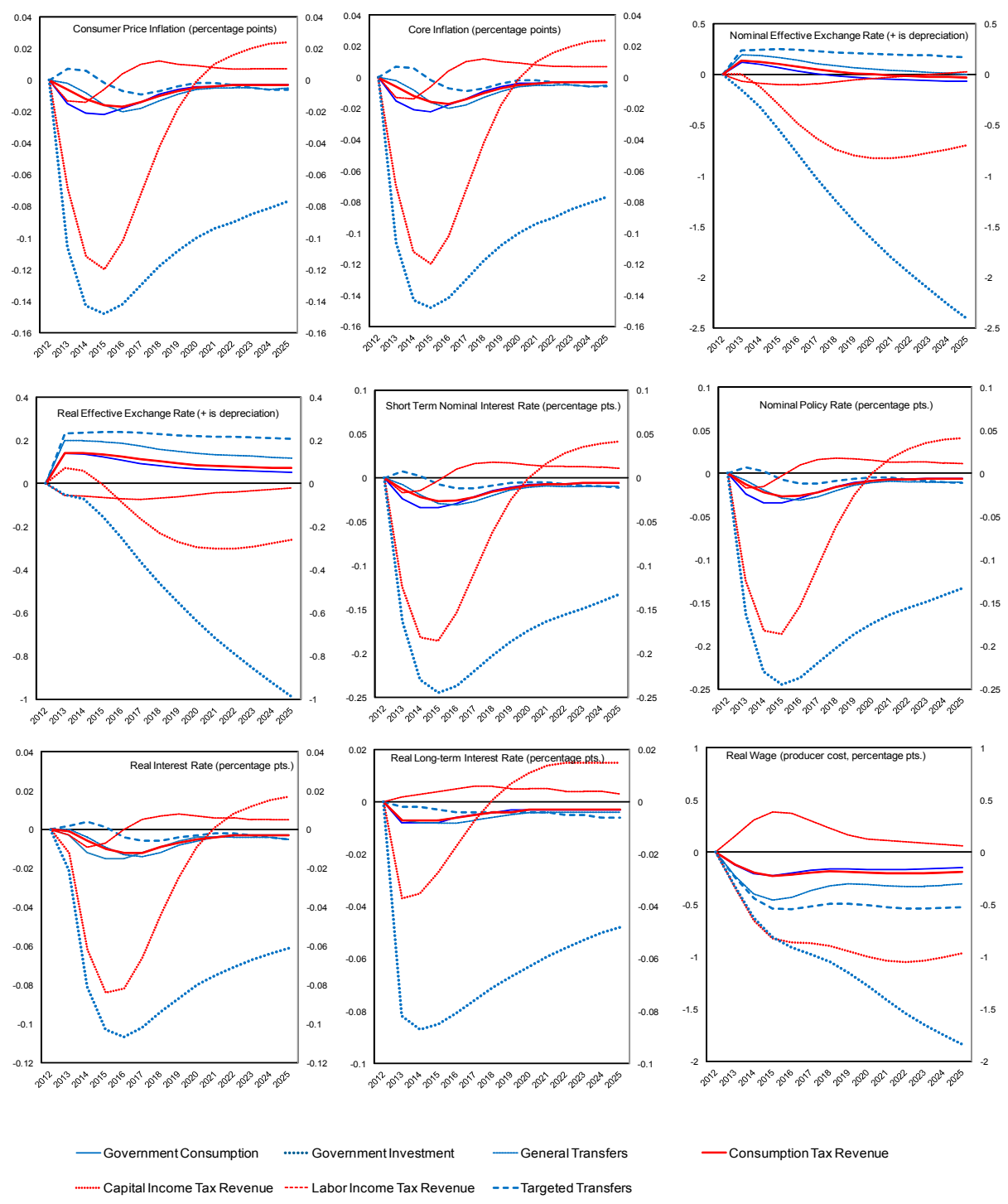
Consolidation of government consumption

23.   If fiscal consolidation is achieved through a reduction in government consumption of goods and services and/or wage expenditures, aggregate demand declines in the short-term by about 0.25 percent below baseline. It recovers somewhat in later periods, but only partially, and remains short of the baseline level.

24.   In sharp contrast with a cut in public investment, private investment remains almost unaffected. Private consumption, however, increases to almost fully offset the decline in public consumption. The current account balance improves proportionally, with the improvement coming equally from an increase in exports and a decline in imports. This mild result is largely explained by the high degree of openness of the Hungarian economy. The retrenchment in public consumption has a large impact on the demand for imports.

25.   The impact on inflation is minimal, and the nominal and real exchange rate show a small amount of depreciation that peaks in the first year at 0.2 percent compared to baseline (for both core and CPI). Real wages decline by less than 0.5 percent in the short-term, and partially recover over the long-term.

Consolidation of government transfers – general and targeted

26.   The initial impact of a cut in transfers on output is mute (Figure 3). However, output increases in the medium- and long-term, and more so in the case of a cut in targeted transfers (0.5 percent of GDP relative to baseline) than in the case of general transfers (0.1 percent).

27.   The muted impact on output in the short term is explained by the endogenous response of the economy. Unlike in the case of a consolidation through public investment, total investment remains unaffected. As household income is reduced as per the cut in transfers, labor participation increases boosting output and having an offsetting effect. With lower overall household income the decline in consumption becomes protracted and results in permanent currency depreciation in real terms (mainly from a nominal depreciation). Moreover, the currency depreciation reduces the producer-cost of labor, further increasing the demand for labor and output. All in all, the improvement in external competitiveness allows output to remain at the same level as in baseline in the short term despite a decline in private consumption as the external demand offsets the decline in domestic demand.

28.   Over the medium and long terms, the improvement in competitiveness results in higher output permanently. The increases in labor participation and labor demand explained above are large and protracted, given the permanent nature of the cut in transfers. In addition, the gradual reduction in government debt reduces interest rates further, creating fiscal space to increase government consumption and providing further stimulus to aggregate demand. This allows some reversal of the short-term improvement in external accounts (Figure 4). In addition, the sustained improvement in the external balance results in private sector accumulation of net foreign assets, and a gradual increase in the non-wage income of the OLG (forward-looking non-myopic)

consumers. This last effect reduces the negative short-term impact of the cut in transfers and contributes to the gradual recovery in consumption.

29.   The dynamics analyzed above are more pronounced in the case of a cut in transfers that are targeted to liquidity-constrained agents, in comparison with the case of a cut in general transfers. As liquidity-constrained agents do not accumulate assets by assumption, they have less room to cushion the decline in income with other sources of income and savings, and their response is more pronounced (also because the same amount of fiscal consolidation is concentrated in a smaller number of households).

Consolidation with consumption taxes

30.   Increasing consumption taxes permanently to achieve an improvement in the overall balance of 1 percent of GDP reduces growth by 0.2 percent in the first year (Figure 3). Afterwards, GDP growth recovers to near baseline level. Private consumption, however, declines significantly, more than in any other policy instrument considered. Real consumption declines 1 percent of GDP in the first year and 1.5 percent by the third year. It recovers gradually thereafter partly due to the model's assumption on the allocation of any fiscal space created by the reduction in public debt to government consumption.

31.   The external account improves, as expected, but less so than under a reduction in government investment and government consumption (see Figure 3). The current account balance increases gradually to reach 0.8 percent of GDP by year 3 and stabilizing below 1 percent of GDP in the long-term. This is determined by an increase in exports that peaks by year 3 and a contraction in imports that is somewhat more protracted. Inflation declines below the baseline for the first three years, as the impact on prices from a decline in consumption offsets the effect from taxes, but then returns to the baseline in the long-term (Figure 4). Interest rates also reflect the lack of demand and move downward, while the nominal exchange rate depreciates by less than 0.2 percent, allowing a real exchange rate depreciation of about the same amount. This exchange rate depreciation is very protracted.

32.   The results above indicate that higher consumption taxes can have a contractionary effect in the economy, including a decline in growth, inflation, interest rates and exchange rate depreciation. This contraction, however, is small relative to the size of the consolidation. The decline in output is less than ¼ the size of the improvement in the fiscal surplus targeted, and inflation, interest rate and exchange rates show relatively small changes. The reasons behind this result are twofold. First, the increase in consumption taxes stimulates savings. As a result forward looking (OLG) consumers internalize an increase in wealth income, which moderates the decline in consumption (aided also by habit persistence in consumption). The decline in interest rates also increases investment and the capital stock, moderating the decline in output as time passes. This also explains why real wage decline, as determined by a lower demand, but less so than under other consolidation options (0.2 percent below baseline by year 3, protracted). Second, with Hungary being a very open economy, the external balance improves considerably, more than ¾ the size of the consolidation, as the

exchange rate depreciates in real terms. This implies that the switching effect from domestic to external demand is relatively large, cushioning the domestic demand impact.

Consolidation with corporate income taxes

33.   A consolidation with higher taxes on corporate income depresses output both in the short- and medium-term, and the decline is second only to the reductions stemming from a shock in government investment. Output contracts by 0.3 percentage points below baseline in the first year, and 0.5 percent by year 5. The decline peaks after ten years at 1.5 percentage points below baseline (Figure 3). The main driver for this result is the decline in private investment, which is sustained for a long period of time until capital stock reaches its desired level. Indeed, investment is 5 percentage points below baseline in year 1, and more than 8 percentage points by year 3, when it reaches its minimum level. This decline is far deeper than in any other policy scenario considered. It is interesting to notice that in year 1 private consumption declines to 0.5 percent below baseline, which is about ½ of the decline that would be obtained under the other two tax alternatives and also if government transfers were reduced. This indicates that the distributional impact of this policy is not without cost. Real wages decline considerably, of about the same magnitude than the one predicted under a decline in government investment during the first five years after the policy is implemented. By year 5 real wages are 1 percent below baseline, and remain at around that level thereafter (Figure 4).

34.   The external account shows the biggest improvement in the short term of all policy alternatives under analysis. The improvement peaks at 1.5 percent of GDP by year 3 (Figure 3). Of this, about 1 percent is due to a contraction in imports, which in this case are augmented by the decline in imports of investment goods, and 0.5 percent by a decline in exports.

Consolidation with labor taxes

35.   A consolidation by increasing labor taxes reduces GDP by 0.3 percentage points below baseline in the first year, and the decline continues to increase until year 5 (Figure 3). This decline is larger than obtained by cutting government consumption or transfers, and broadly in line with those seen under the corporate income and consumption taxes cases in the initial years. However, unlike in the cases of corporate taxes and government investment, output recovers after year 5, although this recovery is slow and driven mainly by the assumption of the allocation of fiscal space resulting from public debt reduction to government consumption. The underlying forces behind the initial decline in output, however, are different that in these two alternative policy options. The main driver is a decrease in labor participation resulting from an increase in real wages (Figure 4). As a result, the return to capital declines and investment is reduced (0.7 percentage points below baseline by year 3). With lower household incomes, consumption declines in the short term significantly, almost on par with the result under a cut in consumption taxes, which showed the deepest departure from baseline. This decline is protracted, as the reduction in investment further reduces the demand for labor and the initial real wage increase gradually reverses.

36.   The improvement in the external sector is the smallest across all the consolidation alternatives. The improvement of the current account is near 0.4 percent of GDP in the first year, and gradually increases to around 0.6 percent in the long term. This improvement is mainly driven by the decline in domestic demand for both private consumption and investment, and therefore it is more protracted than in the other alternatives. Exports improvement is the lowest of all alternatives up until year five, when it is 0.3 percent of GDP above baseline.

37.   Inflation and the interest rate show a decline in the near term, remaining below baseline, but then increase to above baseline and remain there after year 3 (Figure 4). This behavior is consistent with the patterns of labor participation and investment explained above. The quantitative values of these changes, however, are not significant.

E.   Conclusions

38.   This chapter uses a general equilibrium model calibrated for Hungary to simulate the economic impact of fiscal consolidations using different fiscal policy instruments. The results indicate that a fiscal consolidation based on cuts in current expenditures is in general more conducive to growth and investment. In particular, a reduction in government transfers can stimulate labor participation, with the resulting increase in the return to capital yielding an increase in investment and output in the long term. On the other hand, a fiscal consolidation based on cutting capital expenditures is the least preferred, as it results in large and protracted declines in private investment, output and real wages.

Table 1: Maximum Declines Relative to Baseline After 1 percent of GDP Consolidation

Fiscal Consolidation Instrument	Deviation from baseline			Ranking			
	GDP	Investment	Real wage	GDP	Investment	Real wage	Avg.
Consumption taxes	-0.15	-0.36	-0.15	3	4	3	3
Corporate taxes	-1.52	-8.08	-1.52	6	7	6	6
Labor taxes	-0.63	-0.80	-0.63	5	5	5	5
Government consumption	-0.25	-0.33	-0.25	4	3	4	4
Government investment	-2.86	-1.93	-2.86	7	6	7	7
General transfers	-0.04	-0.13	-0.04	2	2	2	2
Targeted transfers	0.00	0.05	0.00	1	1	1	1

Source: Staff computations.
Declines in GDP and investment are measured in percentage points of GDP; declines in real wages are measured in percent of the baseline level.

39.   On the revenue side, all tax increases reduce GDP in the short and the long term. However, their impact on the economy varies significantly depending on the type of tax considered. An increase in corporate income tax has the most negative impact on GDP. Its impact increases over time as investment declines, eroding the stock of capital in the economy, and ultimately reducing real wages. The contractionary impact is the second largest among the policies considered.

40.   On the other hand, an increase in labor taxes has a smaller impact on investment, but a more negative impact on labor participation. GDP does not decline as much, in part because real wages increase following the reduction in labor supply, mitigating the decline in employment. Taxes on consumption appear the least costly in terms of growth and investment among all tax policies under consideration. They improve external competitiveness but depress consumption the most.

41.   The results above should be interpreted with caution, as they are subject to several caveats. First, the results are specific to the model set-up and transmission channels assumed. This is a typical caveat that applies to any model-based policy simulation. For example, Benk and Jacab (2012) find that non-Keynesian effects may dominate over the contractionary forces of a fiscal consolidation in the medium term. They show that, in order for a consolidation to be expansionary, it is necessary that there is a decline in the sovereign premium that reduces interest rates further. Also, some channels potentially affecting growth are not modeled explicitly. For example, if transfers to private agents (OLG and LIQ) affect investment in human capital such as in health and education, then it is possible that the growth effects of transfers as included in the model are underestimated. Second, the results above assume that the consolidation is fully credible after it is announced, meaning that all participants in the economy internalize the policy change in full and anticipate no policy reversals or implementation problems. This assumption is critical to the investment and output results obtained, which are largely based on forward-looking behavior assumptions in a context of rational (OLG) consumers and investors.

Appendix

Model Calibration

Hungary represents 0.15 percent of world population and 0.25 percent of world GDP (PPP adjusted). The steady-state world technology growth rate is set at 1.5 percent per year, and the world population rate is set to grow at 1 percent. Inflation was set at 2 percent in Hungary and the Euro Area, and at 2.5 percent in the rest of the World. The world real interest rate is equalized across countries at 3 percent per annum. The external financing premium function is calibrated to produce 250 basis points premium over international interest rates at steady state net foreign liabilities to GDP ratio of 0. Factor shares in aggregate production are set at 40 percent for capital and 60 percent for labor for the three regions. The calibrated shares of labor for the Hungarian tradable sector is 54 percent, and for the non-tradable sector is 71 percent, which are higher than in the other two regions.

The liquidity constrained agents are assumed to represent 40 percent of consumers in Hungary, 30 percent in the Euro Area and 40 percent in the rest of the world. The share of these agents in dividend income is assumed to be half of their share in the population. The real and price adjustments costs are calibrated to yield plausible dynamics over the first couple of years following the shock.

Table A1 also shows the decomposition of steady-state GDP at producer prices into its expenditure components. Investment shares are set at 17.8 percent for Hungary, 18.3 percent for the Euro Area and 20 percent for the Rest of the World. The rest of the expenditure shares are obtained endogenously from the evolution of the economy, including as a result of preference and technology parameters. The resulting values are in line with the historical data.

The bottom section of Table A1 shows the calibrations for the government revenue and expenditure shares in percent of GDP. Revenues are set at 45 percent of GDP (general government), in line with recent historical trends. The long-term debt target is set at 50 percent, which is the upper threshold mandated by the Hungarian Constitution. This long-term steady state debt stock, together with equilibrium interest rates and long-term growth, result in a primary surplus of ¼ percent of GDP in steady-state. Government consumption is calibrated at 17.5 percent of GDP for Hungary, which is about the value of the sum of general government expenditure in goods and services and wages and salaries. Investment is calibrated at 3 percent of GDP, also consistent with historical trends. The calibrations for EU and RW are also displayed in the second and third columns of Table 1, consistent with KLLM.

Table A2 presents the international trade flows among the three regions, as obtained from the Comtrade and Dots databases. It is important to notice that the model's internal consistency requires that world trade is balanced in net terms. Exports for Hungary are set at near 80 percent, somewhat below current estimates (affected by recession in the context of the global crisis), but in line with historical trends. Of this, about ¾ is final goods and ¼ is intermediate goods. In a steady-state, the model requires that aggregate exports are equal to aggregate imports, so the later are

also at near 80 percent of GDP. About ¼ of total imports are investment goods, and the rest is divided between consumption goods and intermediate goods in roughly the same amounts.

Table A3 shows the parameter calibrations for the monetary authority's endogenous policy response and also for fiscal policy. The central bank responds to lagged interest rates, the inflation gap between CPI and core prices, and CPI inflation (concurrent and one-period-ahead expected, see KLLM for details). Fiscal policy responds to the size of the output gap. The government endogenous rule targets a stabilization of the overall fiscal surplus around its steady state level, but allows larger deficits (surpluses) if output is below (above) potential. The sensitivity of the response of the surplus has been calibrated to fit the historical data series. Notice that this fiscal policy rule is not as the one introduced in 2012, which is anchored around the stock of public debt. However, under the EU rules, members are expected to start the process for the adoption of structural balance rules, which will be in line with the calibrated rule. As the analysis focuses on long-term implications of permanent fiscal consolidations, it is assumed that Hungary adopts a structural balance rule within the not too distant future.

Table A.1. Calibration

	HN	EU	RW
GDP (% of World Nominal)	0.25	22.24	77.51
Production Function (% of GDP)			
Capital/GDP (CAPITAL)	40	40	40
dividend income (DIVINCOME)	6.407	5.233	1.464
capital income (CAPINCOME)	33.593	34.767	38.536
Labor (LABOR)	60	60	60
nontradables (LABOR_NTG)	66	66	66
tradables (LABOR_TG)	51	51	51
Factor Shares (% total)			
Tradables Production			
capital (FACSHARE_KT)	45.509	46.184	48.242
labor (FACSHARE_LT)	54.491	53.816	51.758
Nontradables Production			
capital (FACSHARE_KN)	29.482	30.355	33.02
labor (FACSHARE_LN)	70.518	69.645	66.98
National Expenditure Accounts (% of GDP)			
Consumption (CONS)	61.70	58.20	60.50
liquidity-constrained (C_LIQ)	18.73	12.76	18.66
forward-looking (C_OLG)	42.97	45.44	41.84
Investment (INV)	17.80	18.30	20.00
Government Expenditures (GOV)	20.50	23.50	19.50
on consumption			
total (GOVCONS)	17.50	20.50	17.00
on investment (GOVINV)	3.00	3.00	2.50
Net Exports (TBAL)	0.00	0.00	0.00
Exports (EXPORTS)	78.89	20.15	5.75
final goods (EXPORTS_D)	60.25	14.67	3.43
intermediate goods (EXPORTS_T)	18.64	5.48	2.33
Imports (IMPORTS)	78.89	20.15	5.75
final goods (IMPORTS_D)	50.68	12.09	4.20
consumption goods (IMPORTS_C)	32.04	8.22	2.55
investment goods (IMPORTS_I)	18.64	3.87	1.64
intermediate goods (IMPORTS_T)	28.21	8.07	1.55
National Income Accounts (% of GDP)			
Wage Income (WAGEINCOME)	42.00	35.50	46.50
Dividend Income (DIVINCOME)	6.41	5.23	1.46
Capital Income (CAPINCOME)	33.59	34.77	38.54
Taxes on Wages (TAXREV_L)	18.00	24.50	13.50
Taxes on Capital (TAXREV_K)	2.50	2.80	3.60
Interest Rates (Levels in %)			
Nominal Policy (INTMP)	4.98	4.98	5.47
Nominal Short-Term (INT)	4.98	4.98	5.47
Real Short-Term (RR)	3.00	3.00	3.00
Fiscal Sector (% of Nominal GDP)			
Govt Primary Spending (G)	44.74	40.06	27.79
Govt Consumption (GOVCONS)	17.50	20.50	17.00
Govt Investment (GOVINV)	3.00	3.00	2.50
Transfers	24.24	16.56	8.29
general (TRANSFER)	24.24	16.56	8.29
targeted (TRANSFER_TARG)	0.00	0.00	0.00
OLG (TRANSFER_OLG)	0.00	0.00	0.00
LIQ (TRANSFER_LIQ)	0.00	0.00	0.00
Govt Revenue (GOVREV)	45.00	40.50	28.00
Tax Revenue (TAXREV)	45.00	40.50	28.00
lumpsum (LSTAX)	6.50	2.50	1.90
labor (TAXREV_L)	18.00	24.50	13.50
capital (TAXREV_K)	2.50	2.80	3.60
consumption (TAXREV_C)	18.00	10.70	9.00
Government Debt (B)	50.00	85.00	40.00
government deficit (GOVSUR)	2.18	3.71	1.93
primary balance (PRIMSUR)	0.26	0.44	0.21
interest payments (INTCOST)	2.44	4.15	2.14

Table A.2. Trade Matrix

	HN	EU	RW
GDP (% of world nominal GDP)	0.249	22.241	77.510
Population Size (% of world)	0.150	5.121	94.729
Aggregate Exports (EXPORTS)	78.887	20.154	5.751
to Hungary	...	0.498	0.110
to Euro Area	44.344	...	5.641
to Rest of World	34.543	19.656	...
Final Goods (EXPORTS_D)	60.245	14.673	3.426
to Hungary	...	0.340	0.065
to Euro Area	33.575	...	3.360
to Rest of World	26.670	14.333	...
Intermediate Goods (EXPORTS_T)	18.642	5.481	2.325
to Hungary	...	0.158	0.045
to Euro Area	10.769	...	2.280
to Rest of World	7.873	5.323	...
Aggregate Imports (IMPORTS)	78.887	20.154	5.751
from Hungary	...	0.497	0.111
from Euro Area	44.501	...	5.640
from Rest of World	34.386	19.657	...
Final Goods (IMPORTS_D)	50.679	12.087	4.198
consumption goods (IMPORTS_C)	32.037	8.221	2.554
investment goods (IMPORTS_I)	18.642	3.866	1.644
from Hungary	...	0.376	0.086
from Euro Area	30.384	...	4.113
from Rest of World	20.295	11.711	...
Intermediate Goods (IMPORTS_T)	28.208	8.067	1.553
from Hungary	...	0.121	0.025
from Euro Area	14.117	...	1.527
from Rest of World	14.091	7.946	...

Table A.3. Policy Rules

	HN	EU	RW
Monetary: Weight on the			
lagged interest rate (DELTAI)	0.30	0.30	0.30
inflation gap			
core (DELTAPIE)	0.75	1.13	0.75
weight on inflation:			
contemporaneous (PIEWT0)	0.25	0.25	0.25
1 Periods Ahead (PIEWT1)	0.75	0.75	0.75
real output gap (DELTAY)	0.00	0.00	0.00
real output growth (DELTAYGR)	0.00	0.00	0.00
nom. exchange rate target(DELTAE)	0.00	0.00	0.00
NEER (DELTANEER)	0.00	0.00	0.00
Fiscal: weight on excess			
output gap (DAMP_GDPGAP)	0.47	0.49	0.35
government debt (DAMP_DEBT)	0.00	0.00	0.00
inflation (DAMP_PIE)	0.00	0.00	0.00
tax revenues (DAMP_TAX)	0.00	0.00	0.00

Table A.4. Preferences and Population Related

	HN	EU	RW
Elasticities of Substitution in Utility			
Intertemporal (1/GAMMA)	0.5	0.5	0.5
Labor and Consumption			
OLG Agents (ETA_OLG)	0.834	0.832	0.798
Elasticity of Labor Supply			
OLG Agents	0.5	0.5	0.5
LIQ Agents	0.5	0.5	0.5
Other Structural Parameters			
Habit Persistence (NU)	0.4	0.4	0.4
'Pure' Discount Factor (BBETA)	98.498	99.046	98.012
Probability of Survival (THETA)	0.95	0.95	0.95
Income Decline Rate (CHI)	0.95	0.95	0.95
Marginal Propensity to Consume (MPC)	4.458	4.665	4.974
Share of LIQ Agents (PSI)	0.4	0.3	0.4

Table A.5. Production, Distribution and Finance

	HN	EU	RW
Depreciation Rate for			
business capital stock (DEPKBAR)	0.1	0.1	0.1
public capital stock (DEP_KG1)	0.04	0.04	0.04
public durables stock (DEP_KG2)	0.04	0.04	0.04
P-share for Investment	0.314	0.329	0.089
Financial Accelerator			
Borrower Riskiness			
tradables (ZIGGY_T)	0.452	0.452	0.452
nontradables (ZIGGY_N)	0.452	0.452	0.452
Cost of Bankruptcy			
tradables (MU_T)	0.357	0.357	0.357
nontradables (MU_N)	0.357	0.357	0.357
Elasticities of Substitution			
between varieties in all sectors			
Nontradables (SIGMA_N)	11	11	11
Tradables (SIGMA_T)	11	11	11
Retail (SIGMA_R)	21	21	21
Consumption Goods (SIGMA_C)	21	21	21
Investment Goods (SIGMA_I)	21	21	21
Real Wages (SIGMA_U)	11	11	11
Final Imports (SIGMA_DM)	41	41	41
Intermediate Imports (SIGMA_TM)	41	41	41
Markups on Price (in %)			
Nontradables (MUN)	10	10	10
Tradables (MUT)	10	10	10
Retail (MUR)	5	5	5
Consumption (MUC)	5	5	5
Investment (MUI)	5	5	5
Real Wages (MUW)	10	10	10
Final Imports	2.5	2.5	2.5
Intermediate Imports	2.5	2.5	2.5
Elasticities of Substitution			
Home versus Foreign			
consumption (XI_C)	1.5	1.5	1.5
investment (XI_I)	1.5	1.5	1.5
intermediate (XI_T)	1.5	1.5	1.5
Among Foreign			
final (XI_DM)	1.5	1.5	1.5
intermediate (XI_TM)	1.5	1.5	1.5
Tradable/Nontradable (XI_A)	0.5	0.5	0.5
Capital versus Labor			
nontradables (XI_ZN)	0.99	0.99	0.99
tradables (XI_ZT)	0.99	0.99	0.99

Table A.6. Production, Distribution and Finance

	HN	EU	RW
Bias Parameters			
Home Bias			
consumption (ALPHA_CH)	0.525	0.934	0.93
investment (ALPHA_IH)	0.305	0.927	0.895
intermediate (ALPHA_TH)	0.409	0.894	0.921
Nontraded vs Traded (ALPHA_N)	0.514	0.511	0.58
Labor Over Capital			
nontradables (ALPHA_N_U)	0.701	0.691	0.666
tradables (ALPHA_T_U)	0.54	0.532	0.513
Trade-Related Bias Parameters			
Domestic over Iported Tradables for			
intermediate goods (ALPHA_TH)	0.409	0.894	0.921
consumption goods (ALPHA_CH)	0.525	0.934	0.93
investment goods (ALPHA_IH)	0.305	0.927	0.895
Among Foreign Countries for			
final imports (ZETA_D)			
from Hungary		0.045	0.015
from Euro Area	0.747		0.985
from Rest of World	0.253	0.955	
intermediate imports (ZETA_T)			
from Hungary		0.022	0.012
from Euro Area	0.674		0.988
from Rest of World	0.326	0.978	
Nominal Rigidities			
Real Wage (PHI_P_U)	40	60	40
Consumption Price (PHI_P_C)	40	60	40
Investment Price (PHI_P_I)	40	60	40
Nontradables Price (PHI_P_N)	40	60	40
Tradables Price (PHI_P_T)	40	60	40
final goods (PHI_P_DM)	4	20	30
intermediate goods (PHI_P_TM)	4	20	30
Real Adjustment Costs			
Labor Demand (PHI_U)	1	1	1
Consumption (PHI_C)	2	2	2
Investment (PHI_I)	1	1	1
Imports of			
consumption goods (PHI_FC)	1	1	1
investment goods (PHI_FI)	1	1	1
tradable goods (PHI_FT)	1	1	1

Table A.7. Corporate Sector Calibration

	HN	EU	RW
Corporate Sector (% GDP unless otherwise stated)			
Aggregate Capital Stock			
utilized (K)	142.229	146.225	159.808
equity price (level)	1.042	0.989	1.037
investment (I)	17.8	18.3	20
current price (level; PI)	1.042	0.989	1.037
Tradables Capital Stock			
utilized (KT)	72.134	73.631	78.852
equity price (level; QT)	1.042	0.989	1.037
investment (IT)	9.028	9.215	9.868
current price (level; PI)	1.042	0.989	1.037
Nontradables Capital Stock			
utilized (KN)	70.096	72.594	80.956
equity price (level; QN)	1.042	0.989	1.037
investment (IN)	8.772	9.085	10.132
current price (level; PI)	1.042	0.989	1.037
All Firms			
net worth (NW)	72.903	74.951	81.914
debt (BPRIV)	72.903	74.951	81.914
insolvencies (%)	8	8	8
leverage ($; LEVERAGE_T)	100	100	100
Tradables Firms			
net worth (NWT)	36.974	37.741	40.418
debt (BPRIV_T)	36.974	37.741	40.418
insolvencies (%; BUST_T)	8	8	8
leverage (%; LEVERAGE_T)	100	100	100
premia			
equity (EQPT)	8.209	8.209	8.209
external financing (XFPT)	2.5	2.5	2.5
Nontradables Firms			
net worth (NWN)	35.929	37.21	41.496
debt (BPRIV_N)	35.929	37.21	41.496
insolvencies (%; BUST_N)	8	8	8
leverage (%; LEVERAGE_N)	100	100	100
premia			
equity (EQPN)	8.209	8.209	8.209
external financing (XFPN)	2.5	2.5	2.5

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