MITIGATING THE COST OF STRICTER MACROPRUDENTIAL POLICIES*

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Abstract

We examine how to implement macroprudential policies – stricter capital requirements and loan-to-value limits – in order to mitigate the output loss of corporate debt deleveraging. The analysis is performed in a dynamic general equilibrium model calibrated to fit the U.S. economy. Stricter capital requirements are generally costlier in terms of output losses than stricter loan-to-value limits. For both instruments, the output loss is a convex function of the debt-to-GDP ratio. Finally, the output loss can be significantly reduced by implementing the requirements gradually, and by activating a countercyclical capital buffer.

Keywords: capital requirements, loan-to-value requirements, output loss, gradual implementation.

JEL classification: C54, E44, G28, G38

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1. Introduction

Total private debt-to-GDP in the United States has fallen from about 170 percent at the onset of the financial crisis in 2008 to about 150 percent in 2018. However, corporate debt-to-GDP is at the same level as in 2008, at 72–73 percent. Following a decrease in 2010–2011, the corporate debt-to-GDP ratio has slowly increased back to the 2008 level, see Figure 1. Corporate debt-to-GDP in the G20 economies, at almost 95 percent, is also high – and has been rising since 2008. China is an important contributor to this overall high value, with a corporate debt-to-GDP ratio of more than 160 percent.

It is well known that excessive debt carries risks for growth and poses a threat to financial stability. Macroprudential policies have been used extensively in recent years to mitigate excessive debt accumulation (see Akinci and Olmstead-Rumsey (2018) for a review). However, such policies can also be associated with a cost in terms of output losses. One of the challenges in implementing these policies is therefore how to mitigate the output loss.

We examine how two common macroprudential policy instruments – capital requirements and loan-to-value (LTV) limits – can be implemented to mitigate output losses, where the aim is to reduce the corporate debt-to-GDP level. The analysis is carried out in a dynamic general equilibrium model calibrated to fit the features of the U.S. economy. To measure the cost of deleveraging, we calculate the cumulated output loss during the first year, in which the long-run non-financial corporate debt-to-GDP ratio is reduced by one percentage point. Hence, the measure can be interpreted as a "sacrifice ratio" of deleveraging – the loss in output per 1 percentage point change in the debt-to-GDP ratio.

We are thus not studying the benefits of the policies, i.e., the reduction in the likelihood of a financial crisis and the associated social and economic costs. The benefits are in this respect exogenous to the analysis. This approach is common in earlier studies as well, see for example BCBS (2010).

Stricter capital requirements generally lead to higher output losses than LTV limits. For both instruments, the output loss is a convex function of the corporate debt-to-GDP ratio. The convexity starts to become severe at ratios of about 50–60 percent, i.e., at ratios notably lower than the current ratio of about 70 percent. At a 70 percent debt-to-GDP ratio, the output loss of stricter capital requirements is 5.71 percent, while it drops to 2.02 percent at a 30 percent ratio. For the LTV limit, the output loss drops from 3.42 percent at a 70 percent debt-to-GDP ratio, to 0.80 percent at a 30 percent debt-to-GDP ratio.

The output loss can be significantly reduced by gradually implementing the requirements. Consider the current level of the corporate debt-to-GDP ratio of 70 percent. By gradually implementing stricter capital requirements eight quarters ahead, the output loss is reduced from 5.71 percent to 2.24 percent, while the output loss of the LTV limit is reduced from 3.42 percent to 1.18 percent. By activating a countercyclical capital buffer, the output loss of stricter capital requirements can be further reduced from 2.24 percent to 1.39 percent, while the output loss of the LTV limit can be reduced from 1.18 to 0.95 percent.

We are not aware of any other academic paper studying the cost of deleveraging in terms of corporate debt in a dynamic general equilibrium framework. Scott and Vlček (2011) study the cost of raising capital requirements from 8 percent to 10 percent in several different scenarios, although they do not focus on corporate debt specifically. They use a rich DSGE-model based on Iacoviello (2005) and Gerali et al. (2010). The output loss varies in their simulations depending on the scenario, but in general the output loss is lower than our results suggest. The Macroeconomic Assessment Group established by the Financial Stability Board and the Basel Committee on Banking Supervision in their final report estimated the output loss of raising capital requirements by 1 percentage point in 97 different models, and in different scenarios. The maximum impact on output varied between about -1.3 percent to zero percent, with an unweighted mean of about -0.2 percent, see BCBS (2010). Alpanda et al. (2018) use a new Keynesian DSGE-model to study the cost of reducing household debt by activating a countercyclical LTV-limit and a countercyclical capital requirement. They find, in line with our results, that the LTV-limit is less costly than the capital requirement, but since they do not quantify the cost of permanent debt reductions, their results are not directly comparable to our findings. Richter et al. (2018) quantify the effects of changes in maximum LTV ratios on output. They use a narrative identification approach based on a large cross-country panel of 56 countries over more than two decades. They find that a 10-percentage point reduction in the maximum LTV ratio lowers output by about 1.1 percent after four years. This is also lower than our model results suggest.

The paper is organized as follows: In the next section, we present the economic environment, the calibration, and the method of measuring the output loss. Section 3 shows that stricter capital requirements are generally more costly than stricter LTV limits. Section 4 and 5 show that gradually implementing the requirements and activating a countercyclical capital buffer both mitigate the output loss. Conclusions are in section 5.

2. The economic environment

We use the economic model developed by Iacoviello (2015). The economy features households, banks and entrepreneurs. Households gain utility from the consumption of goods, housing services and leisure. They are also the savers in the economy, and finance a portion of production by providing loans to entrepreneurs, intermediated by the banks. Disposable income consists of wage income and interest on savings. Formally, households choose consumption C^H, housing H^H, deposits D, and time spent working N, to maximize expected utility,

$$\max_{C_t^H, H_t^H, D_t, N_t} E_t \sum_{t=0}^{\infty} (\beta^H)^t \mathcal{U}(C_t^H, H_t^H, N_t), \tag{1}$$

where β denotes the subjective discount factor, a superscript H denotes households, and $\mathcal{U}$ the utility function. Maximization is subject to the following budget constraint,

$$C_t^H + D_t + Q_t(H_t^H - H_{t-1}^H) = R_t^D D_{t-1} + W_t N_t, \tag{2}$$

where R^D denotes the one-period (gross) deposit rate, H^H housing services, Q the house price, and W the real wage rate.

Entrepreneurs produce the economy's output. The input to production is mainly labor from households, but a relatively small share (about 5 percent) consists of commercial real estate. The entrepreneurs finance part of production with loans from households that are intermediated by banks. Entrepreneurs are borrowing constrained and cannot borrow more than a fraction of the expected value of the real estate stock, less the wage bill, which must be paid in advance. Entrepreneurs choose consumption C^E, commercial real estate H^E, loans from the banks L, and labor input (hours worked) N, to maximize expected utility,

$$\max_{C_t^E, H_t^E, L_t, N_t} E_t \sum_{t=0}^{\infty} (\beta^E)^t \mathcal{U}(C_t^E), \tag{3}$$

where the superscript E denotes entrepreneurs.

The maximization is subject to the following budget constraint,

$$C_t^E + Q_t(H_t^E - H_{t-1}^E) + R_t^L L_{t-1} + W_t N_t + \mathcal{A}^E(L_t, L_{t-1}) = Y_t + L_t, \tag{4}$$

where R^L denotes the one-period (gross) loan rate, Y output, H^E commercial real estate, and $\mathcal{A}^E$ the loan portfolio adjustment cost function.

Output is produced through a production function, $\mathcal{P}$, with commercial real estate and labor as inputs,

$$Y_t = \mathcal{P}(H_{t-1}^E, N_t), \tag{5}$$

Entrepreneurs cannot borrow more than a fraction θ of the expected value of the real estate stock and, as in Iacoviello (2015), we assume that the wage bill must be paid in advance,

$$L_t \leq \theta \frac{Q_{t+1} H_t^E}{R_{t+1}^L} - W_t N_t, \tag{6}$$

Banks are intermediaries in lending between households and entrepreneurs. They have two sources of funding, capital (equity) and deposits from households. The conversion of deposits into loans is subject to a portfolio adjustment cost. Moreover, when issuing loans, banks are constrained by a capital requirement in terms of a capital-to-asset ratio.

Banks are denoted by superscript B and are maximizing expected utility. They choose consumption C^B, deposits D, and loans to entrepreneurs L, to solve the following maximization problem,

$$\max_{C_t^B, D_t, L_t} E_t \sum_{t=0}^{\infty} (\beta^B)^t \mathcal{U}(C_t^B), \tag{7}$$

subject to the following budget constraint,

$$C_t^B + R_t^D D_{t-1} + L_t + \mathcal{A}^B(L_t, L_{t-1}) = D_t - R_t^L L_{t-1}, \tag{8}$$

and the following capital requirement κ,

$$\kappa \leq \frac{K_t}{L_t}, \tag{9}$$

where K denotes bank capital, which equals loans minus deposits.

Finally, the following market clearing conditions hold in equilibrium,

$$H_t^H + H_t^E = 1 \tag{10}$$

$$C_t^H + C_t^E + C_t^B + \mathcal{A}^B(L_t) + \mathcal{A}^E(L_t) = \mathcal{P}(H_{t-1}^E, N_t). \tag{11}$$

2.1. Calibration and functional forms

To parameterize the model, we use estimated and calibrated values from Iacoviello (2015) as well as our own calibrated values, see Table 1. The length of a time period is assumed to be a quarter. The parameter β^H is set to 0.9951, implying an annual long-run real interest rate of 2 percent. The weights on housing and labor in the utility function are set to 0.075 and 2, respectively, as in Iacoviello (2015). We also follow Iacoviello (2015) and set the income share of commercial real estate to 0.05 and the adjustment costs to 0.25. The LTV limit is set to 0.9 in Iacoviello (2015), while we set it slightly higher at 0.91 to facilitate the calibration of the current U.S. corporate debt-to-GDP ratio of 70 percent. The discount factor for banks is also set a bit higher than in Iacoviello (2015) for the same reason. The discount factor for entrepreneurs varies between 0.7525 and 0.94825 to study different debt-to-GDP ratios. In the benchmark case, the discount factor is set to 0.94825, which gives a debt-to-GDP ratio of 70 percent.

Regarding functional forms, we follow Iacoviello (2015). To capture the idea that bank lending changes slowly over time, the portfolio adjustment cost is assumed to be quadratic. It is also assumed that the adjustment cost is similar for both banks and entrepreneurs,

$$\mathcal{A}^B(L_t, L_{t-1}) = \mathcal{A}^E(L_t, L_{t-1}) = \frac{\psi}{2}\frac{(L_t - L_{t-1})^2}{\bar{L}}, \tag{12}$$

where a bar denotes a steady state value.

Output is produced by a Cobb-Douglas production function,

$$\mathcal{P}(H_{t-1}^E, N_t) = (H_{t-1}^E)^\alpha (N_t)^{1-\alpha}. \tag{13}$$

And finally, the aggregate utility functions are specified as log-utility,

$$\mathcal{U}(C_t^H, H_t^H, N_t) = \ln C_t^H + \phi \ln H_t^H + \chi \ln(1 - N_t), \tag{14}$$

$$\mathcal{U}(C_t^B) = \ln C_t^B, \tag{15}$$

$$\mathcal{U}(C_t^E) = \ln C_t^E. \tag{16}$$

2.2. Measuring the short-run output loss of deleveraging

To measure the output loss of deleveraging, we calculate the percentage output loss the economy has to give up for a percentage point reduction in the long-run corporate debt-to-GDP ratio. Mathematically, the output loss of deleveraging, $\mathcal{O}$, is defined in the following way,

$$\mathcal{O} = -\sum_{t=0}^{T} \frac{Y_t - \bar{Y}}{\bar{Y}}, \tag{17}$$

where $\bar{Y}$ denotes steady-state output. To focus on the short-run costs, we set T to four quarters. This choice does not affect the conclusions of the paper.

3. Capital requirements costlier than LTV limits

Stricter capital requirements and LTV limits have short- and long-run effects on debt, output and other variables. To illustrate the mechanisms in the model, it is useful to first consider the long-run (steady-state) effects. Consider the effects of reducing the corporate debt-to-GDP ratio by 1 percentage point, from 70 to 69 percent. This can be achieved by either increasing the capital requirement from 10.0 to 10.6 percent, or by lowering the LTV limit from 91.0 to 90.8 percent. Both instruments reduce bank lending by the same amount, i.e., 1.45 percent, see Table 2. But the instruments have different effects on the bank's funding. The LTV limit reduces capital and deposits by the same amount, while an increase of the capital requirement, on the other hand, leads to higher capital and reduces deposits. In terms of output, stricter capital requirements are slightly more costly than stricter LTV limits. The effect on output is mainly driven by the effect on real estate, which is an input to a firm's production function. The decrease in bank lending limits the entrepreneurs' possibilities to finance commercial real estate, which leads to lower output.

The short-run effects of stricter capital requirements and LTV limits are shown in Figure 2. Stricter capital requirements force banks to build up their capital position and/or reduce deposits. In the model, it is optimal for the banks to increase capital and reduce deposits. The banks' borrowing constraint – i.e. the capital requirement – becomes more binding and increases the spread between lending and deposit rates. Borrowing becomes costlier for the entrepreneurs, and the demand for loans thus declines, which in turn decreases demand for both labor and real estate. In particular, there is a sharp decline in labor demand due to the fact that the wage bill must be paid in advance.

The effects of stricter LTV limits are in many respects similar to stricter capital requirements, but there are differences. The most important difference is the response of capital, which in the case of stricter LTV limits falls somewhat, while stricter capital requirements cause an increase in capital. Banks respond to stricter LTV limits by decreasing both capital and deposits. Stricter LTV limits also imply that the demand from entrepreneurs for bank loans falls. Hence, the demand for labor and commercial real estate falls, and as a result output falls – but to a lesser extent compared to stricter capital requirements.

3.1. The output loss is a convex function of the debt-to-GDP ratio

Theory tells us that the output loss of deleveraging is a convex function of the corporate debt-to-GDP ratio. To show the quantitative importance of the convexity, we calculate the output loss under four different assumptions of the corporate debt-to-GDP ratios: 10, 30, 50 and 70 percent. Figure 3 and Tables 4 and 5 show the results.

First, the output loss of stricter capital requirements is generally higher than that of stricter LTV limits. For values of the corporate debt-to-GDP ratio of around 10-30 percent, the output loss is about 1 percent higher if imposing stricter capital requirements instead of stricter LTV limits. However, for higher values closer to the U.S. data, i.e., a corporate debt-to-GDP ratio of around 70 percent, stricter capital requirements lead to about 2 percent higher output losses. In absolute terms, the output loss is quite high for both policies. If the corporate debt-to-GDP ratio is 70 percent, as in the data, stricter LTV limits imply an output loss of 3.42 percent, and stricter capital requirements – a loss of 5.71 percent.

Second, the output loss is a convex function of the debt-to-GDP ratio for both instruments. At ratios of about 50–60 percent the convexity starts to become severe, as seen in Figure 3. The output loss of stricter capital requirements is for example 5.71 percent at a 70 percent debt-to-GDP ratio, while it drops to 2.02 percent at a 30 percent ratio. For the LTV limit, the output loss drops from 3.42 percent to 0.80 percent.

4. Gradual implementation mitigates the output loss

Gradual implementation strategies can be beneficial, as they may mitigate the short-run output loss. This could be an important factor in achieving a wider acceptance of stricter macroprudential policies. To show the quantitative effects of gradual implementation, three different strategies are examined: In the first strategy, the implementation date is announced two quarters in advance, in the second four quarters in advance, and in the third eight quarters in advance. In addition to preannouncing the implementation, the implementation path itself also has an influence on the policy’s effects. To simplify the comparison of the different preannouncement horizons, we apply a similar linear path in all cases.

Consider first capital requirements and an initial corporate debt-to-GDP ratio of 70 percent: By gradually implementing the requirement two quarters in advance, the output loss is reduced from 5.71 percent (immediate implementation) to 3.68 percent, as seen in Figure 4a and Table 3. Gradual implementation eight quarters in advance reduces the output loss to 2.24 percent. The diagram also shows that the convexity of the output loss is mitigated by gradual implementation strategies. Hence, gradual implementation strategies are particularly beneficial for large high corporate debt-to-GDP ratios.

Implementing stricter LTV limits also gradually reduces output losses. If the corporate debt-to-GDP ratio is 70 percent, the output loss is reduced from 3.48 percent (immediate implementation) to 1.18 percent, as seen in Figure 4b and Table 3. The convexity of the output loss is also mitigated for LTV limits by gradual implementation, implying that the benefits in terms of mitigating the output loss are greatest for high corporate debt-to-GDP ratios.

The benefits in terms of reduced output loss due to gradual implementation are larger for stricter capital requirements relative to stricter LTV limits. Still, stricter capital requirements are more costly than stricter LTV limits. Consider a corporate debt-to-GDP ratio of 70 percent and gradual implementation eight quarters in advance: The output loss is in this case about 1 percentage point higher when imposing capital requirements as opposed to LTV limits, compared to 2 percentage points if the policies are immediately imposed.

5. The countercyclical capital buffer mitigates the output loss further

The countercyclical capital buffer (CCyB) is a relatively new policy instrument that was introduced in Basel III. The main purpose of the buffer is to protect the banking system against potential losses when excessive credit growth is linked to higher risks in the financial system. In contrast to other capital requirements, the buffer varies over time. The buffer is supposed to counteract excessively high accumulations of debt and may therefore mitigate the tendency of the financial system and the economy to reinforce each other in upturns and downturns. However, we show that the CCyB can also play a role in mitigating the output loss when stricter capital requirements and LTV limits are imposed. Formally, we assume the CCyB follows a simple rule,

$$\kappa_t = \rho\kappa_{t-1} + (1-\rho)\left(\bar{\kappa} + \frac{Y_t - \bar{Y}}{\bar{Y}}\right), \tag{18}$$

where κ denotes the capital-to-asset ratio, a bar the steady state, and ρ a smoothing term. According to the simple rule, banks increase the capital-to-asset ratio when output is above the long-run level, and decrease this ratio when output is below the long-run level. We also examine the effects of including a smoothing term to make the rule more realistic, since banks usually have a year or more to implement a change in the capital buffer. The smoothing term is a simple way to capture this, given our modelling framework.

The output loss of stricter capital requirements was 5.71 percent in the benchmark case. By activating the CCyB, the loss falls to 3.38 percent, and including the smoothing term the loss is reduced further, to 2.35 percent, as seen in Figure 5a and Table 6. Output falls initially below the steady-state level, which allows banks to initially reduce capital, even though the long-run level is higher. Among other things, this mitigates the fall in output compared to the benchmark scenario. As we have shown, the output loss can be mitigated further by gradually implementing the instrument. Assume an implementation period of eight quarters – the output loss is then reduced to 1.39 percent. Hence, to minimize the output loss, the most effective strategy is gradual implementation in combination with activating the CCyB.

Activating the CCyB is also effective in mitigating the output loss when implementing stricter LTV limits. By activating the CCyB, the output loss decreases from 3.42 percent to 2.17 percent, as seen in Figure 5b and Table 6. The smoothing term does not reduce the output loss further, but instead increases the loss somewhat, to 2.61 percent. By also adding gradual implementation eight quarters in advance, the output loss is reduced to 0.79 percent.

6. Conclusions

We have shown that stricter LTV limits generally lead to less output losses than stricter capital requirements, and that the output loss can be significantly reduced by gradually implementing the requirements. This should not be taken as a policy recommendation *per se*, since there are other important aspects to consider that we have not been able to evaluate in our simple modelling framework. For example, the benefits of the instruments are exogenous to the analysis. This has simplified the analysis, but it may also have hidden important interaction effects. Uncertainty over the impact and effectiveness of the instruments is another important aspect. As shown by Brainard (1967) uncertainty could lead to a more cautious approach, which would be in line with our results. However, as shown by Bahaj and Foulis (2016), Brainard's result can be challenged in a more complex environment, and they also provide examples of where a more active policy is optimal in the face of uncertainty.

We have also shown that the output loss of deleveraging is a convex function of the corporate debt-to-GDP ratio. From a policy perspective, this is an important fact to consider, since deleveraging at high debt levels can be very costly. Avoiding reaching overly high debt levels is therefore important, although more research is needed to establish the actual debt levels at which the convexity becomes severe.

Regarding our modelling framework, we acknowledge it is simple and neglects many important features of the banking system and the economy in general. Hence, future work should evaluate the effects of incorporating additional features that have an important influence on costs. Moreover, we have studied the cost of deleveraging corporate debt. In many countries, household debt is currently high by historical standards. Examining the output loss from deleveraging household debt is therefore an important policy issue. The interaction of macroprudential policies and monetary policy is another issue that we did not consider, but that is also potentially important.

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Tables

Table 1. Benchmark calibration.

Parameter	Description	Value
β^H	Discount factor for households	0.9951
β^B	Discount factor for banks	0.970
β^E	Discount factor for entrepreneurs	0.7525-0.94825
φ	Weight on housing in utility function	0.075
χ	Weight on leisure in utility function	2.00
α	Income share of commercial real estate	0.05
κ	Capital-to-asset ratio	0.10
η	Loan-to-value ratio	0.91
ψ	Adjustment cost loans	0.25
ρ	CCyB smoothing parameter	0.75

Table 2. Long-run output loss of deleveraging through applying stricter capital and LTV requirements.

	Debt-to-GDP	
Initial value	70.0	
End value	69.0	
	Cap. req.	**LTV req.**
Initial value	10.0	91.0
End value	10.6	90.8
Output, change	-0.023	-0.019
Bank capital, change	+3.80	-1.45
Bank loans, change	-1.45	-1.45
Bank deposits, change	-2.04	-1.45
Real estate (value), change	-0.81	-0.63
Spread, change	+0.06	±0.00

Table 3. Short-run output loss of stricter capital and LTV requirements.

	Debt-to-GDP	
Initial value	70.0	
End value	69.0	
	Cap. req.	**LTV req.**
Initial value	10.0	91.0
End value	10.6	90.8
Immediate	5.71	3.42
Gradual, 2 q.	3.68	1.92
Gradual, 4 q.	2.85	1.48
Gradual, 8 q.	2.24	1.18

Table 4. Short-run output loss of deleveraging applying stricter capital requirements under gradual implementation and different debt-to-GDP ratios.

	Debt-to-GDP	Debt-to-GDP	Debt-to-GDP	Debt-to-GDP
Initial value	70.0	50.0	30.0	10.0
End value	69.0	49.0	29.0	9.0
	Cap. req.	**Cap. req.**	**Cap. req.**	**Cap. req.**
Initial value	10.0	10.0	10.0	10.0
End value	10.6	10.8	11.5	14.3
	Loss	**Loss**	**Loss**	**Loss**
Immediate	5.71	2.67	2.02	1.54
Gradual, 2 q.	3.68	1.90	1.56	1.47
Gradual, 4 q.	2.85	1.47	1.19	1.15
Gradual, 8 q.	2.24	1.11	0.85	0.77

Table 5. Short-run output loss of deleveraging applying stricter LTV requirements under gradual implementation and different debt-to-GDP ratios.

	Debt-to-GDP	Debt-to-GDP	Debt-to-GDP	Debt-to-GDP
Initial value	70.0	50.0	30.0	10.0
End value	69.0	49.0	29.0	9.0
	LTV req.	**LTV req.**	**LTV req.**	**LTV req.**
Initial value	91.0	91.0	91.0	91.0
End value	90.8	90.8	90.7	90.6
	Loss	**Loss**	**Loss**	**Loss**
Immediate	3.42	1.35	0.80	0.51
Gradual, 2 q.	1.92	0.94	0.62	0.43
Gradual, 4 q.	1.48	0.74	0.49	0.32
Gradual, 8 q.	1.18	0.60	0.40	0.24

Table 6. Short-run output loss of deleveraging applying stricter capital and LTV requirements under different implementation strategies and with the countercyclical capital buffer activated.

	Debt-to-GDP	Debt-to-GDP
Initial value	70.0	70.0
End value	69.0	69.0
	Cap. req.	**LTV req.**
Initial value	10.0	91.0
End value	10.6	90.8
	Loss	**Loss**
Benchmark	5.71	3.42
CCyB	3.38	2.17
CCyB w/smoothing	2.35	2.61
Gradual, 2 q.	3.68	1.92
Gradual, 2 q., CCyB	2.19	1.30
Gradual, 2 q., CCyB w/smoothing	1.77	1.53
Gradual, 4 q.	2.85	1.48
Gradual, 4 q., CCyB	1.77	0.99
Gradual, 4 q., CCyB w/smoothing	1.56	1.18
Gradual, 8 q.	2.24	1.18
Gradual, 8 q., CCyB	1.45	0.79
Gradual, 8 q., CCyB w/smoothing	1.39	0.95

Figures

Figure 1. Total credit to non-financial corporations, adjusted for breaks, percentage of GDP.

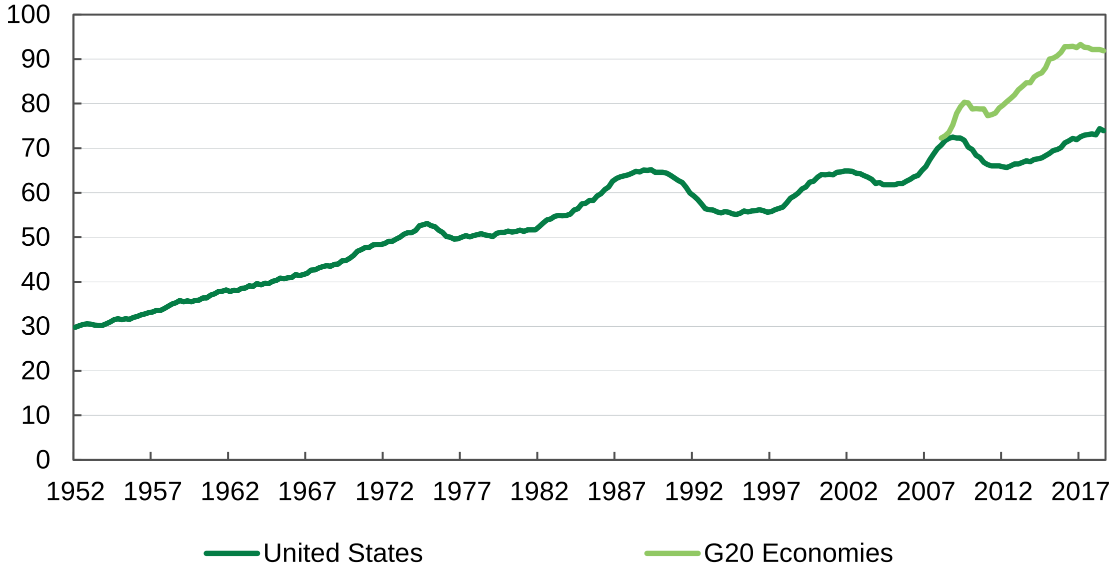

Figure 2. Long-run macroeconomic effect of deleveraging applying stricter capital and LTV requirements.

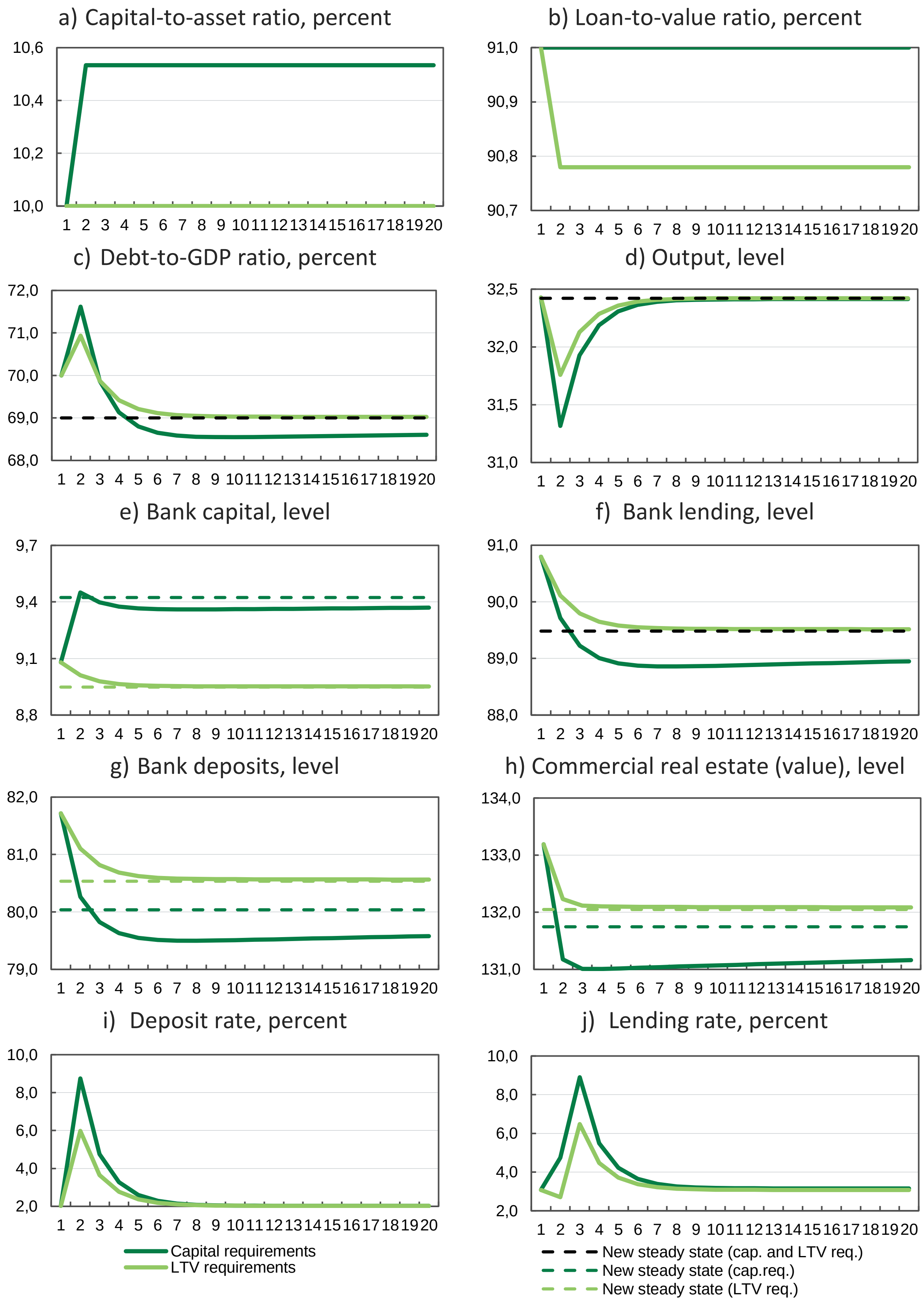

Figure 3. Output loss of deleveraging applying stricter capital and LTV requirements at different debt-to-GDP ratios.

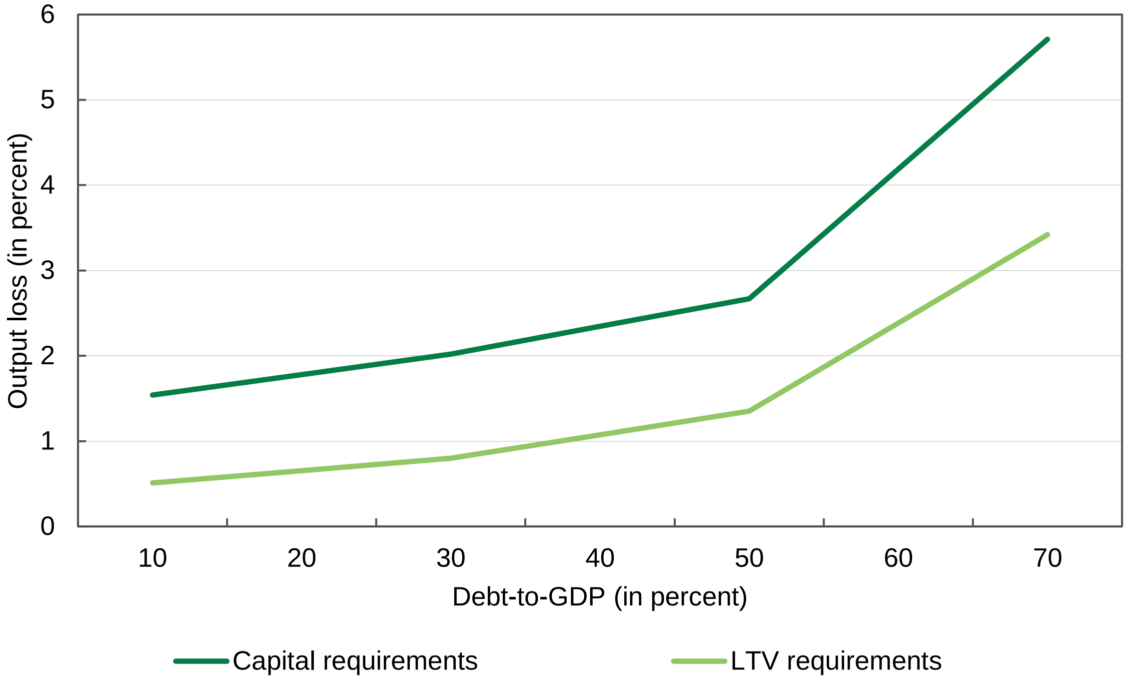

Figure 4. Output loss of deleveraging applying stricter capital (a) and LTV (b) requirements under gradual implementation with different implementation horizons.

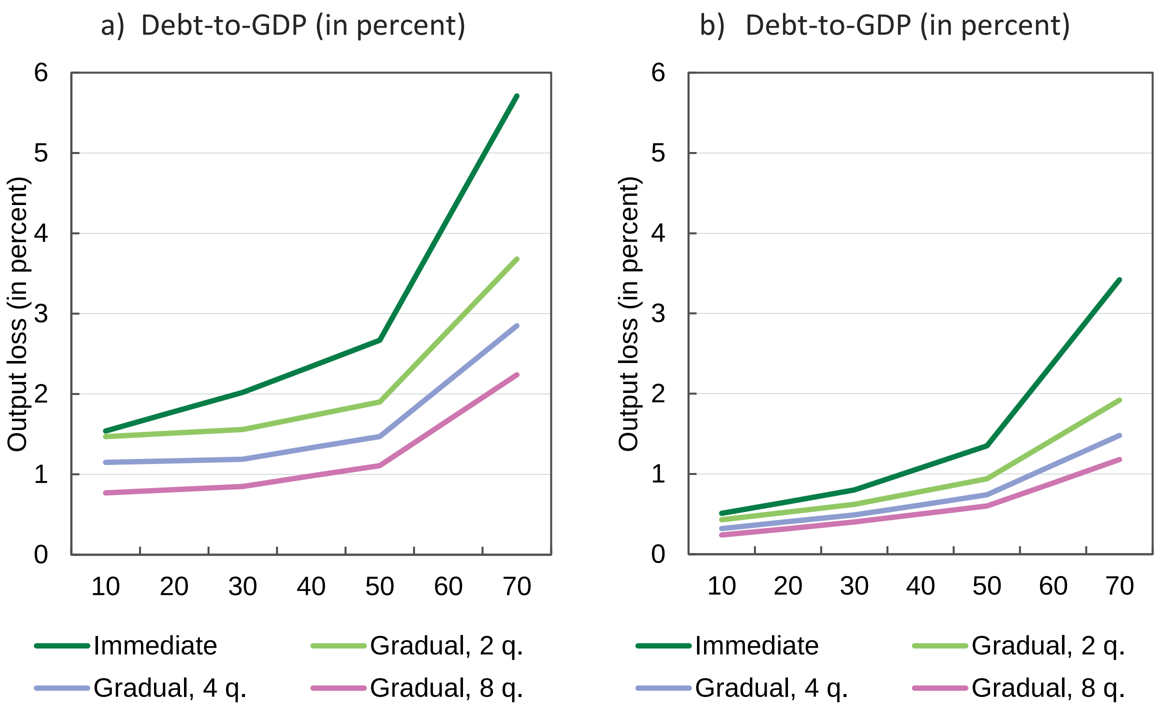

Figure 5. Output loss of deleveraging applying stricter capital (a) and LTV (b) requirements under different implementation strategies and the countercyclical capital buffer activated.