



DENMARK

SELECTED ISSUES

June 2018

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June 5, 2018

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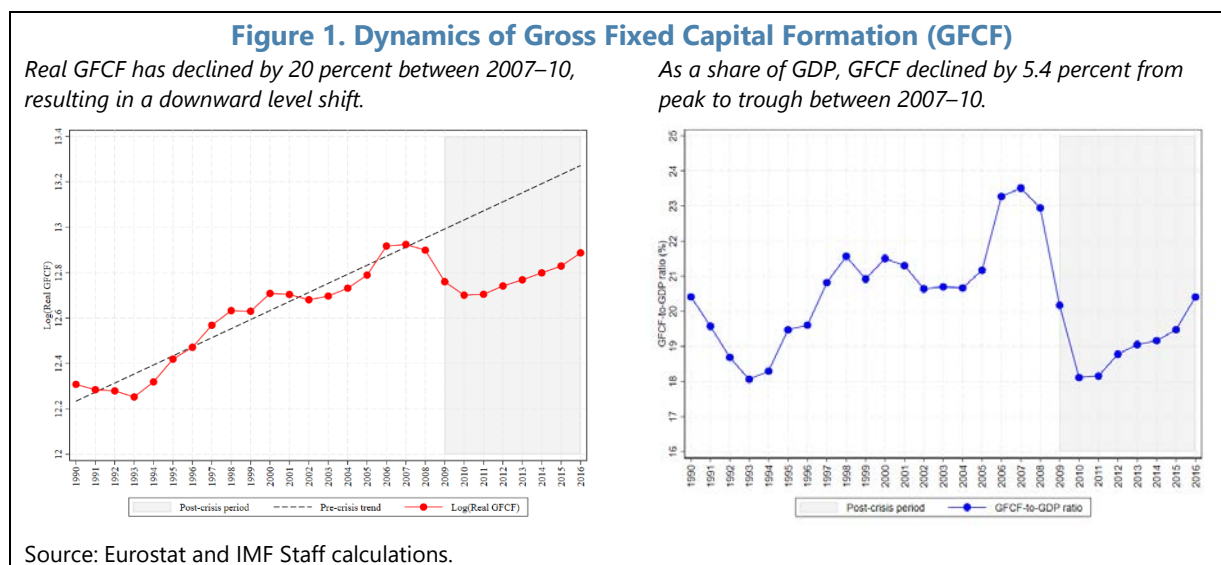
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INVESTMENT SLOWDOWN IN DENMARK: DIAGNOSIS AND POLICY OPTIONS¹

A. Introduction

1. Total investment in Denmark has fallen rapidly after the global financial crisis (GFC). Real gross fixed capital formation (GFCF) has dropped by 20 percent over 2007–10 (Figure 1, left panel). From 2010 onward, investment recovery was not sufficiently strong to compensate for the losses incurred during the GFC, resulting in a downward level shift in GFCF. As a share of GDP, investment has declined by 5.4 percent during 2007–10 and now remains about 3 percent of GDP lower relative to its pre-crisis level (Figure 1, right panel). This decline, albeit from a historically high pre-crisis level, has slowed down capital accumulation.



2. The post-GFC investment weakness has important macroeconomic implications. It brings about two macro-critical issues:

- *Drop in labor productivity growth.* Using the standard production function, labor productivity can be defined as: $\frac{Y}{L} = A \left(\frac{K}{L}\right)^\alpha$, where Y is the real output, K is the stock of capital, L is the labor input, A is the total factor productivity, and α is a constant measuring the share of capital in total output. This formula suggests that reduction in capital-to-labor ratio driven by weak investment has a direct adverse effect on labor productivity.² Figure 2, left panel, illustrates this relationship in

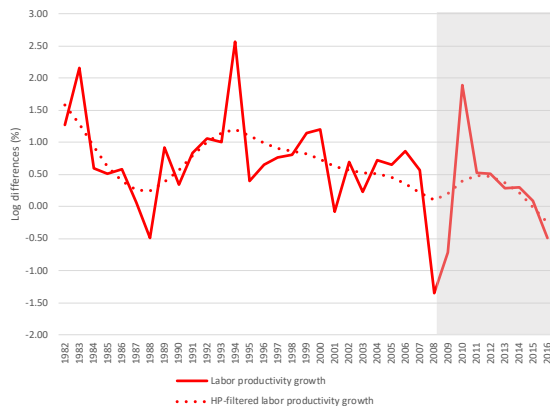
¹ Prepared by Tigran Poghosyan. In addition to the IMF's Denmark team, I would like to thank Aqib Aslam, Romain Duval, Davide Furceri, Rasmus Mose Jensen, and seminar participants at the IMF's European Department and Denmark's Nationalbank for helpful comments and suggestions.

² From the capital dynamics equation: $K_t = I_t + \delta * K_{t-1}$, where I denotes investment and δ denotes the depreciation rate. Hence, a slowdown in I would directly translate into lower K .

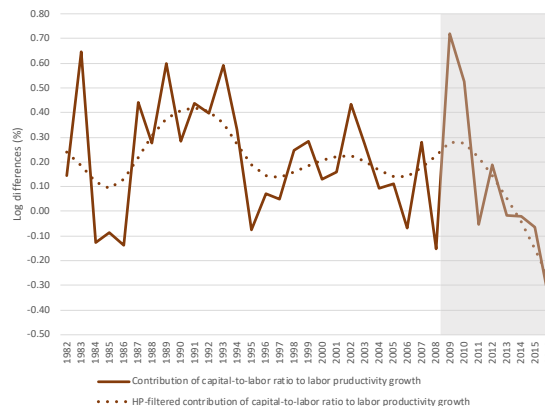
Denmark. As expected, the rapid decline in investment following the GFC was associated with a slowdown in labor productivity growth from close to 2 percent in 2010 to close to 0 percent in 2016³, suppressed by the slowdown of contributions from the capital-to-labor ratio from 0.7 percent in 2010 to -0.3 percent in 2016 (Figure 2, right panel).

Figure 2. Implications of the Investment Slowdown: Drop in Labor Productivity Growth

The decline in GFCF-to-GDP ratio was associated with a slowdown in labor productivity growth...



... suppressed by a slowdown of contributions from the capital-to-labor ratio.



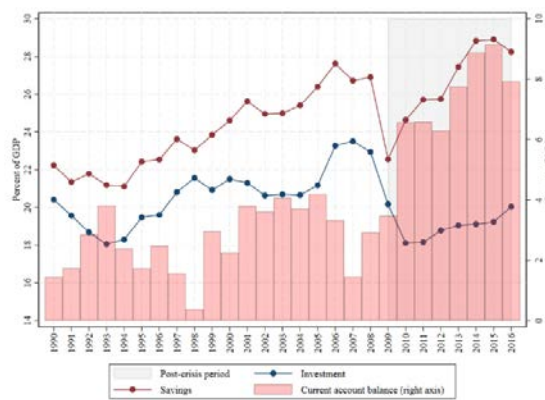
Source: Eurostat and IMF Staff calculations.

Note: Labor productivity is defined as the ratio of real GDP and employment.

- Surge in the current account surplus. Following the national accounts identity, the current account surplus can be defined as the difference between aggregate savings and investment ($CAB = S - I$). In Denmark, both aggregate savings and investment have declined in the aftermath of the GFC. However, starting from 2010 savings have recovered and surpassed their pre-crisis peak in 2016, while investment recovery was sluggish. Hence, the increase in the current account surplus from less than 2 percent of GDP in 2007 to 8 percent of GDP in 2016 was largely driven by the slowdown in investment-to-GDP ratio following the GFC.

Figure 3. Implications of the Investment Slowdown: Surge in the Current Account Surplus

The expansion in the current account surplus between 2007–16 was largely driven by weaker investment.



Source: Eurostat and IMF Staff calculations.

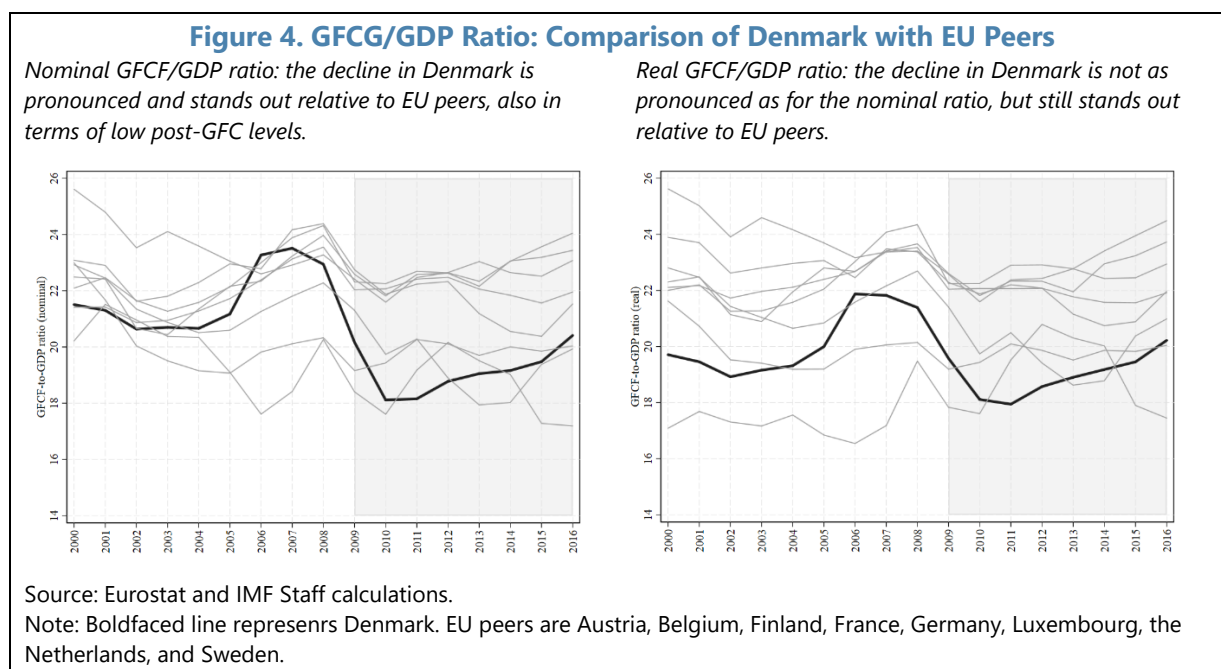
3. The purpose of this paper is to analyze the determinants of investment slowdown and identify policies to boost investment. Section B provides stylized facts on investment dynamics in

³ Using output-to-hours worked ratio shows a smaller deceleration in labor productivity growth: from 1.1 percent in 2010 to 0.4 percent in 2016.

Denmark. Section C reviews the determinants of investment slowdown discussed in the literature and illustrates the Danish data. Section D presents empirical analysis using the baseline and augmented versions of the accelerator model. Section E focuses on the role of leverage and product market reforms as drivers of investment. The last section concludes with policy recommendations.

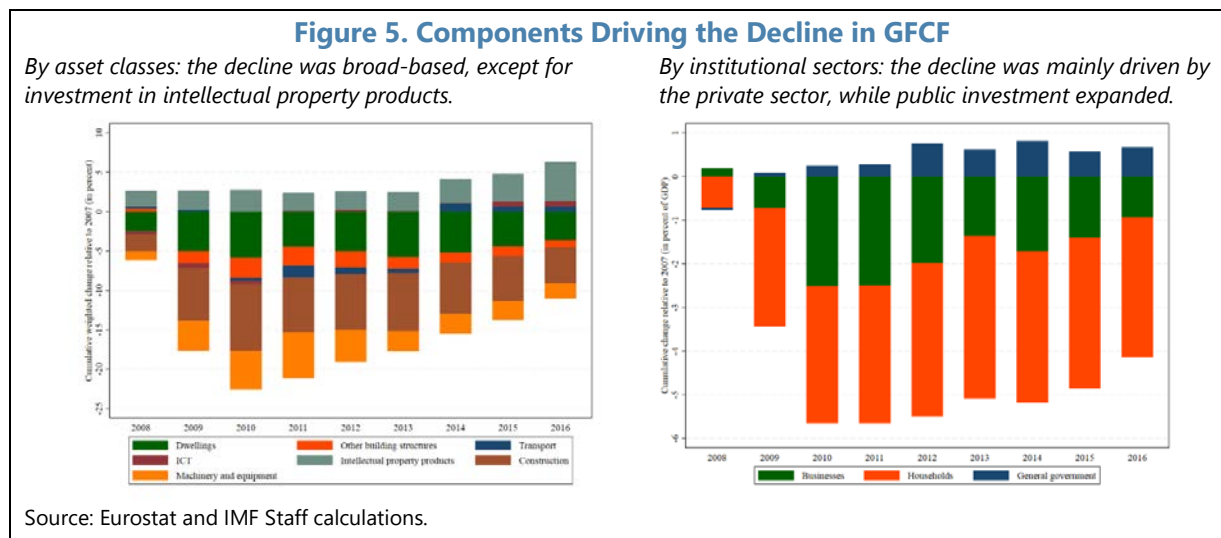
B. Investment Dynamics in Denmark: Stylized Facts

4. Many advanced economies have experienced investment slowdown after the GFC, but the decline in Denmark has been particularly pronounced. Figure 4, left panel, presents the dynamics of *nominal* GFCF-to-GDP ratio in Denmark and EU peers over 2000–16 period. Total investment in Denmark has peaked at 24 percent of GDP before the crisis and dropped to 18 percent of GDP in 2010. This decline, albeit from a historically high pre-crisis level, has been the most rapid in comparison to EU peers. Moreover, despite the gradual recovery, the post-GFC investment ratio in Denmark remains low in comparison to peers. Some commentators have argued that the decline in nominal GFCF-to-GDP ratio could be partly explained by the decline of investment prices relative to the overall prices in the economy. Therefore, in Figure 4, right panel, we show the dynamics of *real* GFCF-to-GDP ratio, which accounts for changes in relative investment prices. The decline in real GFCF-to-GDP ratio in Denmark is not as pronounced as that of the nominal ratio, supporting the conjecture of decline in relative prices. Nevertheless, the decline in the Danish real investment ratio is still more rapid compared to the peers and its post-GFC levels are still among the lowest.

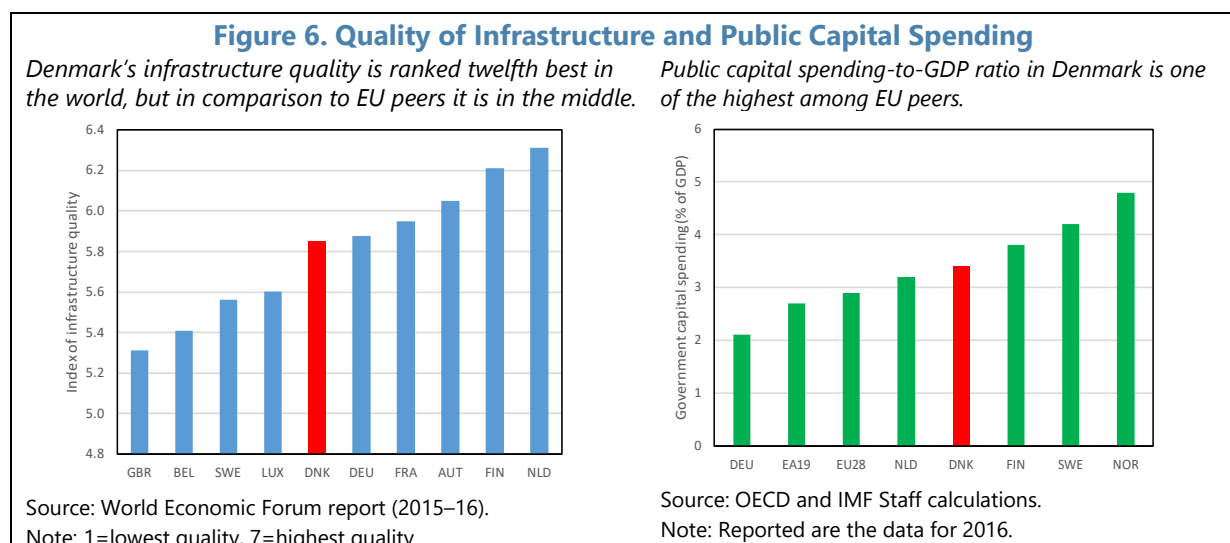


5. Decomposition of the decline into components shows that it was broad-based across asset classes and was mainly driven by the private sector. Figure 5, left panel, shows the decomposition of the cumulative decline relative to 2007 by asset classes. Almost all asset classes

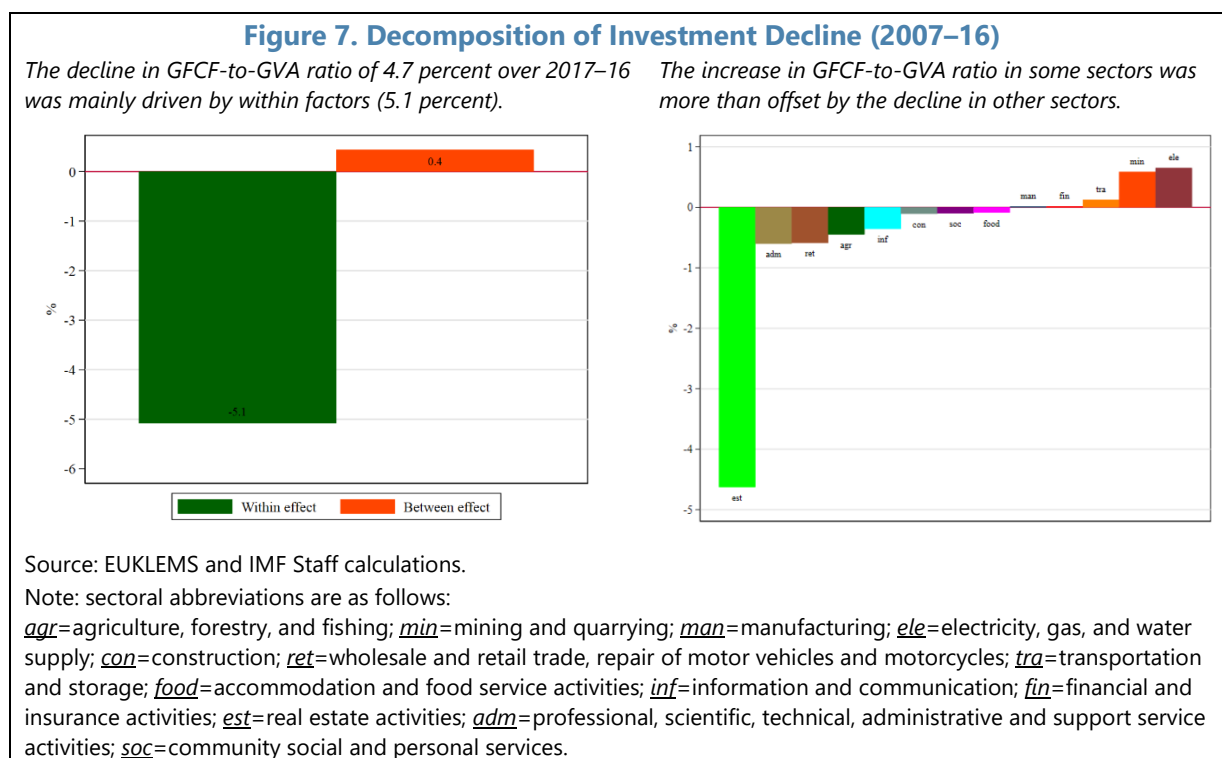
have seen a decline in the post-GFC period, with the notable exception of investment in intellectual property products. Figure 5, right panel, shows the breakdown of the decline by institutional sectors. The results suggest that the decline was mainly driven by the private sector, while public sector has expanded offsetting part of the decline. The expansion in public capital spending was supported by the countercyclical measures implemented by the government following the GFC.



6. There is some scope to increase aggregate investment through further expansion in public capital spending, but it is limited. In the latest survey conducted by the World Economic Forum, Denmark's infrastructure quality is ranked twelfth best in the world (Figure 6, left panel). When comparing with EU-peers, Denmark's infrastructure quality is somewhere in the middle. While there is some scope to boost public infrastructure further to improve connectivity across Denmark's geographically scattered urban areas, it is limited as Denmark's government spending on capital is already one of the highest among EU peers (Figure 6, right panel).



7. The decline in investment was mainly driven by weak investment dynamics within individual sectors. We conduct a shift-share analysis of GFCF-to-GVA ratio over 2007–16 to explore the drivers of the post-GFC investment slowdown at the sectoral level (see Annex 1). This methodology allows decomposing the change in GFCF-to-GVA ratio into *within-factors* (decline of investment in individual sectors) and *between-(or structural shift) factors* (increase in the share of low-investment sectors in the total output). The decomposition suggests that within-factors have dominated and the role of structural shifts was negligible (Figure 7, left panel).⁴ Moreover, in several sectors, such as mining, manufacturing, electricity, transport, and financial, the post-GFC GFCF-to-GVA ratio has increased by 1.4 percent in total, but this increase was more than offset by the decline in other sectors (Figure 7, right panel).



C. Determinants of Investment Slowdown

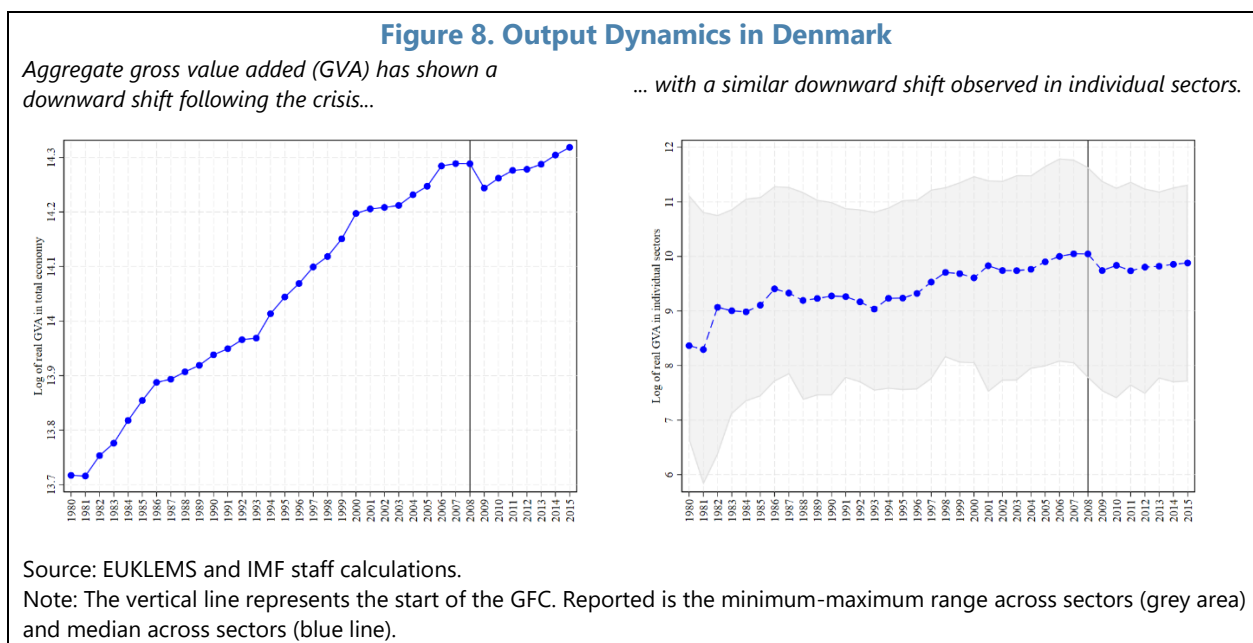
8. There is a vast empirical literature on the determinants of investment. The recent IMF contributions include Barkbu and others (2015) and WEO (2015), which analyze the slowdown of investment in AEs. EC and ECB also addressed this issue in recent reports (ECB 2016; EC 2017).

9. A widely popular conceptual framework underlying the empirical analysis is the accelerator model. The accelerator model postulates that dynamics of investment should be explained by changes in output (see Annex 2).⁵ The recent IMF analysis provides evidence in support

⁴ A similar picture emerges when doing a shift-share analysis for the 2008–16 period.

⁵ Other models include the Tobin's Q, the neoclassical model, and various formulations of the Euler's equation (see Oliner and others 1995 for a survey).

of the accelerator model. For instance, IMF (2015) finds that economic weakness has been the overriding factor holding back private investment worldwide in recent years. Barkbu and others (2015) echo this finding and show that output dynamics explained part of the investment weakness in euro area countries, particularly before the European sovereign debt crisis. ECB (2016) and EC (2017) also find evidence supporting the pronounced role played by output. Figure 8 shows that there was a downward shift in gross value added in Denmark following the crisis, which likely contributed to the investment slowdown.



10. However, most studies find that output alone is not sufficient to explain investment and call for studying the impact of additional factors. Several impediments to investment have been put forward in the literature:

- *Debt overhang.* GFC led to an increase in private leverage. This in turn reduced the ability of private firms—especially small- and medium-sized ones—to raise funding for investment projects (Kuchler 2015). Empirical evidence suggests that highly indebted firms appear to be less responsive to demand fluctuations (IMF 2016a).
- *Uncertainty.* Uncertainty about future economic conditions and expected profits can be a drag for investment plans, because of the lumpy and irreversible nature of investment projects. Increased uncertainty can lead to a postponement of investment plans in anticipation for more desirable risk-return prospects (IMF 2015; Barkbu and others 2015; Busetti and others 2016).
- *Financial constraints.* GFC reduced the value of collaterals (equity, real estate), making it more difficult for firms to obtain loans from banks for investment purposes. Firms with financial constraints face difficulties expanding investment because of the lack of funding resources and irrespective of their business perspectives (IMF 2015; Barkbu and others 2015).

- *Weak competition.* Greater market concentration and reduced competition—due to technological progress, regulatory bottlenecks, barriers to entry, or common ownership—reduce incentives for investment (Danish Ministry of Business and Growth 2014; Guitierrez and Philippon 2016).
- *Tax burden.* The taxation regime has important implications for the return on investment projects, which has ramifications for investment behavior. The effective tax rates are affected not only by the statutory tax rates, but also by the tax base (e.g., asset specific depreciation allowances, investment tax credits, interest deductibility, among others). This was explicitly recognized in the report on growth and competitiveness prepared by the Danish government (Danish Ministry of Business and Growth 2014).
- *Stringent product and labor market regulations.* More stringent product and labor market regulations can create barriers for investment by imposing constraints on the ability of firms to realize profits. For instance, product market regulations can create impediments for entry and exit, reducing competition and dis-incentivizing innovation. Similarly, rigid market regulations could lead to shortages of qualified labor force. Empirical evidence for OECD countries provides support to the negative association between product and labor market regulations and investment (Egert 2017). Moreover, the relationship seems to be asymmetric, with tightening of the regulations having a stronger impact on investment compared to the relaxation.
- *Intangible assets.* In the modern world, the composition of capital in advanced economies shifted more toward intangibles, such as human capital (education and training), R&D expenditure, market development, and organizational and managerial efficiency. The latter are more difficult to quantify/measure using the current statistical definitions, which could lead to underestimation of private investment. Moreover, due to their specific nature, their association with output developments may not be as close as that of tangible assets (Thum-Thysen and others 2017). IMF (2017a) analyses intangible investment in Denmark using firm-level data.

11. Uncertainty and capacity constraints are important impediments to investment in

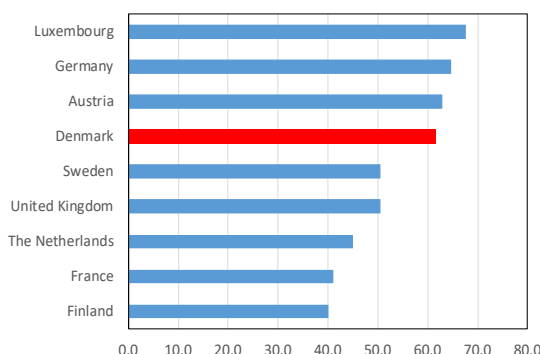
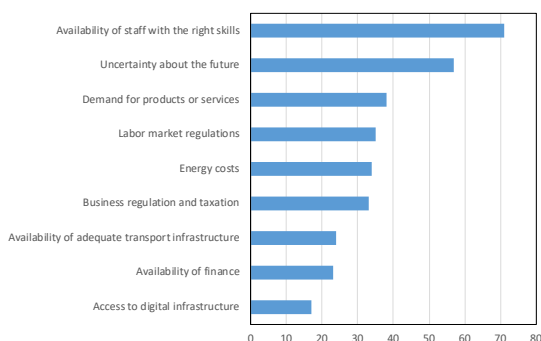
Denmark. The recent firm survey by EIB shows that most firms have identified skilled labor shortages and uncertainty about the future as major impediments to investment by firms (Figure 9, left panel).⁶ It is also notable that capacity constraints are mentioned as one of the largest in Denmark (Figure 9, right panel), indicating a scope for expansion in investment demand by firms once the obstacles have been removed.

⁶ The uncertainty is most likely related to international developments rather than domestic factors.

Figure 9. Investment Constraints in Denmark: Evidence from a Firm Survey

Skilled labor shortages and uncertainty are the largest investment constraints in Denmark.

Capacity constraints in Denmark rank high among EU peers.



Source: EIB–EIBIS 2017 survey.

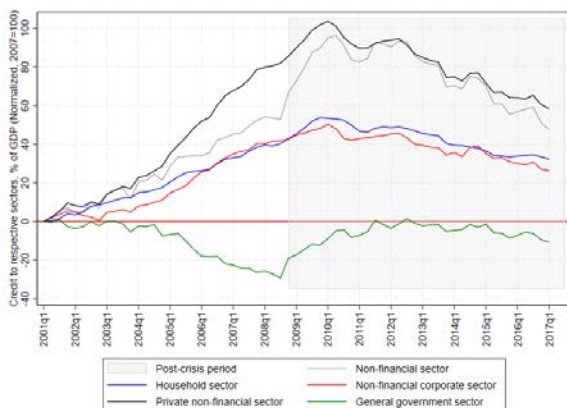
Note: Reported is the share of firms responding positively.

12. High and growing leverage could also explain the weakness in investment. Figure 10 shows that leverage in Denmark has been on the rise since 2001 in all sectors, except general government. Leverage picked up around 2010 and started declining since then, but remains elevated. Largest leverage buildup was observed in the private non-financial sector. IMF (2017a) shows that more highly leveraged firms had lower tangible investment in Denmark.

13. Product market regulation (PMR) in Denmark is relatively less restrictive compared to OECD countries, but there is scope for improvement. OECD surveys conducted in 5-year intervals over 1998–2013 rank Denmark quite favorably relative to OECD countries in terms of restrictiveness of PMR (Figure 11). Moreover, Denmark’s ranking has gradually improved over this period. Nevertheless, as identified by Copenhagen Economics (2013a, 2013b, 2013c) and IMF (2016c), there is scope for further deregulation in certain sectors, notably the electricity, gas, retail, and rail sectors.

Figure 10. Leverage in Various Sectors

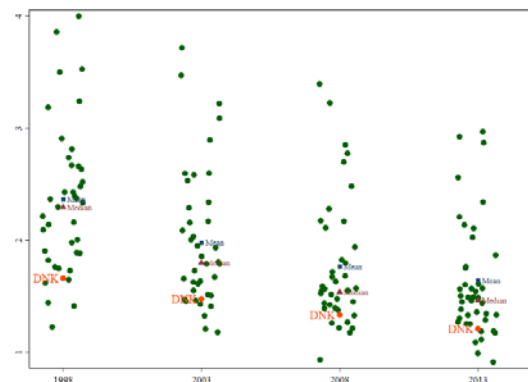
Leverage in Denmark has seen a sizeable expansion since 2001 in all sectors, except general government.



Source: BIS and IMF Staff calculations.

Figure 11. Product Market Regulation (PMR): Denmark Versus OECD Countries

PMR in Denmark are relatively less restrictive compared to OECD, but there is scope for further improvement.



Source: OECD.

Note: Product market regulation (PMR) index is ranging between 0 (least restrictive) and 6 (most restrictive).

D. Empirical Analysis: The Accelerator Model

14. We use the accelerator model to disentangle the role of output and non-output drivers of investment slowdown. Following the two-step accelerator approach (see, e.g., Barkbu and others 2015; WEO 2015; EC 2017), we start by estimating the baseline accelerator model. This model allows to assess whether the dynamics of investment could be explained by changes in output. If the decline in investment was deeper than what is explained by the changes in output, then the benchmark accelerator model is augmented by additional explanatory factors discussed above in the second step.

15. The baseline accelerator model suggests that the post-GFC weakness in GFCF cannot be fully explained by the output movements. As discussed above, both GFCF and GDP have dropped following the GFC, raising the question of whether the decline in GFCF is solely a result of weaker economic environment. Table 1 shows estimation results of the baseline accelerator model using 12 quarterly lags of output, like in IMF (2015). Most coefficients of the lagged output variables, as well as the sum of 12 coefficients, are significant, supporting the baseline accelerator hypothesis of the importance of output for investment dynamics. The residual from the baseline accelerator model displayed in Figure 13, left panel, shows that part of the GFCF movements cannot be explained by the output dynamics. Specifically, the residual has been persistently negative following the GFC, suggesting that GFCF has fallen beyond the level explained by weaker output. More recently, the residual converged to zero, suggesting that GFCF has converged to the level explained by the output dynamics. Nevertheless, one would have expected much stronger investment in the most recent period given ultra-low borrowing costs.⁷

Table 1. Denmark: Estimation Results: Baseline Accelerator Model for Denmark

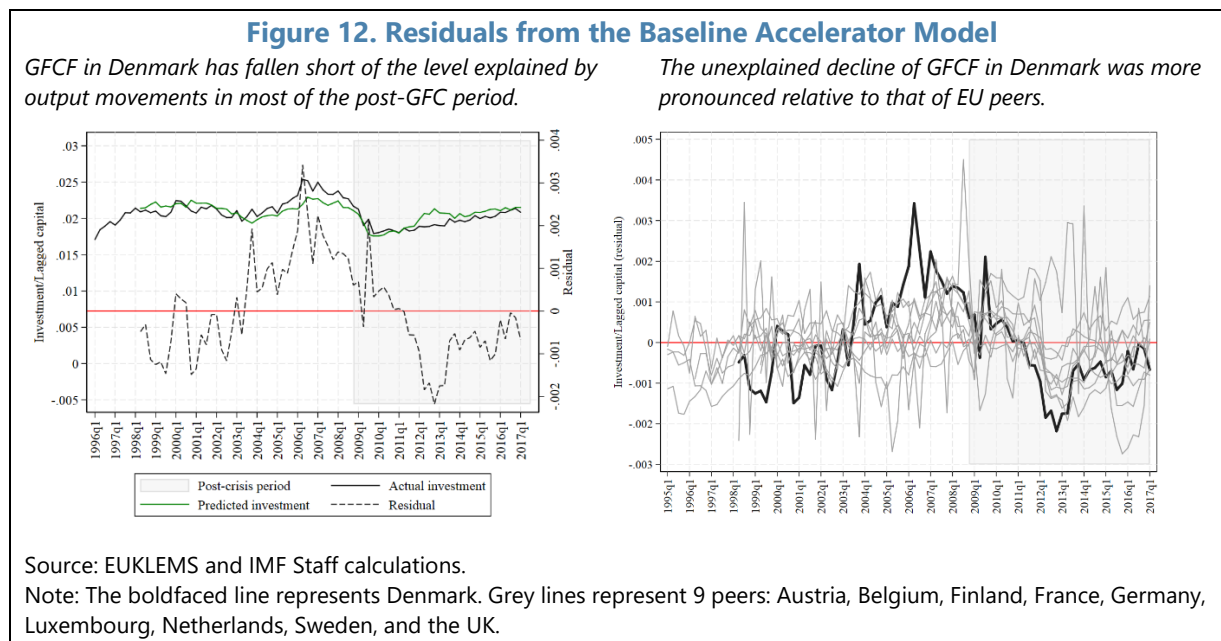
	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}	β_{12}	α	δ
Coefficient	0.22	0.25**	0.33**	0.45***	0.27*	0.41***	0.47***	0.24**	0.36**	0.27*	0.46***	0.29*	-14.76	0.02***
Standard error	(0.21)	(0.12)	(0.16)	(0.17)	(0.14)	(0.12)	(0.12)	(0.11)	(0.17)	(0.14)	(0.16)	(0.17)	(14.92)	(0.00)
Observations	76													
R-squared	0.476													
Sum of β s	1.475													
Standard error (sum of β s)	0.625													
t-stat (sum of β s)	2.360													
Source: Eurostat and IMF Staff calculations.														
Note: Estimations are performed using the Newey-West estimator on quarterly data for the 1998-2016 period. *, **, and *** denote significance at 10, 5, and 1 percent confidence level, respectively.														

16. The decline in Danish GFCF beyond the level explained by output movements has been one of the most pronounced among EU peers. In addition to Denmark, we run the baseline accelerator model for 9 EU countries.⁸ Figure 12, right panel, displays the residuals from these regressions. The results suggest that the unexplained (negative) component of the GFCF has been

⁷ Selected Issues Chapter “Danish Households, Asset Prices, and Interest Rate Shocks.”

⁸ Following the classification in the latest EIB report (EIB 2017), we compare Denmark with the following EU peers: Austria, Belgium, Finland, France, Germany, Luxembourg, the Netherlands, Sweden, and the United Kingdom.

particularly pronounced in Denmark in the immediate aftermath of the GFC. It is also notable that Denmark had highest positive residuals in the pre-GFC period, corroborating the previous claim that the investment slowdown started from the historically high pre-GFC levels. In more recent periods, the residual for Denmark has converged to zero, while residuals in some EU peers have become even more negative.



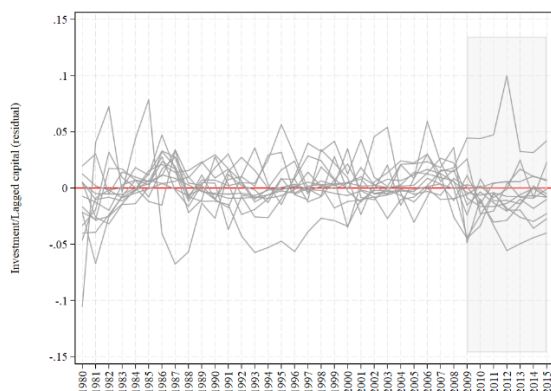
17. The decline in the GFCF of individual sectors and investment categories in Denmark cannot be fully explained by the output movements either. We run the baseline accelerator model for GFCFs in 13 sectors⁹ and 10 GFCF categories¹⁰ in Denmark. For the sectoral regressions, we use sector-specific GVAs, while for the category-specific regressions we use aggregate GVA. Figure 13, left panel, shows that the residual turns negative post-GFC and remains negative through 2016 in most sectors. A notable exception is the “financial and insurance activities” sector, for which the residual is positive and large. Figure 13, right panel, shows a similar picture for the GFCF categories. The residual turns negative for many GFCF categories in the post-GFC period. There is a positive spike in the “communications equipment” category in 2014–15.

⁹ The sectors are: (1) agriculture, forestry, and fishing, (2) mining and quarrying, (3) manufacturing, (4) electricity, gas, and water supply, (5) construction, (6) wholesale and retail trade, repair of motor vehicles and motorcycles, (7) transportation and storage, (8) accommodation and food service activities, (9) information and communication, (10) financial and insurance activities, (11) real estate activities, (12) professional, scientific, technical, administrative and support service activities, and (13) community social and personal services (see [EUKLEMS](#) for further information).

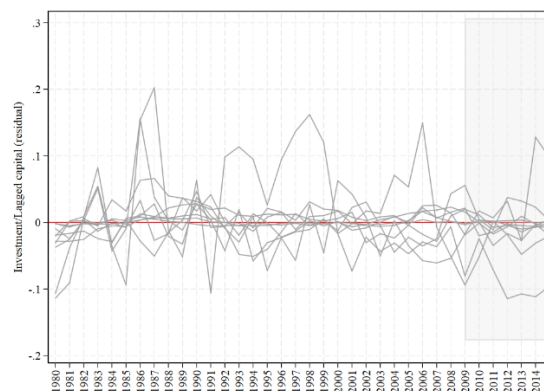
¹⁰ The categories are: (1) computing equipment, (2) communications equipment, (3) computer software and databases, (4) transport equipment, (5) other machinery and equipment, (6) total non-residential investment, (7) residential structures, (8) cultivated assets, (9) research and development, and (10) other intellectual property products (IPP) (see [EUKLEMS](#) for further information).

Figure 13. Residuals from the Baseline Accelerator Model, by Sectors and Categories

GFCF by 13 sectors.



GFCF by 10 investment categories.



Source: EUKLEMS and IMF Staff calculations.

Augmented Accelerator Model

18. Inclusion of additional controls in the augmented accelerator model improves the fit after the GFC. Figure 14 shows that the persistence of negative residuals following GFC disappears once additional controls for leverage, price markups, product market reforms, and economic policy uncertainty are included. This implies that in addition to output, other factors have played a role in driving investment down following the crisis. Identifying these impediments and focusing policies on removing them is thus warranted.

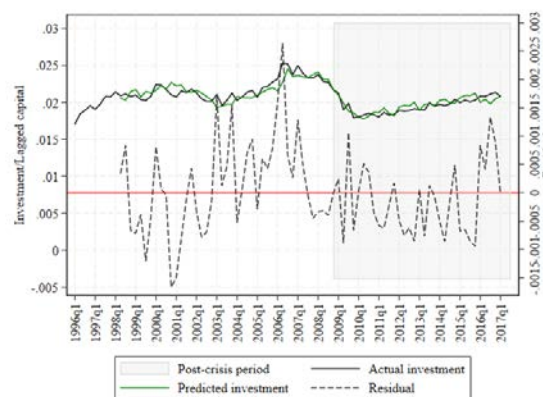
19. Panel regressions for OECD countries

confirm the importance of leverage, competitiveness, and policy uncertainty variables for investment dynamics. Table 2 shows estimation results from the augmented accelerator model for a panel of OECD countries. Estimations for an annual data with 3 lags of output (equivalent of 12 quarterly lags used in the baseline specification) confirm the significance of lagged output. In addition:

- Non-financial corporate leverage has a negative and significant effect on investment, confirming that elevated leverage is another drag holding back investment (Kuchler 2015; IMF 2017a).
- The level of competitiveness, proxied by the price markup, also has a significant negative effect. This confirms that low level of competition adversely affects investment (Copenhagen Economics 2013a, 2013b, 2013c).

Figure 14. Denmark: Residuals from the Augmented Accelerator Model

Inclusion of additional controls removes the persistence of negative residuals following the GFC.



Source: Eurostat and IMF Staff calculations.

- Policy uncertainty, proxied by the level of uncertainty in the EU, also has a negative and significant effect. This is not surprising given the openness of the Danish economy.
- The impact of the product markets reform variable is insignificant, which could be driven by low variability of this extrapolated 5-year interval variable. Another reason could be that product market reforms tend to be responsive to developments in the real sector (including investment), which can lead to a reverse causality. In the next section, we explore the role of product market reforms in greater detail using the narrative database.

Table 2. Estimation Results: Augmented Accelerator Model for a Panel of OECD Countries

	β_1	β_2	β_3	Leverage (non-financial corporations)	Change in PMR index	Markup indicator	Uncertainty index (EU-level)	α
Coefficient	0.57***	0.21***	0.36***	-43.71*	27.28	-2.10**	-0.04**	-2,881.51**
Standard error	(0.07)	(0.03)	(0.06)	(23.48)	(15.93)	(0.95)	(0.01)	(1,319.04)
Observations	283							
R-squared	0.87							
Sum of β s	1.720							
Standard error (sum of β s)	0.194							
t-stat (sum of β s)	8.849							

Source: Eurostat and IMF Staff calculations.

Note: Estimations are performed using the fixed effects estimator on annual data for OECD countries over the 1999–2016 period. *Leverage* is measured as credit to non-financial corporations as a share of GDP (source: BIS). *PMR index* is the OECD's index of product market regulations for 1998, 2003, 2008, and 2013, with interpolated values for the years in between (source: OECD and IMF Staff calculations). *Markup indicator* is the price markup measured as (gross output-intermediate inputs-labor inputs)/gross output (source: EUKLEMS and IMF Staff calculations). *Uncertainty index* is European-policy related measure of economic uncertainty (source: <http://www.policyuncertainty.com/>).

*, **, and *** denote significance at 10, 5, and 1 percent confidence level, respectively.

E. Diving Deeper: The Role of Leverage and Product Market Reforms

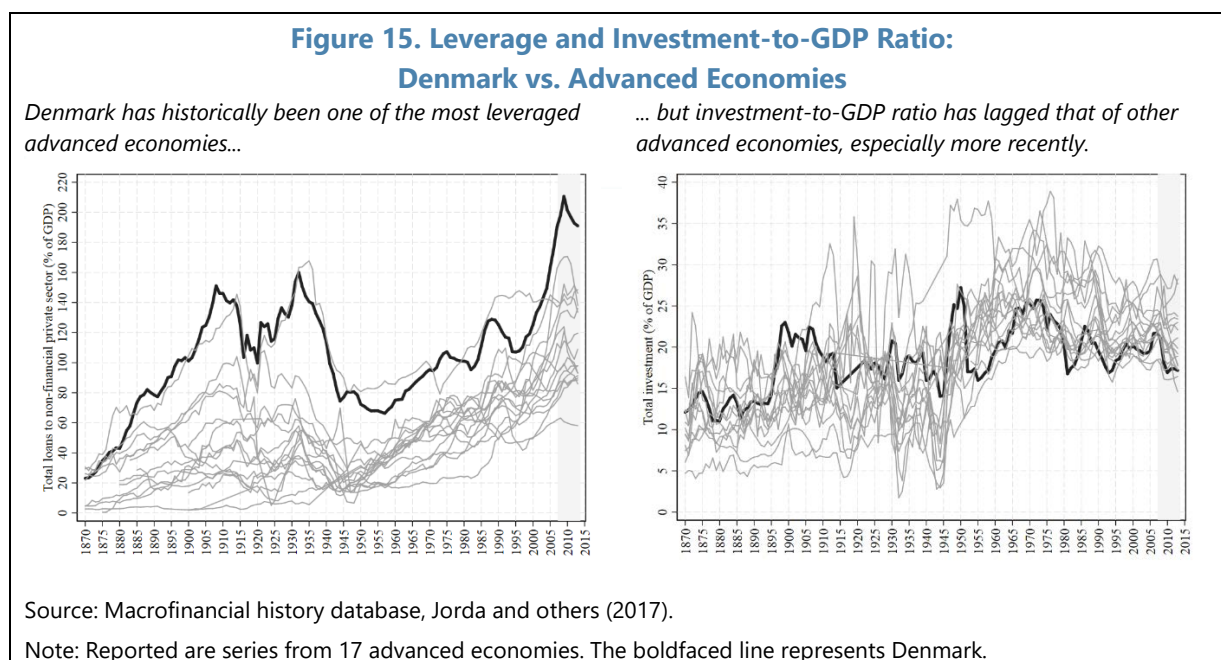
20. We use two empirical methodologies to provide further evidence on the importance of leverage and product market reforms for investment. First, we employ the methodology of Gaspar and others (2016) to estimate a tipping point in leverage beyond which advanced economies have experienced a major slowdown in investment growth.¹¹ The analysis is performed using long time series on investment and leverage for the period 1870–2013. Second, we use the local projections methodology to analyze the impact of product market reforms on investment. Product market reforms are identified using the narrative methodology (IMF 2016b). We also use the difference-in-difference approach of Rajan and Zingales (1998) to explore mechanisms through which product market reforms affect investment.

Leverage and Investment

21. High leverage is an impediment to investment. The augmented accelerator analysis suggests that leverage has negative impact on investment. This result corroborates firm level evidence on the negative association between leverage and investment (Kuchler 2015; IMF 2017a). In this section, we use long historical series on leverage and investment to assess a tipping point of

¹¹ The author would like to thank Philippe Wingender for sharing his codes.

leverage beyond which advanced economies have experience a major slowdown in long-run investment growth. We start by analyzing the historical dynamics of leverage and investment-to-GDP ratio¹² in Denmark and other advanced economies using the macrofinancial history database put together by Jorda and others (2017) for 17 advanced economies for the period 1870–2013.¹³ As shown in Figure 15, left panel, Denmark has historically been one of the most leveraged advanced economies. At the outset of the crisis, Denmark’s leverage reached historical peak of about 210 percent of GDP. In the meantime, investment-to-GDP ratio in Denmark has not matched the high levels of leverage (Figure 15, right panel). Since 1970s, investment-to-GDP ratio has been relatively low—one of the lowest among advanced economies. As discussed above, it dropped rapidly following the GFC and remains at the bottom of the distribution across advanced economies.



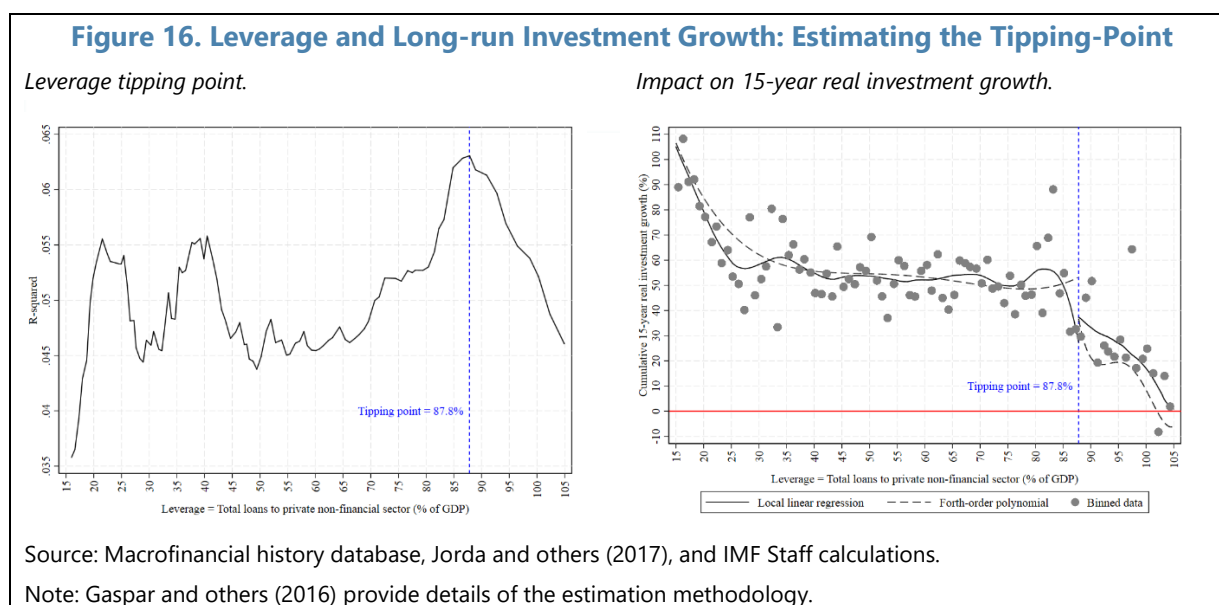
22. Regression discontinuity analysis suggests that long-run investment growth declines rapidly once leverage exceeds 87.8 percent of GDP. Following Gaspar and others (2016), we adopt a two-step regression discontinuity framework. First, we assess the impact of leverage on 15-year real investment growth, which we allow to vary discontinuously at the unique unknown threshold value γ .¹⁴ We also include long term interest rates (current and lagged) and country fixed effects as controls. The level of γ that maximizes the R-squared of the regressions is the tipping point, which is estimated at 87.8 percent (Figure 16, left panel). Second, we illustrate graphically the investment effect of crossing the tipping point of leverage. Figure 16, right panel, presents:

¹² Ideally, we would have preferred to use different components of investment and leverage (corporate sector, households, etc.). However, such a breakdown is not available in the macro financial history database.

¹³ The database is available at: <http://www.macrohistory.net/>. 17 countries included in the sample are: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

¹⁴ Following Gaspar and others (2016), we exclude outliers of leverage (below 5th and above 95th percentiles).

(i) average 15-year real investment growth within bins equal to 1 percent of leverage, (ii) predicted values from a local linear regression with bandwidth of 3, and (iii) predicted values from a global fourth-order polynomial regression that includes leverage fully interacted with the threshold variable as a dependent variable. The picture shows clearly that investment growth drops rapidly and even becomes negative from the 87.8 percent discontinuity point onward. Given that Denmark's leverage level is currently above 200 percent of GDP, this analysis indicates that it is an impediment to long-run investment growth.



Product Market Reforms and Investment

23. Product market reforms can boost investment. IMF (2016b) shows that product and labor market reforms raise long-term output by boosting productivity and employment, which in turn can encourage more investment especially by firms that are not constrained by high leverage. We provide evidence on the impact of PMR on investment using data for total economy and individual sectors using a methodology similar to that adopted for analyzing output in IMF (2016b) and IMF (2017b). Intuitively, if product market reforms boost output, they should also boost investment to support the expansion in output. Product market reforms can affect investment in several ways, including through lowering markups, reducing costs of capital adjustment, and affecting the ownership structure (Alesina and others 2005). We use three empirical specifications to analyze the relationship between product market reforms and investment.

24. Model 1: Country-level reforms and aggregate investment. The empirical specification takes the following form:

$$r_{i,c,t+h} - r_{i,c,t-1} = \alpha_c + \gamma_t + \beta_h R_{c,t} + \theta_h X_{c,t} + \varepsilon_{c,t}$$

where $r_{i,c,t+h}$ is the log of real investment in country c and period t . The model is estimated for yearly horizons $h = 0, 1, \dots, 5$. α_c are the country fixed effects included to take account of country-specific

differences in average investment growth rates, γ_t are time fixed effects included to take account of global shocks affecting the global business cycle and investment, R is a binary variable indicating the occurrence of a product market reform, and X is the set of control variables, including lagged aggregate investment growth, lagged recession dummies defined as growth below -3 percent (following IMF 2017b). The latter are included to control for a possible correlation between cyclical developments, aggregate investment dynamics and reforms (IMF 2016b). The main coefficient of interest is β_h , which indicates the cumulative response of the log of aggregate real investment in period $t+h$ to product market reforms implemented in period t relative to a no reform baseline.

Figure 17, left panel, presents the results from model 1. Product market reforms have a statistically significant impact on investment in the medium-term. This complements the earlier positive results on the impact of reforms on output. On the 5th year following from the reform, real investment is 4.5 percentage points higher relative to where it would have been if the reform did not take place.

25. Model 2: Country-level reforms and sectoral investment. The empirical specification takes the following form:

$$ri_{c,s,t+h} - ri_{c,s,t-1} = \alpha_{c,s} + \gamma_{s,t} + \beta_h R_{c,t} + \theta_h X_{c,s,t} + \varepsilon_{c,s,t}$$

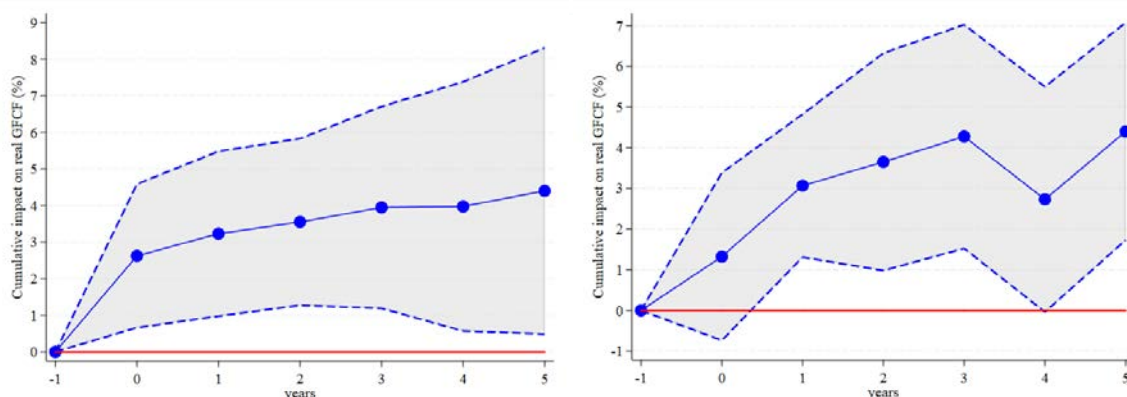
where $ri_{c,s,t+h}$ is the log of real investment country c , sector s , and period t . The model is estimated for yearly horizons $h=0, 1, \dots, 5$. $\alpha_{c,s}$ are the country-sector fixed effects included to take account of sector-specific differences in average investment growth rates within individual countries, γ_{st} are sector-time fixed effects included to take account of global shocks affecting the sector-specific business cycle and investment, R is a binary variable indicating the occurrence of a product market reform, and X is the set of control variables, including lagged sectoral investment growth, lagged recession dummies defined as growth below -3 percent (following IMF 2017b). The latter are included to control for a possible correlation between cyclical developments, sectoral investment dynamics and reforms (IMF 2016b). The main coefficient of interest is β_h , which indicates the cumulative response of the log of sectoral real investment in period $t+h$ to product market reforms implemented in period t relative to a no reform baseline.

Figure 17, right panel, presents the results from model 2. It shows that product market reforms have a statistically significant impact on investment at the sectoral level in the medium-term. Real investment in an average sector gains about 4 percentage points relative to the no-reform baseline. This average effect can mask substantial heterogeneity across sectors with different exposures to product market regulation.

Figure 17. Impact of Product Market Reforms on Investment

Model 1: Country-level reforms and aggregate investment.

Model 2: Country-level reforms and sectoral investment.



Source: EUKLEMS, Duval and others (2018), and IMF Staff calculations.

26. Model 3: Country-level reforms and sectoral investment accounting for sectoral exposure (difference-in-difference estimator). Following Rajan and Zingales (1998), the empirical specification takes the following form:

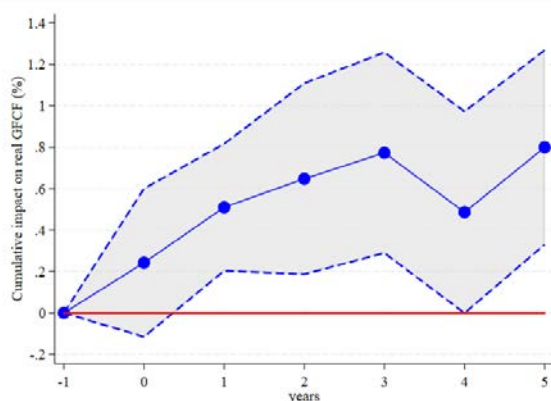
$$ri_{c,s,t+h} - ri_{c,s,t-1} = \alpha_{c,s} + \gamma_{s,t} + \beta_h(Exp_s * R_{c,t}) + \theta_h X_{c,s,t} + \varepsilon_{c,s,t}$$

where the main difference from the previous specification is that the reform dummies are multiplied by the term Exp_s . The latter is the sector-specific “natural” turnover rate (the sum of firm entry and exit rates), which is taken from the U.S. Bureau of Labor Statistics (Andrews and Cingano 2014).¹⁵ Sectors with relatively higher “natural” turnover rates are expected to be more bound by product market regulations compared to sectors with relatively lower “natural” turnover rate. Hence, the coefficient β_h represents the cumulative difference-in-difference effect of the impact of reforms on investment in higher “natural” exposure sectors relative to lower “natural” exposure sectors in period $t+h$. In the empirical analysis, we estimate the investment gain from reforms between a sector with a relatively high “natural” turnover rate (at the 75th percentile of the cross-sector distribution of turnover rates in the U.S.) and a sector with a relatively low “natural” turnover rate (at the 25th percentile of the cross-sector distribution of turnover rates in the U.S.). Figure 18 presents the results from model 3. It shows that product market reforms tend to increase investment in sectors that have higher propensity of turnover relative to those with a lower propensity. At the 5th year following the reform, the cumulative investment gain is about 0.8 percent. These results confirm the positive effects obtained in the previous analysis.

¹⁵ A similar exercise for labor market reforms and employment was performed by Duval and others (2017).

Figure 18. Product Market Reforms and Investment: Difference-in-difference Approach

Model 3: Country-level reforms and sectoral investment accounting for sectoral exposure (difference-in-difference estimator).



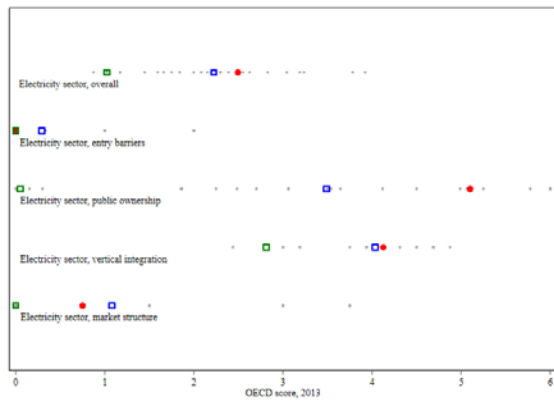
Source: EUKLEMS, Duval and others (2018), and IMF Staff calculations.

Note: Solid line denotes the differential investment effect of reform between a sector with a high “natural” turnover rate (at the 75th percentile of the U.S. distribution) and a sector with a low natural layoff rate (at the 25th percentile of the U.S. distribution). Dotted lines indicate 90 percent confidence interval based on standard errors clustered at country-sector level.

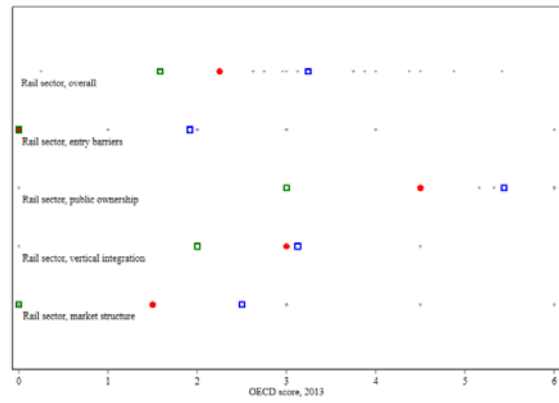
27. Further deregulation of network and retail sectors can help boost investment in Denmark. As shown in the empirical analysis above, PMR has a strong impact on investment, while Denmark’s standing in the OECD’s overall PMR indicator is above OECD average. To explore areas where Denmark can make further progress in deregulating product markets we looked at the components of the product market reform index in 2013—the latest year of the OECD survey. Figure 19 shows that there is scope to improve Denmark’s PMR standing in network sectors (electricity, rail, telecom, postal, and gas) relation to OECD EU frontier in areas of entry barriers, public ownership, vertical integration, and market structure. Similar picture emerges when looking at the retail sector, in areas of licenses/permits needed, regulation of large outlets, protection of existing firms, regulation of opening hours, and price controls.

**Figure 19. PMR in Network and Retail Sectors:
Comparison of Denmark with OECD EU Peers**

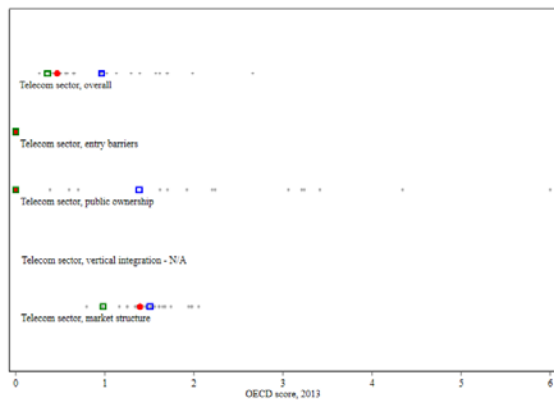
Electricity sector



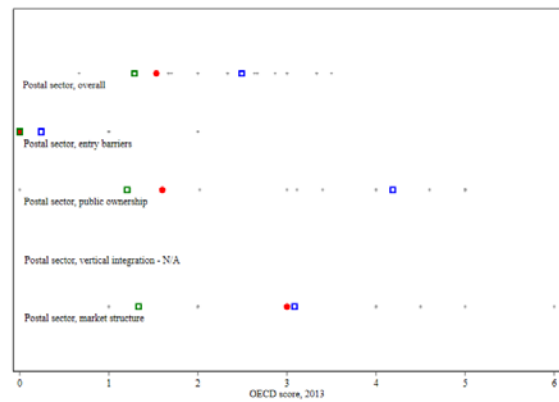
Rail sector



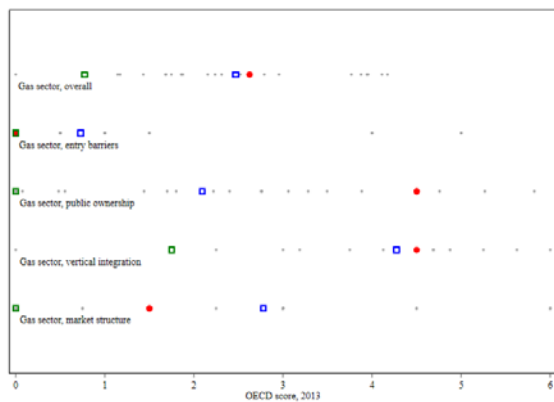
Telecom sector



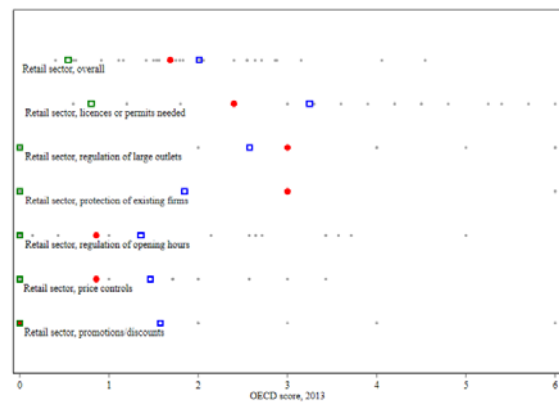
Postal sector



Gas sector



Retail sector



Source: OECD and IMF Staff calculations.

Note: Grey dots represent OECD EU countries, ● represents Denmark, □ represents OECD EU countries' average, and ◻ represents OECD EU countries' frontier (measured as the average of top three OECD EU countries).

F. Conclusions and Policy Implications

28. The post-GFC weakness in Denmark’s aggregate investment cannot be fully explained by the output slowdown. The baseline accelerator model confirms that output slowdown played a role, but post-GFC investment has fallen beyond the level explained by output movements in most of the post-GFC period. Most recently, investment converged to the level explained by output movements, but one would have expected much stronger investment given the record low interest rates. The augmented accelerator model suggests that additional factors, such as high leverage, weak competition, and elevated policy uncertainty, also had a significant impact. Panel regressions using a panel of advanced economies show that reduction in leverage and product market reforms can boost investment in the medium term.

29. Well-designed policies are needed to boost private investment. Policy actions should target the following areas:

- *Reduce debt-bias.* Leverage has increased at the outset of the crisis and despite recent declines remains elevated. Tax policy measures aimed at reducing “debt-bias” would reduce the vulnerabilities of the private sector to shocks and would promote additional investment.¹⁶
- *Enhance competition.* As mentioned in Copenhagen Economics (2013a, 2013b, 2013c) and IMF (2016c), regulations could be eased further in some sectors. The gap from OECD EU countries is particularly high in regulations pertaining to network and retail sectors. The breakdown of the OECD index suggests further scope for deregulation in areas of public ownership, vertical integration, and market structure. For the retail sector, regulation in Denmark is most restrictive in areas of licensing, large outlets, protection of existing firms, shop opening hours, and price controls. For instance, the call from the Productivity Commission to liberalize the Planning Act to allow the construction of hypermarkets that combine supermarkets and department stores seems warranted.

30. Higher investment would help address two macro-critical issues. First, higher investment would increase capital-labor ratio and boost labor productivity, which in turn would lead to higher output and economic prosperity. Counterfactual simulations suggest that 2 percentage points higher annual real investment over the 2018–22 period would result in 0.7 percent higher real output relative to the baseline in 2022. Second, higher investment supported by PMR reforms would help reduce current account surplus. This is clear from the national accounts identity, but is also supported by theoretical and empirical studies. For instance, Cacciatore and others (2016) develop a New Keynesian model which shows that PMR reforms would increase firm entry and boost investment, which in turn would reduce current account balance. In addition, Culiuc and Kyobe (2017) use local projections methodology to show that PMR reforms in advanced economies have a negative short-term effect on the current account balance.

¹⁶ See Selected Issues Chapter “Capital Income Tax Reform Options in Denmark” for details of tax policy measures.

Annex I. Shift-share Analysis of Investment Dynamics

This annex describes the methodology used for performing a shift-share analysis of the investment-to-output ratio dynamics.

Each sector can contribute to the investment-to-output ratio dynamics in two ways: by changes in investment within the sector (within-effect) and by changes in the share of the sector in aggregate output (between-effect, or structural shift). To decompose the contributions into within- and between- effects, we follow the shift-share methodology (see Buseti and others 2016 and EC 2017, among others).

The simplest way to illustrate the approach is to consider a one country, two-sector ($i=[1, 2]$), and two-period ($t=[0, T]$) model. Let Y_i denote output in sector i , INV_i denote investment, and superscripts 0 and T denote the beginning and the end of the period, respectively.

The aggregate investment-to-output ratio (I) at time T can be written as:

$$I^T = \frac{INV^T}{Y^T} * 100 = \frac{INV_1^T + INV_2^T}{Y^T} * 100 = \frac{INV_1^T}{Y_1^T} \frac{Y_1^T}{Y^T} * 100 + \frac{INV_2^T}{Y_2^T} \frac{Y_2^T}{Y^T} * 100 = I_1^T S_1^T + I_2^T S_2^T \quad (1.1)$$

where S_i denotes share of sector i output in total output. The difference in investment ratios at time 0 and T can be written as:

$$I^T - I^0 = (I_2^T - I_2^0)S_2^T + (I_1^T - I_1^0)S_1^T + (S_2^T - S_2^0)I_2^0 + (S_1^T - S_1^0)I_1^0 \quad (1.2)$$

or alternatively as:

$$I^T - I^0 = (I_2^T - I_2^0)S_2^0 + (I_1^T - I_1^0)S_1^0 + (S_2^T - S_2^0)I_2^T + (S_1^T - S_1^0)I_1^T \quad (1.3)$$

To make the decomposition invariant to a particular base, one could use period averages as weights by combining (1.2) and (1.3):

$$I^T - I^0 = (I_2^T - I_2^0)\bar{S}_2 + (I_1^T - I_1^0)\bar{S}_1 + (S_2^T - S_2^0)\bar{I}_2 + (S_1^T - S_1^0)\bar{I}_1 \quad (1.4)$$

where bars indicate the arithmetic average over period $[0, T]$.

In a multi-sector setting, expression (1.4) can be written as:

$$I^T - I^0 = \underbrace{\sum_{i=1}^N (I_i^T - I_i^0) \bar{S}_i}_{\text{within-effect}} + \underbrace{\sum_{i=1}^N (S_i^T - S_i^0) \bar{I}_i}_{\text{between-effect}} \quad (1.5)$$

where N is the number of sectors. This breakdown could be used to gauge the magnitude of within- and between-effects.

Annex II. The Accelerator Model

Following IMF (2015) and EC (2017), we adopt the accelerator model to model investment. Investment in time t and country i (I_{it}) is a function of a desired stock of capital (K_{it}^*), its lags (up to N periods) to account for inertia in the adjustment of the capital stock to its desired level, and the capital depreciation rate (δ_i)¹:

$$I_{it} = \alpha_i + \sum_{j=0}^N \lambda_j \Delta K_{it-j}^* + \delta_i K_{it-1} \quad (2.1)$$

The accelerator model postulates proportional relationship between changes in desired stock of capital and changes in output:

$$\Delta K_{it}^* = c \Delta Y_{it} \quad (2.2)$$

Plugging in (2.2) into (2.1), dividing both sides by K_{it-1} , and lagging the output by one year to alleviate the endogeneity issues yields the following baseline empirical specification:

$$\frac{I_{it}}{K_{it-1}} = \delta_i + \frac{\alpha_i}{K_{it-1}} + \sum_{n=1}^N \beta_j \frac{\Delta Y_{it-n}}{K_{it-1}} + \varepsilon_{it} \quad (2.3)$$

where α_i is the country-specific fixed effect and ε_{it} is the i.i.d. error.

Baseline regression (2.3) allows modeling the dynamics of investment based purely on output developments. The residual of this regressions would indicate whether the investment slowdown following the GFC can be largely explained by sluggish output developments. If that is not the case, then the baseline model can be augmented to include additional determinants of investment:

$$\frac{I_{it}}{K_{it-1}} = \delta_i + \frac{\alpha_i}{K_{it-1}} + \sum_{n=1}^N \beta_n \frac{\Delta Y_{it-n}}{K_{it-1}} + \sum_{k=1}^K \gamma_k P_{it} + \varepsilon_{it} \quad (2.4)$$

where P denotes additional factors driving investment, including those affected by policies. The significance of γ_s would help judging their importance in explaining the investment slowdown following the GFC.

The model is estimated using fixed effects panel estimator with standard errors corrected for autocorrelation, heteroskedasticity, and intra-group correlation. In some specifications, the regressions are run for a panel of sectors within countries (sector-specific fixed effects regressions) or for individual countries/sectors (time series regressions).

¹ See Jorgenson and Siebert (1968) for a theoretical derivation of the accelerator model and Oliner and others (1995) for an empirical specification based on the theory.

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THE ROLE OF ASSET PRICES IN HOUSEHOLDS, PENSION FUNDS, AND CREDIT INSTITUTIONS¹

Denmark is a financially deep economy where households have a central role in the propagation of credit and financial flows. As monetary policies across advanced economies may begin to normalize, this chapter explores the role of higher interest rates on the broader economy via the macrofinancial channel. The application of macroprudential policy measures may also need to be considered in light of potential vulnerabilities for some households-at-risk.

A. Introduction

1. **The ongoing global economic recovery continues to raise the possibility of monetary policy normalization in the euro area and in other advanced economies.** This chapter explores some implications to Denmark from a rise in interest rates. Danish households took advantage of low interest rates, and deleveraged, albeit only moderately, since the financial crisis. Nonetheless, household gross balance sheets continued to expand to considerable levels by international standards, suggesting potential vulnerabilities to shifts in interest rates and asset prices.
2. **This chapter explores the impact of a shock to interest rates on financial assets held by households directly and indirectly via their pension investments.** The large amount of financial assets reflects financial instruments both held (directly) as investments and (indirectly) as retirement savings. The exercise examines the impact of interest rates shocks on financial assets managed by pension funds and outright investments held by households. Given the robust and well capitalized nature of Denmark's financial system, there is little evidence of systemic concerns arising from 100–200 basis points interest rate shocks. However, linkages between households and asset prices appear strong and capable to propagate shocks to the economy via reduced consumption.
3. **Negative wealth effects from pension assets and financial assets could lower household consumption in a highly heterogenous way.** The analysis finds some evidence that the sensitivity of consumption in response to shocks to financial wealth may be highly heterogenous across household groups. Households that share certain characteristics, such as low wealth levels and high debt-to-income ratios are impacted considerably harder than low-leverage households. If internalized, these asymmetries in household responses could aid the calibration of economic policies including macroprudential measures.
4. **The structure of this chapter is as follows.** Section B discusses the interaction of households with the rest of the economy, noting the important role of the financial system in allocating credit. Section C describes some basic features of Danish pension funds and the assets they hold. Section D explores the potential impact of higher interest rates on pension fund and life insurance assets. Section E extends the analysis to household consumption sensitivity to asset price

¹ Prepared by Evan Papageorgiou and Vladimir Pillonca (both EUR) with contributions from Andreas Kuchler (Danmarks Nationalbank). This chapter has benefitted from useful discussions with Miguel Segoviano (EUR).

shocks via wealth effects, discussing its potentially large role in propagating shocks to the economy. We also emphasize the likelihood of large heterogeneities across income groups. Finally, Section F suggests some policy recommendations to build resilience and some tentative conclusions.

B. Interaction of Households with the Rest of the Economy

5. Credit provision relies on the efficient transfer of capital between economic sectors. In

a typical private-sector setup of a market economy, households save for future consumption or bequest via banks and pension funds, while also investing in financial and nonfinancial firms.

Pensions and insurance firms also invest to generate income and pay out benefits. The financial sector facilitates lending and engages in investments with the rest of private sector (Figure 1).

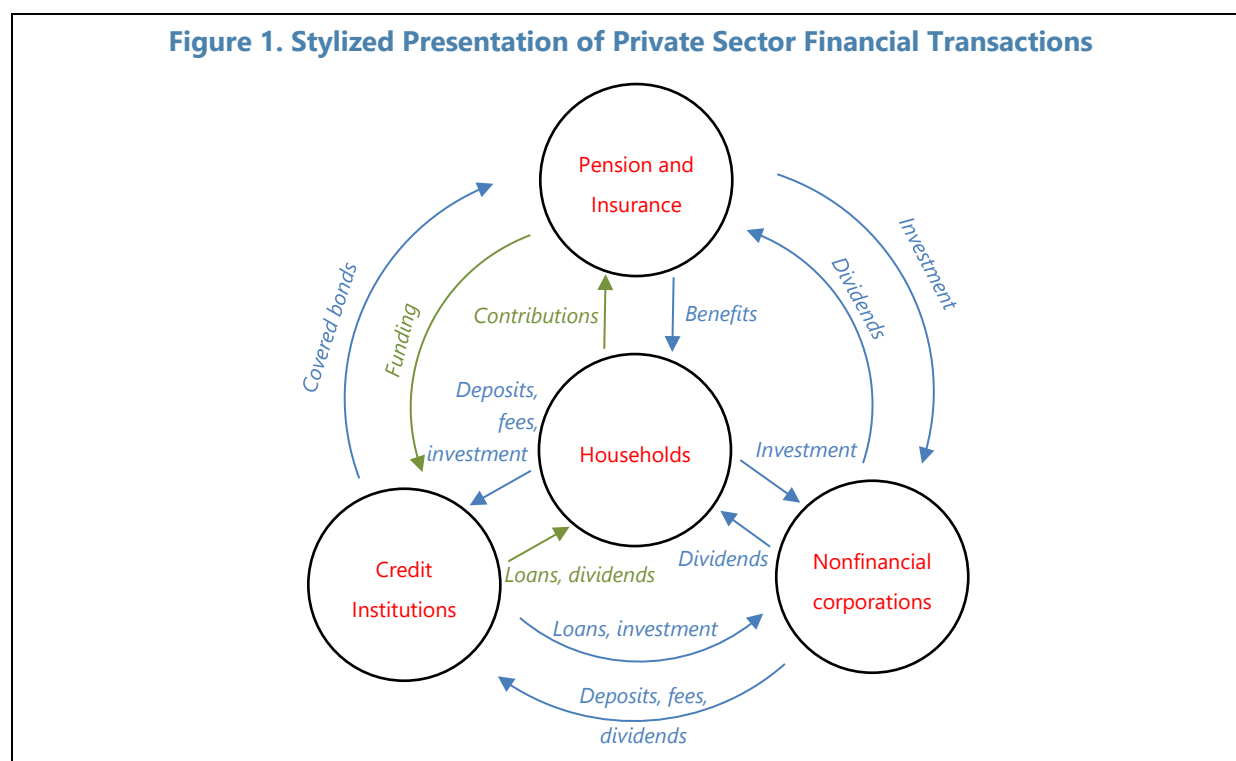
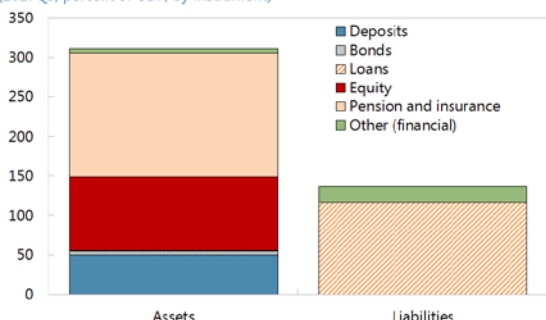


Figure 2. Private Sector Financial Balance Sheets and Comparison

Households have a large net financial position, with half of their assets allocated to pensions and 1/3 in investments...

Households and NPISHs Financial Balance Sheet

(2017Q3; percent of GDP; by instrument)

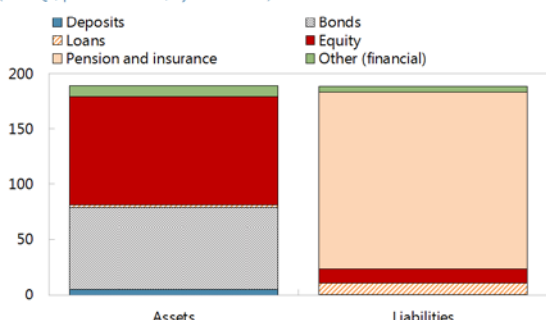


Sources: Danmarks Nationalbank; and Fund staff calculations. NPISHs: Non-profit institutions serving households. Net financial assets not included.

In turn, pension funds invest heavily in equities and bonds, including covered bonds...

Pension Funds and Insurance Financial Balance Sheet

(2017Q3; percent of GDP; by instrument)

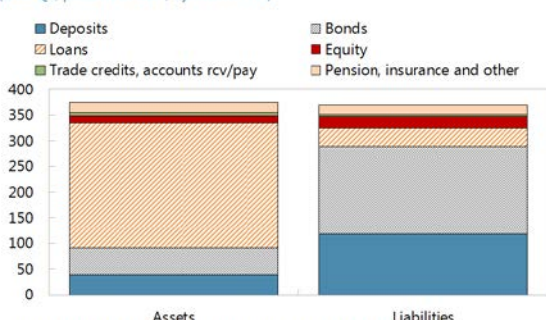


Sources: Danmarks Nationalbank; and Fund staff calculations. Net financial assets not included.

Banks and mortgage credit institutions (MCIs) are heavily funded by covered bond issuance...

Banks and MCIs Financial Balance Sheet

(2017Q3; percent of GDP; by instrument)

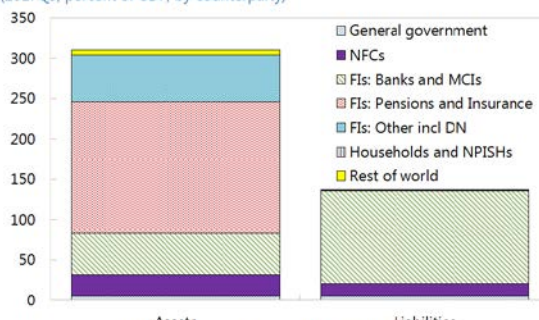


Sources: Danmarks Nationalbank; and Fund staff calculations. Net financial assets not included.

...and banks and mortgage credit institutions (MCIs) hold almost all of their debt.

Households and NPISHs Financial Balance Sheet

(2017Q3; percent of GDP; by counterparty)

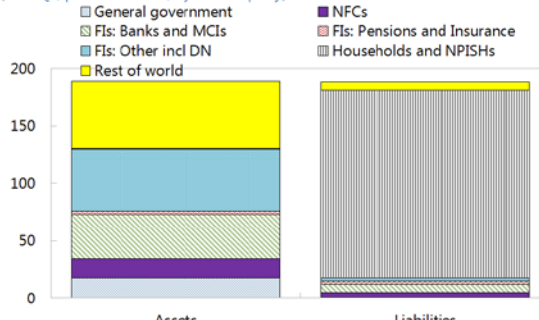


Sources: Danmarks Nationalbank; and Fund staff calculations. NPISHs: Non-profit institutions serving households. Net financial assets not included.

...both domestic and overseas.

Pension Funds and Insurance Financial Balance Sheet

(2017Q3; percent of GDP; by counterparty)

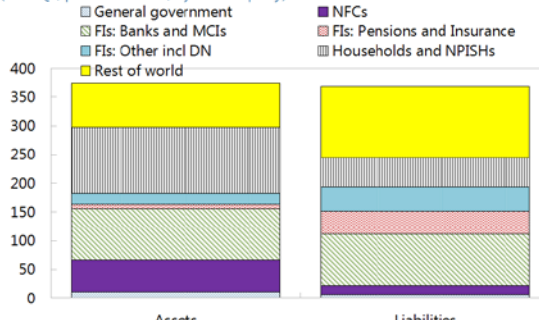


Sources: Danmarks Nationalbank; and Fund staff calculations. Net financial assets not included.

...to private credit to the private sector.

Banks and MCIs Financial Balance Sheet

(2017Q3; percent of GDP; by counterparty)

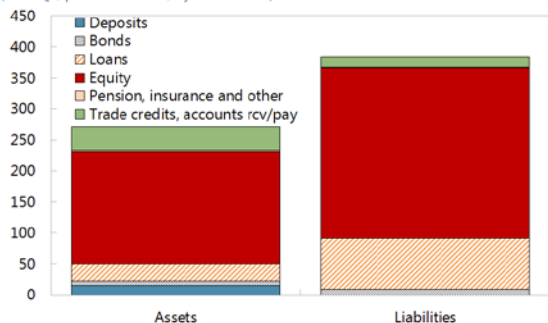


Sources: Danmarks Nationalbank; and Fund staff calculations. Net financial assets not included.

Figure 2. Private Sector Financial Balance Sheet and Comparison
(concluded)

Firms' large equity positions reflect valuations...

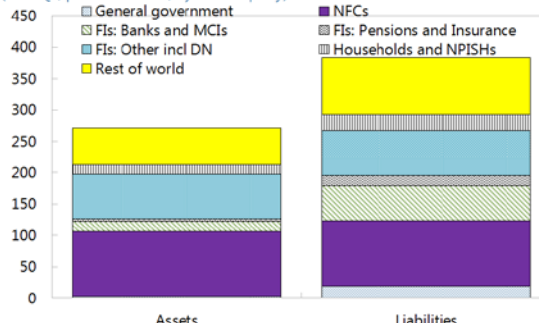
Nonfinancial Corporations Financial Balance Sheet
(2017Q3; percent of GDP; by instrument)



Sources: Danmarks Nationalbank; and Fund staff calculations.
Net financial assets not included.

...to a broad set of counterparties.

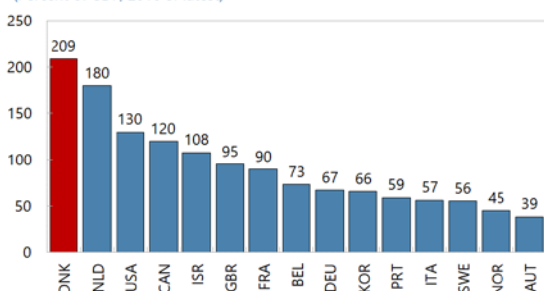
Nonfinancial Corporations Financial Balance Sheet
(2017Q3; percent of GDP; by counterparty)



Sources: Danmarks Nationalbank; and Fund staff calculations.
Net financial assets not included.

Large household savings and mandatory pension contributions have created a very large pension system...

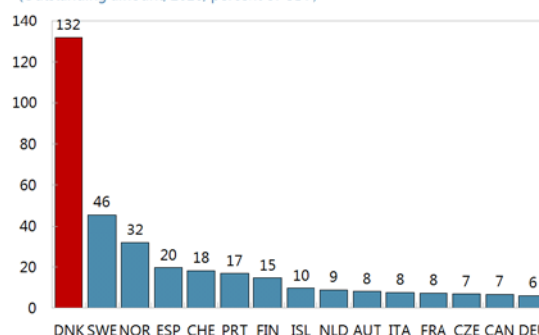
Pension and Insurance Assets
(Percent of GDP; 2016 or latest)



Sources: OECD Financial Balance Sheets database; OECD Global Pension Statistics.
Note: Assets for funded and private pension arrangements are shown for Denmark, Netherlands, the U.K. and Israel.

...which facilitated the development of a large mortgage covered bond market...

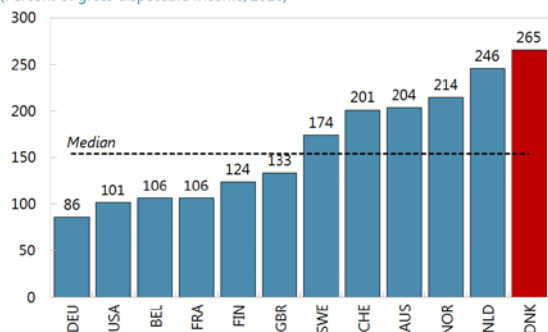
Mortgage Covered Bond Markets
(Outstanding amount, 2016; percent of GDP)



Sources: European Covered Bond Council; IMF WEO.

...and allowed credit institutions to intermediate needed credit to households in the absence of liquid savings.

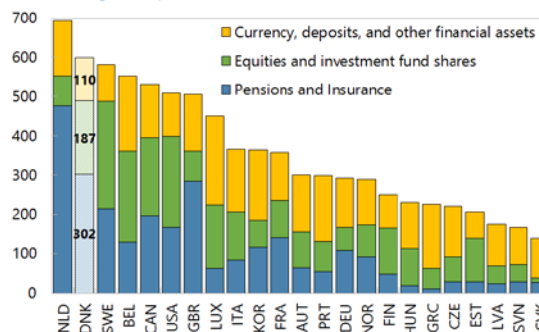
Household Debt
(Percent of gross disposable income; 2016)



Sources: Eurostat; Fund staff calculations.

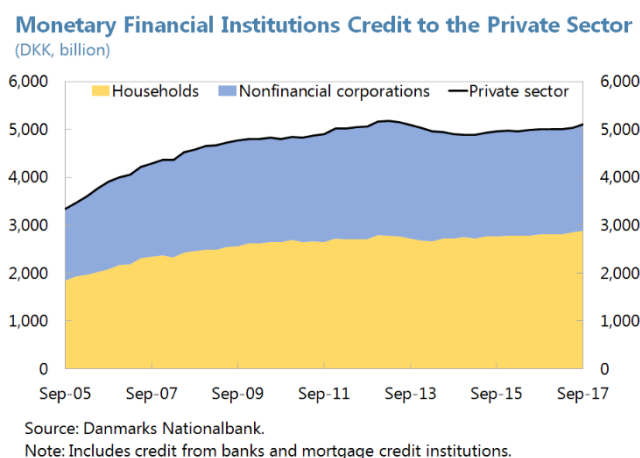
Danish households stand out for their large total financial assets and pension assets in particular.

Financial Assets
(Percent of gross disposable income, 2016 or latest available annual data)



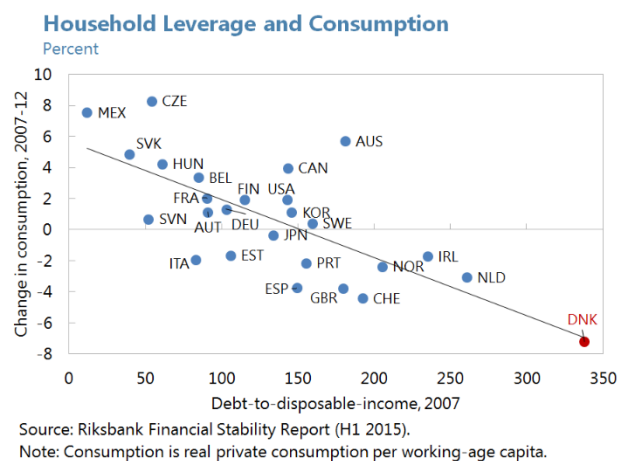
Sources: OECD; and Fund staff calculations.

6. The role of households is central for credit creation and the structure of the private sector balance sheets. Half of domestic private sector credit is provided to households to finance housing purchases and consumption.² The need for large borrowing is partly due to households' relatively large savings via contributions to mandatory saving schemes. As a result, the fully-funded occupational pension system is a natural counterpart to the large household debt stock. The loop completes with pension funds investing heavily in covered bonds issued by credit institutions which use to fund their loan book. A balance sheet decomposition shows the magnitude of this funding/lending relationship of households, pension funds and credit institutions (Figure 2).



C. Household and Pension Fund Balance Sheets

7. The large assets and liabilities make households more sensitive to shocks. The sharp fall of house prices in the aftermath of the financial crisis resulted in a large consumption decline in Denmark, consistent with their high leverage. Further suggesting that high leverage tends to have an important role in households' financial health, Andersen *et al.* (2016) find that the drop-in consumption was stronger among high-leverage Danish households.³ The 2017 Denmark, Selected Issues Chapter 1 examined the risk of higher rates to, primarily, household liabilities. Here the analysis looks further into the sensitivity of household assets to interest rates and asset prices, focusing on the effect of an interest shock on their pension assets, and the potential knock-on impact on household consumption.



8. The direct risks to the financial sector from household debt tend to be low. Despite highly indebted households the fallout from the decline in housing prices did not have significant first-order effects on the banking system. Housing loans in Denmark are full-recourse making it

² Throughout this chapter "households" refer to the national accounts sectors households and non-profit institutions serving households.

³ To be sure, large diversified assets and savings also have significant benefits such as funding future consumption, contributing to fiscal sustainability and accelerating wealth creation (see 2017, Denmark Selected Issues, Chapter 1, Section B).

more difficult for households to default on their loans. In turn, households and their creditors are incentivized to seek out arrangements such as temporary modified repayment agreements to continue servicing their mortgage and staying in their properties. The strong social safety net and welfare programs can also soften the blow from economic hardship and smooth consumption. Danish credit institutions are liquid and well-capitalized, with regulatory capital amounting to nearly 20 percent of risk-weighted assets. In the past they have been able to withstand reasonable increases in nonperforming loans to the household sector. Ongoing stress tests by Denmark's Nationalbank show that risks to the financial system from household debt deterioration are generally manageable, owing to banks' excess capital. Although some systemically important institutions may have small capital shortfalls under a severe recession scenario (DN, 2017), their effect arises from falling stock prices, changes in interest rates, and increasing credit spreads, rather than household debt specifically.

9. Credit conditions play a central role in the propagation of shocks in modern, financially deep economies, especially during downturns. Financial accelerator effects (BGG) are important in understanding the transmission of macro financial shocks. As noted by [Bernanke, Gertler and Gilchrist](#) (BGG, 1999) "endogenous developments in credit markets work to propagate and amplify shocks to the macroeconomy." The key mechanism is the link of lending credit premia and the net worth of potential borrowers, which declines in value during downturns. These effects can play powerful roles in asset-rich and financially deep economies like Denmark. As noted by these authors, "this extra amplification is a step in resolving the puzzle of how relatively small shocks (such as modest changes in real rates induced by monetary policy, (...), can have nevertheless large real effects," explaining how "deteriorating credit market conditions may materialize in the form of falling asset prices, rising real debt burdens or even sharp increases in insolvencies and bankruptcies". The extension to bankruptcies and insolvencies does not apply directly to Denmark, where various institutional features such as variable mortgage and deferred amortization mean that households can offset shocks to incomes and interest rates, but the other channel, including via collateral effects remain valid.

10. Danish households hold a high amount of real (housing) and financial assets, even relative to the wealthiest economies. The combination of large asset holdings and leverage may explain why the Danish economy appears sensitive to adverse shifts in interest rates. Housing plays an important role in the financial system (Figure 3):

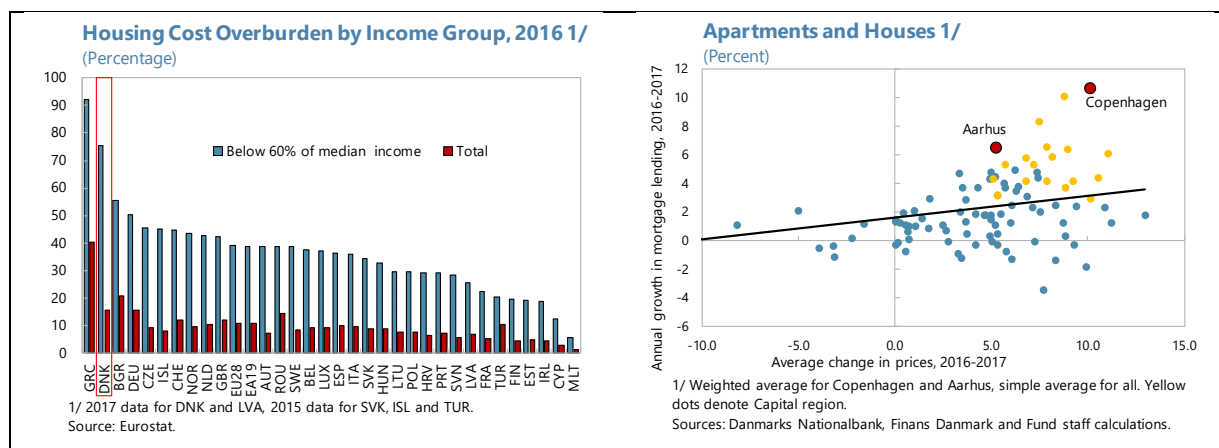
- Housing is a major asset held by Danish households, together with pensions and financial assets.
- High valuations and favorable tax treatment incentivize large house purchases, often funded via large mortgages. The factors above in conjunction with easy access to low interest rate borrowing helps to explain why Danish households' debt to income ratios are among the highest among advanced economies.
- Households are exposed to housing markets developments through their pension and life insurance investments. Mortgage credit institutions issue covered bonds to fund the mortgages provided to households, transferring part of mortgage risks to investors. These covered bonds

are in turn purchased by other financial institutions (35 percent) and, crucially, pension funds and insurance companies which hold a substantial (28 percent) of the market.

11. Mortgage bonds link real estate developments back to households' balance sheet and the broader financial system. Mortgage banks issue covered bonds to fund the mortgages provided to households with two main implications:

- Mortgage credit institutions (MCIs) transfer part of mortgage risks to those investors who purchase their covered bonds, i.e. market risk. But MCIs are ultimately responsible to cover any shortfalls, should the value of (real estate) collateral fall sharply, for example.
- Since the largest owners of covered bonds other than pension funds and insurance companies (28 percent) and domestic financial institutions (35 percent), most of the risks associated to lending to the real estate market remain in the domestic financial system.

Because of this additional channel of covered bond holdings, real estate developments not only affect household consumption via the usual wealth effects and collateral (financial accelerator) effects via housing, but also via potentially mutually reinforcing financial wealth effects through households' large pension savings invested in financial assets, which are discussed next.

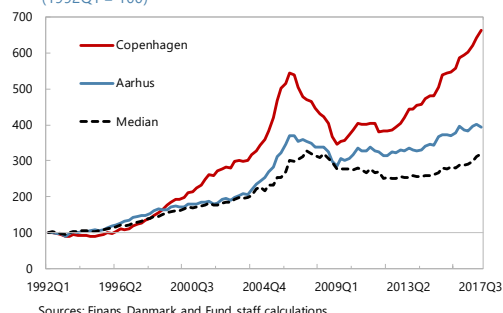


12. Understanding the effect of interest rate increases on household consumption is important for Denmark and other Nordic economies. Mian *et al.* (2013) examine the wealth shocks from the housing market collapse in the United States during the global financial crisis and their impact on consumption. Andersen *et al.* (2016) (and earlier versions of their work since 2013) make use of rich microdata for Danish households to study the relationship between household leverage and spending. Hviid and Kuchler (2017) analyze consumption and savings decision of Danish households and estimate the effect of rising housing prices on consumption formation. In other related studies, Floden *et al.* (2016) and Gustafsson *et al.* (2017) study the cashflow channel of repricing of liabilities and interest income for Swedish households using microdata.

Figure 3. Households, Credit and Leverage

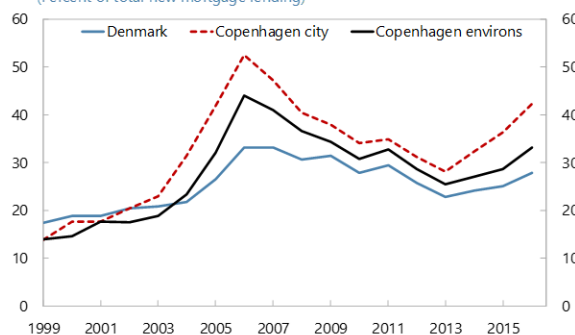
House prices keep rising, especially in urban areas...

Nominal House Price Index
(1992Q1 = 100)



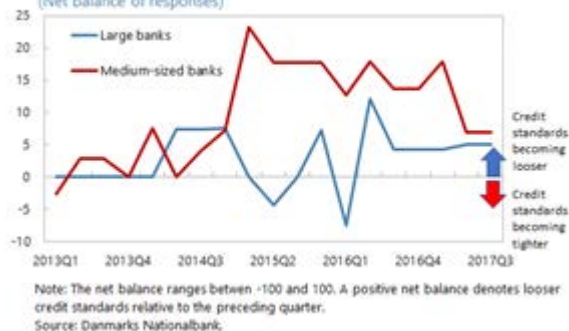
...where LTIs on new mortgages have risen steeply.

Share of Households with LTI Greater than Four
(Percent of total new mortgage lending)



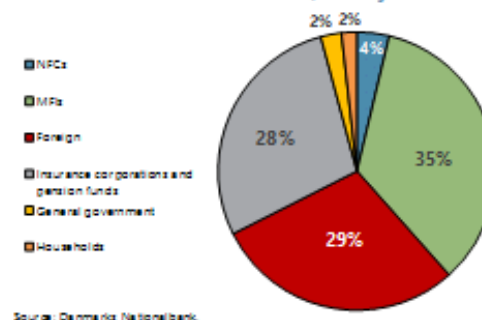
Credit standards are being eased further, led by medium-sized banks,

Credit Standards by Bank Size
(Net balance of responses)



Pension and Insurance companies are significant holders of covered bonds.

Investors in Danish Covered Bonds, January 2018



13. Two types of households appear particularly vulnerable to shocks: those on low incomes and those on high LTIs. The first vulnerable group are low-income households who spend a considerable share of their disposable income on housing (Figure 3). Higher interest rates will ultimately increase mortgage repayments, likely increasing the proportion of this vulnerable segment. The second group are households who have purchased in highly appreciating and potentially overvalued urban areas such as Copenhagen ([Selected Issues](#)), where LTI ratios and credit growth are noticeably higher than in the rest of the country. These vulnerabilities are compounded by the large proportion of variable-rate and interest-only mortgages in the system. There is a risk that high and still rising house prices (particularly in urban areas), relaxed credit standards (Figure 3), and extremely low mortgage rates, may increase the perception of affordability across a broad spectrum of income levels.

14. When households' financial wealth falls, whether because the value of their financial asset prices decline, consumption falls (wealth effect). What makes Denmark vulnerable to shocks to asset prices is that its "households have very large assets and are among the households in the world with most financial assets" (Finance Denmark, 2017), combined with a large gross balance sheet and a high level of household debt. To get a sense of the potential magnitude of the

ultimate impact on households' balance sheets, we sketch the possible impact of a hypothetical 100 bps interest rate increase on the portfolio of Danish pension funds and life insurers,⁴ given they hold a significant share of household wealth in the form of pension savings. We then explore a series of possible implications for households.

15. Servicing mortgages and credit ultimately become more onerous for borrowers when interest rates rise. At the same time, asset prices decline when interest rates increase, this opposite move means that net asset position deteriorates when interest rates rise.

16. The pension fund system is among the largest as a share of the economy. Danish pension fund assets, at around \$600 billion and 215 percent of GDP, are the largest relative to GDP, even relative to the most advanced and richest economies (Table 1). The large size of pension funds and life insurance portfolios reflects the high level of pension contributions and household savings.⁵

Table 1. Denmark: Total Pension Assets in Major Advanced Economies

Country	Total pension assets (USD billion)	GDP (USD billion)	Total pension assets as % of GDP	Population (millions)	Total pension assets per capita (USD)	Old-age dependency ratio (%) 2010	Old-age dependency ratio 2100 (% projected)
Australia	1,583	1,184	134	24	65,958	22.7	53.0
Denmark	599	278	215	6	99,833	29.6	52.7
Japan	2,808	5,287	53	127	22,110	43.3	69.1
Netherlands	1,296	871	149	17	76,235	27.9	57.3
Switzerland	817	533	153	8	102,125	26.9	57.0
United Kingdom	2,868	2,813	102	65	44,123	27.6	53.5
United States of America	22,480	18,569	121	321	70,031	22.3	47.9

Source: GDP: OECD (2016), except Denmark (2015). Old-age dependency ratio: ratio of population aged 65+ per 100 population 15-64; UN World Population Prospects (2015). Population: World Bank (2015). Total Pension assets (2016): Towers Watson Global Pension Assets Study, except Denmark: OECD (2015).
Towers Watson Global Pension Assets Study 20159FT, "Foreign fund houses compete for \$170 bln of Chilean retirement money", 13 April 2014.

17. Households hold financial assets both (directly) as investments in their portfolios and (indirectly) by pension funds. The high debt of households is partly offset by large pension savings, but the resulting high gross balance sheets means that shifts to asset prices and changes in interest rates have the potential to shift the net asset position of households significantly because of the different effect on assets (which typically fall in value) and liabilities (which rise, even if with some desirable flexible features in Denmark, which tend to lessen the adverse impact). To better understand the potential type of vulnerabilities the first step of the analysis is on the balance sheets of pension funds and life insurers, as they hold a significant amount of households' financial assets. The second step is to reconcile this with analysis on household liabilities and discuss the impact on households' net asset position.

⁴ This exercise is not intended to be an accurate stress test, but merely an illustrative exploration of the potential impact of higher interest rates on asset prices and balance sheets, based on available information.

⁵ Selected Issues papers for the 2014 and 2017 Denmark Article IV consultations provide more information on the structure of the Danish pension system.

D. The Impact of Interest Rates on Asset Prices and Balance Sheets

18. The normalization of monetary policy by the ECB and other major central banks is likely to impact asset prices. This may have ramifications for Danish households and pension funds balance sheets. Interest rates are anticipated increase further across Europe, US and other advanced economies in the coming years, as the post crisis exceptional monetary policy measures are withdrawn, as warranted by improving economic conditions. Nonetheless, long-term interest rates could increase more than widely anticipated given that bond term premia remain near historically low levels across major advanced economies (see IMF GFSR, October 2017). Danmarks Nationalbank estimates that ECB's "unconventional monetary policy in the beginning of 2015 reduced the term spread in Denmark by at least 50 bps" (see [Danmarks Nationalbanken Working Paper](#)). Even 50 bps may be a lower bound, as it does not encompass the effects of asset purchases of other major central banks⁶. Even assuming two 25 bps interest rates ECB hikes over the coming 2–5 years,⁷ in addition to the unwinding of the 50 bps fall of the term spread, Danish longer-term interest rates could easily rise by 100 basis points, which provides the baseline shock for the next exercise.

Exploring the Impact of Higher Interest Rates on Pension Fund Assets

19. Fluctuations of pension assets can affect consumption decisions. It is often assumed that pension assets have a relatively small impact on consumption and savings decisions, especially in the short to medium run, because they are tied until retirement, and paid out over many years, and not all households monitor the fluctuations of pension savings frequently, unless they are moving closer to retirement age (as populations age a larger proportion of households will get closer to entering retirement).⁸ Nonetheless, there is recent evidence that suggest otherwise, and so we explore some reasons why households may become more sensitive to movements in their pensions assets. With the increasing dominance of DC schemes, gains and losses on pensions assets are transferred back to households (net of eventual guarantees which are typically set conservatively low). For this reason, shifts in asset prices on pension funds' investments of households' future pensions may becoming a more important channel of transmission of revaluation effects, and by reflex to consumption and savings decisions.

20. As the provision of pension shifts more prominently to the private sector, future pension payouts may become more linked to financial market developments. Simultaneously, investment risk is increasingly being transferred from pension funds and life insurance companies back to households, as schemes are now predominantly DC. Consequently, it is plausible to

⁶ To evaluate the plausible increase in long-term interest rates as captured, say, by a 10-year bond, one would need to add to the term spread component (50 bps) an estimate of how much interest rates themselves are anticipated to rise over that period. Even assuming conservatively that interest rates are expected to be on average 50 bps higher over the coming ten years, would result in an increase of 10-year bond yield of 100 bps (assuming expectations theory).

⁷This implicitly assumes a broadly unchanged interest rate monetary policy differential between the Danmarks Nationalbank and the ECB.

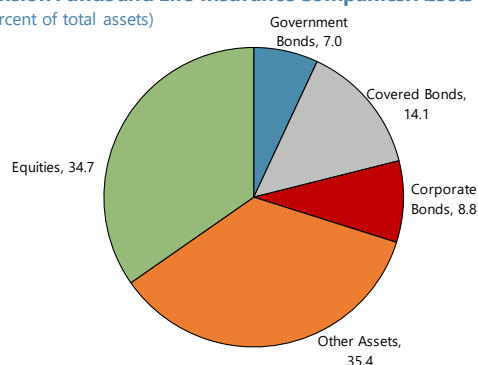
⁸ If life expectancy were to increase more than retirement age, retirees will have to rely on pensions savings for a higher number of years, although this is not a major issue in Denmark.

speculate that household consumption and savings decisions may be becoming more sensitive to shifts in asset prices, and will continue to do so for the foreseeable future, particularly in wealthy and financially deep economies such as Denmark and the Nordics.

21. Danish pension funds invest heavily in equities and fixed income assets.

About 35 percent of pension fund and insurance company (PFIC) portfolios are allocated to equities, a significant proportion of which are invested in US European and emerging markets. Another 30 percent are allocated across fixed income assets (spanning government (7 percent), corporate (9 percent) and mortgage bonds (14 percent)). The bond exposures are concentrated in European, Danish and other developed markets, while covered bonds are overwhelmingly domestic. The largest remaining category, “other assets” (35 percent), includes an array of instruments (including derivatives, trade credits, real estate and other illiquid assets whose returns we assume are moderately (positively) correlated with the rest of the portfolio).

Pension Funds and Life Insurance Companies: Assets
(Percent of total assets)



Source: Danish FSA and Fund staff calculations

22. Asset prices are sensitive to interest rates. The value of a financial asset, is determined by the future income investors expect to gain from it, discounted by an appropriate “risk free” interest rate (such as the yield on a long-term government bond). So, when interest rates rise, typically asset prices fall (all else equal). These estimates of the price impact of interest rate shocks were performed on the major asset categories held by pension funds (corporate, government and covered bonds and equities across the major developed and emerging economies). Given these characteristics, we then match a benchmark bond index to captures the essential features of each category: namely duration and convexity. Based on these characteristics we estimate⁹ the impact of interest rate changes on the price of that type of bond trading in that country, based on the key attributes that determine its interest rate sensitivity: duration and convexity. To analyze equity price valuations, we employ a multi-stage dividend discount model, calibrated separately on each major equity market, and then determine the impact of a given interest rate shock holding all other variables constant (see Annex 1 for more information).¹⁰

23. Assessing the impact of interest rate shocks on asset prices. Many factors determine the impact of an interest rate shock on asset prices, so these estimates are best viewed as tentative starting point, subject to large uncertainties. The exercise’s overall outcome is that a 100 bps (or one percentage point) interest rate shock would reduce the value of the portfolio assets held by pension

⁹ These estimates of the impact on fixed income assets were performed on assets by type and location e.g. bonds may be i) covered ii) corporate and iii) government) and may trade in a) Denmark, b) Germany, c) US, d) UK and so on). Each bond type was matched as closely as possible to a representative benchmark index (e.g. ICE-BofAML European Government index) on which the analysis was then performed, based on duration and convexity characteristics. See Annex for details.

¹⁰ For example, the equity risk premium and dividends are held constant, and earnings per share continue to grow steadily as the interest rate shock is applied.

funds and life insurance companies' (from now on referred to just pension funds) by as much as 6–8 percent, rising to 9–15 percent if we double the shock to 200 bps. In terms of major asset classes our estimates suggest:

- **A one-off 100 basis points interest rate shock lowers the value of pension funds fixed income assets by approximately 4–7 percent.** For the fixed income assets held by pension funds, we find that duration captures most of the negative impact from interest rates, although interest rate sensitivity varies significantly across the range of fixed income instruments.¹¹ For example, Danish government bond benchmark indices,¹² because of their higher duration (8.6 years), are more price-sensitive to interest rate increases than most US and European benchmark indices (in the 4-year and 7–8 year ranges, respectively). At the other extreme, Danish mortgage bonds, due to their short duration), are resilient to changes in interest rates.
- **The same 100 bps interest rate shock lowers the value of pension funds' equities portfolios by around 8–11 percent.** The equity markets analyzed included the US, Denmark, Germany and euro area ex-Germany, UK. The estimated impacts of the shock on stock prices ranged from under 9 percent to over 12 percent. The standard premise of our analysis was that the price of a stock captures the present value of its future income stream, and specifically future dividends, discounted by a long-term "risk free" interest rate. And a higher interest rates will lower the present value of that future income stream, resulting in a lower equity price (see Annex for details).¹³

24. Equity valuations are sensitive to shifts in interest rates. The current sensitivity of stock prices to interest rate shocks reflects two developments: i) Equity Risk Premia (ERP) in major advanced economies, Denmark included, have declined (according to some models¹⁴) as investors reached for yields in a global environment of accommodative monetary policies and low interest rates across, and, ii) corporate earnings growth has been slowing (or is expected to slow¹⁵) in several major advanced economies (it peaked around mid-2017 in Denmark). In principle, a low ERP signals reduced compensation for risk, and consequently vulnerability to shifts in risk perceptions. The combination of low ERP and slowing earnings growth reinforces the sensitivity of equity valuations to adverse shocks, whether economic or financial, domestic or external, because current prices do not offer much return for equity risk over and above the yield on domestic government bonds.

¹¹ See footnote 9.

¹² ICE-BofAML Denmark Government index.

¹³ To analyze the impact of interest rates shocks on equity prices, we employ a dynamic multi stage dividend discount model see Annex 1 and Inkinen et al, 2010, Panigirtzoglou and Scammell, 2001, and Fuller and Hsia, 1984.

¹⁴ ERP are not directly observable and their estimates are inherently uncertain and dependent on the model specifications and the data series chosen. For example, the time horizon of EPS forecasts used (particularly where analyst forecasts are drawn from a small sample, as in Denmark). In addition, the calibration of the model's settings can also have an impact (e.g. assumed transition path to steady state).

¹⁵ As captured by analyst projected earnings growth estimates 12- and 18-months ahead, source: Reuters I/B/E/S.

25. Small open and financially deep economies are vulnerable to global financial shocks.

Denmark's status as a safe-haven offers some protection in the face of adverse global financial shocks. Nonetheless, a marked decline in the global price of risk (reflecting, say, an increase in global risk aversion) could result in a significant downward adjustment in Danish risk assets, and notably equity prices, for the reasons discussed above. The large and increased share of foreign investors in Denmark's financial markets also suggests a degree of exposure to external shocks, potentially increasing the sensitivity of domestic asset prices to external forces, and possibly to funding stress in the case of very large shocks (for example, if some foreign investors were to exit covered bond markets). Denmark's financially-deep economy with some highly leveraged households, means that domestic macro-financial channels, such as the financial accelerator and collateral effects discussed earlier in the note could amplify the initial impact of asset price falls to the broader economy.

E. Asset Prices and Consumption: Who is More Vulnerable?

26. Adding the effect of rates on financial assets provides interesting insights into household consumption.

The 2017 Denmark Article IV, Selected Issues Chapter 1 focused on the liabilities side of balance sheets, and found Danish household consumption to be overall modestly sensitive to interest rates, but with some groups exposed disproportionately. To examine the impact of interest rate shocks on the asset side of the balance sheet, the analysis focuses on the sensitivity of consumption, or marginal propensity to consume (MPC) out of financial wealth. The MPC out of wealth is often found to be relatively small when estimated from (aggregate) economy-wide data, and at times estimated to be slightly smaller than MPC out of housing wealth, especially in less recent studies. However, more recent studies have been attributing increasingly more importance to financial wealth effects, finding it to be larger than previously thought.

27. Recent evidence suggests financial wealth effects might be even larger than housing wealth effects.

Wealth effects are typically believed to be important, particularly during downturns (see also Hiivid et al, 2017), and their magnitude can be amplified by high debt levels and credit constraints. These channels were an important amplifier of the downturn during the Great Recession, including in Denmark, where the drop of household consumption was among the sharpest in advanced economies. In addition, to the more widely explored wealth effects from housing, some recent studies based on extensive micro data find wealth effects on consumption from financial assets to be stronger than from housing for all but the wealthiest households. Although similar analytical studies based on Danish data are not available, it is plausible that given Danish households' high levels of financial and housing wealth, these effects are significant and likely mutually reinforcing also in Denmark.

28. In addition, MPC out of financial wealth varies sharply across household types.

Recent studies based on detailed micro data show how marginal propensity to consume out of financial wealth¹⁶ varies across income/wealth groups. Notably, ALS 2015 finds that French households' MPC

¹⁶ Financial assets in ALS (2015) are defined to include: deposits, mutual funds, shares, voluntary private pensions, whole life insurance and other financial assets (excluding business assets). The estimates control for many factors, including age (i.e. position in life-cycle), and also: income expectations, work status, education level, household composition, credit constraints, unemployment episodes and sick leaves.

out of financial assets is considerably larger across the bottom half of the wealth distribution (see Table 2), even though the former group holds less (net and gross) wealth in the form of financial assets than their richer counterparts.

Table 2. Denmark: Impact of Asset Price Shocks on Consumption, Across Different Wealth Groups

Wealth group	Wealth percentile	Marginal propensity to consume out of financial wealth	Wealth to consumption ratio	Consumption elasticity to financial wealth	Effect on Consumption from shock to asset prices (due to 100 bps interest rate shock)		Effect on Consumption from -shock to asset prices (due to 200 bps interest rate shock)	
					Asset price change [range]		Asset price change [range]	
					-6%	-8%	-9%	-15%
		(mpc_w_fin)	w_fin/c	mpc_w * (w_fin/c)	Impact on consumption [based on asset price range]		Impact on consumption [based on asset price range]	
Lower Half	1-49***	0.122	0.364	0.044	-2.7%	-3.5%	-4.0%	-6.7%
Mid-to-mid-high	50-69***	0.020	1.114	0.022	-1.3%	-1.8%	-2.0%	-3.3%
Mid-high to High	70-89**	0.013	1.872	0.024	-1.5%	-1.9%	-2.2%	-3.7%
Top	90-99	0.002	4.975	0.010	-0.6%	-0.8%	-0.9%	-1.5%

Sources: Arrondel L., Lamarche P, and Savignac F, 2015¹ for details on the parameter estimates. Stars denote significance levels as follows: **: 5% *** 1%. IMF estimates for asset price changes resulting from interest rate shocks.

¹See Arrondel L., Lamarche P, and Savignac F, 2015; their study controls for a wide range of variables: income expectations, age, work status, education, household composition, credit constraints, unemployment spells, sick leave. Financial wealth includes voluntary pension and life insurance schemes.

29. The impact of asset prices on consumption likely varies significantly across wealth groups. In Table 2, we provide the results of the impact of shocks to financial asset prices on household consumption, across the wealth distribution. However, due to the lack of Danish estimates for the necessary MPC parameters (and wealth to consumption ratios), we apply ALS (2015) MPC estimates, which rely on a rich French dataset.¹⁷ The assumption is that the French parameters applied to calculate the impact of asset price shocks on consumption are broadly representative for the Danish case, or at least insightful on some potentially important heterogeneities. With this in mind, the results should be interpreted with caution, as there may be significant differences between the French and Danish results. Some insights however, are likely to be relevant for Denmark.

30. Pensions make up a considerable part of households' financial assets and reflect Danish households investing and risk preferences. For this reason, to apply a representative shock to wealth it is assumed that household portfolios have the same structure as the portfolios of Danish pensions funds and life insurance companies. To then get a sense of the impact of the resulting change in asset prices on household consumption, we apply the change in the value of the asset price to the estimates of the elasticity of consumption to asset prices, as shown in Table 2. rather than assuming a single population-wide estimate of the consumption elasticity, we apply the relevant elasticity across each of the key wealth percentiles based. To obtain an estimate of the impact on

¹⁷ This dataset combines the French Wealth Survey (INSEE) and the Household Budget Survey (INSEE-Eurostat).

consumption for a given shocks to financial wealth, we apply the same shocks we applied to the portfolios of Danish pension funds.¹⁸

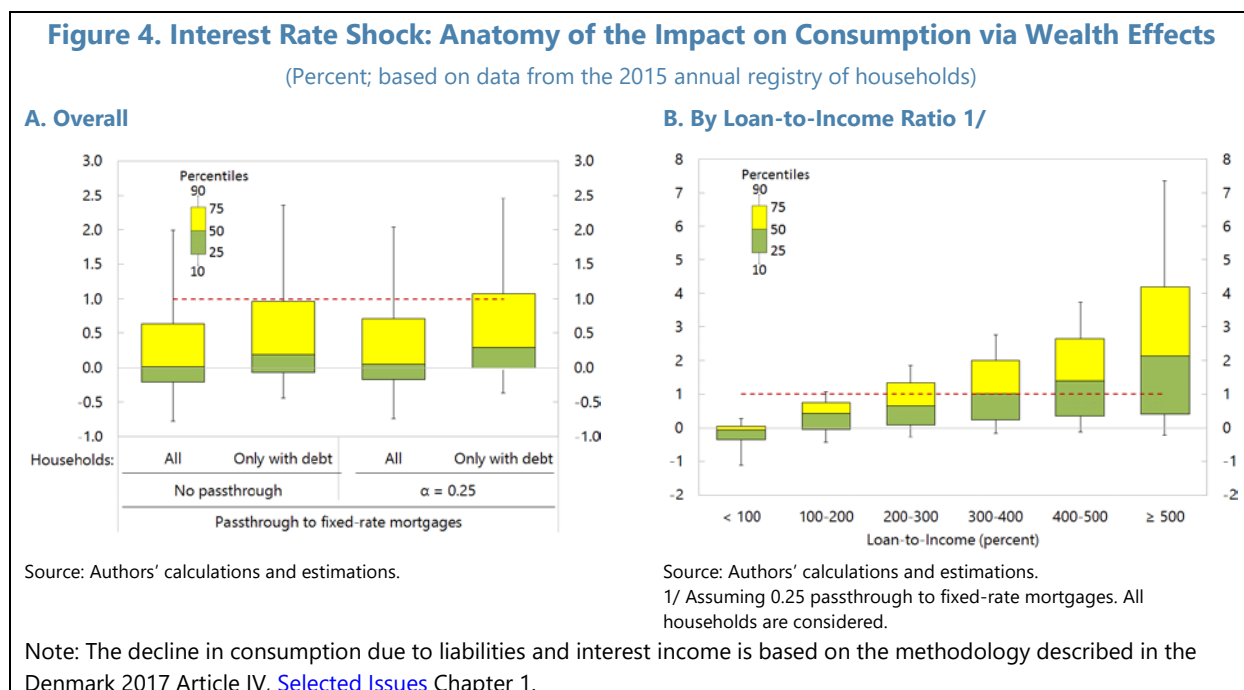
31. Consumption of the least wealthy households is the most vulnerable to asset price shocks. As caveated upfront, the reference consumption parameter estimates used are based on micro data from French household survey (in absence of equivalent estimates on Danish households). With this limitation in mind, we use them as an indicative proxy for what Danish MPC and consumption elasticity estimates might look like across the wealth distribution. In addition, as mentioned above we make sure to apply the shock to a portfolio structure of Danish pension and life insurance companies, which capture Danish investor preferences, and are in this sense representative. The most important result is the heterogeneity of financial wealth effects across different income/wealth groups. A 5–8 percent drop in asset prices has a strong negative and statistically significant effect on consumption of the group with below median wealth (-2.7/-3.5 percent drop in consumption). Some appreciable impact is also found on the following wealth cluster (where consumption falls between 1.3 percent-and1.8 percent), there is virtually no effect on the wealthiest group (where the MPC parameter is not statistically different from zero, see last row of Table 2). While this discussion focuses on financial assets across the wealth distribution, it should be noted that wealth effects from housing could alter the estimated impact of a shock to households' total wealth (i.e. both housing and financial assets). For instance, low income households often rent, and hence a housing price shock would likely impact middle income households comparatively more.

32. Less wealthy households are more consumption sensitive to shifts in asset prices. The higher sensitivity of the less well-off households is based on a French-specific dataset and may appear counterintuitive, but many members in this group are not home owners, and often hold some financial assets, even if in limited amounts (e.g. savings and pensions). Their increased sensitivity to shocks in asset prices may reflect limited buffers to absorb adverse shifts in their wealth (for example, gross wealth well in excess of net wealth, which may even be negative). This variation in consumption sensitivity across household groups dilutes the estimation of MPC when estimated from economy-wide (aggregate) data, hiding important heterogeneities that seem relevant for policy settings. For example, Jappelli and Pistaferri (2014) show that households with little liquid wealth and without high past income react particularly strongly to economic stimuli. Recent research has also shown that transitory shocks can have a very substantial impact on MPC and that such shocks can be quite large (Carrol, 2017).

33. The effect of interest rate increases on household liabilities continues to suggest modest overall consumption sensitivity but higher for certain groups-at-risk. Based on the methodology presented in earlier analysis (see Denmark 2017 Article IV Selected Issues, Chapter 1) household-level data on liabilities show that the median sensitivity of household consumption to rate increases is modest. One percentage point increase of the borrowing rate decreases consumption to the median household by less than 0.1 percentage points (Figure 4), and by 0.4 percentage points for the entire population on average, or some 0.2 percentage points of GDP.

¹⁸ That is, the 6–8 percent and 9–15 percent fall in financial assets resulting from, a 100 basis and 200 points interest rate shocks, respectively.

This is lower than the 2017 estimate (0.3 percentage points) based on the previous survey of household microdata. The rising share of fixed-rate mortgages owing to the Supervisory Diamond (see Annex [II]), and rising disposable income may explain the declining sensitivity. Nevertheless, the previously-identified groups-at-risk with high loan-to-value, and high loan-to-income characteristics maintain much higher consumption sensitivity with respect to rising rates (Figure 4).



34. Combining the microdata analysis on liabilities with the financial wealth effects mentioned above offers a more thorough view of the sensitivity of households to rates. Using the granular financial balance sheet data provided by the household-level registry and applying the framework for the effect of rate rises on financial assets generates estimates for the entire financial balance sheet. Like the analysis above, consumption elasticities for the marginal propensity to consume from assets are drawn from [Arrondel et. al. \(2015\)](#), and are applied to the asset composition of each cohort considered in the analysis of the liabilities.¹⁹ Figure 5 presents the results of the estimation, and for presentational simplicity only the effect on the median household in each cohort is shown.²⁰ The analysis does not consider the value of nonfinancial assets, such as housing, and several offsetting factors such as rising wages and the effects of asset diversification from rising

¹⁹ Consumption elasticities with respect to asset changes for the ten income deciles are {5, 4.5, 4, 3.5, 3, 2.2, 2.2, 2.4, 2.4, 0.9} percent for the 1st, 2nd, ..., 10th deciles in line with Table 4, column 4 of [Arrondel et. al. \(2015\)](#). Consumption elasticities with respect to asset changes for the loan-to-value and age cohorts are taken constant at 3 percent because average income does not vary significantly among them. Finally, consumption elasticities for the 6 loan-to-income cohorts are {2, 2.5, 3, 4, 5, 6} percent (from the cohort with LTI < 100 percent to LTI ≥ 500 percent), based on calibration of the cohorts using income information.

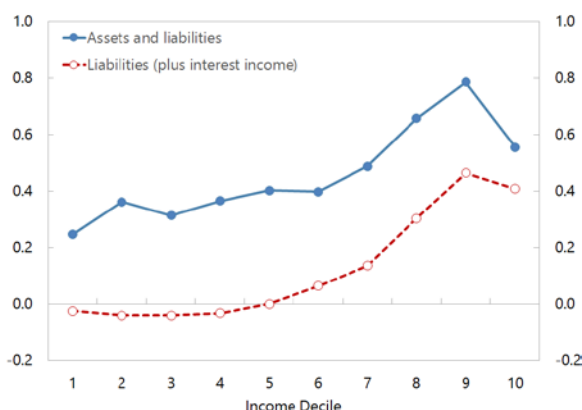
²⁰ Therefore the red dashed line of Figure 5, panel C is the same as the levels of the median ("50") show in the box-plots of the right panel of Figure 4.

housing prices are not considered which may reduce the hit to consumption. Considering the effect of interest rate increases on real assets could change some conclusions.

Figure 5. Anatomy of Impact on Consumption, Introducing Liabilities Explicitly

(Percent; based on median household in each cohort from 2015 annual registry household data)

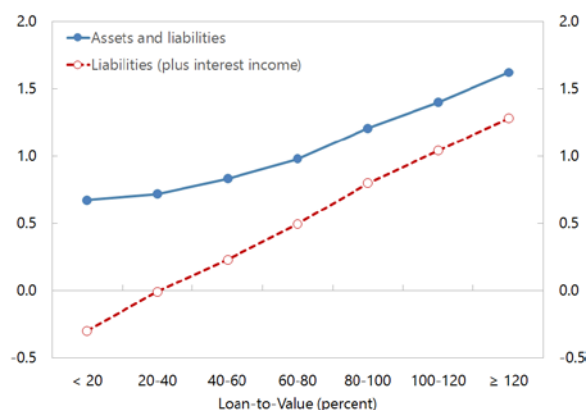
A. By Income Decile 1/



Source: Authors' calculations and estimations.

1/ Assuming 0.25 passthrough to fixed-rate mortgages. All households are considered. The elasticity of the marginal propensity to consume from financial assets varies by income decile.

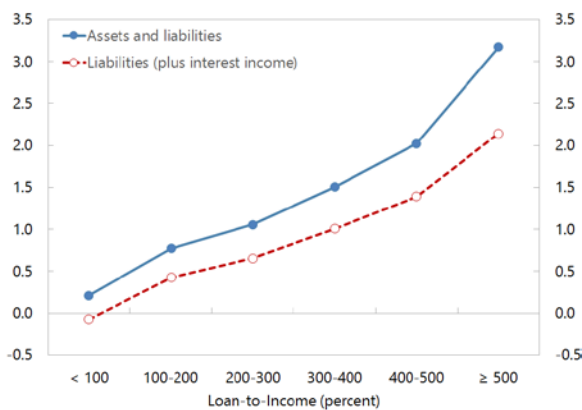
B. By Loan-to-Value Ratio 2/



Source: Authors' calculations and estimations.

2/ Assuming 0.25 passthrough to fixed-rate mortgages. Only households that own homes and have debt are considered. The elasticity of the marginal propensity to consume from financial assets is constant at 3 percent.

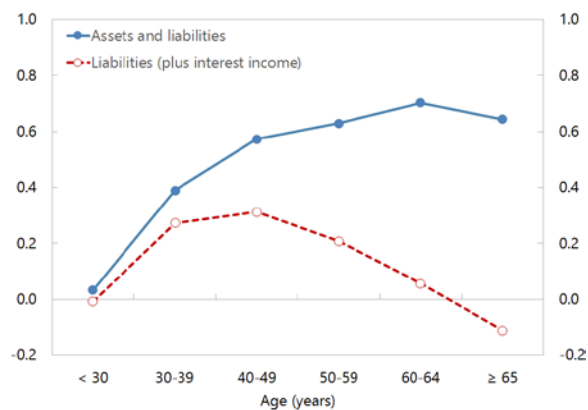
C. By Loan-to-Income Ratio 3/



Source: Authors' calculations and estimations.

3/ Assuming 0.25 passthrough to fixed-rate mortgages. All households are considered. The elasticity of the marginal propensity to consume from financial assets varies by LTI cohort.

D. By Age of Household's Oldest Family Member 4/



Source: Authors' calculations and estimations.

4/ Assuming 0.25 passthrough to fixed-rate mortgages. All households are considered. The elasticity of the marginal propensity to consume from financial assets is constant at 3 percent.

Note: The decline in consumption due to liabilities and interest income is based on the methodology described in the Denmark 2017 Article IV, [Selected Issues](#) Chapter 1. The decline in consumption due to financial assets is based on elasticity assumptions for the marginal propensity to consume from financial wealth from [Arrondel et al. \(2015\)](#) and simulated declines of 8 percent for equity and other investment and 5 percent for pension and insurance assets.

35. Consumption sensitivity varies considerably among households, and certain groups-at-risk are significantly more exposed to rising rates. Households with low incomes are exposed more to rising rates via their financial asset holdings (including via pension and insurance assets) than higher income households that have lower marginal propensity to consume from their financial wealth as shown earlier in this chapter. The combined effect on assets and liabilities shown in

panel A of Figure 5 shows broadly rising impact with higher incomes (except the top-income households). Similarly, higher rates affect more households with higher debt relative to their value of their property rather than ones with low loan-to-value (LTV; panel B). The balance sheet impact appears to be increasing marginally more for households with LTV greater than 80 percent, which supports an ongoing staff recommendation to lower the LTV cap from the current 95 percent. Highly-leveraged households shown in panel C are also significantly more prone to reducing their consumption with rate increases. Like in last year's assessment on liabilities, the marginal impact to consumption from the high loan-to-income (LTI) cohorts, such as above 400 percent, is found to be evident of larger vulnerabilities in high-leverage households. Equally, the consumption sensitivity of both financial assets and liabilities to rates declines faster within lower-LTI households. Unlike the LTV cap which is less effective as house prices continue to rise, LTI-based macroprudential measures are not subject to property price fluctuations and can be more effective in enhancing household resilience. Relatedly, with respect to the effect of higher rates on consumption by LTV and LTI cohorts the quantitative assessment is likely unchanged if nonfinancial assets (such as housing) were also considered, because of the positive relationship between indebtedness and housing values. Finally, the sensitivity of household consumption to rising rates does not decline for older households when considering their holdings of financial assets and the increased propensity of retired people to consume out of wealth rather than regular income. Considering only the liability structure of older households may be underestimating their consumption sensitivity.

F. Policy Recommendations and Conclusions

36. Macrofinancial linkages among households, assets prices and the financial system are strong. While Denmark has a robust economy, with a large net asset position and substantial buffers, risks from rising interest rates may exacerbate latent vulnerabilities, particularly for households and household consumption. The linkages between households, asset prices and the financial system are capable to propagate and amplify shocks to the broader economy.

37. Tightening existing macroprudential measures could help contain the formation of high risk debt, and build resilience. Some policy recommendations based on the analysis above are listed below. Their implementation via the existing frameworks of the Supervisory Diamond for Mortgage Credit Institutions and the Good Business Practice for Housing Credit can speed up their application.

- **Lower LTV limits** from 95 to 90 percent or lower, to reduce the exposure of households to swings in housing prices, and help buffer the impact to consumption. Figure 5 suggests that consumption is affected marginally more for households with LTV greater than 80 percent, and limiting the effect of housing price fluctuations may boost resilience. Earlier staff analysis (IMF 2016 Article IV, [Selected Issues](#), Chapter 3) suggests that an additional 5 percent down-payment lowers aggregate consumption by 1.5 percentage points one year after introduction, and increases it by 0.2 percentage points in a new steady-state because of lower debt-servicing burden.²¹ Therefore, the stability gains may be significant in the long-run.

²¹ Borrowers' mortgage debt is expected to fall by 7 percent.

- **Impose mandatory amortization for highly-leveraged households** for households with loan-to-income above 400 percent. To encourage further reduction of interest-rate sensitivity the loan-to-income limit could be raised to 500 percent if financing is via fixed-rate mortgages.
- **Stricter loan-to-income restrictions for all loans irrespective of LTV considerations,** possibly with tighter limits for interest-only and adjustable-rate mortgages should be evaluated to help contain household leverage, increase resilience, and limit the dampening effects on consumption. Staff analysis suggests that the consumption sensitivity of both financial assets and liabilities to rates declines faster for lower-LTI households, and removing the link to LTV, may remove the influence of rising property prices.

38. Mortgage interest deductibility (MID) could be reduced further than currently planned, as MID distorts investment incentives and incentivizes leverage ([Gruber, 2017](#)). That would bring Denmark in line with other European economies that removed the bias for such borrowing (see table below). During the transition period to a lower mortgage deductibility regime, the current low rate environment would mitigate the adverse impact on homeowners. Supply-side rigidities in urban areas should be addressed. There is room to simplify both the length and complexity of the planning process (EC, 2017b), particularly in urban areas. Simpler and more streamlined zoning and planning processes would allow housing supply to respond to increases in demand without steep price increases. Rent controls remain among the tightest in the EU and should be reduced. According to EC estimates, around 80 percent of private rental housing remains under rent control. Below-market rents limit the incentive to supply rental units, and incentivize the purchase of housing, adding upward pressure to property prices. This restricts labor mobility and migration toward cities, with adverse consequences for productivity and social mobility. There are emerging signs of pressures in the public transportation system contributing to housing pressures, especially around Copenhagen area, which could be alleviated by increasing public capital spending.

Current Mortgage Interest Deductibility from Personal Income Taxes				
	Denmark	Finland	Ireland	Netherlands
General rule	32.7 percent	45 percent capital income deduction in 2017; 35 percent in 2018; 25 percent in 2019 and thereafter	Sliding scale until end-2020. Up to 30 percent for first-time homebuyers; half for others. 1/4 nominal reduction each year	100 percent for pre-2013 loans; 100 percent for post-2013 fully amortizing loans (within 30 years)
Caps/notes	Reduced to 26 percent in 2018 for annual mortgage interest expense over DKK 50,000; 25 percent in 2019 and thereafter	30 percent deduction of the excess interest expense over capital income against income tax, up to EUR 1,400 per year (32 percent for first-time homebuyers)	Deductibility varies by origination date (only 2004-12), and borrower's marital status. All deductibility ends as of Jan 1, 2021.	The maximum tax rate that mortgage interest can be deducted decreases by 3 points annually from 2019, to 36.9 percent in 2025 (around 50 percent in 2018)
	Norway	Spain	Sweden	United Kingdom
General rule	100 percent (full deduction)	0 percent for properties purchased after Jan 1, 2013	30 percent	0 percent
Caps/notes		15 percent deduction up to EUR 9,040 per year, for properties purchased before Dec 31, 2012	Reduced to 21 percent for annual mortgage interest expense over SEK 100,000	Mortgage interest relief at source abolished in 2000
Sources: National tax and other authorities; IMF staff calculations.				

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Annex I. Estimating the Impact of Interest Rate Shocks on Assets Prices—A Simple Approach

A standard approach is to express the current value of a stock p_t , at time t , in terms of the expected stream of dividends, D , from the next period ($t+1$) onwards:

$$p_t^{eq} = \frac{D_{t+1}}{(1+r_{t+1})} + \frac{D_{t+2}}{(1+r_{t+2})^2} + \frac{D_{t+3}}{(1+r_{t+3})^3} + \dots$$

This stream of future dividends must then be discounted by a discount rate $R(t)$, which contains a risk-free long-term interest rate (such as the US Treasury yield or the German Bund yield) and a risk spread known as the equity risk premium (ERP).

The ERP, captures the expected return on stocks *in excess of* the risk-free rate.¹ The ERP is considered a measure of aggregate risk and a determinant of the cost of capital for corporations, and of savings decisions of individual households. In the simplest case, dividends are assumed to grow at a constant rate, g , over the life of the asset. In this case, we can re-write the equity price level as a ratio of the growth rate of dividends scaled by the ERP plus the difference between a constant² risk free rate r and the steady state growth rate of earnings:

$$p_t^{eq} = \frac{(1+g_1) D_t}{(ERP+r) - g_1}$$

The assumption of constant dividend growth can be relaxed. In this exercise, we assume a 3-stage process for earnings growth (specifically for earnings per share, EPS). That is, the growth rate of EPS ultimately converges to a steady state level (i.e. EPS growth is mean-reverting). While the equity price level ($P(t)$) is observable and so are the dividend and the current risk-free rate, the the growth rate of EPS g is not. So, analyst earnings forecasts (source: Reuters I/B/E/S) are used to provide an estimate for $g=g(ibes)$ over the first dynamic stage of the model (see Figure A1). Thereafter, the growth rate transitions towards a steady-state rate g , which is pinned down by long-term restrictions.³ For a 3-stage dividend discount model, the valuation equation can be written as:

$$p_t^{eq} = \frac{D_t}{(ERP+r_{t+h}) - g_{ss}} [(1+g_{ss}) + \gamma (g_{fcts,t+h} - g_{ss})]$$

¹ Specifically, the ERP is the extra compensation that investors require to make them indifferent at the margin between holding the risky market portfolio and a risk-free bond. But because this compensation depends on the future performance of stocks, the ERP incorporates expectations of future stock market returns, which are not directly observable (but can be inferred using models).

² During the life of the assets.

³ g which is pinned down by a long-term restriction which simply imposes the return on equity to be equal to the cost of equity. The duration of the transitional phase towards steady state may be up to 7–8 years, depending on the calibration chosen. This long-term equilibrium is pinned down by a LT restriction which simply imposes the return on equity to be equal to the cost of equity.

The ERP affects the cost of capital, and is therefore a determinant of investment. For example, when the ERP is high, issuing equities is costly for corporates, and are not incentivized to finance in capital markets to invest.

Bonds and Fixed Income Assets

To estimate the effect of a given shock to interest rates on the price of a bond, we can approximate the impact by using the relevant bond's duration and convexity properties.

$$P_{t,t+T}^{fi} = \frac{C_{t+1}}{(1+r_{t+1})} + \frac{C_{t+2}}{(1+r_{t+2})^2} + \frac{C_{t+3}}{(1+r_{t+3})^3} + \dots + \frac{P_{t+T}}{(1+r_{t+T})^T}$$

Specifically, the change in the price of the bond is a negative function of duration (d), plus a second order term which captures the effect of convexity:

$$\frac{\partial p}{\partial y} \frac{1}{p} = \frac{1}{\Phi} [-d] dy + \frac{1}{2} \frac{\partial^2 p}{\partial y^2} \left[\frac{dy}{\Phi} \right]^2$$

The longer the duration of the bond (d) the more negative will be the impact of an interest rate increase on its price level. Higher convexity also results in a larger price impact of interest rate shocks.

Annex II. Summary of Macroprudential Policy Measures in Denmark

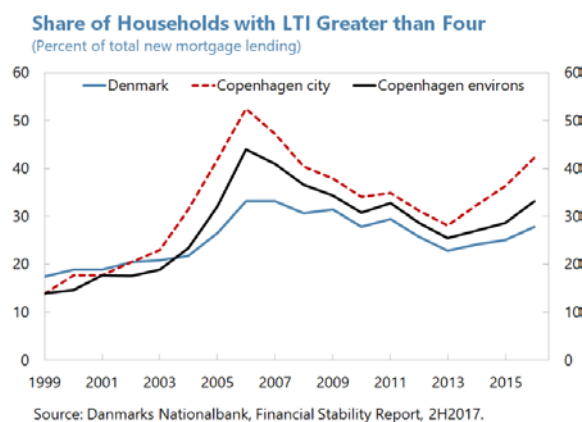
1. The global financial crisis and the ensuing credit crunch contributed to a housing market bust in Denmark. Housing prices declined 23 percent in real terms nationally from their 2006 peak to their eventual trough in 2009, and in some regions and housing market segments, such as the Copenhagen metropolitan area and owner-occupied flats, prices fell as much as 40 percent over the same period. The subsequent recovery was slow at first, led by the major metropolitan areas partly reversing their substantial decline, but it gained speed after 2013 and became more widespread as economic growth resumed.

2. Rising housing prices amid high household debt have beckoned the need to control the formation of new debt, and build resilience in households. The decline in housing prices and household incomes following the global financial crisis forced households to reduce consumption while deleveraging. Credit creation slowed down considerably compared to its pre-crisis trend, and has grown only marginally in nominal terms since 2009 (and declined as a share of GDP or disposable income). Nevertheless, household debt in Denmark remains among the highest in the OECD, and the recovery in housing prices has added to the propensity for risky borrowing. The rapid increase in housing prices in the metropolitan areas overlaps with the areas with strongest credit creation, inviting concerns that households are forced to borrow more than they can afford. This makes them sensitive to future increases in lending rates and tightening of financial conditions. As such, macroprudential and other housing policies in Denmark since 2012 centered around the need to control risks related with the high household debt, and rising housing prices.

3. Danish authorities have adopted many measures to address the increasing formation of risky debt. Measures are usually announced in combination of metrics, and the paragraphs below discuss the main macroprudential and other measures announced since 2012.

4. Nevertheless, ongoing housing price increases may be seeding more macroeconomic vulnerabilities. The rise in housing prices forces households to borrow more relative to their income. This can make them more sensitive to interest-rate shocks, as there is still a high share of adjustable-rate mortgages.

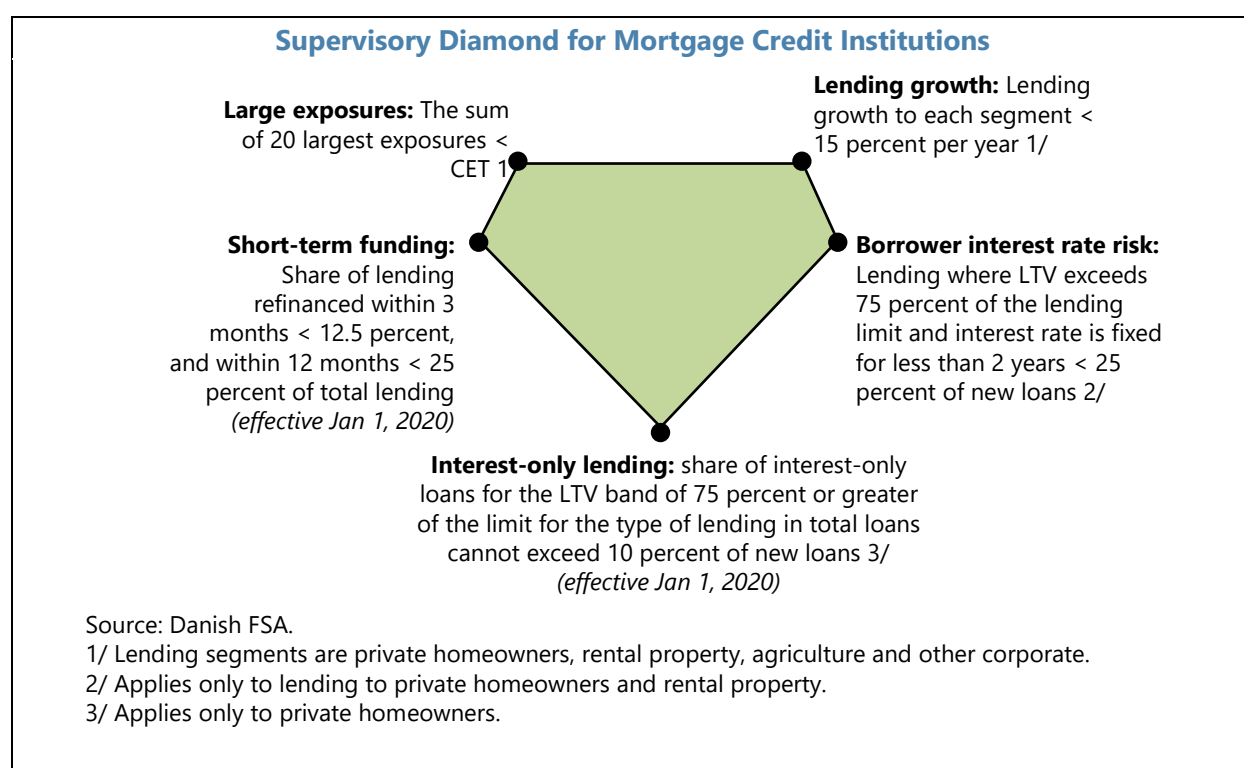
5. Macroprudential policy in Denmark is performed with a broad input from several authorities. The designated macroprudential authority in Denmark is the Ministry of Industry, Business and Financial Affairs (formerly known as the Ministry of Business and Growth) and operates within an institutional framework. A key component of the framework is the [Systemic Risk Council](#), which is tasked with identifying and monitoring systemic financial risks. The Systemic Risk



Council meets and assesses risks periodically, and issues observations, warnings and recommendations to the Ministry of Industry, Business and Financial Affairs with a “comply or explain” principle. The Systemic Risk Council comprises the Danish central bank (head), the Danish Financial Supervisory Authority and other public entities and experts.

6. Many demand-side macroprudential measures have been put in place since 2014 to bolster the resilience of borrowers. Loan origination and amortization measures have been bundled in primarily four sets of measures:

- **Supervisory Diamond for Mortgage-Credit Institutions.**¹ (Proposed: December 2014; effective: January 2018, unless otherwise noted.) A regulatory framework consisting of 5 benchmarks for mortgage credit institutions was announced in 2014 and amended in 2016.



- **Mandatory Downpayment.** (Proposed December 2014; effective November 2015). A consumer protection clause mandates at least 5 percent downpayment for residential real estate purchases, translating into an effective 95 percent maximum loan-to-value (LTV) limit. However, tighter single-loan restrictions apply, with 80 percent LTV per loan.² The remaining 15 percent of the value of the property is financed with an additional loan having a secondary lien status.

¹ The Danish FSA characterizes the regulatory purpose of the supervisory diamond for MCIs as prudential due to its implementation, but in a broader context it functions as a macroprudential tool by applying to all systemic credit institutions.

² Secondary homes and vacation properties have lower LTV limits. LTV limits were raised for vacation properties from 60 percent to 75 percent in 2017 to promote a broader national housing recovery following the housing bust.

- **Guidelines on Good Mortgage Lending in Growth Areas (Seven Best Practices).** (Proposed September 2015; effective February 2016). On a recommendation by the Systemic Risk Council, the Danish FSA set seven guidelines in 2015 on good mortgage lending, particularly in areas with large price increases, dubbed *Seven Best Practices*. The first five practices apply only to borrowers in high housing price growth areas (Copenhagen district area and the municipality of Aarhus).
 - i. Before granting floating-rate mortgages lenders must assess borrowers' repayment ability under a scenario of interest rate hikes.
 - ii. When granting loans to applicants for buying into cooperative housing associations lenders must assess the cooperative associations' debt under a scenario of interest rate hikes.
 - iii. Borrowers with negative equity position must amortize sufficiently with a maximum repayment period of 30 years, but exceptions may be granted if LTV is below 80 percent.
 - iv. Borrowers with loan-to-income (LTI) between 4 and 5 must have positive net wealth in the event of a 10 percent decline in house prices, and borrowers with LTI above 5 are similarly stress-tested for a 25 percent decline in house prices. Exemptions may be given to borrowers with high job security if they have fixed-rate and amortizing mortgages.
 - v. In cases where a borrower buys a new home before the old one is sold, the borrower must pay interest and principal payments on both homes until the lender expects the old home to be sold (6 months minimum). Similar provisions apply to borrowers with more than two residences.
 - vi. Lenders must make individual considerations for assessing a borrower's repayment capacity rather than only meeting institutional minimum requirements for their disposable income.
 - vii. When financing purchases in cooperative housing associations, lenders must review the association's underlying financial status (annual reports and budget) to ensure that the borrower is buying a healthy association.
- **Good Business Practice for Mortgage Lending.** (Proposed March 2017; amended October 2017; effective January 2018.) Following recommendations by the Systemic Risk Council the government adopted lending restrictions for households with LTI greater than 4 times and LTV greater than 60 percent: (a) the interest-rate fixation of floating-rate mortgages needs to be at least 5 years, and (b) deferred amortization is only applicable on 30-year fixed-rate loans.

Demand measures tend to be tailored to fit the risks forming in households, rather than applying them as outright restrictions of lending. The summary table below shows the span of these measures along the traditional LTV, DTI, and amortization taxonomy.

Demand-Side Macroprudential Measures in Denmark and their Scope			
	Loan-to-Value	Debt-to-Income	Amortization
Supervisory Diamond for Mortgage Credit Institutions		✓	✓
Seven Best Practices		✓	✓
Mandatory Downpayment	✓		
Good Business Practice for Mortgage Lending		✓	✓
Source: IMF staff.			

7. Supply-side measures have also increased in line with European legislation. The Danish authorities have introduced capital measures within the relevant European directives.

- A **capital conservation buffer** applies to all Danish credit institutions since 2015, and will reach 2½ percent of risk-weighted assets by 2019.
- A **systemic risk buffer** applies to six systemically-important institutions,³ and by 2019 it will range between 1 and 3 percent of risk-weighted assets, depending on the institution.
- A **countercyclical capital buffer** for all credit institutions currently set at ½ percent of risk-weighted assets set to take effect on March 31, 2019. The Systemic Risk Council has recommended that this measure may have to rise to 1 percent next year if risks continue to build up, but the government warned that under current credit conditions this will not be approved.

The six systemically-important financial institutions will carry fully-loaded combined buffer requirements between 4 and 6 percent of risk-weighted assets by 2019, in excess of minimum capital and Pillar II add-ons.

8. New liquidity measures were introduced with the Capital Requirements Directive IV (CRD IV). The 2009 Danish Financial Business Act set requirements for banks to hold liquid and unencumbered assets as a liquidity buffer. Banks were subject to a funding ratio to prevent maturity mismatches. The 2010 Supervisory Diamond for Banks framework tightened some of these regulations with the excess liquidity coverage.⁴ Since 2015 under CRD IV a liquidity coverage ratio and net stable funding ratio (NSFR) have replaced the liquidity buffer and funding ratio. While most credit institutions observe liquidity requirements in line with the NSFR guidelines, institutions are not required to meet the NSFR requirements yet. The authorities are currently awaiting the legislative process in the EU with respect to the NSFR.

³ The designated systemically-important institutions are Danske Bank, Nykredit, Jyske Bank, Sydbank, Nordea Kredit, and DLR Kredit.

⁴ The [2014 Denmark FSAP](#) details the requirements under each regulation and the changes resulted from the transposition of the CRD IV framework.

9. Some tax reforms have also been implemented. The deduction of mortgage interest expense against income taxes is being reduced through 2019. Borrowers can deduct up to 32.7 percent of their mortgage interest expense from their personal income taxes for expenses up to DKK 50,000. For expenses over DKK 50,000 the deduction is limited to 26 percent of interest expense in 2018 and 25 percent in 2019 and thereafter. A property and land tax reform was agreed in May 2017, and when it goes in effect in 2021 it aims to remove a property tax freeze and allow for more representative land tax increases.

CAPITAL INCOME TAX REFORM OPTIONS IN DENMARK¹

Like other countries, Denmark faces pressures from international tax developments, such as tax competition and profit shifting, and increasingly digitalization. The international tax provisions of Denmark are comparatively strong and require only minor technical adjustments for full alignment with international initiatives such as the EU Anti-Tax Avoidance Directive. Domestically, the Danish tax system could be made more favorable toward investment, especially for small and high-technology firms, for example by reducing dividend taxation, relaxing rules on loss utilization, and making the R&D tax treatment more generous. Moreover, starting from a relatively efficient tax system, Denmark is in a position to consider fundamental reforms that would address the debt bias and disincentives to investment at the margin, for example through the introduction of an allowance for corporate equity. Addressing the fundamental problems of international corporate income taxation, such as those exacerbated by digitalization, would benefit from multilateral rather than unilateral actions.

A. Introduction

- 1. Corporate income tax (CIT) systems around the world are under increasing pressure from international profit shifting and the mobility of capital.** Tax competition over reported profits² and investment has put downward pressures on CIT rates, which have been on a downward trend for the least three decades. Denmark, like any small open economy, is affected strongly by these developments.
- 2. Recently various international initiatives have been taken to curb profit-shifting opportunities of multinational enterprises.** These include the OECD/G20 initiative to curb Base Erosion and Profit Shifting (BEPS) and the EU's Anti-Tax Avoidance Directive (ATAD). For Denmark, these initiatives provide opportunities, in that they may help reduce profit-shifting and they bring other countries closer to the relatively tight rules already existing in Denmark. They also affect Denmark in requiring some adjustments, where Danish rules are not fully in line with agreed standards.
- 3. Digitalization intensifies many of the existing difficulties in the international tax system.** Digital companies—or more generally any companies becoming more digitalized—are often marked by high profitability and intensive use of intangible assets. Neither issue is new, for example they are also prevalent in the pharmaceutical industry, but they are increasing in importance. One feature of the so-called “digital economy” is sales without a physical presence. This

¹ Prepared by Alexander Klemm, Shafik Hebous (both FAD), and Cory Hillier (LEG). This paper has been prepared as part of FAD's initiative to support IMF surveillance with analyses of international tax issues. It has benefited from discussions with the Danish authorities, business representatives, and tax experts. We gratefully acknowledge useful comments from the Danish authorities, Victoria Perry, Miguel Segoviano, and Tigran Poghosyan.

² Profit shifting methods abound, but prominent ones include transfer pricing (e.g., overpricing of imports from affiliates in low tax jurisdictions), intra-company debt (i.e., affiliates in high tax countries borrow from affiliates in low tax jurisdictions and pay interest to them), and royalties for uses of patents or trademarks.

is also not entirely new, but is much more prevalent now than during times of catalogue shopping. Under the current tax system, market jurisdictions (i.e., where consumers are located) cannot tax the profits of companies selling into their economy from abroad, because, in the generally agreed architecture, a nexus in the form of a physical presence (or “permanent establishment (PE)”) is a precondition. Moreover, some firms make use of user-generated value, from data that users provide in return for access to a service. This is a relatively newer issue, and there is no consensus on whether and how this should affect international tax design issues.

4. The challenges of the digitalization of the economy are also reflected in international efforts, like those on BEPS generally, but unlike on those issues, no consensus has yet been achieved at all. Digitalization was a specific focus of the BEPS Action Plan leading to the 2015 BEPS Action 1 Report. Although the BEPS project addressed some of the BEPS challenges exacerbated by digitalization, no consensus was reached in 2015 on either an interim or longer-term solution. It was further acknowledged that it would be difficult—if not impossible—to ‘ring-fence’ the digital economy from the rest of the economy. The OECD Interim Report—Tax Challenges Arising from Digitalization—mandated in 2017 by the G20 and published on March 16, 2018 (Interim Report) did not contain concrete proposals for international tax reform. However, the Interim Report did recognize the need to continue to work toward a consensus-based solution over the longer term—noting that at present—there are divergent views on how the issue should be approached, with also no agreement on the need for interim measures. In contrast, on March 21, 2018, the European Commission (EC) published a concrete proposal for a two-fold strategy to reform the taxation of digital companies and business models. The EC put forward a “comprehensive solution” over the longer term, together with a more “targeted solution” in the interim in the form of a digital services tax at a rate of 3 percent on the turnover of certain large digital companies. The OECD will also undertake further work in this area with the intermediate step of updating the G20 on its progress in 2019 and with the ultimate aim of continuing to work toward a consensus-based solution by 2020. Table 1 provides a comparison of key aspects of the OECD Interim Report and EC proposal. Denmark, as both a user and producer of digital services, will clearly be affected by these initiatives.

B. Assessment of Business Taxes

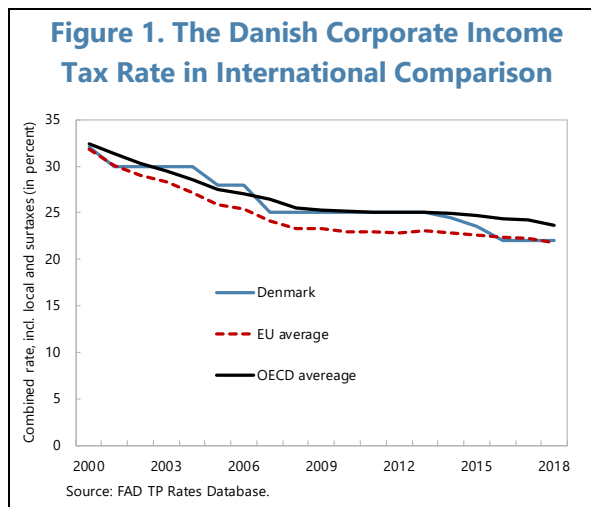
Main Features

5. The CIT rate of 22 percent is close to the EU and OECD averages. As shown in Figure 1, when local taxes and surtaxes are included (which can be sizable in some countries, such as Germany, Switzerland, or the United States), the Danish rate is at the EU, and slightly below the OECD, average. The recent U.S. reform brought the federal U.S. rate down to 21 percent. However, as the average combined rate including state taxes stands at around 25.75, the Danish rate remains lower.

	OECD Interim Report	EC Proposal
Digitalization, Value Creation, and Tax	No agreement was reached on whether—and to what extent—the key characteristics of highly digitalized businesses (such as the role of data and user participation) contribute to value creation by the enterprise.	The EC seeks to tax digital companies and business models on the basis that users contribute considerably to value creation by the enterprise.
Longer-term solution	Need to continue to work toward a consensus-based solution—noting that, at present, there are divergent views on how the issue should be approached.	The EC envisages a “comprehensive solution” with a reform of the nexus and profit allocation rules that centers on the introduction of a virtual permanent establishment (so-called “significant digital presence”). This would require EU Member States to amend their existing tax treaties with third countries, and involves consequential amendments to the CCCTB proposal.
Interim solution	The Interim Report considers an interim measure in the form of an excise tax on the supply of certain e-services within the local market jurisdiction that would apply to the gross consideration paid for the supply of such e-services. However, there was no consensus on the need for—or merits of—interim measures, but design considerations were outlined to limit risks, which include the need to comply with existing tax treaties and international obligations.	Need for a “targeted solution” in the interim in the form of a specific tax on certain digital services (i.e. a “Digital Services Tax” or DST). This tax would be levied on gross turnover at a uniform tax rate of 3 percent. The DST generally covers services where the main value is created by user data, with some exceptions. The DST would apply to both foreign and domestic companies, but only to firms with a worldwide turnover exceeding EUR 750 million and which generate revenues from digital services in the EU of at least EUR 50 million.

Source: IMF staff assessment.

6. The tax base is marked by relatively generous depreciation, but restrictive loss offsets. Most plant and machinery is depreciated using the pooled³ declining-balance method under a 25 percent rate. Business buildings are depreciated individually at 4 percent straight line. An interesting feature of Danish depreciation rules is that they are only maximum amounts, and companies can choose lower—even zero—depreciation if they prefer. Losses may be carried forward but cannot offset more than 60 percent of future profits above DKK 8.2 million (2018).⁴



7. A limited number of business tax incentives are offered, most importantly for Research and Development (R&D). As a general investment incentive additional depreciation was used in the past (e.g., between May 30, 2012 and December 31, 2013). Shipping companies benefit from a tonnage tax regime (with European Commission approval). R&D costs can be expensed—as in most countries; moreover, the tax benefit of R&D expensing of up to DKK 25 million per year is refundable for loss-making taxpayers. Nonetheless, the implied tax subsidy rate is far below the OECD median (OECD, 2017). The government announced (February 2, 2018) an R&D super-deduction of 110 percent of R&D spending by 2026, phased in from 2018 at initially 101.5 percent. Unlike the standard deduction, the tax value of the part that exceeds 100 percent is not refundable.

International Initiatives

8. Denmark is an early adopter of strong anti-avoidance rules. Denmark's rules cover transfer pricing, controlled-foreign companies (CFC), limitation on interest deductibility, and other more general anti-abuse provisions. These are largely in line with the G20/OECD BEPS Project and the July-2016 ATAD (Box 1). However, some further strengthening of existing anti-avoidance rules is expected.

Box 1. Denmark's International Obligations and Commitments Regarding the CIT

Denmark is committed to implementing the four Minimum Standards of the G20/OECD BEPS Project. These are: countering harmful tax practices, preventing tax treaty abuse, transfer pricing documentation, country-by-country (CbC) reporting, and improving tax treaty dispute resolutions. Denmark has already largely implemented all 15 BEPS Actions. For example, Denmark has implemented CbC reporting under which multinational groups with a consolidated turnover of at least DKK 5.6 billion must prepare and submit a CbC report to the Danish tax administration. In addition, Denmark has several obligations and commitments under EU law. Notable obligations include the implementation of the ATAD, adopted on July 12, 2016. ATAD requires all Member States to implement five anti-tax abuse measures. The ATAD goes further than the four minimum standards under BEPS. Table 2 provides a summary.

³ Except that losses on sale of assets can be deducted immediately rather than remaining in the pool.

⁴ Companies cannot benefit much from using the flexible depreciation rules to circumvent the loss-offset limitations, because they must not exceed the maximum annual rate, even if they took less depreciation in previous years.

Table 2. Denmark: ATAD Implementation in Denmark

ATAD Measures	BEPS Action/ Minimum Standard?	Denmark	Description
Interest limitation rule	Yes/No	Some differences ¹	ATAD prescribes an earning-stripping rule that denies interest deductions if the ratio of net interest payments to EBITDA exceeds 30 percent. Unused deductions can be carried forward. In Denmark, interest deductions may be limited by three sets of rules: (1) a thin capitalization debt to equity ratio of 4:1; (2) an asset test which limits interest deductions to 2.9 percent of the tax basis of assets; and (3) an EBIT test which limits interest deductions to 80 percent of earnings before interest and tax. Some legislative amendments may be made to align the current EBIT test with the EBITDA rule in the ATAD.
Controlled foreign company (CFC) rule	Yes/No	✓	Under the ATAD, Member States must implement CFC legislation in their national laws incorporating certain legal design features. Denmark has adopted a CFC regime which applies where: (i) a Danish company controls, directly or indirectly, more than 50 percent of the voting power of the foreign company; (ii) more than 50 percent of the income of the foreign company is of a financial nature; and (iii) financial assets of the foreign company constitute more than 10 percent of the total assets of that company. In 2017, Denmark resolved to further strengthen its CFC regime in connection with the ATAD.
Hybrid mismatches rule	Yes/No	✓	This rule counters tax planning that exploits differences in countries' legal characterization of an entity or a financial instrument (leading to double deductions or a deduction without an equivalent income inclusion). The ATAD, which originally addressed arrangements within the EU, was extended in March 2017 to cover arrangements between EU and nonmember states (ATAD II). Denmark's current rule on hybrid companies targets similar hybrid structures.
GAAR	No/No	✓	Under the GAAR in the ATAD, nongenuine arrangements that are put in place for the main purpose of obtaining a tax advantage that defeats the object or purpose of the applicable law should be ignored when determining a tax liability. The GAAR in the ATAD should be applied to the entire domestic corporate tax laws of the Member States. Denmark has a broadly consistent GAAR but it applies more specifically to deny tax treaty and EU Directive benefits where abuse is found.
Exit taxation	No/No	✓	EU Member States shall apply an exit tax to prevent companies from avoiding tax in the state of origin by moving their tax residence or closing a permanent establishment. This tax safeguards against base erosion, rather than being a source of revenue. Denmark applies an exit tax.

¹ Denmark has until January 1, 2024 to conform to the ATAD where its targeted rules are equally effective as the prescribed interest limitation rule.

Source: IMF staff assessment

9. Being an early adopter, Denmark imposed relatively higher compliance costs on firms and, because of frequent changes in the past, had a reputation of lack of tax certainty among taxpayers. Denmark therefore stands to gain from the international initiatives, which will lead to the adoption of similar rules in other countries through more significant reforms, and which will only—in comparison—require minimal changes in Denmark. Tax certainty is increasingly recognized as an important factor in encouraging investment (Box 2). Further, a stable, competitive and predictable tax

Box 2. Tax Certainty

Tax uncertainty is a concern among the business community—as in many other countries. It has been subject to a longstanding debate in Denmark, given that Denmark has historically been an early adopter of strong anti-avoidance rules. The importance of improving stability and certainty in tax matters has also received attention internationally in the context of the G20 tax agenda (IMF/OECD, 2017). An update on tax certainty is expected to be delivered to the G20 in July 2018.

Theoretically, the impact of uncertainty on investment is unclear, but empirical studies, while limited, suggest that tax uncertainty can adversely impact investment and trade. This is supported by the business and tax administration surveys included in the IMF/OECD (2017) G20 report on tax certainty, according to which uncertainty in the CIT (and VAT) systems has an important impact on investment and location decisions of businesses.

Various tax integrity or anti-avoidance rules are very important in order to effectively counter tax avoidance practices and protect the integrity of the tax system. This is because even the best-designed and drafted tax laws are not capable of anticipating every taxpayer transaction and aggressive tax-planning structure. Anti-avoidance provisions can take different forms and their effect on tax certainty needs to be carefully managed. For instance, the success of a GAAR is often dependent on it being applied by the tax administration in a measured, even handed and predictable way, particularly given that a GAAR is necessarily less rules-based and more discretionary in its application (Waerzeggers and Hillier, 2016).

Unacceptable tax avoidance practices may also be dealt with through other legal instruments or doctrines, each of which can also affect tax certainty. These include a more specific legal provision of targeted application in domestic law (for instance, a specific anti-avoidance rule or SAAR), equivalent provisions to that of a GAAR or SAAR in tax treaties, and/or judicial anti-abuse doctrines. All of these instruments and doctrines are already features of the Danish tax system. Anecdotal evidence suggests that this has made the Danish tax system relatively more complex and uncertain for businesses when compared to other countries who have deferred adoption of new or tighter tax anti-avoidance rules, despite many of those rules being considered necessary to protect the local CIT base.

Many of the stronger and more complex tax anti-avoidance rules that have been adopted early by Denmark now form part of the BEPS and ATAD measures. Therefore, the Danish tax system could now benefit from relatively greater stability and predictability (and therefore reduced taxpayer compliance costs) when compared to other countries which need to implement more significant tax law reforms in order to comply with those measures.

Important efforts have also been made to improve legal certainty for taxpayers in Denmark, in particular through the advance tax rulings system. Advance tax rulings are widely recognized as an important tool for improving taxpayer certainty (IMF/OECD, 2017, pp. 45–46), and as a way to promote clarity and consistency in the application of the tax law for both taxpayers and the tax administration (Waerzeggers and Hillier, 2016). To fully achieve these objectives, however, taxpayers should be able to obtain a swift response from the tax administration on the widest range of material issues, including international tax issues. Other tools—such as an increased Advance Pricing Agreements (“APAs”) program—can also improve certainty for businesses and tax administrations (IMF/OECD, 2017, pp. 52–54).

system is also important from the perspective of businesses as well as governments. Complexity of tax legislation and frequency of tax law changes are commonly cited sources of tax uncertainty for both taxpayers and tax administrations. Denmark should also take into account the impact of implementing more extensive measures than are required under the international initiatives, with particular regard to what is being adopted by other relevant countries. For example, Denmark's interest limitation rules are generally more extensive than ATAD.

10. Denmark's tax policy is also constrained by obligations and commitments under the EU, notably the Code of Conduct for Business Taxation and the State Aid Rules. The Code of Conduct for Business is a political commitment by Member States to refrain from engaging in "harmful tax competition," which covers many preferential tax regimes, including those targeted at attracting reported profits. EU state aid rules prohibit Member States from offering government support, including through the tax system, that gives a company an advantage over its competitors in the EU. Cases can be simultaneously within the ambit of the Code of Conduct and state aid rules. Currently, no major Danish rule is known to be in violation of these obligations. The preferential shipping regime has EU approval.

11. Despite tight tax anti-avoidance rules in Denmark, the observed bilateral FDI pattern suggests that international profit shifting remains a risk to CIT revenue. Cristea and Nguyen (2016) estimate that Danish multinationals reduced their tax liabilities by 3.2 percent during the period 1999–2006. Comparing data from bilateral FDI stocks to data that are adjusted for the country of ultimate ownership, reveals that inbound FDI often comes through indirect routes (Table 3). While this may have many reasons, it is very likely that it also reflects tax-driven conduit and other complex structures of multinationals. One factor may be special tax provisions offered in some countries.⁵ Another important factor that may drive bilateral Danish FDI is seeking to benefit from double tax treaties between a conduit country and a non-EU member ("treaty shopping")—which can be especially important for non-Danish multinationals. This pattern occurs despite Denmark's strong anti-abuse rules to combat treaty shopping, including a domestic law general anti-abuse rule (GAAR) that applies to deny tax treaty benefits where the most significant purpose of an arrangement or transaction is to obtain treaty benefits which are not in accordance with the content and purpose of the particular tax treaty. Denmark also signed the Multilateral Convention (MLI) on June 7, 2017 which will see Denmark's covered tax treaty network adopt the principal purpose test (PPT) to address situations of treaty abuse.

⁵ For example, since 2013 the European Commission has been investigating whether some tax ruling practices (i.e., potential state aid in the form of reduced effective tax rate for specific companies) in some EU Member States were compliant with EU state aid rules. These include cases such as GDF Suez ENGIE, Amazon, and McDonalds. The Commission has made findings of state aid through tax rulings against Ireland (in relation to Apple), the Netherlands (in relation to Starbucks), Luxembourg (in relation to Fiat) and Belgium (for its excess profits rulings). As of 2018, such rulings are no longer in place, although several EU Member States have appealed against the Commission's decisions.

Table 3. Denmark: Top Danish FDI Partners

Inward FDI (percent of total inward FDI)		Outward FDI (percent of total outward FDI)	
<i>Unadjusted figures (2016)¹</i>			
Sweden	17	Sweden	13
Luxembourg	13	United Kingdom	11
Netherlands	12	Switzerland	11
United Kingdom	9	United States	9
Norway	9	Germany	7
<i>Figures adjusted for ultimate origin (2015)</i>			
United States	17		
United Kingdom	10		
Germany	9	Not available.	
Netherlands	7		
France	7		

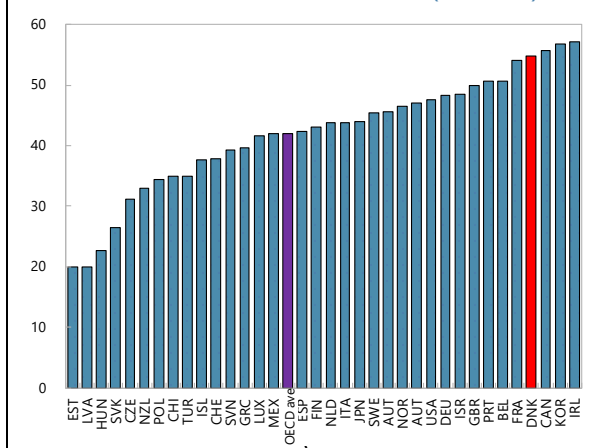
¹ Inward FDI figures for 2015 are extremely similar.
Sources: unadjusted: IMF Coordinated Direct Investment Survey (CDIS), adjusted: Danmarks Nationalbank (2017).

C. Integration with Personal Income Taxes

12. Personal income is taxed at progressive rates, which differ by the type of income.

- Labor income faces a top tax rate of 55.9 percent. This rate includes the labor market contribution of 8 percent, which applies without allowance to all labor income and is deductible for other taxes. The other taxes, which include the national income tax, the municipal income tax, and health contributions add up to at most 52.02 percent (the national tax is reduced below its 15 percent top value in case the total of all three taxes exceeds 52.02 percent). Moreover, labor income is additionally subject to a fixed monthly supplement payment of DKK 94.65.
- Income from capital other than shares is taxed at a top rate of 42.7 percent. The rate is thus lower than for labor income, and moreover capital income benefits from additional allowances. Capital gains are taxable at the same rate, and capital losses are deductible within this income category. Both are recognized only on realization.
- Income from shares is taxed at rates of up to 42 percent. Below DKK 51,700 a rate of 27 applies, which is collected through withholding. As for other capital income, capital gains are taxed on realization at the same rate, and losses are deductible against other income from shares. The combined rate

Figure 2. Combined CIT and Dividend Tax Rate on Distributed Profits (Percent)



on dividends, including the CIT paid before distribution, reaches 54.8 percent, which is very close to the top rate on labor income. The combined rate is also very high by international comparison (Figure 2).

13. **Capital invested through certain vehicles, most notably pension funds, benefits from preferential tax rates.**

- Pensions contributions are made out of pre-tax earnings, returns are taxed, and final pensions are also taxed (ETT). This is less generous than in most other countries that either tax contributions (TEE) or pensions (EET). However, it is still an advantage compared to saving outside of pension funds, because the tax on return is reduced to 15.3 percent.⁶ Even though this tax applies to accrued capital gains, rather than realized ones as for direct share holdings, the much lower rate will in most cases provide a reduction. Any capital losses can be used only against pension account income. Contribution levels are usually set in labor contracts (typically 12 percent of salary, 2/3 of which is paid by the employer), but individuals can also set up individual pension accounts to which they may contribute up to DKK 54,000 per year.
- Authorities are planning to introduce a Share Savings Account as a vehicle for saving in listed shares. This will benefit from a preferential rate of 17 percent (including on accrued capital gains, as in the case of pensions), and would be limited to DKK 50,000 or DKK 200,000 (discussions are ongoing) per person. Once the limit is reached individuals will not be allowed to add further new funds into these accounts, but any returns on existing shares may be kept in the account without limit.

14. Overall, the Danish tax system can be described as a dual income tax, although it is relatively close to comprehensive income taxation. Compared to theoretical tax systems ranging from consumption to comprehensive income taxation, the Danish system is closer to the latter. Capital income, except for income from shares, does face a slightly lower rate and various savings vehicles ensure preferential treatment of savings, but only within limits. Investment in owner-occupied housing, as in many other countries, has tax advantages through the nontaxation of imputed rents, while mortgage interest is partly deductible.

D. Reform Options

15. Overall, the Danish CIT system is in good shape with no urgent need for major adjustments. Still, some relatively small adjustments need to be taken to fully align the system with international requirements, and some reforms could be considered to improve investment incentives, especially of small and high-technology firms. Moreover, fundamental tax reforms could be considered to go beyond international standards and make the system neutral with respect to debt and investment.

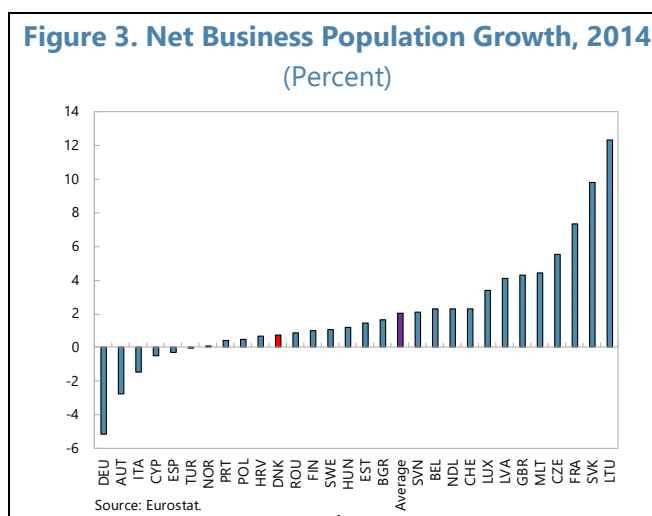
⁶ For high-income earners, this also increases incentives to save. For low-income earners, this incentive is much weaker, because there is also a means-tested noncontributory pension. The withdrawal rate of means-tested pensions reduces the return on savings for these individuals, and this is usually more important than the tax advantage of contributory pensions. High-income earners simply expect to receive the minimum noncontributory pension and are not affected by withdrawal at the margin.

Reforms within the Current System

16. In response to recent international initiatives aimed at reducing profit shifting, Denmark will require minor technical changes only. Specifically, one of the Danish interest deduction limitation rules will need to be changed from EBIT to EBITDA to be aligned with the requirements. The practical implication is likely to be limited, as for most firms the more binding limitation is the restriction in terms of assets, which is not affected. In general, there is little need for further tightening of anti-avoidance rules, which are already stronger than in most countries. However, as new avoidance strategies keep being developed, vigilance in this area is always warranted.

17. Various measures could be taken to decrease disincentives for investment by small and high-technology companies.

New companies naturally face cash constraints and obstacles in access to finance, given their lack of history. High-technology companies also face difficulties in obtaining loans, because of a greater share of intangible assets, which cannot be used as collateral. Moreover, both startups and high-tech companies are prone to have many years of loss-making, followed by very high profits in case of success. Given the importance of such firms for technological progress, the tax system should at least not create additional difficulties for such firms. The rate of net new business creation in Denmark is relatively low compared to other European countries (Figure. 3), although this certainly is not only driven by the tax system. Various aspects of the Danish tax system discourage such businesses and could be reformed. In order of priority:



- The tax rate on dividends could be reduced.⁷ The high taxation of dividends discourages equity investments in startups by individuals. Listed firms are less affected, as their marginal shareholders are likely to be pension funds or foreign investors. For small investors with little collateral, there is no alternative to equity funding, which implies a very high cost of capital for them.
- The limitations on the use of losses carried forward could be relaxed. The limitation poses a challenge for cash-constrained startups. When they finally become profitable, this slows down the rate at which they can use up past losses. For some business activities, such as the development of patents, which are sold in case of success, loss recovery may never happen, as a successful year is followed by loss-making years during which the next patent is developed.

⁷ The revenue consequences should be manageable, as total taxes on shares made up about 1.8 percent of total tax revenues (2016).

- Alternatively, rules restricting the deductibility of costs for business establishment, expansion or development could be relaxed. As a result of the current rules, existing businesses with free cash flow that could instead undertake new investments are also disincentivized by the tax system.
- The treatment of R&D deductions could be made more generous. The refundable part of the R&D deduction counteracts some of the problems of cash-constrained firms in a loss-making position. However, to fully reap the benefit of the super-deduction, this could also be made refundable.

18. Reducing the rate of taxation on dividends would require accompanying regulations, but international experience suggests that these would be manageable. The advantage of the current system is that owner-run businesses have little incentive to categorize income as dividends rather than labor, as top tax rates are very similar. If the tax rate on capital income is materially lower than the tax rate on labor income, then owners face strong incentives to withdraw most of their income in the form of capital income (dividends and capital gains). A number of rules-based approaches have been developed in other countries to allocate income between labor and capital income in these circumstances (Table 4).⁸ These approaches are generally preferred over a more case-by-case rule using taxpayer specific facts and circumstances to determine reasonable compensation amounts. Denmark already has some similar rules, so as to prevent excessive savings inside such firms. Ensuring the effectiveness of the chosen rules will require striking an appropriate balance with respect to the inherent trade-off between certainty and simplicity. In this regard, the ultimate set of rules must be effective in achieving their policy objective of combating income shifting towards low taxed capital income and preventing abuse,⁹ but not become so complex that they are difficult to:

Table 4. International Approaches to Splitting Wages and Profits of Owner-Run Businesses

Approach	Description
Dividend income allocated between capital income and labor income	Specific rules of mechanical application apply to calculate a statutory rate of return on an owner-manager's equity investment/investment in business assets (e.g., the sum of the owner-manager's investment is multiplied by the return on government debt plus a premium to produce the statutory rate of return). The owner-manager's dividend income is then treated as: (i) low-taxed capital income up to the calculated statutory rate of return; (ii) as labor income to the extent of any excess up to a labor income cap; and (iii) with further excess returns above that labor income cap, being (again) treated as low taxed capital income. An approach of this kind has been adopted in Sweden and Finland.
Minimum salary payment requirement	The owner- <i>manager</i> must treat an amount equal to a prescribed minimum salary (e.g., EUR 45,000) as labor income. Alternatively, each company that does not <i>pay</i> the <i>minimum</i> annual salary to each owner- <i>manager</i> is liable for a separate <i>tax</i> . An approach of this kind has been adopted in Belgium and the Netherlands.

Source: IMF Staff compilation

⁸ Other mechanisms also exist that could be adapted to reduce the overall rate of taxation on dividends, such as a shielding deduction (e.g., the Norwegian *skjermingsfradrag*) to reduce the taxable dividend. The shielding deduction could equal a statutory rate of return on the owner's share investment.

⁹ See, for example, the recent review in Sweden (Statens Offentliga Utredningar, 2016) of their so called 3:12 rules in relation to the taxation of dividends and capital gains for owners of closely held companies to determine the extent of income shifting in Sweden, and if the rules in place were being misused.

(i) apply by taxpayers; and (ii) administer by the tax administration. It is considered important that the Danish authorities conduct a comprehensive study of costs and benefits and the effects on revenue and distribution before implementing such rules.

19. A reduction in dividend taxes would not only benefit small and high-tech firms, but also have other long-term benefits. The authorities are currently considering an alternative measure to support the growth of small equity-financed businesses by allowing a special tax deduction worth 15 percent for individuals investing up to DKK 1.05 million equity in unlisted firms. This would also help some firms, but it would also make the tax system more complicated and may run into difficulties in practice. Private sector representatives expressed concerns about the practicality, given that one condition appears to be that investor must not personally know the owner (and it certainly does not help owners investing their own funds). Lower dividend taxes, however, would reduce the debt preference of the tax system (if the combined CIT and dividend tax comes closer to the tax on interest). The lower cost of capital for new equity would increase investment for all firms whose marginal cost of funds is equity. Finally, with continued downward trends in CIT rates, it is possible that Denmark, too, will wish at some point to reduce the CIT rate further. That would then in any case require rules for splitting profits of owner-run businesses, unless the dividend tax rate is increased even further, which would exacerbate the trapped equity problem.

20. It will be important to minimize the distortions that could arise from the Digital Services Tax (DST) which is proposed to be introduced uniformly in all EU Member States, including Denmark. There is a risk that the DST could create distortions because the tax applies irrespective of the level of profit; can lead to international double taxation; and might not achieve its goal of taxing profits, as the tax may ultimately be shifted onto local consumers. Further, interim or temporary measures often become permanent, thus prolonging these risks, and can be counterproductive if they reduce the likelihood of a global consensus. The comprehensive solution proposed by the EC also raises concerns associated with ring fencing, and should be become part of a wider debate at the global level. Addressing the challenges posed by digitalization coherently requires a vision of the longer-term design of the international tax system. Continued attention should be focused on a coordinated and well-integrated approach to resolve the wider challenges that digitalization imposes to the international tax framework. This will be important to minimize significant spillovers and distortions.

Fundamental Reform Options

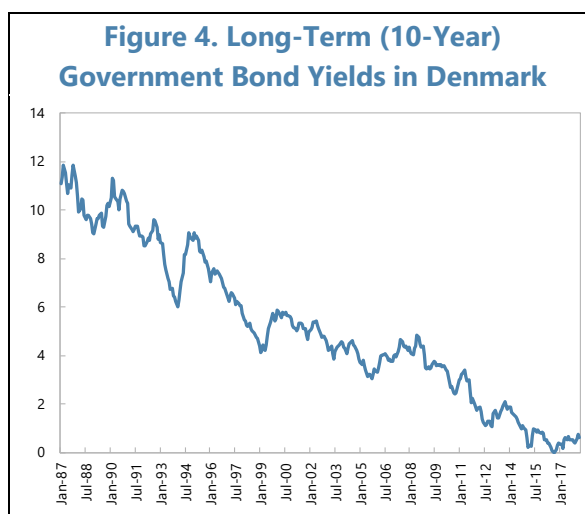
21. A fundamental reform option that would achieve neutrality toward investment and between debt and equity would be the introduction of an allowance for corporate equity (ACE). The idea of the ACE is to maintain deduction for interest expenses¹⁰ and give a tax allowance for equity. An alternative design, known as an allowance for corporate capital (ACC) developed in Boadway and Bruce (1984), eliminates interest deductions, but offers an allowance for notional return independent from the source of financing (interest or equity). Despite its theoretical advantages, no country, has implemented such a system. In theory, the base of the ACE is the total

¹⁰ Empirical evidence suggests that thin-capitalization rules do not resolve debt bias (De Mooij and Hebous, 2017).

book value of the stock of equity based on tax accounting. When it is introduced for the first time, however, it is appealing to define the base as new equity relative to a reference year (incremental ACE), as this prevents loss of tax revenue regarding past decisions. Eventually, the base of the incremental system evolves to the total stock of equity. The Budget proposal for 2017 (Finanslovsforslaget 2017) proposed an ACE for Denmark, but it has not been implemented. Based on estimates published by the Ministry of Finance (Finansministeriet, 2017) and ACE would boost GDP by 1.7 percent in the long run, through its positive impact on investment.

22. The current low interest rate environment is an opportunity to introduce the ACE at a relatively low short-term cost, but the decision should take into account the estimated long-term revenue implication.

Theoretically, the rate of the ACE should be the “risk-free” rate at which shareholders discount the tax savings from the company’s future ACE.¹¹ In practice, the risk-free rate is typically approximated with the yields on long-term government bonds. Figure 4 shows that the long-term yield on Danish government bonds has been following a downward trend reaching 0.64 percent in March 2018. Thus, the cost of introducing the



ACE in the first year would certainly be moderate, though the exact figure will depend on many other factors including the size of economic rents in the economy and the share of loss-making firms. Over time, the cost of the ACE increases as the interest rate goes up and the base of the ACE converges to the total book value of equity. This long-run cost should be taken into account in advance, as abolishing the ACE later based on revenue concerns would only create tax uncertainty and undo all of the beneficial effects of the ACE. A cap on the rate of the ACE would relinquish the desirable neutrality properties of the ACE, and is hence generally not recommended. The Ministry of Finance has undertaken a study of the revenue estimates which suggests a long-run cost of DKK 8 billion after dynamic scoring (compared to total company tax revenue of DKK 65 billion in 2017), which could be reduced to DKK 5.4 billion in case of an interest rate cap of 3 percent.¹²

23. A few countries currently implement an ACE system and a similar system was recently proposed by the EC under the CCCTB. Except for Malta, all existing ACE systems—including Belgium, Cyprus, and Italy—have an incremental base. Belgium has had the total book value of

¹¹ See Fane (1987) and Bond and Devreux (1995).

¹² Preliminary estimates by IMF staff, based on a commercial database (ORBIS), excluding banks, and assuming a notional interest rate of 2 percent, suggest a long-term reduction in the corporate tax base by 12 percent. The data used has various weaknesses compared to administrative data, notably equity is defined using an accounting rather than tax approach and includes participations, which leads to double counting. Moreover, no positive behavioral effects were included. Nevertheless, this simple estimate is relatively close to the figures by the Ministry of Finance.

equity as the base until 2017, but switched to an increment base starting in 2018. The rates are all linked to the yields on government bonds. Countries such as Austria, Croatia,¹³ Latvia, and Portugal abolished their ACE regimes. Some countries have had a form of an ACE, but eventually it was abolished (Appendix Table).

24. Empirical evidence suggests that an ACE reduces corporate leverage, including for banks. Table 5 provides an overview of empirical evidence on the impacts of ACE regimes on corporate debt and investment. The evidence on the impact on investment is mixed. Furthermore, appropriate-anti tax avoidance measures are important to accompany the adoption of the ACE (Hebous and Ruf, 2017; IMF, 2016).

Study	Reform	Data	Findings	
			Debt	Investment
Hebous and Ruf (2017)	Multiple ACE countries, special focus on Belgium	Administrative data (MiDi data)	Negative	Zero for active investment Positive for passive investment
Klemm (2007)	Brazil		No big effect	Weakly Positive
Panteghini and others (2012)	Italy	AIDA database	Negative	
Petutschnig and Runger (2017)	Austria	AMADUES data	Negative	
Princen (2012)	Belgium	AMADUES data	Negative	
Van Campenhout and Van Caneghem (2013)	Belgium	KeFiK survey on SME financing 2008	No impact	
Studies on Banks				
De Mooij and Hebous (2018)	Belgium	BankScope	Negative	
Schepens (2016)	Belgium	BankScope	Negative	
Martin-Flores and Moussu (forthcoming)	Italy	Banks	Negative	
C�el�erier and others (2017)	Belgium	Bank and loans data	Negative	Positive effect on the supply of credit

Source: IMF Staff compilation

Multilateral Reform Options

25. In October 2016, the European Commission relaunched the proposal for a Common Consolidated Corporate Tax Base (CCCTB) in the EU. Under this proposal, Member States need to first agree on and implement a single EU-wide set of rules for computing the tax base of companies in the EU, and then consolidate that tax base and share it between relevant Member States using an apportionment formula. It would be mandatory for multinational groups with global consolidated revenues of at least EUR 750 million and optional for other companies. The proposed common tax base would include an ACE and a super-deduction for R&D expenditures. The proposal

¹³ Keen and King (2002) discuss the Croatian experience with the ACE.

contemplates several anti-avoidance measures consistent with ATAD, including a net interest deduction limitation rule. Apportionment is proposed using three equally weighted factors representing labor, assets and sales. The CCCTB would constrain profit shifting within the EU. However, it may intensify CIT rate competition, reallocation of factors of production, and perhaps regulatory competition. Incentives to shift profits out of the EU would remain, and may become even more important, though resources freed from controlling intra-EU transactions could be concentrated on fewer transactions with the rest of the world.

26. Denmark should study carefully the revenue and other implications of the CCCTB proposal, which Denmark cannot implement unilaterally, but can support in the EU. The tax base appears narrower than Denmark's current base, though the difference is likely to recede as Denmark increases the R&D super-deduction and if it introduces an ACE. The allocation by formula may also reduce the share attributed to Denmark, given Denmark's strong position as a producer and R&D developer, while the domestic market is (and hence sales are) small. However, even a small revenue loss may be acceptable if weighed against the reduced need for control of intra-EU transactions.

Annex I. Country Experiences with the ACE

Country	Name	Base	Rate	Notes
Austria, 2000–2004	Notional interest	Book value of incremental equity	Average return of government bonds in secondary markets plus 0.8 p.p.	The notional return is taxed at a reduced rate of 25 percent instead of 34 percent.
Belgium, Since 2006	Risk capital deduction / notional interest deduction	Until 2017: Full book value of equity Since 2018: Incremental system, whereby the base is equal to 1/5 of the increase in equity over past 5 years.	Average monthly government bond rate of year preceding fiscal year by 2 years. Rate capped at 6.5 percent and cannot change more than 1 p.p. from year to year. Special SME rate is 0.5 p.p. higher.	In 2013, carry forward of any unused allowances abolished, new tax on distributed dividends of large firms introduced.
Brazil, Since 1996	Remunera tion of equity	Book value of equity; deduction only for distributions (in the case of closed companies also credits to owners)	Rate applicable to long-term loans	Up to the level of the notional return, dividends can be paid as “interest on equity.” This is deductible for all corporate income taxes and subject to the usual withholding tax on interest.
Croatia 1994–2000	Protective interest	Book value of equity	5 percent plus inflation rate of industrial goods if positive.	The notional return is deductible.
Italy, 1997–2003	Dual income tax	Book value of incremental equity. From 2000: 120 percent of new equity. In 2001: 140 percent, From 2001: again 100 percent.	1997-2000: 7 percent, 2001-2003: 6 percent	The notional return is taxed at a reduced rate of 19 percent. Other profits are taxed at 37 percent (34 percent in 2003). Before 2001: the average tax must be at least 27 percent.
Italy, Since 2012	Notional interest deduction (NID)	Incremental equity (over 2010 base)	2011-2013: 3 percent; 2014: 4 percent 2015: 4.5 percent 2016: 4.75 percent From 2017: average return on Italian public debt securities plus risk factor set annually by the Minister of Finance.	New equity does not include current year profits. It may not exceed the company's equity at the end of the given fiscal year.

Country	Name	Base	Rate	Notes
Latvia, 2009–2014	Notional interest deduction	Retained earnings	Weighted average rate of interest on loans to nonfinancial enterprises made in the current taxable period. 5.05 percent in 2010, 4.37 percent in 2011.	The deduction is equal to the specified percentage of the retained earnings of the immediately preceding taxable period.
Liechtenstein Since 2011	Notional interest deduction	Modified equity	Specified annually based on market developments (currently: 4 percent).	
Portugal, 2010–2013	Notional interest deduction	Share contributions 2010–2013 or share capital	SME's held by individuals, venture capital companies and business angels can benefit for a three-year period from a notional interest deduction of 3 percent on the amount of cash contributions by shareholders to share capital made during 2010–2013; from 2014, individual-owned micro, small and medium-sized enterprises may deduct 5 percent of the company's share capital for three years (limited to EUR 200,000).	
Cyprus, Since 2015		Incremental equity in the form of issued share capital and share premium (provided fully paid)	10-year government bond yield of the Republic of Cyprus, or if higher, 10-year government bond yield of the country in which the new equity is invested. In either case 3 p.p. are added.	
Turkey, Since July 2015	Notional interest deduction	Incremental cash capital	50 percent of the annual weighted average interest rate applied to Turkish-denominated loans provided by banks	Not applicable to companies with high passive income or high financial assets, shares in subsidiaries or participations.
Malta	Notional interest deduction	Share capital, including any share premium, interest-free debt, positive retained earnings and contribution reserves.	The current yield on 20-year Maltese government bonds plus 5 p.p.	Limited to 90 percent of taxable income. Excess can be carried forward

Source: IMF Staff Compilation

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