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EURO AREA POLICIES: SELECTED ISSUES

INTERNATIONAL MONETARY FUND

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EURO AREA POLICIES

SELECTED ISSUES

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INTERNATIONAL MONETARY FUND

EURO AREA POLICIES

SELECTED ISSUES

June 22, 2016

Approved By
The European Department

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CONTENTS

THE IMPACT OF WORKFORCE AGING ON EURO AREA PRODUCTIVITY[1]

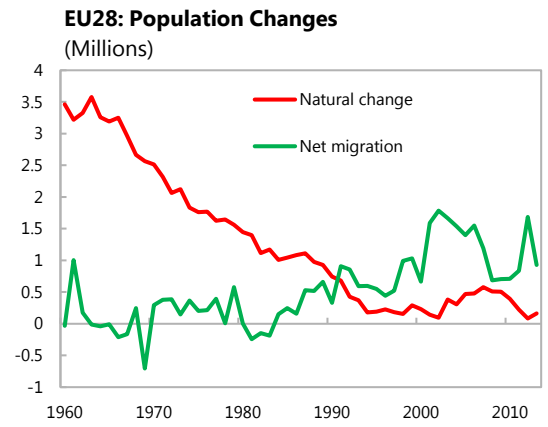
The euro area population has aged considerably over the past few decades, a process expected to accelerate in the years ahead. At the same time, labor productivity growth in the euro area has been sluggish, posing risks to long-term growth prospects. This paper studies the effect of the aging of the workforce on labor productivity, identifies the main transmission channels, and examines what policies might mitigate the effects of aging. We find that workforce aging reduces growth in labor productivity, mainly through its negative effect on TFP growth. Projected workforce aging will reduce TFP growth by an average of 0.2 percentage points every year over the next two decades. A variety of policies can ameliorate this effect.

A. Aging Headwinds

1. **Aging is intensifying in the euro area**. Declining fertility rates combined with increased life expectancy have reduced the natural increase in population. Immigration has helped to offset this trend but only partially. The old age dependency ratio is high in a number of euro area countries.

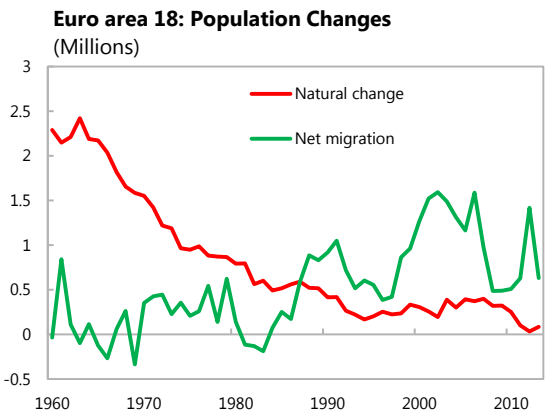
Figure 1. Demographic Developments

Europe is facing demographic challenges….



Source: Eurostat and IMF staff calculations

Including in the euro area….

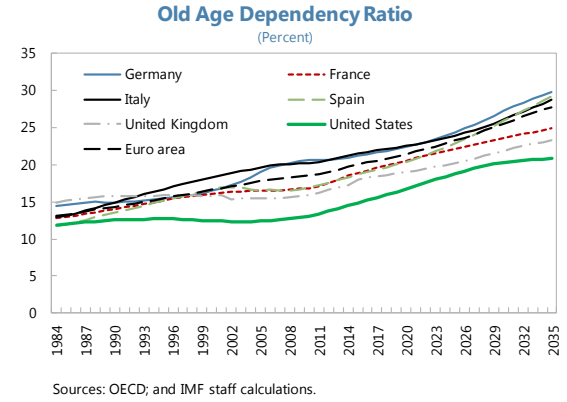


Source: Eurostat and IMF staff calculations

[1] Prepared by Shekhar Aiyar, Christian Ebeke, and Xiaobo Shao (all EUR). We thank staff from the European Commission for their helpful comments and feedback.

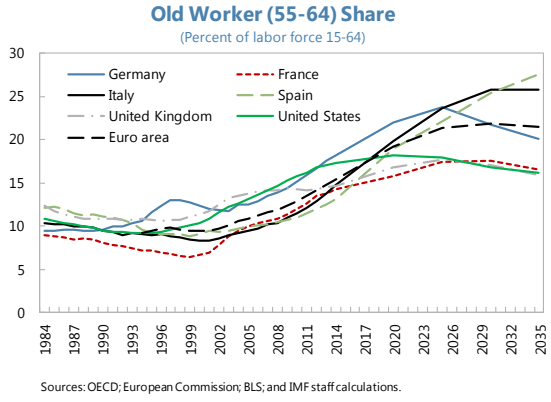
Figure 1. Demographic Developments (Concluded)

The old-age dependency ratio is projected to rise considerably in the euro area…



Sources: OECD; and IMF staff calculations.

….and so is the share of senior workers in the labor force.



Sources: OECD; European Commission; BLS; and IMF staff calculations.

2. **Demographic projections point to a rapid aging of the European workforce**. Not only will there be a sharp increase in the share of the elderly in the total population (and the old-age dependency ratio as well), but also a shift in the composition of the workforce from relatively young to relatively old workers, a phenomenon that we will refer to as "workforce aging". In particular, the share of seniors (workers aged 55+) in the labor force is expected to increase sharply over the next few decades, especially in countries such as Spain, Italy, Portugal, Greece and Ireland.

3. **Aging exerts a macroeconomic impact in two conceptually different ways: through a higher dependency ratio (i.e. a higher proportion of retirees to workers), and through workforce aging.[2]** The first of these, the impact of a higher dependency ratio, has been well studied. Mechanically, fewer workers in a fixed population produce less output, so per capita GDP should fall with a higher dependency ratio.[3] The life cycle theory suggests that aggregate savings rates could decline as the elderly dissave after retirement. Public finances could be put under pressure in graying economies as the level of age-related spending increases. In the euro area, large increases in age-related spending are expected in countries that currently have high public debt-to-GDP ratios.[4] The erosion of fiscal buffers—coupled with more volatile participation rates for seniors—can lead to greater aggregate volatility (Jaimovich and Siu, 2009). Recent papers have also examined the role of aging on the structural transformation of economies, noting that the consumption pattern shifts towards goods that are more relevant for the elderly, such as energy, house-keeping, health and leisure services. The supply-side composition of the economy shifts in tandem, with the service sector growing relative to manufacturing (Siliverstovs et al., 2011).

[2] See Appendix A for an extensive empirical literature review of the macroeconomic consequences of aging.

[3] Several studies document a negative impact of a higher dependency ratio on per capita GDP growth in different parts of the world, e.g. Persson (2002) for the US; Bloom, Canning and Malaney (2000) for East Asia; Aiyar and Mody (2013) for India.

[4] The adverse impact of aging on public finances in Advanced Economies has been re-examined recently in Clements and others (2015).

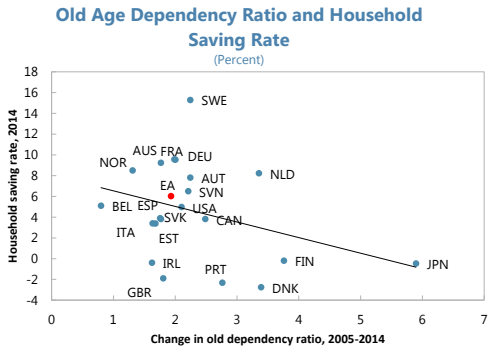
4. **But workforce aging has direct implications for labor productivity.** Mechanically, if different age cohorts differ in their productivity, then changes in the age distribution of the workforce will affect average output per worker. The literature stresses that a worker's productivity systematically varies over his or her working life, for reasons such as the accumulation of experience over time, depreciation of knowledge, and age-related trends in physical and mental capabilities. A more mature labor force will have higher average levels of work experience, with potentially positive effects on productivity (Disney, 1996). On the other hand, workforce skills also depend on the stock of knowledge acquired before entering the labor market, or in the early stages of individuals' careers. This stock of skills is likely to become increasingly dated as the average age of participants in the workforce rises, with negative effects on innovation and productivity (Dixon, 2003). Moreover, if job requirements change over time, older workers may find it more difficult to adapt (OECD, 1998). For example some have argued that the increased penetration of information technologies might place older workers at a disadvantage (Dixon, 2003). Recently, Venn (2008) has provided an interesting taxonomy of economic sectors depending on their exposure to workforce aging risks: occupations and professions in which productivity increases (on average) with age, occupations that are age neutral, and occupations in which productivity declines with age.[5]

5. **The combination of these factors typically leads to profiles exhibiting a strong increase in productivity until workers are in their 40s and a decline toward the end of their working life.** Several scholars emphasize that the drop-off in the productivity of senior workers is related to lower levels of innovation, technology adoption and dissemination. For example Feyrer (2008) shows that in the US innovators' median age is stable around 48 over the 1975–95 sample period whereas the median age of managers who adopt new ideas is lower at around 40. Aksoy et al (2015) show that demographic structure affects innovation, with older workers (in particular the 50-59 age group) having a strong negative impact on total number of patent applications. Jones (2010) finds that innovation is positively affected by young and middle-aged cohorts and negatively affected by older cohorts. Some recent papers, based on sector or firm-specific data have however found a mixed picture. Göbel and Zwick (2012) find no significant differences in the age-productivity profiles between manufacturing and service sectors in Germany. Börsch-Supan and Weiss (2016) find that the productivity of workers in a large car manufacturer in Germany declines around age 60. These results might suggest that aggregate effects could be larger than sector or firm-level effects when externalities linked to workforce aging are taken into account (Feyrer, 2007).

[5] For example, Veen (2008) argues that those with basic jobs, especially blue-collar jobs such as tilers or bricklayers are likely to become less productive as they age. Age-neutral occupations might include bank or commercial clerks and electronic engineers. Occupations in which productivity increases with age might include lawyers, professors, managers and medical doctors. If the impact of workforce aging differs between sectors, its aggregate impact would depend on the industrial structure of the economy.

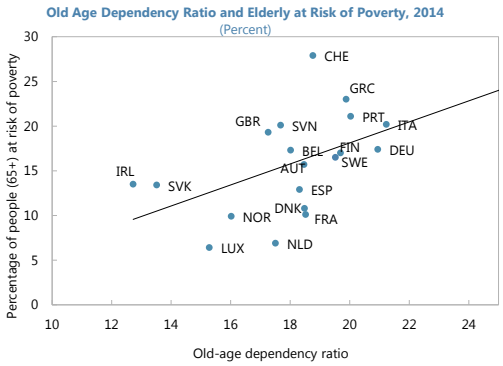
Figure 2. Aging and the Macroeconomy

Aging has lowered private saving rates....



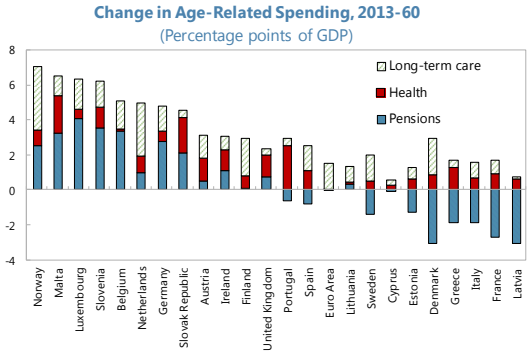
Sources: OECD; and IMF staff calculations.

....amid risks of elevated old-age poverty



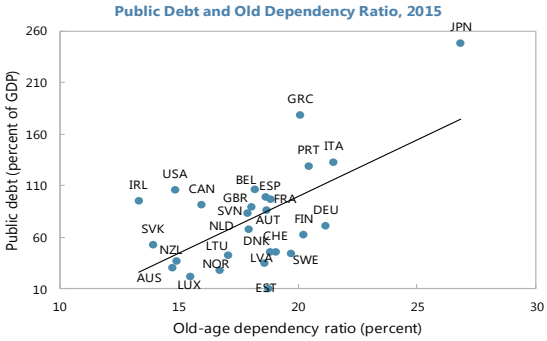
Sources: Eurostat; and IMF staff calculations.

Pressures on public finances will intensify...



Sources: European Commission and IMF staff calculations.

....including in countries already lacking fiscal space



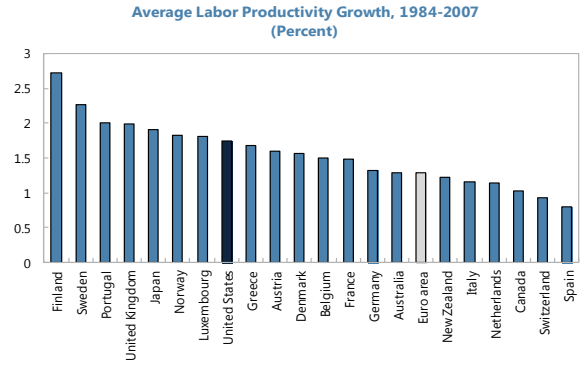
Sources: OECD, WEO and IMF staff calculation.

6. **An aging workforce could impact already sluggish aggregate productivity growth in the euro area.** Labor productivity (output per worker) and TFP have on average grown more slowly in the euro area compared to the U.S. Average labor productivity and TFP growth gaps between the U.S. and the euro area between 1984–2007 have been about 0.5 and 0.3 percentage points every year.[6] Moreover, there is considerable heterogeneity within euro area countries.

[6] Euro area aggregates are reconstructed using data of Belgium, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal and Spain.

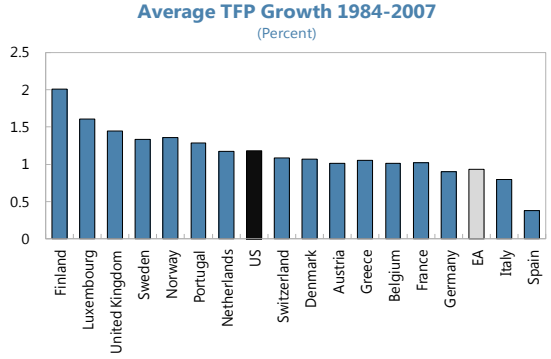
Figure 3. Aging and Aggregate Productivity

Aggregate labor productivity shows considerable heterogeneity….



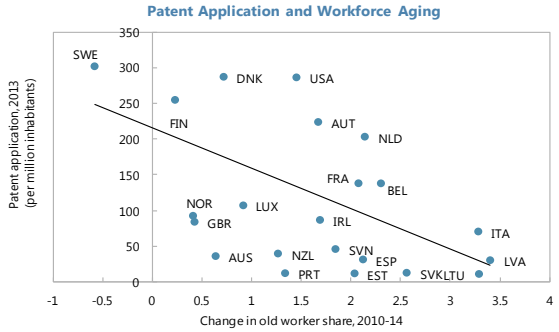
Sources: OECD and IMF staff calculations.

….as does TFP growth.



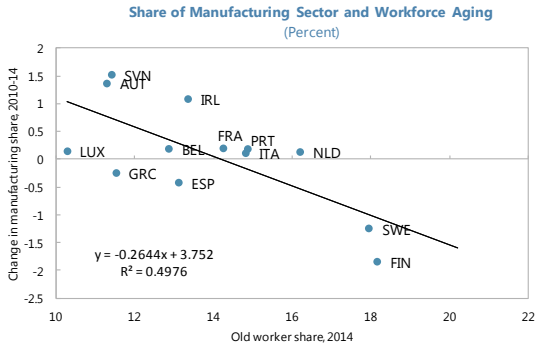
Sources: AMECO database and IMF staff calculations.

Aging has been associated with lower innovation…



Sources: Eurostat and IMF staff calculations.
Patent data for US are 2010.

….amid the shrinking of the manufacturing sector.



Sources: Eurostat and IMF staff calculations.

7. **In this paper we examine the link between workforce aging and labor productivity in Europe.** Drawing on the recent cross-country empirical literature (Feyrer, 2007; Cuaresma et al., 2016), we measure the effect of workforce aging (measured by the ratio of workers aged 55+ to the total workforce) on productivity. We find that an increase in this ratio of 1 percentage point is associated with a reduction in the growth rate of labor productivity of between 0.2 and 0.6 percentage points per annum. Further, we decompose the slowdown in labor productivity into factor accumulation and TFP growth, and find that most of the adverse effects of aging come from its negative impact on TFP growth. Our estimates show that the aging of the workforce in the euro area has lowered TFP growth by about 0.1 percentage points each year over the past two decades. The results are robust to various econometric specifications and different strategies to address potential endogeneity concerns.

8. **Our estimates suggest that workforce aging could significantly retard TFP growth over the medium to long term.** Given current demographic projections from the OECD, the aging of the workforce in the euro area could lower TFP growth by about 0.2 percentage points each year between 2014 and 2035. This effect is very substantial given EC forecasts that most countries are expected to post average TFP growth rates less than 1 percent every year over that horizon. To put it

another way, absent the adverse impact of aging, TFP growth could be higher by about a quarter over the next two decades.

9. **Appropriate policies can mitigate the adverse effects of aging.** Our econometric analysis underscores the key role played by specific policies to improve health outcomes, boost the productivity of workers through ALMP reforms, reduce the tax wedge to increase labor mobility and spur innovation through R&D spending.

B. Estimating the Effect of Aging on Productivity in the Euro Area

Empirical design and econometric results

10. **We use standard panel techniques to estimate the effect of aging and its channels**. Our baseline specifications build on work by Feyrer (2007) but expand his methodology to better account for heterogeneity across countries and endogeneity issues. The sample is restricted to euro area countries over 1950 to 2014.[7] Our baseline model fits the real output per worker growth on the share of workers aged 55+ years, the youth and the old dependency ratios, year and country fixed effects. More specifically, the model takes the following form:

$$\Delta logYW_{it} = \theta_1 \mathrm{w55}_{it} + \theta_2 \mathrm{YADR}_{it} + \theta_3 \mathrm{OADR}_{it} + u_i + \eta_t + \epsilon_{it} \quad [1]$$

where YW denotes the real output per worker, w55 is the share of the total workforce aged between 55 and 64 years, $YADR$ and $OADR$ are the youth and old dependency ratios, respectively. We expect the coefficient θ_1 to be negative and significant, implying that an increase in the share of old workers is negatively associated with the growth rate of output per worker, even after controlling for the dependency ratios. This means that the coefficient θ_1 represents the effect on output that results from a shift of workforce share out of the 15–54 group, into the 55–64 group. We control for country fixed effects to absorb country specific time-invariant factors that can affect the growth rate of output per worker. We also control for year-specific effects to account for common shocks affecting growth in the euro area.[8] This also implies that our identification of θ_1 is through the age composition of the workforce that is not shared across countries over time. Our benchmark regression does not identify the relative contributions of the various channels through which an aging workforce affects output per worker growth, but identifies the sign and magnitude of the total effect, as highlighted in Jaimovich and Siu (2009). The workforce and population data come from the OECD while the output per worker data are from the Penn World Table 8.1.

11. **We then examine the transmission channels of the effect of aging on real output per worker growth**. In order to account for the transmission channels, we follow the methodology proposed by Wong (2007) which consists in estimating separately the effect of the variable of

[7] Feyrer's (2007) analyses relate to up to 87 developed as well as to developing countries, and his data set spans the period from 1960 to 1990. His major finding is an inversely *U*-shaped relationship between changes in the age structure of the labor force and the growth rate of TFP which peaks for workers aged 40–49.

[8] The model can be amended further to include lagged dependent variable, the entire age distribution of the workforce, exclude the dependency ratios, the year effects, and broadly yields similar econometric estimates.

interest—here the workforce aging variable—on factor accumulation (capital and human capital) and TFP growth rates. Wong (2007) shows that the coefficient on the workforce aging variable derived from each of these regressions will sum up to the effect of workforce aging on labor productivity growth estimated in equation (1). Assuming that the technology follows a Cobb-Douglas function, output per worker is given by:

$y_{it} = k_{it}^{\alpha}(h_{it}A_{it})^{1-\alpha}$, which can be re-written as $y_{it} = \left(\frac{K}{Y}\right)_{it}^{\frac{\alpha}{1-\alpha}} A_{it}h_{it}$,

where *y* is the real output per worker, *k* is the real capital stock per worker, *h* is the human capital per worker, and *A* is the TFP.[9] Taking logs of both sides gives:

$$log(y_{it}) = \frac{\alpha}{1-\alpha} log\left(\frac{K}{Y}\right)_{it} + log(h_{it}) + log(A_{it})$$

12. **We propose a framework to address the endogeneity of the aging variables.** The specification in equation (1) is potentially subject to endogeneity problems because the share in the labor force of any particular age group depends not only on the number of people in that age category, but also in the participation rate of that cohort. This may be influenced directly by the growth of output per worker; or both the participation rate and output per worker may be influenced by common (country-specific) shocks. To address potential endogeneity bias, we first instrument each country's share of the workforce aged 55 to 64 by the population share of those aged 45–54 ten years previously. To address the possibility that dependency ratios can also be endogenous (for example if an immigration shock simultaneously shifts the population distribution and affects the growth rate of output), we instrument the youth and old dependency ratios with the share of population under the age of 4 and the population share of those aged 55 and 59 years ten years ago.

13. **But even the lagged population proportions used as instruments may be endogenous if the shocks that affected the lagged population proportions ten years ago continue to influence current output per worker or TFP growth today.** To address this critique we instrument the workforce aging variable and the dependency ratio with lagged birth rates 40, 30, and 10 years ago, similar to Jaimovich and Siu (2009). Excluding migration and mortality, an age group's share of the 15–64-year-old population is determined by the distribution of births 15 to 64 years prior. To the extent that fertility decisions taken at least fifteen years ago are exogenous to current productivity growth, using lagged birth rates as instruments allows us to obtain unbiased estimates of the causal impact of the labor force composition of old workers. The drawback of this approach is

[9] This decomposition assumes an augmented Cobb-Douglas production function with human capital, which has become standard in the literature (see for example Hall and Jones (1999); and Aiyar and Feyrer (2002)). Alpha is the capital share, assumed to be around 0.3 (see Aiyar and Dalgaard, 2009 for a justification). The capital stock series, output, and human capital data are from Penn World Table. Human capital is defined in terms of average years of schooling, with the returns to primary, secondary and tertiary education taken from Psacharopoulos (1994).TFP is a computed as a residual from the log of real output per worker minus the capital intensity weighted by the factor share, and minus the log of human capital per worker.

a significant reduction in the number of observations, as we instrument the age composition of the workforce using very long lags.

14. **The main channel through which an aging workforce reduces the growth rate of output per worker is lower TFP growth.** Econometric results obtained from various specifications and techniques show two key results. First, there is a negative and statistically significant effect of an increase in the share of the workers aged 55–64 on real growth of output per worker (Appendix, Table 1). The effect is larger and more precisely estimated after addressing endogeneity issues using instrumental variables (Table 2).[10] An increase in the share of workers aged 55–64 by 5 percentage points leads to a decline in the growth of output per worker of between 1.1 and 3.2 percentage points.[11] Second, in terms of transmission channels, it is robustly estimated that the bulk of the negative effect of workforce aging on labor productivity comes from its negative impact on TFP growth. This result is broadly similar to Feyrer (2007) and Werding (2008), who also found a dominant role for the TFP channel in a broad sample of advanced and developing economies in the pre-2000 period.

15. **Controlling for the numbers of hours worked does not modify the results**. One factor that may be influencing the previous results is the relatively crude way in which labor productivity and TFP are constructed. In particular, labor input is measured in terms of the number of workers and does not account for differences in the number of hours worked, which could be affected both by cross-country heterogeneity and by aging. We therefore follow Feyrer (2007) in normalizing real output and TFP by hours worked, using OECD data. The regression results robustly point to a negative and statistically significant effect of the share of workers aged 55+ on both output per hour and *modified* TFP growth (defined as the difference between the log of TFP and the log of hours worked). These are denoted, respectively, as *D*.lnYH and *D*.lnAH (Table 3).

16. **Controlling for the entire age distribution does not modify the results**. We extend the analysis to include a more detailed look at the effect of the workforce age composition. We alter our empirical specification so that the regressor, w55, is replaced by a vector of labor force shares: the shares of the 30–39, 40–49, 50–54, and 55–64, age groups. We exclude the 15–29 age group because all age shares together sum to one. This means that the coefficient on any particular age group represents the impact from a shift of the workforce share out of the 15–29 group, into that

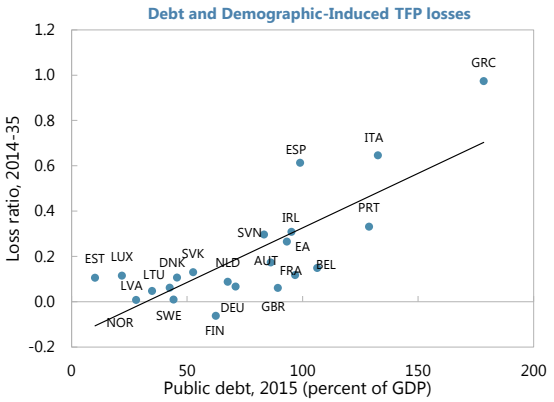
[10] Because the use of long lags of birth rates (40 years ago, for example) reduces the sample considerably and leads in particular to dropping older observations, our second instrumentation strategy could lead to different point estimates in part due to the changing sample. In order to check that the effect of aging in this set up is not driven by the reduced sample, we also re-ran the previous instrumentation strategy which uses 10-year lagged population proportions as instruments on the reduced sample. The estimates are unaffected, supporting the view that the second instrumentation strategy gives stronger results because it deals with endogeneity better, not because the sample is different.

[11] The first-stage regressions are consistent with our priors regarding the signs and the strength of the instruments. Diagnostic statistics suggest that the instruments are strong (F-stat, Shea R2 that comfortably exceed conventional statistical thresholds).

age group. As shown in Table 4, the impact of the age group 55–64 remains negative and statistically significant.[12]

Quantifying the past and future effects of aging on TFP growth in the euro area

17. **Our estimates suggest that workforce aging has not been a major drag on euro area TFP growth to date.** Using the point estimates obtained in Table 2 column 4 (bottom regression), and drawing on evolution of the share of workers aged 55–64 in the total workforce, we can decompose the contribution of the aging workforce to TFP growth in each euro area country from 1984 to 2014.[13] Figure 4 shows that on average workforce aging has reduced TFP growth only marginally. However, this is not uniformly the case. In some countries, such as Latvia, Lithuania, Finland, Netherlands and Germany, workforce aging shaved off 0.2 percentage points of TFP growth every year during this period.



Sources: OECD; WEO and IMF staff calculations.

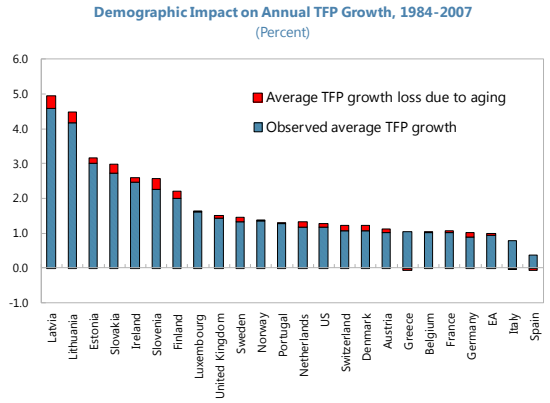
18. **Future effects of aging on TFP growth will be more severe.** Using the OECD forecast of working age population by age groups and the EC's 2015 Aging Report for projections of labor force participation rates, we construct projections of the share of the workforce aged between 55 and 64 years old in each country from 2014 until 2035. We then use our econometric estimates of the effect of aging to derive the projections of the contribution of aging to TFP growth in the long-run. Our calculations point to a more severe effect of demographic pressures on TFP growth in the years to come, consistent with the rapid worsening of the age profile of the workforce expected in the euro area. On average aging will shave off about 0.2 percentage points of TFP growth every year until 2035. This effect is shared by several euro area countries and is substantial if one takes into account that the projected average annual TFP growth in the currency bloc is estimated at only about 0.8 percentage points per annum. In other words, in the absence of workforce aging, euro area TFP growth through 2035 could be about one quarter higher than the current forecast. The countries expected to be worst affected by workforce aging are Greece, Spain, Portugal, Italy, Slovenia, Slovakia and Ireland, where the average increase in the share of old workers in total workforce is about 10 percentage points between 2020 and 2035. Most of these countries are also currently facing a high debt burden.

[12] Using instrumental variables as in Table 2 is challenging in these specifications because instrumenting for multiple age cohorts entails the loss of too many degrees of freedom.

[13] The results obtained using the lagged births as instrumental variables are our preferred specifications given the stronger orthogonality of these instruments vis-à-vis the dependent variables. It is very unlikely that the birth rate 40 years ago could affect productivity performance today through any channel other than the aging variables.

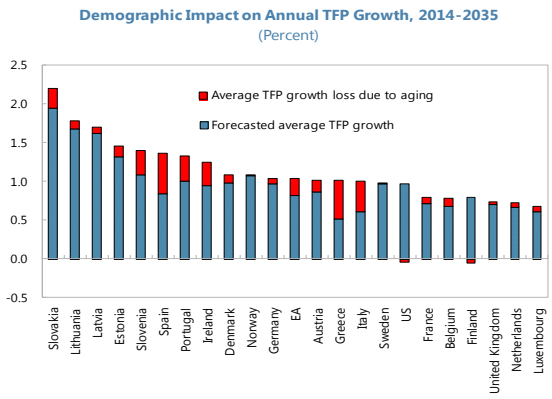
Figure 4. Demographic Impact

Aging has reduced TFP growth by about 0.1pp/year....

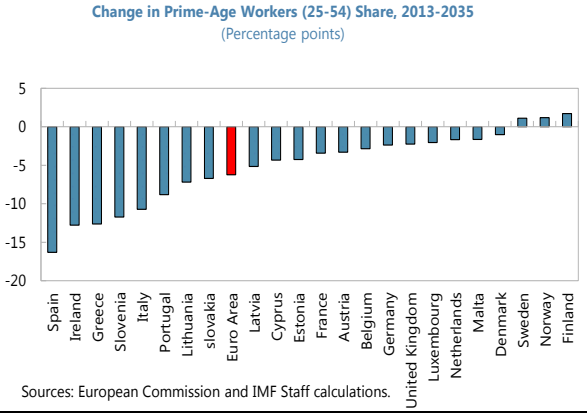


Sources: OECD; European Commission; and IMF staff calculations.
Notes: United Kingdom starts from 1985; Switzerland starts from 1992; Austria and Ireland start from 1995; Estonia and Slovakia start from 1996; Latvia, Lithuania, and Slovenia start from 2001. EA comprises Belgium, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, and Spain.

....but the effect will double in the decades to come

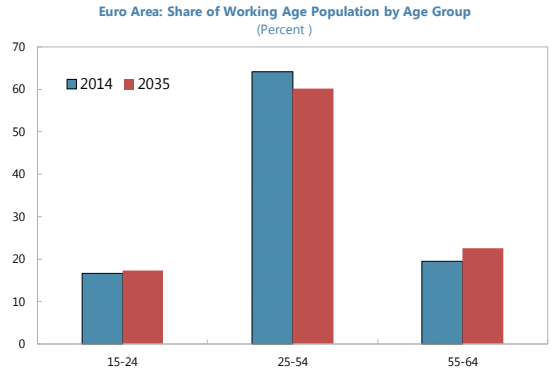


Owing to a decline in the share of prime-age workers....



Sources: European Commission and IMF Staff calculations.

....driven by changes in the age distribution.



Sources: OECD and IMF staff calculations.

C. Living with Aging

19. **Policy reforms can mitigate the impact of aging on productivity growth.** We are interested in a set of specific policies that would improve productivity through the dampening of the adverse effects of workforce aging on productivity. More specifically, the objective is to isolate policies that would reduce the marginal negative effect of aging on TFP growth. These could potentially include several reforms aimed at increasing labor productivity generally—such as innovations in health or training to improve human capital, greater innovation and technology adoption, and the facilitation of productive labor reallocations—provided that the reforms disproportionately enhance the productivity of the 55 plus cohort of workers. Of course, it is important to note that estimating the effects of these reforms is challenging for several reasons, including the inability to factor in the effect of recent policy reforms implemented by countries.

20. **The baseline model is therefore amended to test for the role of policies.** The specification is altered to allow for an interaction of workforce aging with a selected conditioning variable:

$$\Delta logA_{it} = (\theta_4 + \theta_5 P_{it-1}) \cdot \mathrm{w55_{it}} + \beta P_{it-1} + \theta_6 \mathrm{YADR}_{it} + \theta_7 \mathrm{OADR}_{it} + u_i + \eta_t + \nu_{it} \quad [2]$$

where the variable *P* denotes the conditional factor shaping the relationship between TFP growth and the share of old workers (w55).[14] The dampening effect will arise if $\theta_4 < 0$ and $\theta_5 > 0$. This implies that the marginal (and negative) effect of aging on TFP growth is reduced for higher values of the conditional factor *P*. We test for various conditional factors:

- *Health conditions and human capital accumulation*: Aging is associated with a rise in the incidence of ill health and disability within the workforce (Dixon, 2003). The negative impact of an aging workforce on growth could be mitigated by better health conditions and upgraded human capital. Our health care indicator is the availability of doctors measured by the physician density in total population. While doctor availability is an important and widely used "input" indicator for a society's health levels at all age categories, it is likely to be of particular relevance for older people, who are disproportionately likely to be at health risk. We also test for the effect of active labor market policies (ALMPs) focusing on the training or re-training of the workforce (reform dummy taking the value when the change in public spending per unemployed on ALMP on training is greater than one standard deviation of the sample deviation).[15] As with health, while ALMPs could in principle benefit all age cohorts, they are likely to be disproportionately beneficial to senior workers with more dated skills.

- *Labor market flexibility*: Workforce aging is expected to be associated with reduced voluntary mobility between jobs, as younger workers tend to change jobs and employers relatively frequently, while older workers tend to have stable relationships with their employers. A decline in voluntary job mobility could have negative consequences as the labor market as a whole might become less flexible (Dixon, 2003). In turn, this is likely to reduce productivity, since adjusting to changes in technology and changes in product markets could require the movement of workers across firms and geographical regions. We use reforms to the employment protection framework to proxy for labor market flexibility, creating a dummy variable taking the value 1 when the OECD indicator of employment protection of regular contracts declines by at least 1 standard deviation of the sample.[16]

- *Tax wedge*. High rates of tax on marginal employment, coupled with out-of-work benefits can create disincentives to working for any age group. However, the effect may be disproportionately important for seniors because they have larger savings to fall back on than other age cohorts in case of unemployment, and may also have a greater preference for leisure based on their stage of life. The incentive to delay retirement could be eroded by high labor taxation. We define a dummy for the reform of the tax wedge taking the value of 1 when the OECD indicator of the tax wedge declines by at least 1 standard deviation.[17]

- *Innovation*. Technological innovation an adoption is an important source of productivity improvements for the labor force as a whole. To the extent that it differentially benefits

[14] We control for the lagged value of the conditional variable *P* to reduce endogeneity concerns.

[15] Data on ALMP spending are from Eurostat.

[16] Defining structural reform occurrences by dummies variables indicating significant changes in underlying structural indices follows the empirical literature on the macroeconomic effects of structural reforms (Bordon et al., 2016).

[17] Examining the effect of reforms of the tax wedge is useful in its own right given the interest in this variable in the ongoing benchmarking exercise by the Eurogroup.

senior workers, it could also mitigate the negative impact of aging. In principle, one could think of innovations that favor younger workers (e.g. new computer software that enhances the efficiency of those who are capable of easily "switching") and innovations that favor older workers (e.g. mechanical devices that reduce the physical labor associated with certain manufacturing processes). In practice, whether technological innovations on balance favor older workers more than younger workers is an empirical matter. We test whether the effect of aging on TFP growth is dampened by higher spending on R&D, differentiating between public and private spending on R&D as a percentage of GDP.

21. **Policy reforms that improve human capital, labor participation, and innovation mitigate the adverse impact of aging on TFP growth.** The estimates in Table 5 show a robust dampening effect of policy variables. Columns 1 and 2 do not reject the hypothesis that greater access to health services and ambitious active labor market policies focusing on the training of the labor force dampen the TFP growth-reducing effects of an aging workforce. While the results indicate that fiscal reforms lowering the tax wedge would be critical in dampening the effects of demographic pressures (column 3), the effect of labor market reforms granting more flexibility (less protection of regular workers) has the expected sign but is not statistically significant (column 4). Column 5 shows that government contribution to R&D spending is robustly associated with reduced effect of aging on TFP growth, whereas the effect of private sector R&D in the euro area remains statistically unclear (column 6). This can be due to the still very low levels of private sector R&D in several countries.

D. Conclusion

22. **Workforce aging is likely to be a significant drag on European productivity growth over the next few decades.** We estimate that a 1 percentage point increase in the 55–64 age cohort of the labor force is associated with a reduction in total factor productivity of about $3/4$ of a percentage point. Extrapolating this result forward, projected aging will reduce TFP growth by an average of 0.2 percentage points every year over the next twenty years. The largest negative impact will occur in those countries—such as Spain, Italy, Portugal, Greece and Ireland—where rapid workforce aging is expected, and which also face high debt burdens.

23. **Our analysis also suggests that good policies can ameliorate the negative productivity impact of an aging workforce.** A variety of policies can help, such as broadening access to health services, improving workforce training, increasing labor market flexibility by lowering the tax wedge, and promoting innovation via higher R&D to adapt to a changing global environment. Of course many of these policies are desirable in their own right, and may increase productivity growth through multiple channels, but our analysis shows that they are likely to have a disproportionately large impact in rapidly aging societies such as Europe.

Table 1. OLS Estimates of the Effects of Aging on Output per Worker and TFP Growth

Dependent variables	(1) D.lnYW	(2) D.lnKY	(3) D.lnHC	(4) D.lnA	(5) D.lnA^{PWT}
Workforce share, aged 55-64	**-0.118***	**0.0689*****	**-0.0292*****	**-0.160***	**-0.142*****
	(-1.737)	**(2.742)**	**(-2.704)**	**(-1.769)**	**(-2.805)**
Old age dependency ratio	-0.0641	-0.0650	-0.183***	0.204	0.0732
	(-0.445)	(-1.238)	(-8.111)	(1.058)	(0.690)
Youth dependency ratio	0.0761	-0.00166	-0.0604***	0.146	0.120*
	(0.787)	(-0.0478)	(-4.057)	(1.133)	(1.717)
Intercept	0.0242	0.00547	0.0479***	-0.0336	-0.0137
	(0.645)	(0.404)	(8.257)	(-0.670)	(-0.501)
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	578	596	596	578	596
Number of countries	19	19	19	19	19

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2. Controlling for the Endogeneity Bias. Instrumental Variable Estimates

Dependent variable	(1) D.lnYW	(2) D.lnKY	(3) D.lnHC	(4) D.lnA	(5) D.lnA^{PWT}
Workforce share aged 55-64	**-0.221*** **	**0.0991** **	**-0.0160**	**-0.317** **	**-0.220*** **
	(-2.622)	**(2.282)**	**(-1.078)**	**(-2.515)**	**(-3.342)**
Old age dependency ratio	-0.0214	0.159	-0.115	-0.0956	-0.117
	(-0.0655)	(1.294)	(-0.777)	(-0.186)	(-0.359)
Youth dependency ratio	0.139	0.108	-0.0188	0.0280	0.0368
	(0.676)	(1.392)	(-0.182)	(0.0848)	(0.186)
External instruments	10-year lagged population proportions	10-year lagged population proportions	10-year lagged population proportions	10-year lagged population proportions	10-year lagged population proportions
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	596	596	578	596	596
Number of countries	19	19	19	19	19
Workforce aged 55-64 share	**-0.655*** **	**0.231*** **	**-0.130*** **	**-0.756*** **	**-0.499*** **
	(-4.652)	**(4.055)**	**(-5.512)**	**(-3.930)**	**(-4.564)**
Dependency ratio (*combined*)	0.471	-0.409**	0.193***	0.688	0.855***
	(1.193)	(-2.565)	(2.908)	(1.275)	(2.789)
External instruments	Births 10, 30 and 40 years ago	Births 10, 30 and 40 years ago	Births 10, 30 and 40 years ago	Births 10, 30 and 40 years ago	Births 10, 30 and 40 years ago
Country fixed effects					
Observations	298	298	298	298	298
Number of countries	18	18	18	18	18

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Purging the Effect of Hours Worked

Dependent variable	(1) *D*.lnYH	(1) *D*.lnAH
Workforce aged 55-64	-0.187**	-0.223**
	(-2.569)	(-2.070)
Old age dependency ratio	0.398	-0.474
	(0.772)	(-0.717)
Youth dependency ratio	0.564*	-0.0779
	(1.695)	(-0.175)
External instruments	10-year lagged population proportions	10-year lagged population proportions
Country fixed effects	Yes	Yes
Observations	508	508
Number of countries	19	19
Workforce aged 55-64	-0.603***	-0.759***
	(-4.574)	(-4.184)
Dependency ratio (*combined*)	-0.0226	0.361
	(-0.0460)	(0.534)
IV	Births 10, 30 and 40 years ago	Births 10, 30 and 40 years ago
Country fixed effects		
Observations	287	287
Number of countries	18	18

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Controlling for the Entire Age Distribution

Dependent variable	(1) D.lnYW	(2) D.lnKY	(3) D.lnHC	(4) D.lnA	(5) D.lnAH
Workforce aged 30-39 share	-0.172	0.0569	0.0183	-0.255	-0.195***
	(-1.633)	(1.466)	(1.042)	(-1.711)	(-3.342)
Workforce aged 40-49 share	-0.0736	0.0485	-0.0133	-0.127	-0.277**
	(-0.667)	(1.138)	(-1.005)	(-0.834)	(-2.155)
Workforce aged 50-54 share	-0.0988	-0.0237	0.0183	-0.0811	0.369**
	(-0.374)	(-0.290)	(0.314)	(-0.226)	(2.241)
Workforce aged 55-64 share	**-0.259***	**0.141*****	**-0.0393**	**-0.380***	**-0.515*****
	(-1.881)	**(3.154)**	**(-1.197)**	**(-1.937)**	**(-3.362)**
Old age dependency ratio	0.144	-0.121	-0.183**	0.487	0.154
	(0.821)	(-1.448)	(-2.603)	(1.725)	(0.428)
Youth dependency ratio	0.0613	0.00215	-0.0559	0.128	0.0847
	(0.571)	(0.0442)	(-0.990)	(0.761)	(0.467)
Intercept	0.0831	-0.0188	0.0450*	0.0559	0.109
	(1.392)	(-0.811)	(1.992)	(0.622)	(1.557)
Country fixed-effects	Yes	Yes	Yes	Yes	Yes
Observations	541	557	557	541	483
Number of countries	19	19	19	19	19

t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Effects of Policies

Dependent variable: D.lnA	(1) D.lnA	(2) D.lnA	(3) D.lnA	(4) D.lnA	(5) D.lnA	(6) D.lnA
Workforce aged 55-64 (W55-64) share	-1.252**	-0.801**	-0.360	-0.00542	-0.551**	-0.571***
	(-2.281)	(-2.675)	(-1.321)	(-0.0427)	(-2.751)	(-3.070)
W5564*Lagged Physician density to population	0.351*					
	(2.083)					
W5564*ALMP reform dummy (Increase in ALMP on training)		0.422**				
		(2.385)				
W5564*Tax wedge reform dummy (Reduction in tax wedge)			0.444**			
			(2.249)			
W5564*Labor market reform dummy (Reduction in EPLR)				0.469		
				(1.502)		
W5564*Lagged Public sector spending on R&D (in GDP)					2.691***	
					(3.038)	
W5564*Lagged Private sector spending on R&D (in GDP)						0.160
						(0.938)
Lagged Physician density to population	-0.0805**					
	(-2.816)					
ALMP reform dummy		-0.0305				
		(-1.661)				
Labor market reform dummy			-0.0375			
			(-1.230)			
Tax wedge reform dummy				-0.046**		
				(-2.324)		
Lagged Public sector spending on R&D (in GDP)					-0.229**	
					(-2.537)	
Lagged Private sector spending on R&D (in GDP)						-0.0225
						(-0.790)
Intercept	0.314***	-0.0154	-0.0722	-0.199*	-0.566**	0.0636
	(3.495)	(-0.305)	(-0.994)	(-1.755)	(-2.662)	(0.861)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	317	421	413	382	202	236
Number of countries	17	19	19	19	17	16

Notes: The estimates control for the age dependency ratios. *T*-statistics in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

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Appendix I. Aging and Productivity

Population Pressure

(Percent, share of age 65+ to the total population)

	2015	2020	2025	2030	2035
Japan	26.8	29.1	30.3	31.6	33.4
Austria	18.7	19.7	21.5	24.0	26.1
Belgium	18.2	19.2	20.7	22.3	23.5
Denmark	18.8	20.4	21.7	23.3	24.7
Estonia	18.8	20.4	22.4	24.2	25.4
Finland	20.2	22.4	24.1	25.5	26.3
France	18.8	20.6	22.1	23.6	24.8
Germany	21.2	22.4	24.3	27.2	29.7
Greece	20.1	21.3	22.9	24.8	27.2
Ireland	13.3	14.9	16.6	18.5	20.3
Italy	21.5	22.5	23.9	26.1	28.7
Latvia	18.6	18.9	19.9	20.8	21.2
Lithuania	17.1	17.9	19.7	21.8	23.2
Luxembourg	15.5	16.6	18.1	20.0	21.6
Netherlands	17.9	19.9	22.0	24.3	26.2
Norway	16.7	18.0	19.3	20.6	22.0
Portugal	20.5	22.6	24.9	27.5	29.8
Slovakia	13.9	16.6	19.3	21.4	23.0
Slovenia	17.9	20.4	22.7	24.8	26.6
Spain	18.6	20.4	22.8	25.9	29.3
Sweden	19.7	20.3	21.1	22.1	23.2
Switzerland	19.1	20.5	22.4	24.7	26.5
United Kingdom	18.0	19.0	20.2	21.9	23.2
Canada	15.9	18.0	20.3	22.6	23.5
United States	14.8	16.8	18.8	20.3	20.9
Australia	14.9	16.1	17.4	18.6	19.3
New Zealand	14.7	16.6	18.8	21.0	22.6

Super-aged	>20
Aged	14-20
Aging	7-14
Not-aging	<7

Sources: OECD and IMF staff calculations.

Labor Force Pressure

(Percent, share of worker 55-64 to the labor force 15-64)

	2014	2020	2025	2030	2035
Austria	11.3	15.6	16.9	16.3	15.5
Belgium	12.9	16.6	16.4	15.9	15.7
Denmark	16.3	19.2	20.3	20.3	19.2
Estonia	17.8	18.9	19.1	20.8	21.7
Finland	18.2	18.9	18.3	16.7	16.8
France	14.3	15.8	17.4	17.6	16.6
Germany	18.2	22.0	23.7	21.7	20.1
Greece	11.5	18.5	21.3	23.7	25.4
Ireland	13.4	15.5	16.9	19.2	21.5
Italy	14.8	19.9	23.6	25.8	25.8
Latvia	16.8	18.1	18.5	19.3	19.0
Lithuania	16.3	18.0	19.1	19.8	19.2
Luxembourg	10.3	12.7	13.4	12.9	12.2
Netherlands	16.2	18.5	20.2	19.6	17.8
Norway	16.6	17.2	17.9	17.9	16.8
Portugal	14.9	18.4	20.4	22.5	24.1
Slovakia	13.6	14.9	15.2	17.2	20.6
Slovenia	11.4	17.2	18.9	19.3	20.4
Spain	13.1	19.0	22.2	25.4	27.5
Sweden	18.0	17.9	18.6	18.8	18.2

Super-aged	>15
Aged	10-15
Aging	5-10
Not-aging	<5

Sources: OECD; European Comission; and IMF staff calculations.

INVESTMENT, FIRM SIZE, AND THE CORPORATE DEBT BURDEN: A FIRM-LEVEL ANALYSIS OF THE EURO AREA[1]

Corporate investment in the euro area fell markedly with the crisis and has remained weak. Drawing upon a large, cross-country panel dataset of firms' balance sheets and income statements, we investigate the microeconomic drivers of firms' investment choices, finding a negative relationship between a firm's debt and investment. This negative effect is greater for small and medium enterprises (SMEs) than large firms. Highly indebted firms are also found to be less responsive to demand. The results suggest that the weak euro area investment recovery may be partly due to corporate debt burdens, particularly at SMEs, which account for a large share of value-added in the euro area.

A. Introduction

1. **Corporate investment in the euro area fell with the crisis and has remained relatively flat during the subsequent weak recovery.** As shown in Figure 1, panel 1, gross real investment as a share of GDP by non-financial corporations (NFCs) in the euro area slumped almost 15 percent during the global financial crisis, equal to over 2 percentage points of GDP. For selected euro area countries (Greece, Ireland, Italy, Portugal, and Spain), the fall was even more dramatic, with corporate investment dropping about 20 percent.[2] Post-crisis, corporate investment has failed to recover, remaining at this depressed level. By contrast, even though the U.S. had a more severe corporate investment collapse than the euro area, corporate investment in the U.S. recovered much faster, close to levels seen pre-crisis. As a share of GDP, euro area gross corporate investment has historically been above that of the U.S. and below that of Japan.

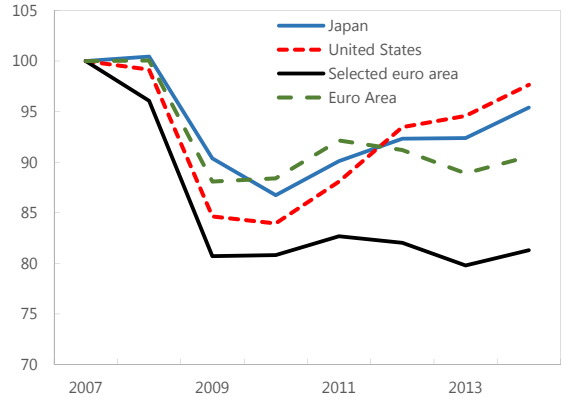
2. **Small and medium enterprises (SMEs) account for over half of gross corporate investment in the euro area in recent years, with more highly indebted firms contributing most of this share** (Figure 1, panel 2). The drop in 2009 investment appears to be largely driven by a severe fall in investment by SMEs (Figure 1, panel 3). These findings suggest that SMEs, and likely those with higher leverage, may have an important role in explaining investment dynamics in the euro area.

[1] Prepared by John Bluedorn and Christian Ebeke (all EUR). We would like to thank Alexander Hijzen and Romain Duval for kindly sharing their cleaned version of the firm-level Orbis database. Xiaobo Shao and Jesse Siminitz provided outstanding research assistance. We thank staff from the European Commission and European Investment Bank for their helpful comments and feedback.

[2] Henceforth, we use the term "corporate investment" to refer to investment by non-financial corporations.

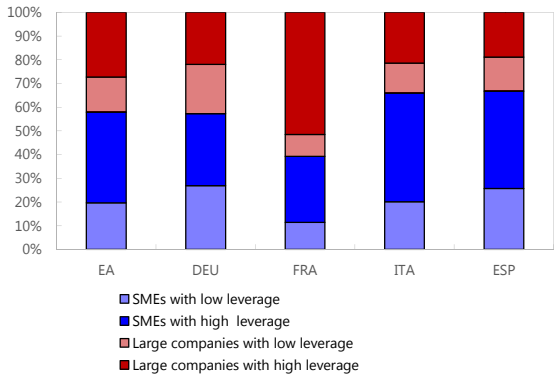
Figure 1. Corporate Investment and Debt

Gross Investment of Non-Financial Corporations
(Percent of GDP, index 2007=100)



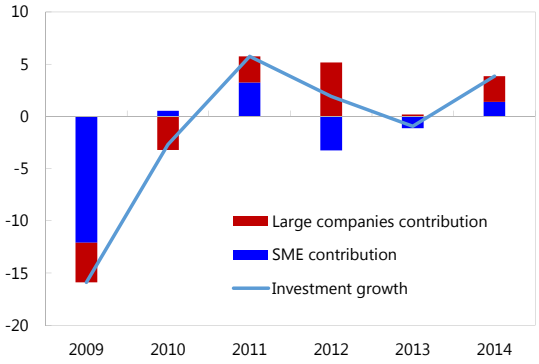
Selected euro area includes: Greece, Ireland, Italy, Portugal, and Spain.
Source: OECD stat. and IMF staff calculations.

Real NFC Gross Investment, 2008-13
(Percent of total real NFC investment)



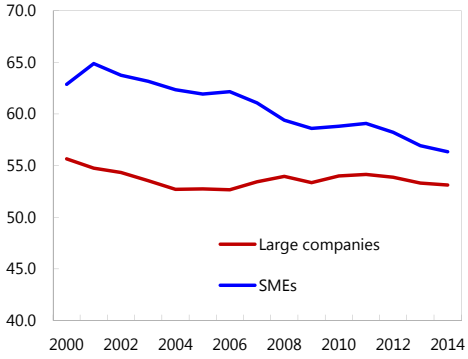
High (low) leverage denotes leverage ratio greater (lower) than the sector-country-year specific median leverage ratio in Orbis.
Source: Orbis, Eurostat and IMF staff calculations.

Euro area: Contribution to Investment Growth
(Percent)



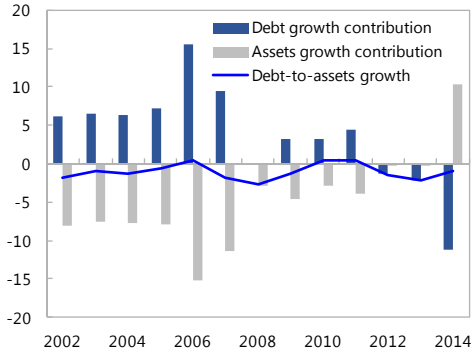
Sources: Banque de France, BACH database; and KfW SME Panel 2009-2015.

Euro Area: NFC Leverage
(Debt to Assets; in percent)



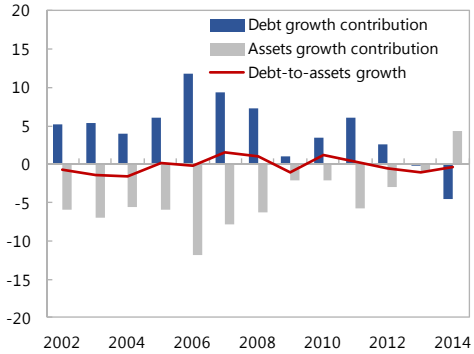
Source: Banque de France, BACH database.

Euro Area: SMEs Leverage
(Annual growth rates; in percent)



Sources: Banque de France, BACH database; and Haver Analytics.

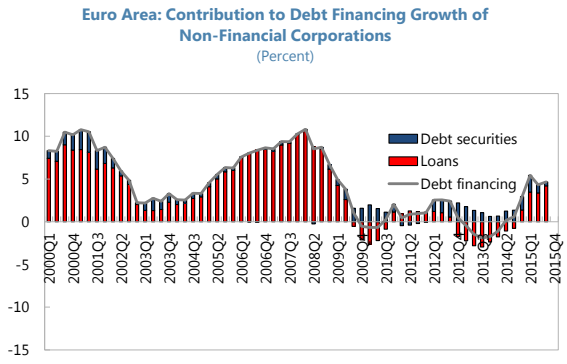
Euro Area: Large Companies Leverage
(Annual growth rates; in percent)



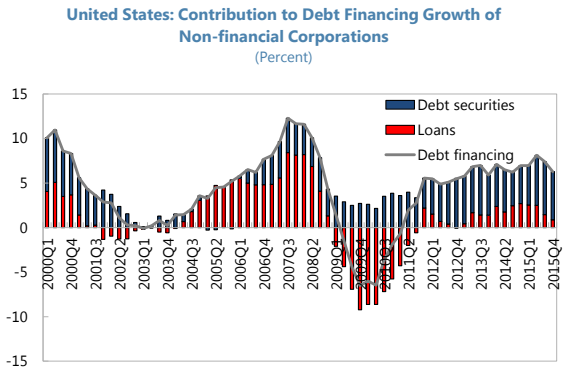
Sources: Banque de France, BACH database; and Haver Analytics.

3. **Overall corporate leverage has remained high for SMEs** (Figure 1, panel 4). Debt growth slowed significantly after the crisis but did not result in significant deleveraging as the lower debt accumulation was partially offset by declining asset values (Figure 1, panel 5). The pattern is similar for large firms but less pronounced (Figure 1, panel 6).

4. **Corporate financing in the euro area relies more on loans, possibly reflecting the region's high share of SMEs in value-added** (see text figure, panels 1 and 2)**.** SMEs account for over 65 percent of value-added in the euro area. Through relationship-based lending, banks are better able than credit and capital markets to overcome the asymmetric information problems related to SME lending (Berger and Udell, 1998). In the U.S., small businesses account for around half of GDP, less than in the euro area (Kobe, 2012), and perhaps relatedly, debt securities play a larger role in corporate financing.

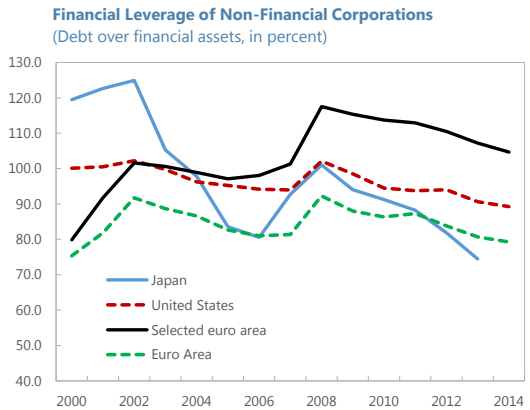


Source: ECB.

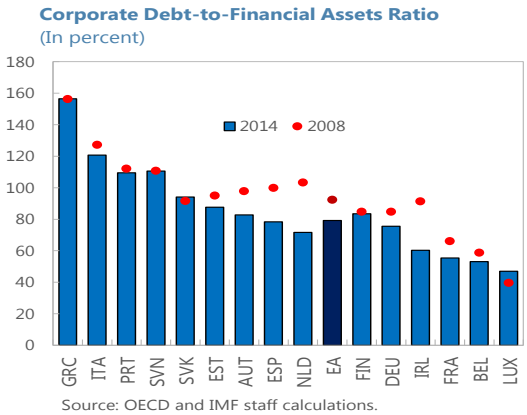


Source: Board of Governors of the Federal Reserve System.

5. **Corporate indebtedness varies significantly across the euro area**. Debt as a share of corporate financial assets (different from total assets) tends to be higher in selected economies than in the core (see text figure, panels 1 and 2).



Selected euro area includes: Greece, Ireland, Italy, Portugal, and Spain.
Source: OECD stat. and IMF staff calculations.



Source: OECD and IMF staff calculations.

6. **Strained corporate balance sheets may reduce firms' ability and willingness to invest.** Many earlier studies show a negative relationship between leverage and firm growth, typically measured as either investment or employment growth (Myers, 1977; Lang and others, 1996; Aivazian

and others, 2005; Kalemli-Ozcan and others, 2015). In these studies, higher leverage is argued to reduce investment by constraining a firm's ability to obtain external financing for new investments and/or incentivizing firms' shareholders to decide against new investments, as a larger share of the gains will necessarily accrue to debtholders than if leverage were lower.

7. **Similarly, leverage may also dampen the sensitivity of a firm's investment to demand.** Firm size can also mediate the negative effect of leverage, as smaller firms tend to be more dependent on bank financing and have lower spare capacities and a lower ability to access alternative financing options, such as issuing debt or equity securities (Kashyap, Lamont, and Stein, 1994; Lang and others, 1996; Kalemli-Ozcan and others, 2015). These arguments suggest that firm size, leverage, and demand may interact to affect investment. They also suggest that these effects could be more pronounced in the euro area, as it is characterized by a dominant share of SMEs and high reliance on bank financing.

8. **Using a large sample of firms in the euro area over 2001–2013, we estimate the responsiveness of real investment to firm size, leverage, and demand.** Taken from a newly assembled and cleaned dataset of firm balance sheets and income statements, the sample contains over six million observations, covering about one and a half million firms in eight euro area countries (Austria, Belgium, Germany, France, Italy, Finland, Spain, and Portugal). The baseline model controls for firm-specific and sector-country-time fixed effects and selected firm characteristics. The results indicate that:

- A 10 percentage point rise in a large firm's leverage is associated with a 3 percentage point fall in the investment-to-capital ratio (physical capital growth) on average.
- For SME, a 10 percentage point rise in leverage would lower investment by about -3.5 percentage points, about 20 percent larger in magnitude than that for a large firm.
- A 10 percentage point rise in a firm's real sales growth (demand) is associated with a 5 percentage point rise in the investment-to-capital ratio of a large firm on average. This effect is smaller by about half for SMEs. Leverage reduces the effect of demand on investment—for an SME, moving from the 10^{th} percentile of leverage to the 90^{th} percentile, investment falls by about 0.5 percentage points, to 2 percentage points.

9. **The findings broadly hold across countries and before and after the crisis, although the magnitudes of the effects changes.** We undertake a variety of checks: allowance for differential effects of positive versus negative sales growth; allowance for differential effects pre- versus post-crisis; and allowance for differential effects across countries. Overall, the negative effects of leverage on the investment-to-capital ratio hold up, as do the exacerbating effects of SME size and the attenuating effect of leverage on the investment response to demand. However, there are differences in the magnitudes of these effects across countries and over time. These effects have increased post-crisis. The negative effects of leverage are particularly strong in Spain and Italy.

10. **The results suggest that policies to reduce high levels of firm leverage post-crisis and boost the size of firms may help spur corporate investment and enhance the transmission of monetary and fiscal policies.** Lower leverage may bolster firms' efforts to undertake new, productive investments by alleviating the financing constraints and providing stronger investment incentives to controlling shareholders. Moreover, the findings suggest that firms with lower leverage raise their investment more in response to higher demand (proxied by real sales growth), which may support accommodative monetary and fiscal policies to the extent that the policies boost firm sales. In other words, aggregate demand policies may transmit better when firms' leverage is lower. High levels of non-performing loans in the euro area (some of which are corporate debt) have also been argued to hamper the transmission of monetary policy by weakening banks' profitability and reducing their propensity to lend (see Aiyar and others, 2015). Finally, larger firms appear to be more responsive to demand, which implies that a shift towards larger firms in the size distribution could boost responsiveness.

11. **The paper proceeds as follows.** In the second section, we briefly present the sample and describe the underlying data. We then describe the empirical research design and econometric model used in the third section. In the fourth section, we outline the baseline results and some extensions. The fifth section summarizes the findings and concludes with some remarks on possible policy implications and directions for future research.

B. Data Description and Summary Statistics

12. **Firm-level balance sheets and income statements come from the Orbis database compiled by Bureau van Dijk Electronic Publishing.**[3] The database includes information harvested from census and regulatory filings in a number of countries for both listed and unlisted firms; it covers all sectors of the economy and all sizes of firms. It includes several million firms and observations at an annual frequency. We use a version of the database processed and cleaned by the Duval and others (2016), which converted the data to local currency and transformed the nominal variables into real values using sector-specific deflators.[4] The extract we focus on includes eight euro area countries for which data is available (Austria, Belgium, Finland, France, Germany, Italy, Portugal, and Spain) from 2001-2013. The sample includes non-financial, private firms that are not engaged in mining or other resource extraction activities. We collapse down the sectoral identifiers to the 2-digit industry level, following the NACE Revision 2 classification. When aggregating up to the country or regional level, we reweight the observations by country-sector-size class to match the population, as tabulated by Eurostat (see OECD, 2013 for a detailed explanation of the resampling procedure).

[3] Orbis includes firm-level data from around 100 countries worldwide, covering both developed and emerging market economies.

[4] The deflators are country-industry purchasing power parity indices taken from the OECD's Structural Analysis (STAN) database. The cleaned database includes information from three vintages, keyed according to the Orbis unique firm identifier. Firms are kept if they have nonmissing values, positive revenue, at least three employees, and at least three consecutive observations.

13. **The dataset exhibits a wide degree of variability, in variables and across countries and sectors.** The firm-level variables that we use include: net investment-to-capital ratio, debt-to-assets ratio, SME indicator (equals one if less than 250 employees), real sales growth, long-term debt-to-assets ratio, and the natural logarithm of total assets. The net investment ratio is computed as the annual change in the real capital stock divided by the lagged capital stock. Leverage is the ratio of debt and loans divided by total assets. Real sales growth is the annual percentage change in real operating revenue (turnover). Finally, the long-term debt ratio is measured as the ratio of long-term debt to total debt. As shown in Table 1, there is a large degree of variability in these variables across the dataset, which contains over a million observations. The sample however is heavily skewed towards SMEs (defined as non-financial corporations with a number of employees between 0 and 249). Table 2 shows a cross-tabulation of the sample by country and sector. Manufacturing and wholesale, retail, and accommodation sectors are highly represented in the sample, followed by the construction and the professional service sectors.

Table 1. Descriptive statistics

Sample	Variable	*N*	mean	sd	p25	p50	p75	min	max
Large firms	Net investment ratio, percent	139,077	13.6	43.1	-6.7	3.4	18.2	-99.9	200.0
	Debt-to-Assets, percent	134,989	15.0	17.6	0.3	8.2	25.1	0.0	100.0
	Real Sales growth, percent	139,057	7.1	25.2	-4.2	3.7	13.2	-100.0	100.0
	Long-term debt ratio, percent	113,341	47.9	39.8	0.0	49.6	89.0	0.0	100.0
	Total assets, log	138,969	18.3	1.8	17.4	18.3	19.3	5.4	31.1
SMEs	Net investment ratio, percent	10,000,000	14.5	57.1	-14.9	-1.9	17.7	-100.0	200.0
	Debt-to-Assets, percent	8,927,845	17.7	21.3	0.0	9.6	28.5	0.0	100.0
	Real Sales growth, percent	10,000,000	4.7	35.2	-12.7	1.0	16.4	-100.0	100.0
	Long-term debt ratio, percent	6,742,116	62.7	41.9	11.9	84.3	100.0	0.0	100.0
	Total assets, log	10,000,000	13.5	1.9	12.3	13.4	14.6	0.0	35.2
All	Net investment ratio, percent	10,200,000	14.5	57.0	-14.8	-1.8	17.7	-100.0	200.0
	Debt-to-Assets, percent	9,062,834	17.6	21.2	0.0	9.6	28.5	0.0	100.0
	Real Sales growth, percent	10,100,000	4.7	35.1	-12.6	1.1	16.4	-100.0	100.0
	Long-term debt ratio, percent	6,855,457	62.4	41.9	11.4	83.4	100.0	0.0	100.0
	Total assets, log	10,200,000	13.6	2.0	12.3	13.4	14.7	0.0	35.2

Note: "sd" denotes the standard deviation. The dataset is further cleaned to reduce the impact of extreme observations. Following Cleary (1999) and Aivazian and others (2005), some variables are winsorized: Set the net investment-to-capital ratio to 200 (-200) if it is greater (less) than 200 percent (-200 percent). Set real sales growth to 100 percent (-100 percent) if it is greater (less) than 100 percent (-100 percent). Set the debt-to-assets ratio (leverage) or long-term debt-to-assets ratio to 100 percent (0 percent) if it is greater (less) than 100 percent (0 percent). The SMEs indicator equals one if the number of employees is less than 250 employees and 0 otherwise. The sample includes 8 euro area countries: Austria, Belgium, Germany, France, Finland, Italy, Spain, and Portugal. The time dimension is 2001-2013.
Source: Orbis database and IMF staff calculations.

Table 2. Sample slice by country and sector

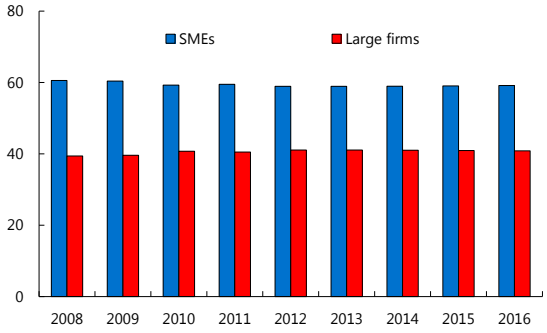
Sector		AUT	BEL	DEU	ESP	FIN	FRA	ITA	PRT
A. Agriculture	Share of SMEs	0.88	1.00	0.98	1.00	1.00	1.00	0.99	1.00
	Sample size	*17*	*329*	*1,286*	*103,404*	*5,170*	*17,128*	*31,684*	*32,042*
C. Manufacturing	Share of SMEs	0.70	0.89	0.75	0.99	0.97	0.96	0.98	0.99
	Sample size	*4,709*	*26,799*	*53,743*	*740,931*	*35,584*	*240,852*	*603,083*	*175,766*
D. + E. Electricity and Water Utilities	Share of SMEs	0.71	0.88	0.85	0.97	0.98	0.93	0.96	0.97
	Sample size	*294*	*1,589*	*11,233*	*24,621*	*2,933*	*10,810*	*25,847*	*4,486*
F. Construction	Share of SMEs	0.81	0.95	0.96	1.00	1.00	0.99	1.00	1.00
	Sample size	*1,129*	*9,478*	*21,579*	*741,124*	*33,555*	*217,012*	*260,574*	*143,689*
G .+ I. Wholesale, retail trade and accommo.	Share of SMEs	0.84	0.96	0.88	1.00	0.99	0.99	0.99	1.00
	Sample size	*4,314*	*39,467*	*49,097*	*1,425,578*	*54,189*	*546,496*	*610,476*	*467,754*
H. Transportation and storage	Share of SMEs	0.79	0.95	0.81	0.99	0.99	0.97	0.98	0.99
	Sample size	*833*	*9,065*	*10,929*	*195,310*	*18,160*	*66,824*	*93,353*	*80,251*
J. Information and communication	Share of SMEs	0.77	0.92	0.84	0.98	0.97	0.97	0.99	0.99
	Sample size	*400*	*4,920*	*9,168*	*100,562*	*6,470*	*44,178*	*94,828*	*23,811*
L. Real estate activities	Share of SMEs	0.84	0.99	0.96	1.00	0.99	0.99	0.99	1.00
	Sample size	*388*	*2,512*	*13,663*	*210,766*	*6,042*	*50,600*	*60,160*	*32,778*
M. + N. Professional and Admin services	Share of SMEs	0.69	0.92	0.81	0.99	0.99	0.98	0.98	0.99
	Sample size	*1,267*	*13,969*	*28,688*	*493,952*	*26,709*	*174,283*	*192,407*	*147,752*

Source: Orbis database and IMF staff calculations.

14. **SMEs generate a large share of value-added in the euro area** (Figure 2, panel 1). In sectors such as construction and many service sectors, they account for well over half of sectoral value-added (Figure 2, panel 2). From the cleaned Orbis data, we can see that leverage rose with the crisis for the typical firm (median firm), but most dramatically for the median SMEs (Figure 2, panel 3). Similarly, investment fell for the typical firm, but most sharply for SMEs (Figure 2, panel 4), providing some empirical motivation for investigating how firm size may affect the relationship between investment and leverage.

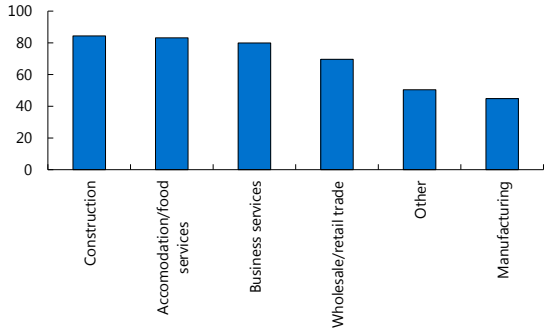
Figure 2. Firm Size and Performance in the Euro Area

Share of SMEs value added in Euro area
(in percent of total economy value added)



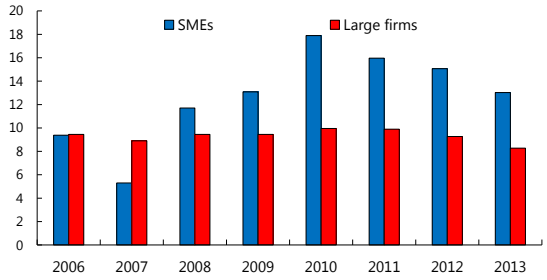
Sources: Eurostat SME Annual Report 2015, and IMF staff calculations.

Contribution of SMEs to Sector-Wide Value Added in 2015, Euro area
(in percent of sector value added)



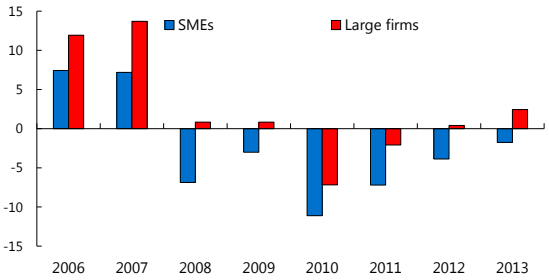
Sources: Eurostat SME Annual Report 2015 and IMF staff calculations.

Non-Financial Corporations Leverage Ratio in the Euro Area*
(Debt in percent of Assets; Median values)



Note: (*) Euro area sample includes 8 countries (Austria, Belgium, Germany, France, Finland, Italy, Portugal, and Spain). The figure shows unweighted median of firms' debt as a percentage of firms' total assets. SMEs include firms with less than 249 employees while large firms include firms with 250+ employees.
Source: Orbis Database and IMF staff calculations.

Non-Financial Corporations Net Investment in the Euro Area*
(In percent of firm's capital stock; Median values)



Note: (*) Euro area sample includes 8 countries (Austria, Belgium, Germany, France, Finland, Italy, Portugal, and Spain). The figure shows unweighted median of firms' real net investment as a percentage of firms' real lagged capital stock. SMEs include firms with less than 249 employees while large firms include firms with 250+ employees.
Source: Orbis Database and IMF staff calculations.

C. Research Design and Econometric Model

15. **The baseline model expands upon the specifications from the previous literature on firm leverage and investment, by including interactions with size and sales growth.** As in Lang and others (1996), Aivazian and others (2005), and Kalemli-Ozcan and others (2015), we estimate a single equation, linear regression model that relates the investment-to-capital ratio to a variety of drivers. It is an augmented version of a traditional accelerator model of investment, where the investment-to-capital ratio is driven by demand changes (sales growth) and additional variables (see Oliner and others, 1995, for a discussion of various investment models). Firm size and leverage are the key additional variables included. They could be viewed as proxies for a firm's financing costs, while also possibly affecting a firm's governance. The baseline panel model specification is as follows:

$$\left(\frac{I_{isc,t}}{K_{isc,t-1}}\right) = \beta_1 \left(\frac{DEBT}{ASSETS}\right)_{isc,t-1} + \beta_2 (SALESGRO)_{isc,t} + \beta_3 (SIZE)_{isc,t}$$

$$+\gamma_1 \left(\frac{DEBT}{ASSETS}\right)_{isc,t-1} \cdot (SALESGRO)_{isc,t} + \gamma_2 \left(\frac{DEBT}{ASSETS}\right)_{isc,t} \cdot (SIZE)_{isc,t} + \gamma_3 (SALESGRO)_{isc,t} \cdot (SIZE)_{isc,t}$$

$$+\delta \left(\frac{DEBT}{ASSETS}\right)_{isc,t-1} \cdot (SALESGRO)_{isc,t} \cdot (SIZE)_{isc,t}$$

$$+\boldsymbol{X}'_{isc,t-1}\Theta + \alpha_i + \alpha_{sc,t} + \epsilon_{isc,t} \quad (1)$$

Here, *I* is the firm's net investment, *K* its tangible, fixed assets, *DEBT* its total debt, *ASSETS* its total assets, *SALESGRO* its real sales growth, and *SIZE* the SME indicator. All ratios and growth rates are expressed in percentage points. The vector ***X*** includes two control variables—the share of long-term debt in debt (following Aivazian and others, 2005) and the natural log of total assets (following Kalemli-Ozcan and others, 2015). *i* indexes firms and *t* indexes years. Each firm is a member of a particular sector *s* and country *c*. α_i denotes the set of firm-specific effects which capture time-invariant unobservable factors at the firm level, while $\alpha_{sc,t}$ denotes the set of sector-country-year-specific fixed effects that capture common shocks to firms belonging to the same sector in a country in a given year. The latter set of fixed effects helps control for aggregate sectoral demand or policy-induced shocks, as well cross-sectional dependence between firms.

16. **By including a variety of interaction terms, the model allows for a rich set of hypotheses with respect to the relationship between firm-level investment and leverage**. In particular, the marginal effects of leverage and sales growth are given by:

$$\frac{\partial \left(\frac{I_{isc,t}}{K_{isc,t-1}}\right)}{\partial \left(\frac{DEBT}{ASSETS}\right)_{isc,t-1}} = \beta_1 + \gamma_1 (SALESGRO)_{isc,t} + \gamma_2 (SIZE)_{isc,t} + \delta (SALESGRO)_{isc,t} \cdot (SIZE)_{isc,t}$$

And

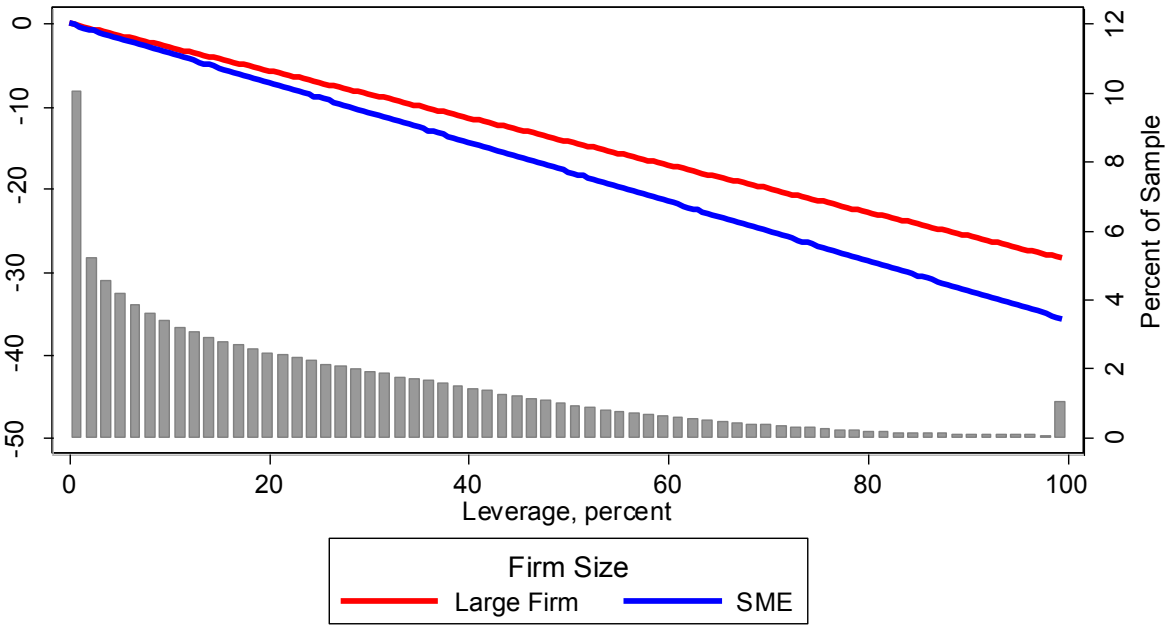
$$\frac{\partial \left(\frac{I_{isc,t}}{K_{isc,t-1}}\right)}{\partial (SALESGRO)_{isc,t-1}} = \beta_2 + \gamma_1 \left(\frac{DEBT}{ASSETS}\right)_{isc,t-1} + \gamma_3 (SIZE)_{isc,t} + \delta \left(\frac{DEBT}{ASSETS}\right)_{isc,t-1} \cdot (SIZE)_{isc,t}$$

Here, the direct effect of the variable is given by the β coefficients, while the indirect effects that are mediated by the levels of other variables are captured by the γ and δ coefficients, with the γ indicative of the two-way interaction and δ of the three-way interaction. This specification makes explicit that the effect of leverage on investment depends on its direct effect, as well as the level of firm-specific demand (real sales growth) and the firm's size. Similarly, the effect of firm-specific demand (real sales growth) on investment depends on its direct effect, as well as the level of firm's leverage and the firm's size. The specification further allows for the possibility that a firm's size may affect these indirect effects (through the three-way interaction in the model). The baseline estimates pool across firms, sectors, countries, and time. Unpacking the estimates, we also look at how they vary by country and differ before versus after the crisis.

D. Empirical Results

17. **The results show that higher leverage is associated with lower investment ratios, and that this effect is greater for SMEs than large firms.** Figure 3 below shows the predicted effect of leverage on investment, conditional on firm size, overlaid on the sample distribution of leverage (full model results are presented in Table A1 at the back, with the underlying coefficients statistically significant). For a large firm, physical capital growth (net investment) is under 3 percentage points lower for a 10 percentage point rise in leverage. For an SME, the estimated reduction is about 3.5 percentage points, about 25 percent larger. The findings that pre-existing leverage has a negative effect on investment and that it is stronger for smaller firms are consistent with the previous empirical literature (such as Kalemi-Ozcan and others, 2015, and Lang and others, 1996).

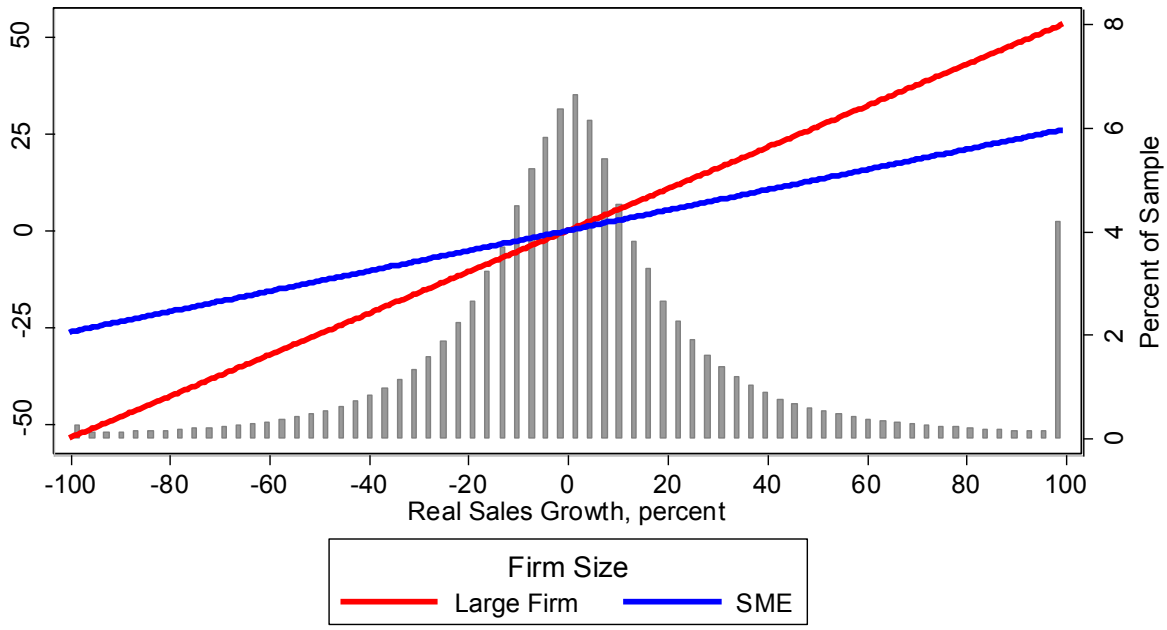
Figure 3. Predicted Effect of Leverage



Note: Lines show the predicted effect on firm investment given the indicated value of leverage, with real sales growth at its mean. Bars show histogram of leverage, with percent of sample shown on right axis. Real Investment Ratio Change is in percentage points.

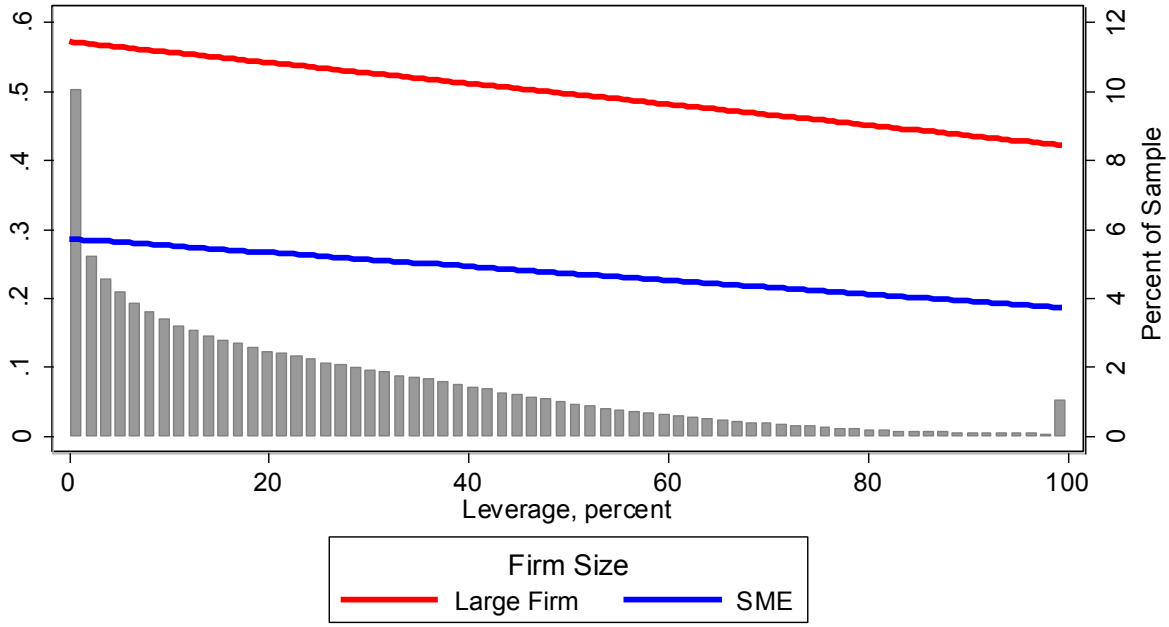
18. **Demand (real sales growth) is associated with higher investment-to-capital, but this effect is weaker for SMEs than large firms and for more highly indebted firms.** As described in the introduction, smaller firms and those with higher leverage are likely more financially constrained. Smaller firms may have recourse only to banks for financing, while higher leveraged firms might be seen as riskier or less able to take on greater debt to invest. Consequently, SMEs and higher leveraged firms could be expected to be less able to find the financing to enable them to invest more in response to demand. Figure 4 below shows the predicted effect, overlaid on the sample distribution of real sales growth. The distribution is roughly symmetric and centered at a slightly positive sales growth, but with somewhat fatter tails than a normal distribution. A 10 percentage point rise in sales is associated with a 5 percentage point increase in the real investment ratio for a large firm, while for an SME, it is about half that, at 2.5 percentage points.

Figure 4. Predicted Effect of Real Sales Growth



Note: Lines show the predicted effect on firm investment given the indicated value of real sales growth, with leverage at its mean. Bars show histogram of sales growth, with percent of sample shown on right axis. Real Investment Ratio Change is in percentage points.

Figure 5. Marginal Effect of Real Sales Growth

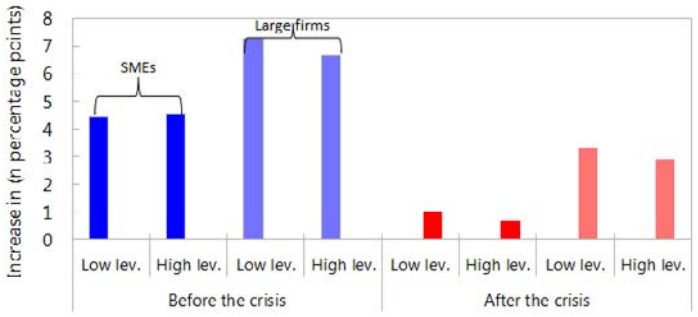


Note: Lines show the marginal effect of one percentage point change in real sales growth on firm investment given the indicated value of leverage and whether or not the firm is an SME. Bars show histogram of leverage, with percent of sample shown on right axis. Real Investment Ratio Change is in percentage points.

19. **Higher leverage is associated with a lower investment response to demand.** Figure 5 shows how the marginal effect of sales growth by firm size depends on the firm's leverage—leverage weakens the firm's investment response to demand. Going from the 10th percentile to the 90th percentile of firm leverage (from about 5 percent to 40 percent leverage) is associated with about a further 0.5 percentage points lower investment response to a 10 percentage point rise in sales growth. Both of these findings are consistent with the financial constraints hypothesis; it appears that smaller and more highly leveraged firms are less able to respond to demand shocks. However, the effect of firm size is by far the greater one.

20. **Splitting the sample into pre- and post-crisis, the results indicate that firms' investment sensitivities to leverage and demand have declined since the crisis.** The pre-crisis sample spans 2001-2007, while post-crisis covers the remainder (2008-2013). The text figure illustrates how the average marginal effect of demand dropped dramatically post-crisis, falling to about three-quarters of the pre-crisis value (see Tables A2 and A3 for the full results). Leverage reduces this sensitivity further. This is consistent with a structural break in the investment response to demand since the crisis. What underlies this shift is unclear. It could reflect an underlying interaction of investment sensitivity to the broader macroeconomic environment (that is, upturn or downturn).

Euro Area: Firm level Investment Sensitivity to Positive Demand Shocks
(Investment increase in response to 10pp increase in real sales growth)

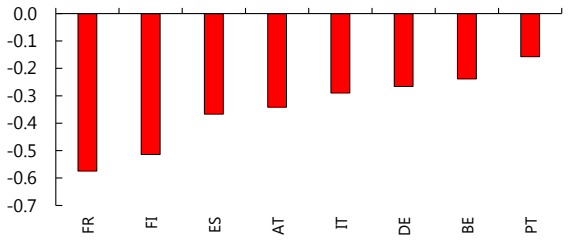


Note: Estimates are based on a non-linear fixed-effects panel regression fitting the firm-level investment-to-capital ratio on leverage, sales, SME dummy, leverage interacted with firm-size class, sales growth interacted with leverage, sales growth interacted with firm size, and a triple interaction of leverage, SME dummy, and sales growth. The model also controls for long-term debt, the log of total assets, sector*country*time effects and firm-fixed effects. The sample is composed of Austria, Belgium, Germany, France, Finland, Italy, Portugal and Spain. The time dimension is 2000 to 2013. Firm level data are from Orbis, BvD Publishing.
Source: IMF staff estimates.

21. **Country-by-country estimates of the investment effects of firm size and leverage suggest that the broad patterns from the panel estimates tend to hold but that the magnitudes of the effects differ across countries.** We estimate the model country-by-country to investigate possible heterogeneity. This will account for the fact that the interactions between size, demand, and indebtedness at the firm could affect investment differently across countries due to country differences in regulations, firms' ability to access financing, and other characteristics. As Table A4 shows, there is considerable heterogeneity across countries. The debt overhang effect is particularly strong in Austria, Finland, France, and Spain. Interestingly, these countries share in common a significant leverage differential between SMEs and large firms compared with others (Figure 6). This is consistent with the previous finding that the marginal effect of leverage was significantly higher for SMEs where credit constraints and debt overhang were the most binding.

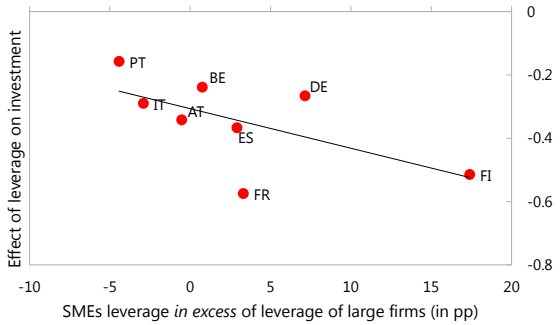
Figure 6. Country-Specific Estimates

Impact of Leverage on Investment
(Average marginal effect)



Note: Estimates are based on country-specific fixed-effects panel regressions fitting the firm-level investment-to-capital ratio on leverage ratio, share of long-term debt, real firm sales growth, log of total assets, full set of interactions between leverage, SME dummy, and sales growth. Sector*time effects and firm-fixed effects are controlled for. The sample is composed of Austria, Belgium, Germany, France, Finland, Italy, Portugal and Spain. The time dimension is 2000 to 2013. Firm level data are from Orbis, BvD Publishing.
Source: IMF staff calculations.

Leverage Differential and Aggregate Investment Response
(Average effect; 2001-2013)



Sources: Orbis (BvD Publishing) and IMF staff estimates.

E. Conclusion

22. **Corporate investment in the euro area fell with the crisis and has failed to bounce back.** In this paper, we try to unpack this fact by undertaking a firm-level analysis of investment in the euro area using a large, cross-country, cleaned dataset of euro area firms from 2001–2013. The results suggest that the euro area's preponderance of smaller firms, which are more reliant on bank-based financing, explains some of the weakness of investment post-crisis. Similar to their share of the euro area economy's value-added, SMEs have accounted for almost 60 percent of gross corporate investment since 2010. Compared to large firms, SMEs tend to exhibit a smaller sensitivity of investment to demand and a larger, negative sensitivity of investment to leverage. The broad findings hold across a number of countries, although the size of the estimated effects differs by country. The analysis also indicates that firms' investment sensitivity has shrunk post-crisis—firms appear less responsive in general.

23. **Taking the stylized facts and analysis together, the results suggest that policies to boost the size of firms, reduce firm leverage, and develop alternatives to bank-based financing could stimulate investment and enhance the transmission of monetary and fiscal policies.** These would not be quick fixes, requiring changes in structural policies to encourage the growth of firms, enable speedier restructuring of corporate balance sheets where leverage is high, and expand corporate financing options for SMEs. However, with larger firms and lower leverage, corporate investment should be more responsive to demand, which may translate into a greater sensitivity to accommodative monetary and fiscal policies, generating a positive feedback to investment.

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Table A1. Effects of firm leverage on firm investment ratio. OLS with fixed effects. Full sample.

Note: The sample excludes firms from the resource extraction sectors, financial and public administration sectors in the Orbis database. The sample spans the years 2003-2013 and includes 8 euro area countries (Austria, Belgium, Germany, France, Finland, Italy, Portugal, and Spain). Firm investment is measured by the annual increase in real capital stock over lagged real capital stock. Leverage is measured as the ratio of total debt to total assets. Debt maturity is measured as the percentage of long-term debt in total debt. To avoid the effect of outliers, we winsorized the observations following Cleary (1999). The cutoff values are 200 and -200 for investment/net fixed asset, 100 and -100 for real sales growth, 100 and 0 for debt maturity, and 100 and 0 for leverage.

Dependent variable: Investment ratio	(1)	(2)	(3)	(4)	(5)
Leverage, lagged	-0.362***	-0.294***	-0.353***	-0.284***	-0.278***
	(-17.07)	(-16.67)	(-16.69)	(-15.99)	(-16.91)
Leverage * SME dummy		-0.0681***		-0.0697***	-0.0756***
		(-2.813)		(-2.886)	(-3.242)
Leverage * Sales growth			-0.00104***	-0.00104***	-0.00151***
			(-6.432)	(-6.433)	(-2.605)
Sales growth * SME dummy					-0.286***
					(-10.45)
Leverage * Sales growth * SME					0.000507
					(0.896)
Sales growth	0.260***	0.260***	0.289***	0.289***	0.571***
	(12.78)	(12.78)	(15.12)	(15.12)	(20.35)
SME dummy		0.518		0.600	3.857***
		(0.375)		(0.438)	(3.552)
Long-term debt	-0.0539***	-0.0540***	-0.0545***	-0.0545***	-0.0544***
	(-8.471)	(-8.466)	(-8.532)	(-8.527)	(-8.531)
Assets, log	8.929***	8.927***	8.906***	8.903***	8.896***
	(25.71)	(25.72)	(25.70)	(25.70)	(25.71)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Sector*Country*Year effects	Yes	Yes	Yes	Yes	Yes
Observations	6,605,325	6,605,325	6,605,325	6,605,325	6,605,325
R-squared	0.350	0.350	0.350	0.350	0.350

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2. Effects of firm leverage on firm investment ratio. OLS with fixed effects. Pre-crisis sample

Note: The sample excludes firms from the resource extraction sectors, financial and public administration sectors in the Orbis database. The sample spans the years 2003-2007 and includes 8 euro area countries (Austria, Belgium, Germany, France, Finland, Italy, Portugal, and Spain). Firm investment is measured by the annual increase in real capital stock over lagged real capital stock. Leverage is measured as the ratio of total debt to total assets. Debt maturity is measured as the percentage of long-term debt in total debt. To avoid the effect of outliers, we winsorized the observations following Cleary (1999). The cutoff values are 200 and -200 for investment/net fixed asset, 100 and -100 for real sales growth, 100 and 0 for debt maturity, and 100 and 0 for leverage.

Dependent variable: Investment ratio	(1)	(2)	(3)	(4)	(5)
Leverage, lagged	-0.564***	-0.404***	-0.562***	-0.402***	-0.366***
	(-20.69)	(-13.03)	(-18.06)	(-12.76)	(-12.85)
Leverage * SME dummy		-0.162***		-0.162***	-0.199***
		(-5.156)		(-5.111)	(-6.246)
Leverage * Sales growth			-0.000131	-0.000130	-0.00221***
			(-0.314)	(-0.310)	(-2.976)
Sales growth * SME dummy					-0.360***
					(-10.83)
Leverage * Sales growth * SME					0.00213***
					(2.709)
Sales growth	0.397***	0.397***	0.400***	0.400***	0.756***
	(9.216)	(9.216)	(11.16)	(11.15)	(25.20)
SME dummy		1.139		1.148	7.360***
		(0.969)		(0.980)	(7.174)
Long-term debt	-0.0369**	-0.0370**	-0.0370**	-0.0371**	-0.0369**
	(-2.470)	(-2.476)	(-2.462)	(-2.468)	(-2.454)
Assets, log	9.884***	9.881***	9.880***	9.877***	9.862***
	(33.58)	(33.60)	(33.88)	(33.91)	(34.11)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Sector*Country*Year effects	Yes	Yes	Yes	Yes	Yes
Observations	2,581,970	2,581,970	2,581,970	2,581,970	2,581,970
R-squared	0.430	0.430	0.430	0.430	0.430

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3. Effects of firm leverage on firm investment ratio. OLS with fixed effects. Post-crisis sample

Note: The sample excludes firms from the resource extraction sectors, financial and public administration sectors in the Orbis database. The sample spans the years 2008-2013 and includes 8 euro area countries (Austria, Belgium, Germany, France, Finland, Italy, Portugal, and Spain). Firm investment is measured by the annual increase in real capital stock over lagged real capital stock. Leverage is measured as the ratio of total debt to total assets. Debt maturity is measured as the percentage of long-term debt in total debt. To avoid the effect of outliers, we winsorized the observations following Cleary (1999). The cutoff values are 200 and -200 for investment/net fixed asset, 100 and -100 for real sales growth, 100 and 0 for debt maturity, and 100 and 0 for leverage.

Dependent variable: Investment ratio	(1)	(2)	(3)	(4)	(5)
Leverage, lagged	-0.324***	-0.252***	-0.321***	-0.245***	-0.244***
	(-9.098)	(-9.350)	(-9.168)	(-9.119)	(-9.465)
Leverage * SME dummy		-0.0726*		-0.0774**	-0.0784**
		(-1.936)		(-2.052)	(-2.166)
Leverage * Sales growth			-0.00117***	-0.00117***	-0.00123
			(-7.391)	(-7.385)	(-1.603)
Sales growth * SME dummy					-0.237***
					(-5.937)
Leverage * Sales growth * SME					9.93e-05
					(0.126)
Sales growth	0.0993***	0.0992***	0.133***	0.133***	0.367***
	(8.364)	(8.364)	(9.023)	(9.022)	(9.448)
SME dummy		-0.934		-0.784	1.330
		(-0.344)		(-0.292)	(0.614)
Long-term debt	-0.0679***	-0.0679***	-0.0678***	-0.0678***	-0.0679***
	(-10.03)	(-10.02)	(-9.980)	(-9.976)	(-9.992)
Assets, log	21.65***	21.63***	21.60***	21.58***	21.56***
	(17.51)	(17.47)	(17.54)	(17.51)	(17.48)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Sector*Country*Year effects	Yes	Yes	Yes	Yes	Yes
Observations	3,688,661	3,688,661	3,688,661	3,688,661	3,688,661
R-squared	0.370	0.370	0.370	0.370	0.370

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.

Table A4. Country-specific estimations: 2001–2013

Note: The sample excludes firms from the resource extraction sectors, financial and public administration sectors in the Orbis database. The sample spans the years 2003-2013 and includes 8 euro area countries (Austria, Belgium, Germany, France, Finland, Italy, Portugal, and Spain). Firm investment is measured by the annual increase in real capital stock over lagged real capital stock. Leverage is measured as the ratio of total debt to total assets. Debt maturity is measured as the percentage of long-term debt in total debt. To avoid the effect of outliers, we winsorized the observations following Cleary (1999). The cutoff values are 200 and -200 for investment/net fixed asset, 100 and -100 for real sales growth, 100 and 0 for debt maturity, and 100 and 0 for leverage.

	AT	BE	DE	ES	FI	FR	IT	PT
Leverage, lagged	-0.357***	-0.124***	-0.200***	-0.435***	-0.284***	-0.197***	-0.267***	-0.195***
	0.0977	0.0346	0.0347	0.0315	0.0922	0.0363	0.0353	0.0598
Leverage * SME dummy	0.0132	-0.125***	-0.0739*	0.0697**	-0.229**	-0.381***	-0.0152	0.0405
	0.116	0.0369	0.0391	0.0331	0.0906	0.0579	0.0391	0.0695
Leverage * Sales growth	0.00395	0.00479**	-0.000459	-0.000123	0.00227	0.00584*	-0.00616***	0.00129
	0.00319	0.00207	0.00121	0.000817	0.00444	0.00306	0.00105	0.00226
Leverage * Sales growth * SME	-0.00517	-0.00479**	-0.000476	-0.0000497	-0.00268	-0.00633**	0.00364***	-0.00254
	0.00327	0.00214	0.00145	0.000818	0.00442	0.00302	0.00106	0.00223
Sales growth * SME dummy	0.0583	0.286***	0.373***	0.466***	0.499***	0.624***	0.754***	0.330***
	0.0652	0.066	0.0416	0.0493	0.111	0.0587	0.0426	0.0593
Sales growth	5.231	5.971***	2.969	2.594**	7.323**	9.375***	4.547***	4.401
	4.244	1.814	1.955	1.172	3.045	3.415	1.378	2.853
SME dummy	0.0145	-0.0586	-0.141***	-0.230***	-0.00564	-0.345***	-0.358***	-0.127**
	0.0686	0.071	0.043	0.0398	0.111	0.0563	0.0393	0.058
Long-term debt ratio	0.0364	-0.0736***	-0.0215***	-0.0936***	-0.0283***	-0.00727	-0.121***	-0.00871***
	0.0476	0.00711	0.00703	0.0059	0.0104	0.00572	0.00414	0.00236
Assets, log	18.74***	11.03***	16.65***	7.851***	7.156***	25.10***	7.466***	15.47***
	3.423	0.621	1.159	0.245	0.226	2.41	0.272	1.291
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector*Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,020	86,554	129,141	2,595,429	159,874	1,670,491	1,254,877	700,939
R-squared	0.423	0.282	0.416	0.352	0.392	0.317	0.403	0.329

Robust standard-error below the coefficients.

*** p<0.01, ** p<0.05, * p<0.1.

OPTIONS FOR A CENTRAL FISCAL CAPACITY IN THE EURO AREA[1]

A key proposal of The Five Presidents' Report is the establishment of a euro area treasury to enhance joint decision-making on fiscal policy. In practice, this implies creating a central fiscal capacity (CFC) at the euro area level. This paper outlines three options for the design of a CFC, focusing on the economic rationale and highlighting pros and cons of each option. The paper is descriptive, rather than normative, and aims to lay the groundwork for further dialogue on this subject.

A. Background and Motivation

1. **The issue**. The design of the European Economic and Monetary Union (EMU) was initially structured around two main pillars: (i) monetary policy to deal with EMU-wide shocks, and (ii) national fiscal policies to address country-specific shocks, within the constraints of the Stability and Growth Pact (SGP). However, some architects of EMU and observers noted that a fiscal capacity would still be desirable (European Commission, 1977), while the global crisis has exposed serious shortcomings in the functioning of the EMU (Allard and others, 2013, 2015; Andrle and others, 2013).

- Monetary policy's capacity to mitigate euro area-wide shocks can be constrained when policy rates approach the effective lower bound (ELB) and with impaired private sector balance sheets. Without central fiscal support, the policy mix may rely too heavily on monetary policy and take longer to close the output gap.

- The buildup of public debt and the slow recovery have reduced fiscal space in many countries, limiting their capacity to respond to shocks. And limited private risk-sharing through capital markets can also exacerbate these country-specific shocks with negative spillovers to the rest of the union.

2. **Central fiscal capacity.** Recognizing these shortcomings in the architecture and building on earlier proposals by the European Commission and the European Council, the Five Presidents' Report (Junker and others, 2015) presented a ten-year roadmap to complete the economic and monetary union. A key element of this plan is the establishment of a euro area treasury to strengthen joint decision-making on fiscal policy in the EMU as a whole and enhance resilience to country-specific shocks. In practice, this implies creation of a central fiscal capacity (CFC) at the euro area level.

[1] Prepared by Tigran Poghosyan. Helpful comments and suggestions were provided by FAD and EUR colleagues, and counterparts at the European Commission and ECB.

3. **Objectives.** In principle, the main objective of a CFC would be to provide fiscal support at the euro area level and enhance the EMU's capacity to respond to both area-wide and country-specific shocks (Allard and others, 2013, 2015; Cottarelli, 2013). Moreover, similar to existing federations and fiscal unions, the CFC could have the following functions (Poghosyan and others, 2015):

- *Fiscal stabilization*. There is a strong case for a CFC to cushion euro area-wide shocks as it would allow for a more effective and balanced policy response. A CFC would also make an important, albeit indirect, contribution to improved policy coordination in the EMU when fiscal space at the country level is limited and macroeconomic conditions call for fiscal support.

- *Fiscal risk-sharing* could be especially useful since private risk-sharing is still limited in the EMU.[2] Greater *ex ante* risk-sharing would limit contagion from national shocks and mitigate the likelihood of resorting to *ex post* ESM support. If market-based risk-sharing mechanisms are strengthened and harmonization is enhanced to the levels observed in existing fiscal unions, the need for fiscal risk-sharing would be reduced somewhat, but would not disappear.

Other objectives could include enhancing fiscal discipline at the national level and promoting structural reforms.

4. **Constraints.** These objectives would need to be achieved within a set of constraints. First, a CFC would need to take into account fiscal conditions at the individual country level. For example, in response to a shock, any fiscal expansion through a CFC would have to be compatible with debt sustainability in individual member states, and should allow for better use of the available fiscal space under the SGP through enhanced coordination. The second constraint is political feasibility. There are likely to be objections to creating a CFC if it is seen as a transfer union, entails mutualizing credit risk across countries, or encourages moral hazard.[3] Establishing a CFC may also take time, especially if it requires Treaty changes. Third, a CFC which focuses on the euro area and the need for fiscal coordination among members of the monetary union would also need to comply with broader EU rules and regulations.

[2] Fiscal risk-sharing in the euro area is much smaller than private risk-sharing in existing federations. For instance, risk-sharing through capital and credit markets is about five times larger than fiscal risk-sharing in the U.S. (Asdrubali and others, 1996). Fiscal risk-sharing in the euro area is also much smaller than in other federations (Allard and others, 2013).

[3] As shown in Poghosyan and others (2015), income redistribution could emerge as a byproduct of a central fiscal capacity. In the EMU case, large permanent transfers across states may be difficult to establish in the absence of a political union.

B. General Characteristics of a Central Fiscal Capacity

5. **Design features.** CFC design schemes differ according to the following broad criteria:

- *Institutional setup.* A CFC could be set up by expanding the mandates of existing European institutions, or by creating a new entity.

- *Type of resources.* A CFC could be financed by (i) transfers from member states (akin to the contributions made to the EU budget), (ii) direct tax collections from individuals or entities within member states, or (iii) borrowing by a separate institutional unit that would be repaid using taxes/contributions or revenues from its operations (i.e., not mutualized debt).[4]

- *Form of demand support.* A CFC could support aggregate demand at the EMU level by: (i) providing intergovernmental transfers or loans to member states which would then use these funds to support demand; (ii) directly funding expenditures in member states, such as infrastructure projects or transfers to individuals (e.g., unemployment benefits); or (iii) providing funding and incentives for the private sector to spend or invest (akin to the EFSI).

Figure 1. Design Features of a Central Fiscal Capacity

6. **Operations.** Depending on the specific scheme, CFC operations could be discretionary or automatic (see below). In addition, CFC operations could be time-dependent, with the degree of stabilization increasing in the presence of large and persistent shocks (Carnot and others, 2015).

7. **Size.** A relatively small CFC could go a long way in enhancing risk-sharing and stabilization. While central budgets in existing federations can exceed 20 percent of GDP, these budgets perform a much broader set of functions beyond fiscal stabilization, including redistribution. Allard and others (2013) estimate that a relatively small centralized fiscal scheme (1.5–2.5 percent of GNP collected annually) could enhance the risk-sharing capacity of euro area, bringing it to the level observed in Germany. For adequate stabilization, the required size of a CFC would depend on the fiscal multipliers and the severity of the economic slowdown. Experience from the global crisis suggests that a temporary fiscal stimulus in the range of 1–2 percent of euro area GDP could suffice to mitigate a severe euro area-wide shock (IMF, 2010).

[4] Joint-liability bonds (such as Eurobonds) have also been discussed as an option to finance national deficits. They are outside the scope of this paper.

C. Three Options for a Central Fiscal Capacity at the Euro Area Level

Tax-Transfer Scheme

Tax-transfer schemes reallocate funds across countries. In each period, a country could be either a net recipient or a net contributor to the scheme depending on its cyclical position (e.g., output gap or unemployment). The most widely discussed option is a common unemployment insurance fund.

8. **Design.** A typical example of a tax-transfer scheme is an unemployment insurance fund (UIF). At the euro area level, a UIF could enhance stabilization against country-specific shocks by pooling risks across countries (Dolls and others, 2014). It would redirect a portion of social contributions from national budgets towards the UIF, and provide minimum unemployment benefits comparable across states that could be capped at a certain level and/or duration.[5] Given that a UIF is a tax-transfer scheme, it would not change the overall level of taxation or rely on common borrowing. It would also not affect the aggregate euro area fiscal stance as the scheme would operate only through automatic stabilizers. Nevertheless, aggregate demand could expand through compositional effects; for example, fiscal multipliers are higher in countries with greater slack or unemployment.

9. **Alternative options.** Alternative tax-transfer schemes could provide support to member states rather than to individuals. They could also use different criteria for providing cyclical support, such as the output gap (e.g., a "rainy-day" fund) (Carnot and others, 2015). Alternative revenue options could target different tax bases (e.g., value added) or rely on contributions proportional to country size.

10. **Pros.** A UIF would aim to enhance resiliency to country-specific shocks. The cyclical nature of the funding, via social security contributions, and the provision of unemployment benefits would enhance fiscal stabilization. Social security contributions raised in countries in good times could be used to fund benefits in countries experiencing an economic downturn. With parameters defined *ex ante*, unemployment benefits would be automatic with limited scope for politically-motivated discretionary actions. A scheme could be designed in a budget-neutral fashion at the euro area level to avoid common borrowing.[6] In the absence of common debt issuance, there would be no effect on the debt of individual countries. Finally, a UIF could provide an incentive to accelerate labor market reforms if the common unemployment insurance mechanism requires a minimum degree of harmonization of labor taxation. In addition, country access to the scheme could be conditional on reaching a certain level of labor market flexibility.

[5] A UIF could mimic the design of similar schemes in existing federations, where minimum insurance against individual income risk is provided through the center. For instance, in the U.S., the federal-state unemployment insurance system is managed largely by the states. Workers are eligible for a maximum of 26 weeks of unemployment insurance in normal periods. Depending on the state, the insurance aims to replace about half of workers' previous earnings up to a maximum level and is funded by federal and state payroll taxes. In periods of economic stress, the insurance period could be expanded beyond 26 weeks through additional support from the federal government (see http://www.cbpp.org/research/introduction-to-unemployment-insurance).

[6] At the individual country level, the scheme may create fiscal deficits or surpluses in a particular period of time, but would be deficit-neutral over an extended period of time.

11. **Cons.** A UIF would have a limited ability to handle common shocks, especially if designed in a deficit-neutral fashion. High cyclicality of revenues and expenditures might stretch the fund in global downturns (when demand for unemployment benefits goes up while payroll taxes shrink), even if the fund has the ability to save surpluses in upturns, although this could be addressed if borrowing were allowed. The responsiveness to shocks might not be timely given that unemployment reacts with a lag to changes in economic activity. Also, if not carefully designed, a UIF might give rise to income redistribution from countries with low structural unemployment to countries with high structural unemployment. One possibility to limit the scope for permanent transfers would be to constrain unemployment benefits to short-term unemployment, which is more closely linked to temporary adverse shocks. Finally, without conditionality on access, a UIF might contribute to moral hazard and slow implementation of reforms.

Borrowing-Lending Scheme

Borrowing-lending schemes entail a central entity, similar to a multilateral bank, which borrows from the market and on-lends the funds either to the public or the private sector.

12. **Design.** Several borrowing-lending schemes already exist in the EU, e.g., the ESM, EIB, EFSI, but they do not have an explicit economic stabilization mandate. A new entity could receive capital contributions from EMU members and borrow from the market.[7] Borrowing costs could be kept low by the capital commitments of member states. Funds borrowed by the entity could be lent to EMU members and possibly earmarked for specific projects, such as infrastructure, and then repaid over time by member states that have received funds. In response to a large common shock, a borrowing-lending scheme could be part of a strategy that involves invoking the SGP's systemic escape clause to provide temporary fiscal support.

13. **Alternative options.** On-lending schemes could also provide loans to the private sector. For instance, the EIB and EFSI borrowing capacity could be expanded by injecting new capital and focusing lending on euro area projects. Another possibility would be to channel the funds for national projects through the EU budget by opening a separate euro area chapter. Such a scheme could direct funds raised by the borrowing-lending entity to national governments in the form of grants, potentially earmarked for specific purposes. The funds would be repaid to the borrowing-lending entity over an extended period of time using regular transfers from euro area members. This would allow individual members to use the current favorable borrowing environment to frontload spending while avoiding risk mutualization.

14. **Pros.** The scheme would create new fiscal space by allowing countries to borrow from the central entity at lower rates.[8] The entity would enhance stabilization by expanding aggregate demand in response to euro area-wide shocks. The debt of the entity would not be a joint liability financial instrument, and with a sufficiently high credit rating, the debt could be a new safe asset

[7] The funds borrowed from the market would be recorded on the balance sheet of the entity and would not increase national debts.

[8] The national debt of the shareholders would nonetheless increase moderately by the amount of capital they have to provide. Also, the lending activities of the entity would be recorded as debt of the countries borrowing from it. Finally, the entity should meet a number of criteria and have sufficient autonomy to limit the risk of debt reclassification.

and eligible for ECB monetary policy operations. Also, the scheme could provide affordable financing to SMEs or other projects. Proper vetting (supported by the EIB/EFSI) could help ensure the efficiency of projects. Finally, the scheme could provide impetus for sound policies if access is conditional on compliance with fiscal rules and a strong structural reform track record, such as implementation of EC country-specific recommendations.

15. **Cons.** The political challenges of creating such a new entity are high, as it might require amendments to existing EU Treaties or intergovernmental Treaty negotiations outside of the EU framework.[9] Economically, new debt issuance by the center could crowd out national borrowing, leading to higher interest rates for some countries,[10] as well as lower budgeted public investment, resulting in a smaller addition to aggregate demand due to the "windfall effect."[11] In addition, there would be no automaticity as in a UIF, as the entity would provide loans on a discretionary basis with longer implementation lags and possible risks of political interference. There might also be a buildup of contingent liability risks for shareholders. An on-lending scheme might create a liability for the shareholders in case of default, either because they would need to recapitalize the entity or because they would have guaranteed its debt. Finally, in the absence of conditionality, the scheme may give rise to moral hazard and undermine fiscal discipline.

Small Euro Area Budget

A small euro area budget would combine the characteristics of the previous two options with more policy levers and flexibility to respond to aggregate and country-specific shocks.

16. **Design.** A new budget could be established at the euro area level (EAB). An EAB would receive revenues in the form of contributions from member states or from taxes for which it would be given the authority to collect, such as value added or corporate income taxes. Expenditures carried out centrally could focus on common public goods or strengthening social safety nets. Expenditure could also be via transfers to member states in a neutral (proportional to country weights) or targeted (supporting more those undergoing downturns) fashion.

17. **Funding capacity.** An EAB could also have the ability to issue its own debt, supported by a dedicated revenue stream. This scheme would differ from the tax-transfer option (which does not entail borrowing), the borrowing-lending option (which does not carry out expenditure), and the EU

[9] For instance, ESM was founded on the basis of a new treaty (the Treaty Establishing the European Stability Mechanism), which stipulated that ESM would be established if member states representing 90 percent of its original capital requirements ratify it. In addition, 27 EU members had to ratify the amendment to Article 136 of the Treaty on the Functioning of the European Union (TFEU) to authorize establishment of the ESM under EU law.

[10] Nevertheless, this is unlikely when economic conditions are weak and monetary policy is accommodative, as is the case now, and given the small size envisaged for the scheme.

[11] The "windfall effect" refers to a temporary and sudden increase in available budget resources, part of which could be saved for various reasons (including meeting SGP targets).

budget (which is broader than the euro area, does not focus on stabilization, and does not have a borrowing capacity).[12]

18. **Alternative options.** The EU budget could be increased and its mandate expanded to provide a stabilization function, in addition to redistribution and public goods provision, but its operations cover EU, and not just euro area, countries.

19. **Pros.** The scheme could cushion both euro area-wide and country-specific shocks. Automatic stabilizers could operate through central revenues and expenditures, providing risk-sharing in response to country-specific shocks. The EAB could expand aggregate demand in response to euro area-wide shocks by issuing common debt and creating new fiscal space.[13] Also, the EAB could generate economies of scale, as centralized provision of some public goods (e.g., infrastructure projects with large network externalities, national defense, R&D, and foreign affairs) could enhance spending efficiency (Escolano and others, 2015). The EAB could also facilitate the coordination of the euro area fiscal stance by influencing and coordinating national budgets from the center.[14] By creating a comparable institution to the ECB on fiscal policy, it would strengthen the credibility and responsiveness of euro area macroeconomic policies. It could also foster harmonization of those taxes and expenditures managed by the center.

20. If an EAB's centrally-supported risk-sharing were conditional upon SGP compliance and structural reform progress, an EAB could enhance incentives for strong policies.[15] Finally, the EAB could be established as an independent statistical unit so its debt would not appear as individual members' debt.[16] At the same time, issuing EAB bonds would increase the pool of safe assets.

21. **Cons.** An EAB may be the most politically challenging among the options discussed, as it would involve transferring taxation, spending, and borrowing powers to the center, subject to corresponding Treaty changes. To be legitimate and credible, an EAB would need some political oversight, such as by the European Parliament, and perhaps even the appointment of a euro area finance minister, which could also increase effectiveness. Any increase in the overall tax burden could generate resistance, if not matched by reductions at the national level. An EAB might indirectly result in income redistribution from richer to poorer countries through permanent differences in tax bases and or transfer needs. Evidence of indirect redistribution is present in existing federations without an explicit constitutional mandate of redistribution (e.g., the U.S.) (Poghosyan and others,

[12] An EAB might share common features with the EU budget. The European Commission is responsible for executing the EU budget, with the European Council and European Parliament all having a say in determining its size and allocation. The European Commission could also be responsible for executing the EAB, with the Eurogroup and European Parliament being involved in determining its size and allocation.

[13] In addition to borrowing to finance EAB spending, if an EAB has a credible revenue stream and/or there is backing (explicit or implicit) by member states of central debt, interest rates paid by the EAB might be below those of highly-indebted countries. Hence, issuing debt at a central level could be cheaper than issuing separately at national levels.

[14] Other federations typically have relatively large central budget capacities.

[15] Stabilization by itself could also support implementation of structural reforms indirectly (IMF, 2016).

[16] Statistically speaking, a central budget is generally recorded as a separate "institutional unit" which borrows on its own behalf (rather than on behalf of its shareholders) and is responsible for repaying its debt from a legal point of view. The central budget's borrowing is backed by future streams of its own central revenues. As a result, its fiscal operations (revenue, expenditure, and borrowing) are recorded separately from its shareholders, similar to the EU budget accounting. This is the case even if member states guarantee the debt issued by the central budget.

2015). The establishment of a separate budget could lead to an increase in government size and impose an additional tax burden at the euro area level, although offsetting the new spending and taxes with smaller national budgets would reduce or eliminate the expansionary effects. Central borrowing might crowd out national borrowing, although this is less likely when economic conditions are weak and monetary policy is accommodative. Finally, the EAB might lead to moral hazard in the absence of conditionality and market pressure.

D. Next Steps

22. **Next steps.** While the Five Presidents' Report makes a strong case for a CFC, it does not elaborate on its design and potential functions. The details are to be laid down in a white paper slated for spring 2017. A special working group in the European Commission will consider details of a CFC and prepare the white paper. However, given the complexity of the issue and various constraints, any move toward a CFC is likely to be gradual in order to accommodate the various concerns and political views regarding further fiscal integration.

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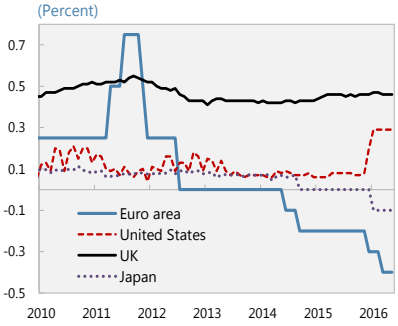
NEGATIVE INTEREST RATE POLICY (NIRP): IMPLICATIONS FOR MONETARY TRANSMISSION AND BANK PROFITABILITY IN THE EURO AREA[1]

Several central banks in Europe have adopted a negative interest rate policy (NIRP) to achieve price stability and/or reduce appreciation pressures. Negative interest rates so far have had an overall positive impact, supporting easier financial conditions and contributing to a modest expansion in credit, demonstrating that the zero lower bound (ZLB) is less binding than previously thought, including with respect to central banks' signaling capacity. But looking ahead, further rates cuts when deposit rates remain sticky will lower bank profitability and may offset the benefits from higher asset prices and lower funding costs in a bank-dominated financial system. For the euro area, this suggests that further monetary accommodation should rely more on credit easing measures than on further lowering negative interest rates.[2]

A. Background

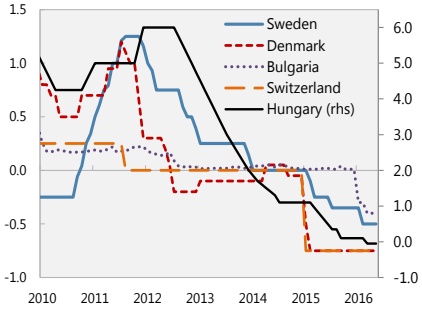
1. **Over the last two years, central banks have pushed the marginal policy rate into negative territory in response to macroeconomic challenges.** The Danmarks Nationalbank (DN), the European Central Bank (ECB), Sveriges Riksbank (SR), and the Swiss National Bank (SNB) all cut their key policy rates to below zero over the period from mid-2014 to early 2015, and the Bank of Japan (BoJ) in February. In addition, the Hungarian central bank (Magyar Nemzeti Bank (MNB)) adopted a negative deposit rate in March 2016 (see text figures). Some central banks have taken policy rates into negative territory to primarily counter a subdued inflation outlook (ECB, BoJ, SR), while others have focused on mitigating spillover effects from the unconventional monetary policy (UMP) measures (Mircheva and others, 2016) and to ward off appreciation pressures (DN, SNB). In Hungary, NIRP was also used to promote new lending and reduce vulnerabilities, in particular regarding public debt. Most central banks have also introduced a tiered deposit rate to

Major Reserve Currencies: Effective Marginal Policy Rates, 2010-2016
(Percent)



Source: Bloomberg, L.P.; and Haver Analytics.
Note: Policy rates used for each country are the following: EA: deposit rate; US: Fed funds rate; UK: O/N interbank rate; Japan: deposit rate.

Other Currencies: Effective Marginal Policy Rates, 2010-2016
(Percent)



Source: Bloomberg, L.P.; and Haver Analytics.
Note: Policy rates used for each country are the following: SWE: reverse repo rate; DEN: repo rate; HUN: deposit rate; BGR: deposit rate; CHE: deposit rate.

[1] Prepared by Andreas (Andy) Jobst and Huidan Lin. We thank EUR, MCM, RES, and SPR colleagues for helpful comments and suggestions. We are also grateful to staff from the Directorate Monetary Policy and the Directorate General for Macro-Prudential Policy and Financial Stability at the European Central Bank (ECB) for helpful feedback.

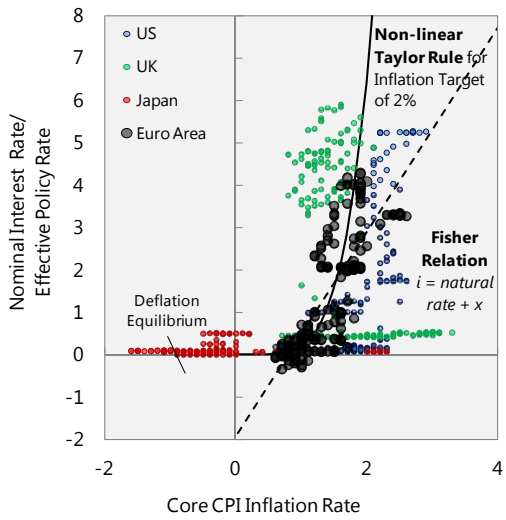
[2] The distributional implications of negative interest rates are beyond the scope of this paper.

reduce banks' cost of holding excess reserves while still allowing for a strong pass-through to money markets (see more details in Appendix I, Table A1 and Appendix II).

B. Advantages and Disadvantages of NIRP

2. **The willingness and capacity of central banks to pursue effective NIRP strongly signals their commitment to price stability objectives and supports portfolio rebalancing.** In an environment of low inflation, negative rates restore the signaling capacity of the central bank by effectively removing the ZLB, which helps avoid a deflation equilibrium as the real rate adjusts downward (see text figure)—and contributes to a significant flattening of the yield curve. If banks hold excess reserves, cuts to the central bank deposit rate lower the money market rate and other interest rates, encouraging banks to take greater risks, strengthening the portfolio rebalancing channel—an important transmission channel of the asset purchase program (Heider and others, 2016).

Inflation and Interest Rates, Jan. 2002-April 2016
(In percent, monthly)



Source: Bloomberg, Haver Analytics, and IMF staff calculations.

3. **However, with sticky deposit rates, NIRP potentially weakens bank profitability through lower net interest income.** If negative policy rates are transmitted to lower lending rates (and term premia), they are likely to reduce the profitability of maturity and liquidity transformation unless banks can substitute more wholesale funding at lower money market rates and/or negative rates are also imposed on deposits (or fees are applied). However, retail deposit rates tend to be downward sticky[3] since (i) households and small businesses do not face the same set-up cost faced by banks and corporations in storing cash due to relatively small amounts of excess liquidity and (ii) a zero percent interest rate could be a psychological threshold.[4] As a result, banks' net interest margins (NIMs), defined as net interest income relative to average interest-earning assets, compress as lending rates for new loans decline, and existing (variable rate) loans re-price while deposit rates remain sticky or do not adjust as quickly. This could reduce bank profitability and impair the pass-through to lending rates in absence of any mitigating actions. Of course, if banks eventually decide to lower retail deposit rates below zero (as already done on large deposits in several countries), this would increase the chances of "leakages" to cash[5]

[3] The stickiness of deposit rates reflects the avoidance of being penalized to save and is determined by the actual costs of holding cash rather than deposits; under these conditions, demand for cash is likely to be greatest for economic agents with high excess liquidity and increases if negative interest rates are expected to persist for some time.

[4] For example, compared to more sophisticated agents, households may simply react more instinctively to negative rates viewing negative rates as "abnormal" or "theft."

[5] For a comprehensive analysis of how cash hoarding can be prevented under NIRP, see Agarwal and Kimball (2015).

but will also induce higher household consumption and portfolio rebalancing towards other investment opportunities, with beneficial effects on aggregate demand.[6]

4. **Other factors could compensate for the adverse impact of NIPR on interest margins.**

- *Stronger credit growth and/or higher non-interest income*. The credit supply effects of reduced profitability from lower lending rates can be offset by the credit demand effects if banks (can) increase lending (Appendix I, Box A1)—but this becomes more difficult if credit demand is low, assets re-price quickly, and competition among banks is high. Banks could also supplement declining interest margins with alternative sources of income, such as fees and commissions.[7]

- *Higher asset prices, asset quality, and lower funding costs.* Portfolio rebalancing with negative rates reduces risk premia, easing financial conditions and ultimately supporting credit creation and economic activity. The resulting decline in risk aversion increases asset prices and generate capital gains on banks' appreciating asset holdings. Furthermore, higher asset prices (especially in tandem with higher inflation) are likely to raise future income and strengthen borrowers' repayment capacity, leading to a reduction in bank non-performing loans (NPLs).

- *Stronger aggregate demand through portfolio rebalancing.* Portfolio rebalancing helps lower firms' general cost of capital via lower term premia, which puts downward pressure on corporate bond yields.[8] At a lower cost, more investment projects would become profitable, raising investment and credit demand. Higher credit demand can offset declining margins, and, in turn, reinforce the impact of TLTRO II on bank profitability (Appendix I, Box A2). Higher asset prices and lower interest expenses for indebted households (who tend to have higher marginal propensity to consume) also boost household consumption through wealth effects.

5. **On the other hand, a prolonged period of negative rates could raise financial stability concerns.** In particular, the downward stickiness of deposit rates encourages the substitution of less stable wholesale funding for deposits. German, Italian, Portuguese, and Spanish banks, whose deposit base is wider than in the rest of the euro area average, have stronger incentives to trade off market-based sources of funding against more stable (term) deposit funding (Figure 1). As much as negative rates ease financial constraints on borrowers in the short run, they could distort the long-term debt affordability of borrowers if lending rates become negative in *real* terms.[9] The reduced debt service burden under NIRP could delay the exit of nonviable firms, hurting demand prospects of healthy firms by adding to excess capacity and delaying the efficient allocation of capital and labor. By effectively removing the profitability constraint of investments if real borrowing rates drop

[6] Thus, the "true" limit on negative deposit rates would the level at which households would find it preferable to hoard large amounts of cash. Given the costs with moving and storing cash, this rate can be well below zero.

[7] For instance, charging retail clients fees to maintain checking accounts as it is done commonly in the United States.

[8] Even though the portfolio rebalancing channel would apply to any reduction of policy rates, its effectiveness is likely to increase in an environment of negative interest rates.

[9] This would necessitate a tightening of lending standards if greater risk-taking due to NIRP undermines the usefulness of asset impairment levels in detecting financial distress.

to (or even fall below) the ZLB, NIRP might also delay corporate restructuring in high debt countries, especially if inflation does not pick up, placing greater emphasis on debtor screening and debt enforcement standards. In these instances, more assertive supervision and regulatory pressures would be needed to address large amounts of non-performing loans and debt overhang problems (Syed and others, 2009).

C. The Impact of Negative Interest Rates

6. **Negatives rates have been fairly effective thus far in reducing money market and lending rates** (Elliott and others, 2016; Viñals and others, 2016). At the same time, retail and corporate deposit rates also declined, allowing banks to maintain their lending margins and supporting credit growth given the importance of the bank lending channel.[10] In cases where sticky deposits (with a limited scope for cheaper wholesale funding)[11] have compressed lending margins, many euro area banks have been able to more than offset declining interest revenues with higher lending volumes, lower interest expenses, lower risk provisioning and capital gains (Cœuré, 2016).[12]

7. **Money markets have quickly adjusted to modestly lower deposit rates without causing a collapse of interbank lending.** In the environment of excess liquidity, the observed money market rate will be at or just above the marginal policy rate at which excess reserves are remunerated (or penalized under NIRP). In all countries, money market rates closely followed the marginal policy rate (Appendix III, Figure A1). In some countries, a tiered central bank deposit rate has facilitated the smooth transmission of the marginal policy rate to money markets reducing the cost of interbank lending. However, several factors, in particular related to the design of a tiered reserve system, could keep the money market rate away from the deposit rate as the technical floor of the policy rate corridor. These include: (i) the amount of excess liquidity and the fraction that is exempted from the marginal policy rate, (ii) the spread between the marginal and average policy rate for excess reserves, and (iii) banks' willingness/ability to lend excess liquidity to each other (fragmentation).

8. **Despite lower lending rates, so far there is limited evidence of negative rates having damaged bank profitability**. Lending rates declined, in most cases, as long as deposit rates still had some room to drop to the ZLB (see text figures), allowing banks to transmit lower policy rates without impeding their profitability (Appendix I, Box A3).[13] While bank profitability has been a long-standing structural challenge for many euro area countries regardless of current monetary easing, the aggregate NIM has remained broadly stable (Appendix III, Figure A2). Euro area banks have reportedly reduced their lending rates to both households and firms over the past six months while

[10] See McAndrews (2015) for a critical review of issues concerning negative interest rates.

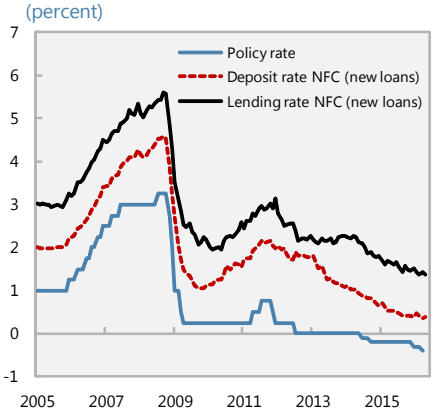
[11] Banks could substitute wholesale funding for higher cost retail deposits (also to meet stable funding requirements under the Basel liquidity risk framework); however, longer term funding contains some term premium, and market access might be limited for smaller banks.

[12] ECB staff estimate that negative rates have contributed about one percent to corporate lending growth since July 2014 (Rostagno and others, 2016).

[13] Whether this effect is stronger or weaker at negative rates remains unclear. Recent work by Claessens and others (2016) suggests that banks' NIMs are negatively impacted by interest rate cuts, and this effect increases the lower the policy rate.

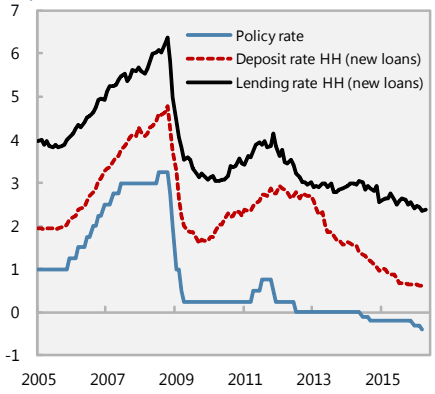
offsetting the negative impact on lending margins by some small increase in fees and commissions and cost cutting. According to the ECB's recent *Bank Lending Survey* (ECB, 2016a) negative rates seems to have also led to an increase in household lending in the euro area, and the impact is expected to continue going forward (Appendix III, Figure A3).[14] Moreover, reduced profitability from lending also puts pressure on the "self-healing powers" of highly cyclical and fragmented banking systems in many euro area countries—such as facilitating bank consolidation and paving the way for greater operational efficiency.

Euro Area: Marginal Policy Rate and Lending/Deposit Rates—NFCs
(percent)



Source: Bloomberg, L.P.; and Haver Analytics.
Note: Policy rate used for this chart is the ECB's deposit rate.

Euro Area: Marginal Policy Rate and Lending/Deposit Rates—Households
(percent)

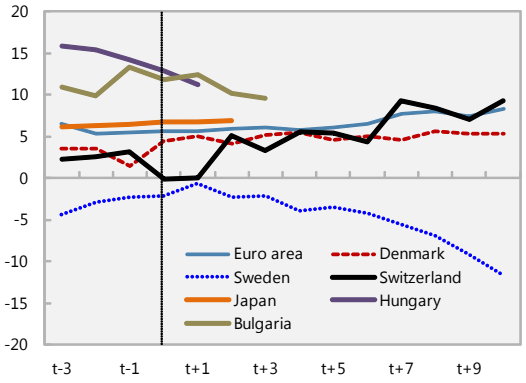


Source: Bloomberg, L.P.; and Haver Analytics.
Note: Policy rate used for this chart is the ECB's deposit rate.

9. **The direct cost imposed on excess bank reserves by NIRP has been found small when compared to the size of the overall balance sheet.** The implementation of NIRP has important implications for banks' cost of holding central bank liabilities depending on the structure of reserves and their remuneration (Appendix I, Box A4) and the transmission of the marginal policy rate to money markets (Appendix I, Box A5). For instance, the peak charge in Switzerland has been 0.03 percent of total banking sector assets. In the euro area, and in countries with an even more negative deposit rate (Denmark, Sweden and Switzerland), there have been no signs of cash hoarding (see text figure); most of the recent increase in some countries can be explained by the normal relation between currency in circulation and movements in the short-term interest rate, with the latter representing the opportunity cost of holding cash rather than deposits. Irrespective of whether interest rates are positive or negative, the amount of currency in circulation increases when interest rates decline. In addition, bank profitability is far less sensitive to declines in negative rates on excess reserves (even under a tiered system) since cash balances of banks represent only a fraction of their deposit base.

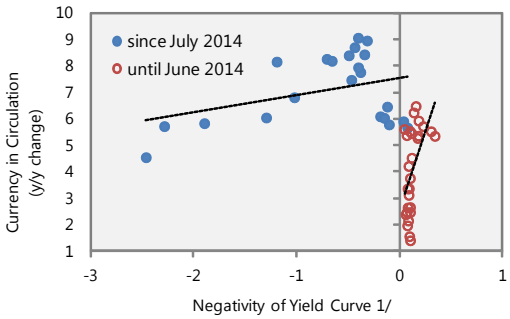
[14] However, negative interest rates had little impact on corporate lending volumes over the past six months, but some positive impact is expected for the coming months.

Currency in Circulation at Time of Negative Deposit Rates
(Percent, year-on-year)



Source: Haver Analytics. Note: the x-axis shows monthly intervals.

Euro Area: Currency in Circulation and Pervasiveness of Negative Interest Rates, 2012-2016
(Percent)



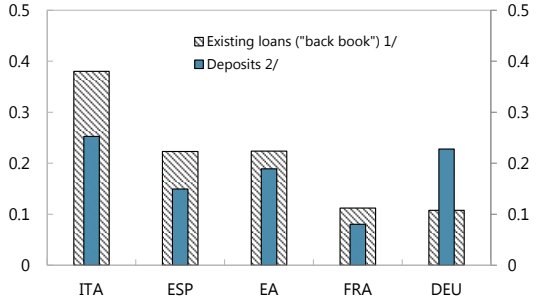
Source: Bloomberg L.P. and IMF staff calculations. Note: 1/ denotes the extent to which the 1-month EONIA forward rate curve is in negative territory, calculated as the product of the maturity term and the interest rate.

10. **Going forward, the transmission of negative rates might become less effective as interest rates become more negative**. This would leave little room for further adjustment of deposit rates to more negative rates without compromising bank lending spreads. While the extent to which deposit rates are sticky remains to be seen, it is very likely that lending rates will decline more than deposit rates in the near term, further reducing interest earnings. Banks might also be less inclined to reduce lending rates unless they can offset lower interest margins by substituting wholesale funding for more expensive deposit funding (which represents a large part of euro area bank liabilities). This holds particularly true in countries where banks face greater earnings pressure, and credit growth has been low. The role of negative rates in reinforcing the transmission of monetary policy to the real economy and supporting aggregate demand would be an offsetting benefit. However, if lending rates do not adjust, monetary transmission could be weakened.

Figure 1. The Impact of NIRP on Bank Profitability and Implications for Credit Growth

Within the euro area, banks in the selected economies will likely re-price lending quicker than deposits, reducing margins ...

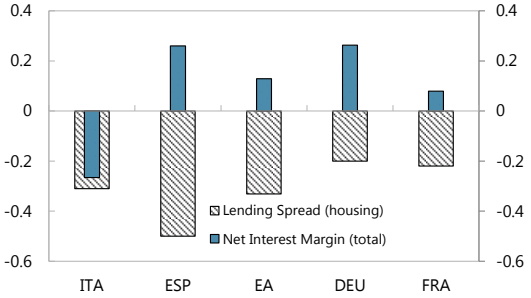
Estimated Sensitivity of the Average Rate of the Loan Book and Deposit Rates to a Change in the Interbank Rate, 2006-2015
(multiple) 1/



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Notes: 1/ volume-weighted average based on lending to both non-financial corporates and households; 2/ deposit rate less three-month money market rate.

As a result, lending margins have compressed most in countries with

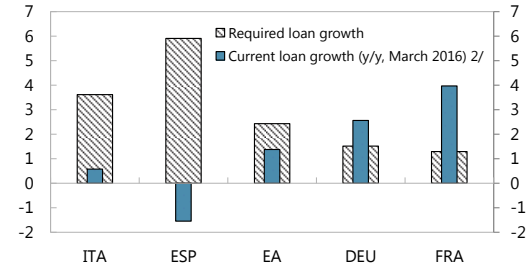
Change in Lending Spread and Net Interest Margin (NIM)
(percentage points) 1/



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Notes: calculated for new agreements between June 2014 and Jan. 2016 (lending spread) and June 2014 and March 2016 (NIM); 1/ lending spread is calculated as the difference between the lending rate for new business less the three-month money market rate; the only until Jan. 2016.

Current loan growth in selected economies is insufficient to offset the

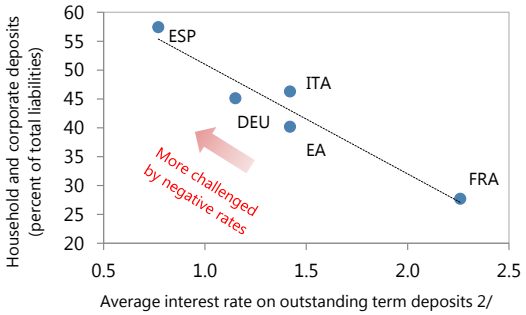
Annual Loan Growth Required to Maintain Net Interest Margin, end-2015
(y/y percent change) 1/



Sources: Bloomberg L.P., EBA Transparency Exercise (2015), ECB, SNL, and IMF staff calculations. Note: 1/ based on the historical pass-through of policy rates and the elasticity of net interest margins to changes in term premia between Jan. 2010 and Feb. 2016; total mortgage and corporate loans at end-2015 to EA residents.; scenario assumes an increase of monthly asset purchases (until Sept. 2017) by the ECB and a reduction of the deposit rate by 10bps (as per ECB decision on March 10).

... given the high reliance on a wide deposit base amid rising pressure to rollover expiring term deposits.

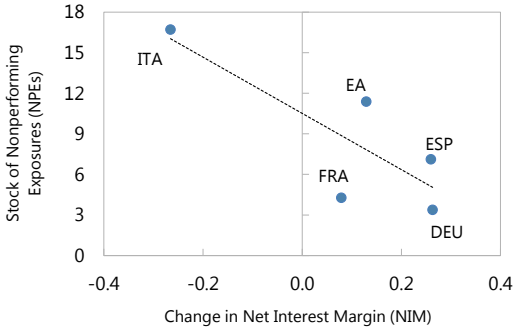
Non-MFI Deposits as a Share of Total Liabilities and Interest Rates on Deposits, January 2016 1/
(percent)



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Note: 1/ MFI=monetary financial institutions; 2/ oth household and non-financial corporates.

... with higher levels of underprovisioned impaired assets weighing on the capacity of banks to maintain their NIMs.

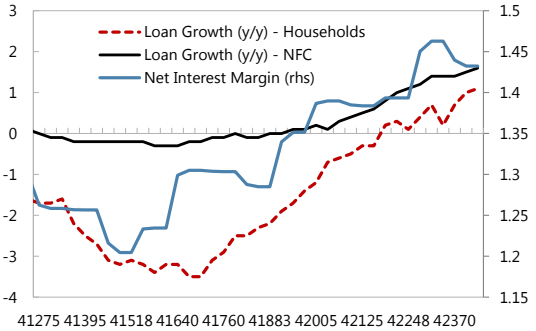
Change in Net Interest Margin and Nonperforming Exposures 1/
(percent change/percent of total exposure)



Sources: Bloomberg LP, EBA Transparency Exercise (2015) and IMF staff calculations. Note: NPEs as of end-June 2015; change of NIM between June 2014 and March 2016.

... and recent history suggests that it is unlikely that credit will pick up under these conditions.

Euro Area: Average Net Interest Margin and Credit Growth
(weighted by bank assets)

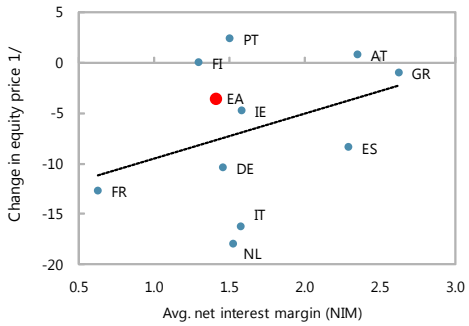


Sources: Bloomberg, L.P.; ECB; and IMF staff calculations.

Figure 2. Bank Equity Valuation and Credit Growth

Banks with weaker profitability experienced a larger decline in equity prices since 2015 ...

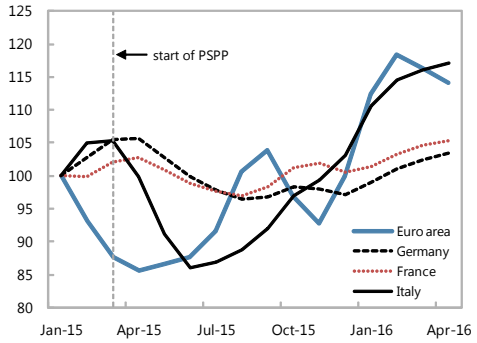
Banking Sector: Change in Equity Price and Net Interest Margins, since 2015
(percent)



Sources: Bloomberg, L.P.; and IMF staff calculations. Note: 1/ since Sept. 2015.

... with low equity valuations raising the cost of equity.

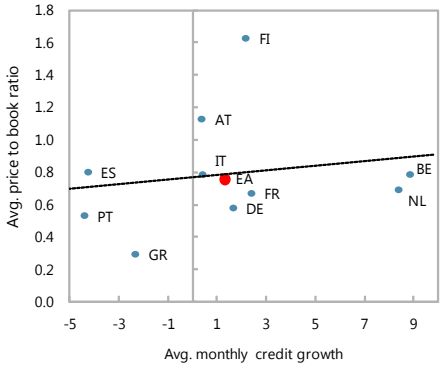
Equity Risk Premium
(index, Jan. 2015 = 100)



Sources: Bloomberg, L.P.; and IMF staff calculations.

The impact of lower returns on valuations has made banks less willing to lend ...

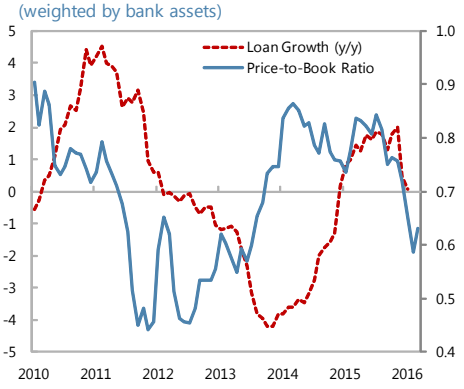
Banking Sector: Price to Book and Credit Growth, since 2015
(percent)



Sources: Bloomberg, L.P.; and IMF staff calculations.

... which credit supply lagging a recovery in bank equity.

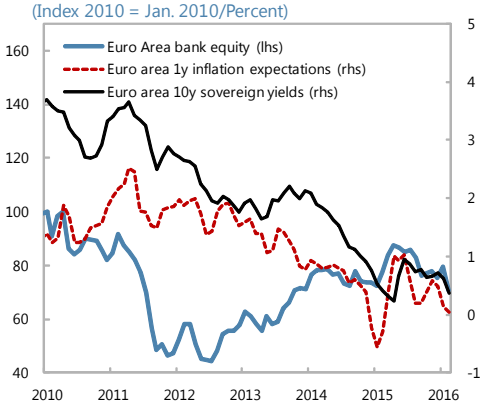
Euro Area Banks: Price to Book Ratio and Credit Growth
(weighted by bank assets)



Sources: Bloomberg, L.P.; and IMF staff calculations.

The combined effect of low inflation and low expected profitability has depressed equity valuations of euro area banks ...

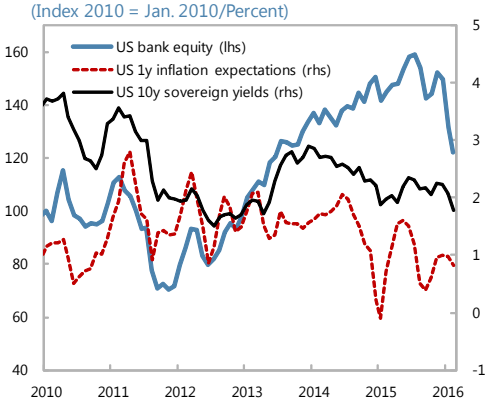
Euro Area: Bank Equity Prices, Inflation Expectations, and Sovereign Yields
(Index 2010 = Jan. 2010/Percent)



Source: Bloomberg, LP.

... while U.S. banks have benefitted strongly from monetary easing, falling only recently as a result a broader market deterioration.

United States: Bank Equity Prices, Inflation Expectations, and Sovereign Yields
(Index 2010 = Jan. 2010/Percent)



Source: Bloomberg, LP.

D. Assessment for the Euro Area

11. **While concerns about their impact on bank profitability have for the most part not yet materialized, negative rates are expected to erode banks' earning capacity going forward amid a flattening yield curve.** Estimates of the impact of the recent decline in policy rates on banks' NIMs suggest a small effect (7 basis points for a 50-basis point reduction in the policy rate),[15] but early evidence from countries with negative rates suggests that this impact may increase non-linearly as the policy rate falls below the ZLB (while deposit rates remain non-negative). Although it is unclear whether banks still have room to cut deposit rates, banks may be reluctant to do so due to competition. Despite broadly stable average NIMs so far, the impact of monetary policy on euro area banks is becoming increasingly adverse. Indeed, the ECB's recent *Bank Lending Survey* (ECB, 2016a) suggests that bank profitability has recently declined and is expected to remain depressed.

12. **Lower bank profitability would weigh on bank equity prices and could blunt the effect of NIRP on credit recovery.** Since negative rates are easier to pass on to lending rates than deposit rates, the prospect of low policy rates for a longer time—amplified by structural challenges to banks in many euro area countries—has already worsened the outlook for bank earnings. Any expectation of further reduction to the already negative rates would lower expectations of banks' future earnings, weighing on equity prices (Figure 2). While the ECB's monetary easing has reduced the cost of borrowing, since Q3 2015 equity risk premia have risen and price-to-book ratios have declined, with the average cost of equity now exceeding the return on equity. This would encourage capital-constrained banks to reduce credit (in absence of sufficiently high-yielding but less capital-intensive lending opportunities), reducing the effectiveness of negative rates as a policy measure.

13. **Despite the potential mitigating effect of higher aggregate demand and asset quality—as well as the potential benefits of negative rates for the implementation of the ECB's asset purchase program—there are two important adverse implications that need to be considered for NIRP within the euro area:**

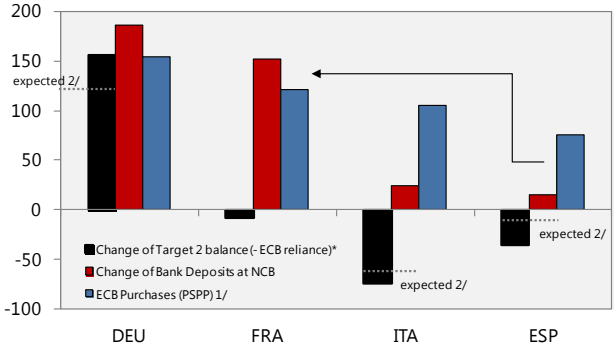
- *Monetary transmission may become less effective in economies most in need of stimulus.* Given the wide deposit base in most euro area countries, the extent to which deposit rates are sticky has a direct impact on bank profitability and the effectiveness of NIRP on monetary transmission. Even if banks were to fund themselves increasingly via money markets, the benefit from wholesale funding at negative rates will be limited by the existing deposit base and cannot offset the negative impact of lower rates on existing loans if credit growth is insufficient (Figure 1). In particular, bank profitability is likely to decline in countries with large outstanding loan amounts at variable rates if lending growth is insufficient to offset diminishing interest margins as existing loans re-price. Among countries with a high share of variable rate loans, such as Italy, Portugal, and Spain, also (still) high asset impairments amplify concerns about banks' earnings capacity, and restrict their ability to supply credit to the real economy. In this regard, TLTRO II (Appendix I, Box A2) could

[15] NIMs have been estimated for all large euro area banks that are directly supervised by the ECB using publicly reported data on consolidated bank balance sheets. For some banks with sizeable (and, in most cases, more profitable, foreign operations), the reported NIMs might overstate the profitability of lending within the euro area.

facilitate the transmission to lending rates by mitigating the potentially adverse impact of negative rates on banks' lending margins.

- *The direct cost of negative deposit rates would be disproportionately greater for banks in surplus countries.* Given the imbalances within the euro area, the Target 2 settlement of capital flows generates large amounts of excess liquidity in the banking sectors of surplus countries, such as Germany and the Netherlands.[16] In addition, the implementation of the Eurosystem's asset purchasing program has generated additional liquidity in other core economies in excess of their national share of asset purchases, such as France (see text figure). Both developments have led to a very uneven distribution of excess liquidity, affecting banks differently across the euro area.[17] In principle, tiering of the deposit rate could mitigate the direct cost of NIRP and ensure effective transmission of the marginal policy rate (to short-term rates) even if rates became more negative. However, the heterogeneity of national banking systems within the euro area might complicate the effective implementation of a tiered reserve regime (Appendix I, Box A4).

Euro Area: Rising Financial Fragmentation, January 2015-March 2016
(absolute change, EUR billion)



Source: Bloomberg L.P., ECB, Haver, NCBs, and IMF staff calculations. Note: */The use of ECB liquidity reduces the Target 2 balance and is subtracted; 1/ public sector purchase program (PSPP; 2/ expected based on changes in balance of payments after accounting for general "leakage" from Target 2 due to non-euro area trade and portfolio flows.

E. Conclusion

14. **So far, NIRP has had an overall positive effect in improving credit conditions and supporting aggregate demand.** Negative interest rates have helped lowered bank funding costs and may have contributed to improved asset valuations. In addition, negative rates have significantly enhanced the signaling effect of the ECB's monetary stance, which complemented the impact of asset purchases on the flattening of the yield curve. In some countries rate cuts have been passed through to corporate and household borrowers thereby contributing to a modest credit expansion and bolstering the economic recovery. Concerns about their negative effect on bank profitability have for the most part not yet materialized.

[16] Note that the extent to which TLTRO II boosts the usage of ECB liquidity (and not just facilitates a rolling over of existing liquidity), existing Target 2 imbalances are bound to increase. This would be consistent with a more positive credit impulse and hence stronger domestic demand growth.

[17] Several countries with NIRP (Bulgaria, Denmark, Japan, and Switzerland) have installed tiered reserve systems, which have facilitated the pass-through of the marginal policy rate to money markets and reduced the direct cost of NIRP (Appendix I, Box A3).

15. **However, further reducing the deposit rate is likely to entail diminishing returns, since the lending channel is crucially influenced by banks' expected profitability.** NIRP involves a difficult trade-off between implementing unconventional policy measures to support aggregate demand and mitigating adverse effects on bank lending channel. Further cuts towards the "true" lower bound could weaken monetary transmission as lending rates do not adjust and/or deposits are increasingly substituted for cash. Lower bank profitability could then constrain credit expansion and undermine the aim of monetary easing. Looking ahead, further monetary accommodation should then rely more on credit easing measures and expanding the ECB's balance sheet. Such measures help raise asset valuations and aggregate demand, while also supporting the bank lending channel.

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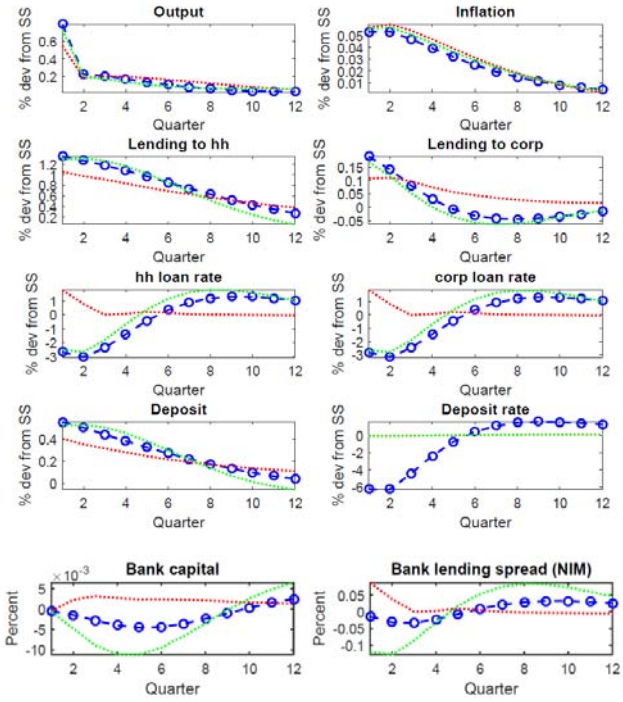
Appendix I. Implementation and Impact of Negative Interest Rates

Box A1. Monetary Transmission under NIRP[1]

We assess the impact of negative rates on bank profitability and its implications for monetary transmission when deposit rates become sticky using a full equilibrium specification. We adapt the DSGE model by Gerali and others (2010), which was estimated using euro area data. In the model, banks enjoy monopoly powers in intermediating funds between savers and borrowers and setting rates on loans and deposits. The modeled banking sector comprises two retail branches, which are responsible for lending and deposit-taking, while the wholesale unit manages the capital position of the banking group subject to a simple solvency constraint, and, in addition, provides wholesale loans and raises wholesale funding. Banks face different adjustment costs when changing rates. A higher cost implies lower adjustment for a given shock, and, thus, the rates are more "sticky."

We find that sticky deposits under NIRP either weaken bank profitability or diminish monetary transmission. We examine three different scenarios reflecting banks' response to a policy rate cut assuming that deposit rates are bounded at zero percent (text chart below). Banks can substitute some cheaper wholesale funding for deposit funding but potentially offsetting components of banks' net operating income are ignored (e.g., capital gains from higher asset prices and lower provisioning cost from higher debt service capacity of borrowers). In the *first case* (blue line), we assume that the pass-through from the policy rate to deposit rate remains unchanged. Banks reduce the both deposit and lending rates, and their profitability increases over time as output and inflation outturns improve. In the *second case* (green dotted line), price-setting banks face (artificially) higher adjustment costs in setting deposit rates (i.e., deposits are "sticky"). Banks optimally choose to lower lending rates to increase lending volume at the cost of deviating temporarily from the minimum capital requirement. Bank profitability declines significantly as lending volumes are initially insufficient to offset the compression of lending margins due to sticky deposit rates. In the *third case* (red line), the solvency constraint is strictly enforced for the second scenario of sticky deposits. Here, monetary transmission breaks down as banks increase lending. However, the impact on output is still positive, although smaller over the short term, as the wealth and substitution effects (from lower discount rates) push up loan demand, consumption and investment.



[1] Prepared by Jiaqian (Jack) Chen and Andreas (Andy) Jobst.

Box A2. The Impact of NIRP on Bank Profitability and the Mitigating Impact of TLTRO II

Euro area banks are under pressure to maintain current profitability from lending in an environment of continued monetary easing. A decline in term premia and a lower marginal policy rate reduce banks' net interest margin (NIM). Based on the historical pass-through of easing measures, it is possible to determine the minimum annual increase in lending (over the average maturity term of the loan book) required to offset the projected decline in net interest income as a result of the impact of the recent ECB monetary policy measures. The recently expanded asset purchase program (with monthly purchases of €80 billion, up from €60 billion, and the reduction of the deposit rate to -0.4 percent, down from -0.3 percent), are estimated to lower the NIMs of euro area banks by 11 basis points on average (Germany: 5 bps; France: 4 bps; Italy: 11 bps; Spain: 13 bps).

The decline of NIMs is greater in countries with a higher proportion of variable rate loans and a higher cost of risk (such as Italy and Spain).[1] These findings suggest that aggregate lending growth in the euro area would need to increase to 2.3 percent annually (up from 1.8 percent at end-January) for banks to maintain current profitability over the amortization period of their current loan book (see text figures).

Annual Loan Growth Required to Maintain Net Interest Margin, end-2015
(y/y percent change) 1/

Sources: Bloomberg L.P., EBA Transparency Exercise (2015), ECB, SNL, and IMF staff calculations. Note: */ assumes that new lending is fully funded using TLTRO I funds at a weighted average borrowing rate of -20bps.1/ based on the historical pass-through of policy rates and the elasticity of net interest margins to changes in term premia between Jan. 2010 and Feb. 2016; total mortgage and corporate loans at end-2015 to EA residents.; scenario assumes an increase of monthly asset purchases (until Sept. 2017) by the ECB and a deposit rate cut of 10bps (as per ECB decision on March 10).

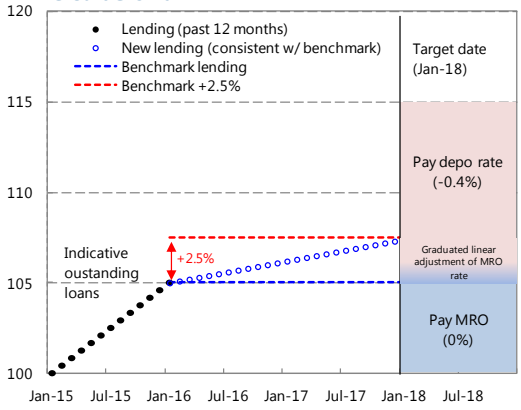
The launch of a second series of targeted longer-term refinancing operations (TLTRO II) will support bank lending (ECB, 2016b). Starting in June, banks will be able to borrow up to 30 percent of eligible non-mortgage private loans over a four-year period at the prevailing MRO rate. TLTRO II has two components to incentivize new lending (see text figures): (i) *conditional liquidity* (at the marginal policy rate, equivalent to the rate on the deposit facility prevailing at the time of the allotment) if banks exceed a benchmark (red line) for net new lending of at least 2.5 percent by January 2018 , and (ii) *unconditional liquidity* at either the MRO rate of currently zero percent if banks do not satisfy the lending benchmark or at a discount to the MRO rate if banks exceed the lower benchmark (blue line).[2] The size of the decrease of the interest rate for conditional liquidity is graduated linearly depending on the percentage by which the bank exceeds the lower benchmark (which is calculated similar to those under current TLTRO).[3]

[1] We control for continued amortization, bad debt write-offs, and re-statements of asset recoveries in estimating the sensitivity of the existing loan stock to changes in interest rates; however, the calculation does not include the effects of capital gains from higher asset prices due to combined effect of negative interest rates and a flattening yield curve.

Box A2. The Impact of NIRP on Bank Profitability and the Mitigating Impact of TLTRO II (Concluded)

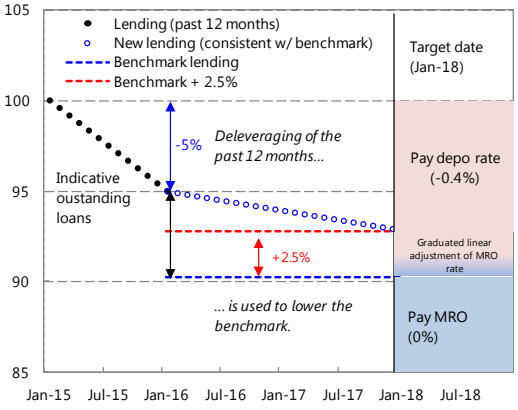
For banks with positive lending growth over the 12 months prior to January 2016, the benchmark is zero net lending. The benchmark is lowered by the decline in eligible net lending in the same period for banks that have seen negative lending benchmark net lending.

TLTROII Benchmark for a Bank with *Positive* Credit Growth



Source: Deutsche Bank; ECB; and IMF staff calculations.

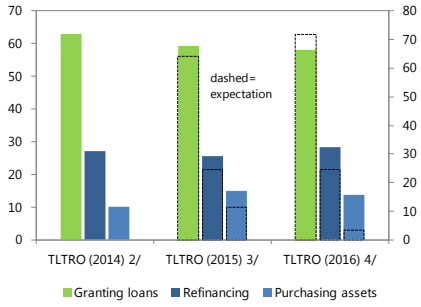
TLTRO-II Benchmark for a Bank with *Negative* Credit Growth



Source: Deutsche Bank;; ECB.; and IMF staff calculations.

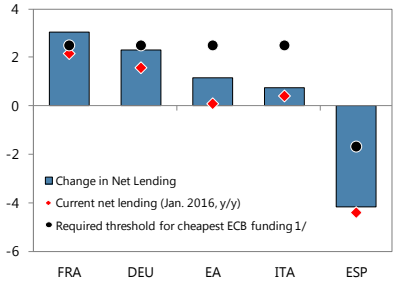
TLTRO II could mitigate the potentially adverse impact of NIRP on bank profitability. Realigning the cost of refinancing to the marginal policy rate (if banks meet a defined minimum rate of net lending growth) facilitates the pass-through of improved bank funding conditions to the real economy by encouraging more lending. It also helps maintain bank profitability, especially in countries where banks face high cost of risk and/or would refrain from lowering lending rates to preserve profit margins without jeopardizing their deposit base (see text figures). Past evidence suggests a high effectiveness of TLTRO in stimulating new lending. Meeting the requirements for TLTRO II funding at the marginal policy rate implies at least 1.2 percent annual lending growth over a two-year period for banks with positive net lending in 2015 but a continued decline in the eligible loan book for banks that have been de-leveraging.

Use of Funds from Past and Future TLTROs
(Percent of Respondents) 1/



Source: ECB Bank Lending Survey and IMF staff calculations. Note: 1/ for survey responses in 2015, the percentage share of responses was re-scaled to unity due to multiple responses or missing responses/responses with no stated preference; 2/ first two series of TLTRO in Sept. and Dec. 2014; 3/ tender offers in Jan. and July 2015; 4/ tender offer in Jan. 2016 only.

ECB TLTRO-II Benchmarking: Net Lending to Non-Financial Corporates and Households, Dec. 2014-Jan 2016
(percent)



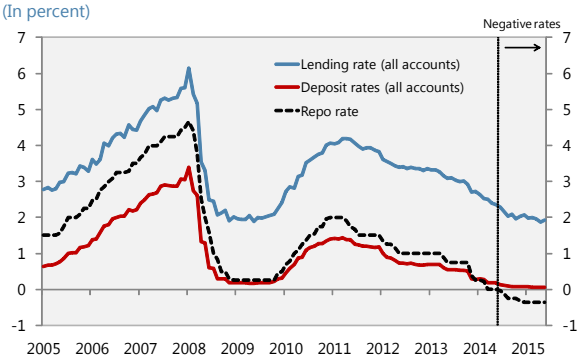
Sources: Bloomberg LP., Haver, and IMF staff calculations. Note: 1/ Net lending growth required to qualify for TLTRO II borrowing at the ECB deposit rate (-0.4%).

[2] As opposed to TLTRO I, failure to meet the benchmark for net lending does not result in an early repayment of funds after two years.
[3] Banks are required to report how much they had lent during the 12 months ending January 31, 2016 to determine how much they can borrow and ascertain the lending performance against the benchmark by end of January 2018.

Box A3. Low and Negative Interest Rates in Denmark and Sweden[1]

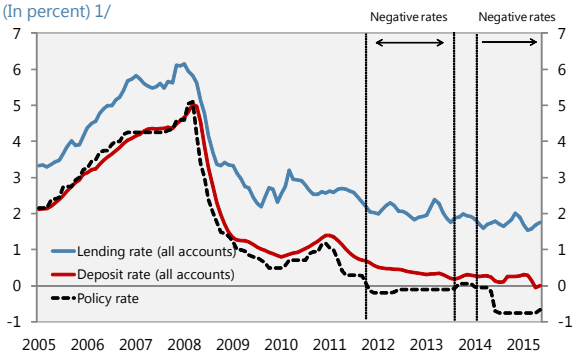
Negative interest rates were introduced in Denmark and Sweden for different reasons. In Denmark—which pegs to the euro—they were introduced in July 2012, in conjunction with other measures, to deter speculative pressures on the peg at a time when the country faced sizeable capital inflows in response to strains in the euro area. Inflows surged once more in 2015, after the Swiss National Bank (SNB) abandoned the currency ceiling to the euro, and the ECB announced the expansion of its asset purchase program, triggering the Danmarks Nationalbank (DN) to further cut the deposit rate by 70 bps over the course of four weeks. In contrast, the Swedish Riksbank adopted NIRP as part of a package of measures aimed at raising inflation to the two percent target and preventing a de-anchoring of inflation expectations.

Sweden: Bank Interest Rates, New Agreements
(In percent)



Sources: Statistics Sweden and Fund staff calculations.

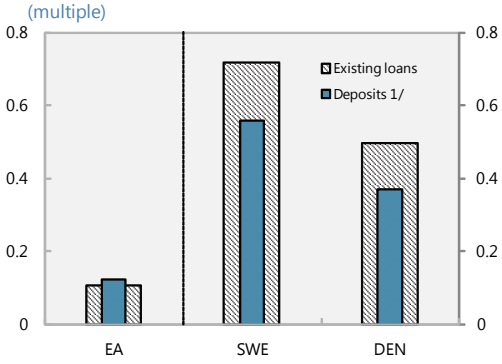
Denmark: Bank Interest Rates, New Agreements
(In percent) 1/



Sources: Statistics Denmark and Fund staff calculations. Note: 1/ 3-month moving average.

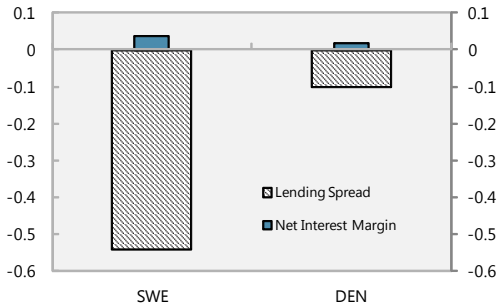
The decline in bank interest margins under NIRP was contained by the high share of wholesale funding. Money market rates turned negative and banks' assets re-priced downwards quickly in response to policy rate changes given the high share of variable rate loans (with a greater importance for household loans in Sweden) (see text figure). While lending rates declined, albeit to a lesser extent in Denmark (Jensen and Spange, 2015),[2] retail deposit rates did not drop below the ZLB (see text figure). As a result, the interest spread between lending and deposit rates narrowed—a development that began in Sweden as interest rates reached low levels in 2014, before turning negative in 2015. However, a relative narrow deposit base (with a high reliance on non-deposit funding at 52 percent of total funding at end-2015) allowed banks to benefit from lower money market rates (below their cost of deposit funding), mitigating the overall impact of NIRP on banks' net interest margins (NIMs), which remained positive in aggregate.[3]

Estimated Sensitivity of the Average Household Lending and Deposit Rates to a Change in the Interbank Rate, 2008-2015
(multiple)



Sources: Bloomberg L.P., Haver, and IMF staff calculations. Notes: 1/ deposit rate less 3-month money market rate.

Change in Lending Spread and Net Interest Margin (NIM)
(percentage points)



Sources: Bloomberg L.P., Danmarks Nationalbank, Sverige Riksbank, and IMF staff calculations. Note: lending spread is calculated for all new loan agreements (non-financial institutions and households) between June 2014 and Jan. 2016; NIMs have been calculated on a bank-by-bank data using publicly reported data up to March 2016.

Box A3. Low and Negative Interest Rates in Denmark and Sweden (Concluded)

Also others factors have so far limited the effects of NIRP on bank profitability, despite the high degree of asset re-pricing. In Denmark, fee income rose as the volume of mortgage refinancing increased with falling interest rates and provisions declined with improved loan portfolio quality (DN, 2015). In Sweden, fee income also increased with rising inflows to banks' investment funds and an expansion of their corporate advisory services (Asterlind and others, 2015). Whereas lending growth remains subdued in Denmark, higher loan volumes in Sweden have also helped compensate for lower rates. However, the compensatory effect of credit growth in an environment of NIRP weighing on banks' net interest income also raises the importance of prudent lending, especially to households.

1/ Prepared by Rima A. Turk and Andreas (Andy) Jobst. For a more detailed analysis of the performance of banks in Denmark and Sweden, see Turk *(forthcoming)*.

2/ Negative interest rates have not been fully passed through to bank deposit and lending rates to households. However, large deposits from firms and institutional investors are paying negative interest rates.

3/ During the first quarter of 2016, however, NIMs for Swedish banks have declined (Kuelpmann and others, 2016).

Box A4. The Mechanics of Tiered Reserve Systems

The implication of NIRP for banks' cost of holding central bank liabilities varies with the structure of reserves and their remuneration. Excess reserves at both the ECB and the Swiss National Bank (SNB) are held as overnight deposits whereas the Danmarks Nationalbank (DN) and the Sveriges Riksbank (SR) use a combination of overnight fine-tuning operations and one-week term deposits to attract reserves and other central bank liabilities above required amounts ("liquidity surplus"). While the ECB was the first central bank to move its deposit rate significantly into negative territory, it continues to maintain a single negative rate for excess reserves. In contrast, other central banks (Bank of Japan, DN, and SNB)[1] have put in place *tiered reserve regimes* for excess reserves[2] to mitigate burdens on bank earnings, facilitate market transactions (by exploiting the uneven distribution of excess reserves among financial institutions), and discourage higher holdings of physical currency.[3] Excess reserves are partially exempted from the marginal policy rate for overnight deposits (Denmark and Japan) or sight deposit account balances at the central bank (Switzerland). Central banks have historically used tiering regimes to try and protect the interests of domestic retail depositors while attempting to push as much of the costs onto wholesale (and especially foreign) investors whose deposits contribute mostly to excess reserves. Thus, the ideal size of the exemption threshold is determined by the amount of domestic retail funding banks have at the time of the introduction of the system (i.e., the level of deposits central banks want to protect).

A tiered reserve regime enhances central banks' capacity to lower the effective policy rate by reducing the *direct* cost of negative rates on excess reserves. The direct cost imposed on excess bank reserves by NIRP has been found small when compared to the size of the overall balance sheet. For instance, the peak charge in Switzerland has been 0.03 percent of total banking sector assets. Exempting a certain amount of excess reserves from the marginal policy rate avoids imposing the full impact of negative deposit rates on banks. Thus, at the same *direct* costs to banks, the marginal policy rate can be lower in a tiered reserve regime. The cost of holding depends on excess reserve holdings in the tier with the lowest marginal policy rate (i.e., deposit rate). The tiering (and the difference of policy rates in each tier) determines the extent to which the interest rate of an additional unit of (excess) reserves differs from the average interest rate for all reserves.

Existing tiered regimes can be broadly categorized based on the number of tiers and the allocation of excess reserves across these tiers: (i) *constant* allocation (e.g., Switzerland), where the exemption threshold for deposits is specific to each bank (as a fixed multiple of a bank's required reserves); and (ii) *dynamic* allocation, where fine-tuning operations determine the share of excess reserves to be placed with the central bank as more costly overnight deposits (Denmark, Sweden) or the portion subject to negative rates is designed to increase over time in line with the monetary base target (Japan). The exemption threshold should be as high as possible to minimize the banks' average cost of holding excess reserves while being sufficiently low to transmit the marginal policy rate to money markets (and increase the opportunity cost of lending rather than depositing cash as reserves with the central bank). Central banks tend to adjust the tiering over time so that the amount of excess reserves below the exemption threshold is sufficient to keep money market rates aligned with the marginal policy rate.

[1] The SR administers a *de facto* tiered reserve regime. The marginal policy rate is determined by the central bank's reserve repo operations ("market-maintaining repo facility") while accepting excess reserves as overnight deposits at the repo rate minus 10 bps or as certificates of deposits, which are issued at the repo rate minus 75 bps for a maturity term of one week.

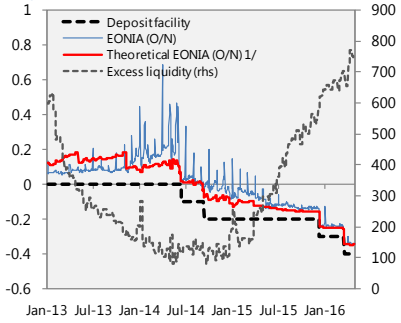
[2] A loosely defined tiered reserve system also applies to the ECB, which remunerates overnight deposits in the current account at the MRO rate of 0 percent, effectively exempting about one-seventh of current reserves from the marginal policy rate.

[3] Negative interest rates create incentives for banks to hold cash rather than reserves, and for households and non-financial corporates to hold cash rather than bank deposits. In countries with an even more negative deposit rate than that of the euro area (Denmark, Sweden and Switzerland), cash in circulation has increased, but growth rates remain within the range seen over the last decade.

Box A5. Reducing the Direct Cost of NIRP and the Role of Tiering in Monetary Transmission

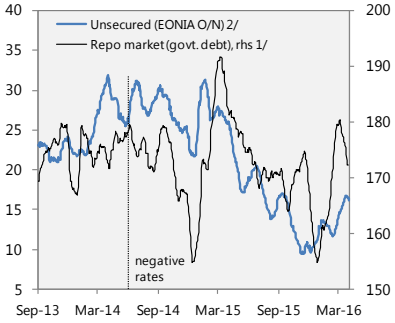
The implementation of a second effective deposit rate for excess reserves (such as through tiering) would increase the ECB's general capacity to pursue NIRP while mitigating the direct cost to banks. Currently, banks' overnight deposits (€310 billion) and current account balances (€613 billion) amount to about €923 billion. The minimum reserve requirement of €115 billion is remunerated at the MRO rate of 0 percent, which leaves excess reserves of €808 billion subject to the negative deposit rate of -0.4 percent as the marginal policy rate—setting the lowest rate at which banks would be prepared to lend to each other. Assuming that the direct cost of NIRP does not exceed 0.03 percent of total assets of the euro area banking sector (which reflects the recent experience in Switzerland as a theoretical benchmark),[1] the current deposit rate has exhausted the theoretical tolerance of euro area banks. However, for a tiered reserve regime excluding 75 percent[2] of excess reserves from the negative deposit rate (in line with reserve system in Switzerland), the Eurosystem could theoretically tolerate a negative deposit rate of up to -1.6 percent (as the direct cost of NIRP remains unchanged).

Euro Area: Actual and Theoretical EONIA Rate
(percent/EUR billion)



Source: Bloomberg L.P., ECB, and IMF staff calculations. Note: 1/ The theoretical EONIA rate is calculated as the average of the MRO and deposit rate, weighted by the relative proportion of the ECB's current account balance and excess reserves.

Euro Area: Secured and Unsecured Lending Volumes (EUR billion)



Source: Bloomberg L.P., ECB, and IMF staff calculations. Note: 1/ Composite outstanding volume of general collateral (GC) repo on German, French, and Italian government debt; 2/ trading volume of overnight contracts.

The effective monetary transmission of NIRP to money markets would require fine-tuning of the exempted portion of excess reserves over time. In its current reserve regime, the ECB achieves negative short-term money market rates by setting a positive policy rate (MRO at 0 percent) and a negative interest rate on the deposit facility (-0.4 percent) while maintaining excess reserves in the banking system. The money market rate is pushed down towards the lowest marginal policy rate because banks individually will try to lend their surplus liquidity to other banks in the interbank market in an attempt to avoid having to use the central bank's deposit facility—but only as long as the lending rate exceeds the deposit rate.[3] Thus, the transmission of the marginal policy rate is also affected by the dispersion of the excess liquidity among banks and banks' willingness/ability to lend excess liquidity to other banks.[4]

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[1] The assumption of exempting 75 percent of reserves from a negative deposit rate was based on the experience in Switzerland where the share of the overall reserve stock subject to negative deposit rates averaged 23 percent until end-2015. In practice, given the significant heterogeneity of bank business models, banks' tolerance threshold for the direct cost of negative rates might be different in the euro area than in Switzerland.

[2] The exemption of a certain amount of reserves can vary over time (and would need to decrease as excess liquidity declines). The opportunity cost of lending can be increased (on average) by calibrating the tiering such that the price of depositing cash with the ECB would be the same (or higher) than the expected net interest margin from lending multiplied by the share of the deposit base funding loans (i.e., the inverse of the aggregate loan-to-deposit ratio of the banking sector).

[3] The money market rate could be higher than the lowest marginal policy rate if the exempted portion of excess reserves is too large, leaving banks little incentive to engage in interbank lending; thus, lower supply of liquidity could create potential scarcity in some parts of the system, pushing up money market rates above the technical floor of the ECB deposit rate.

[4] Given that the average daily quoted turnover underpinning EONIA fixings has only been about €12.6 billion (or 1.5 percent of excess liquidity) since January 2016, the impact of the marginal policy rate on money market rates is quite sensitive to changes in bank behavior and rate setting.

Table A1. Overview of Central Banks with Negative Interest Rate Policy (NIRP)

	Objective	Instrument	Rate
Bulgaria (two tiers)	Transmission of the ECB's monetary policy stand; also aimed at avoiding potential losses to the central bank	Deposit rate	-0.30% (Jan. 4, 2016); -0.40% (March 16, 2016); *Note: the same interest rate as the ECB's deposit facility*
Denmark (two tiers)	Countering safe haven inflows and exchange rate pressures *(continued FX interventions)*	Certificates of deposit (CD)	-0.20 % (July 2012-early 2014) -0.05% (Sept. 2014) -0.20% (Jan. 19, 2015) -0.35% (Jan. 22, 2015) -0.50% (Jan. 29, 2015 -0.75 % (Feb. 5, 2015)
Euro Area (no tiers)[1]	Price stability and anchoring inflation expectations *(in conjunction with asset purchase program)*	Deposit rate	-0.10% (June 11, 2014) -0.20% (Sept. 10, 2014) -0.30% (Dec. 9, 2015) -0.40% (March 16, 2016); asset purchase program increased by €20 billion/month (until March 2017)
Hungary (no tiers)	Price stability and countering exchange rate pressures *(in conjunction with small QE)*	Deposit rate	-0.05% (March 23, 2016)
Japan (three tiers)	Price stability and anchoring inflation expectations *(in conjunction with QE)*	Deposit rate	-0.10% (Feb. 16, 2016)
Switzerland (two tiers)	Reducing appreciation and deflationary pressures[2]	Sight deposits at the SNB (with an exemption threshold)	-0.75% (Jan. 15, 2015)
Sweden (no tiers)	Price stability and anchoring inflation expectations *(in conjunction with QE)*	Reverse repo rate	-0.10% (Feb. 12, 2015); QE of SEK10 billion -0.25% (March 18, 2015); QE increased to SEK30 billion -0.35% (July 2, 2015) -0.50% (Feb. 11, 2016)

Source: national central banks.
Note: Effective January 4, 2016, the Bulgarian National Bank imposed a negative interest rate on banks' excess reserves held in the central bank. Given Bulgaria's currency board arrangement, it was not intended as an active monetary policy measure but served to transmit the ECB's monetary policy stance while avoiding potential losses to the central bank from inaction.
[1] A loosely defined tiered reserve system also applies to the ECB, which remunerates overnight deposits in the current account at the MRO rate of 0 percent (as of March 16, 2016), effectively exempting about one-seventh of current reserves from the marginal policy rate.
[2] In conjunction with the exit from the exchange rate floor.

Appendix II. Overview of Other Countries with NIRP

Denmark

In Denmark, negative rates were adopted to counter large capital inflows speculating against the long-standing Danish peg to the euro. The Danmarks Nationalbank (DN) cut its key deposit rate four times between January and February 2015 to a record low -0.75 percent (from -0.05 percent) to defend its currency peg against the euro—and following the announcement of the ECB's QE program and the Swiss National Bank abandoning its exchange rate floor in mid-January. In March 2015, the DN announced an increase in the current account limit to DKK145 billion from DKK37 billion, thereby increasing the amount of deposit that banks could keep at the central bank without being charged the deposit rate and softening impact on banks. Like in Switzerland, the ability to pass on negative interest rate to depositors was limited to large corporate customers. Denmark's experience so far also points to the importance of activity-based fees, such as mortgage application fees, and a long-term strategy of encouraging a shift from deposits into wealth management products to cope with reduced lending margins under NIRP.

Sweden

In the case of Sweden, rate cuts in 2014 and earlier were driven by persistently low inflation. A notable decline in inflation expectations preceded the shift to negative rates and domestic QE in February 2015, although the move followed the announcement of the ECB's QE program in mid-January, which might otherwise suggest exchange rate pressures as the motivation for the change in the policy rate. In February 2016, the Swedish Riksbank (SR) reduced the reserve repo rate by another 0.25 percentage points to the current level of -0.50 percent, in combination with its own asset purchase program of government debt securities in the amount of SEK40 billion, which amounts to more than 35 percent of the market (and more than twice the relative size of the ECB's QE covering 17 percent of the euro area government bond market).

Japan

On January 29, 2016, the Bank of Japan introduced a three-tiered reserve deposit system (effective on February 16) with a negative interest rate on marginal excess reserves. The *first tier*, remunerated at 0.1 percent, applies to the average outstanding balance of current accounts accumulated under Quantitative and Qualitative Monetary Easing (QQE) up until January 2015 (approx. ¥210 trillion). The *second tier*, remunerated at 0 percent, is the macro add-on balance, including required reserves and the reserves equivalent to the amount of the various lending programs (¥40 trillion). An additional portion will be added to this second tier over time in line with the monetary base target. The *third tier*, remunerated at -0.1 percent, is the policy rate balance, that is, the residual reserve deposit, which is where additional reserves created by QE will initially go until the second tier is adjusted (currently ¥80 trillion/year). The amount in the third tier is expected to remain in the range of ¥10-30 trillion (Barr and others, 2016). To prevent financial institutions from increasing cash holding significantly, any increase in cash holding are deducted from the zero interest rate tiers of current account balance.

Switzerland

On December 18, 2014, the Swiss National Bank (SNB) announced negative interest rates on Swiss franc-denominated sight deposits above a pre-defined threshold which took effect on January 22, 2015. For domestic banks, the threshold was set to 20 times a bank's required reserves as of the reporting period ending November 19, 2014 minus (plus) any increase (decrease) in cash held. The SNB does not charge banks with negative interest rates on their cash deposits below the threshold. Thus, some Swiss banks benefited from being able to obtain market funding at negative rates and place the funds raised with the SNB at zero percent, realizing additional net interest income. Switzerland exited its exchange rate floor vis-à-vis the euro at the same time as it announced a further cut of the central bank deposit rate from -0.25 to -0.75 percent (effective January 22, 2015) less than a month after it announced the cut in the policy rate from 0 to -0.25 percent, which had turned out to be insufficient to stem large safe haven flows. Following the announcement, Swiss banks made more extensive use of this opportunity by raising significant amounts of interbank and/or customer deposits, which helped improve their NIMs.

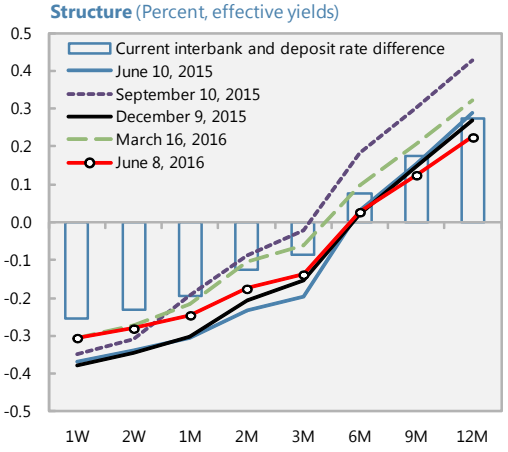
Hungary

Given subdued inflation pressures and a structural liquidity surplus, the Hungarian National Bank (Magyar Nemzeti Bank, MNB) has gradually eased its monetary policy stance and introduced unconventional instruments. The objective has been to strengthen the interest, credit, and expectation channels, and lessen vulnerabilities. Conventional measures have included a gradual reduction of the policy rate, lowering and narrowing of the interest rate corridor, an effective reduction of reserve requirements, as well as changing the collateral requirements for the MNB's lending facilities. Effective March 23, 2016, the MNB reduced the policy rate and reduced the overnight deposit rate from 0.10 to -0.05 percent. Several unconventional monetary policy measures have also been introduced, including (i) supporting SME lending by providing cheap MNB funding for banks to on-lend to SMEs and offering incentives to banks (through interest rate swaps and a special deposit facility) to increase their lending to SMEs; and (ii) incentivizing banks to substitute government securities (especially long-term and local currency-denominated) for excess reserves with the MNB.

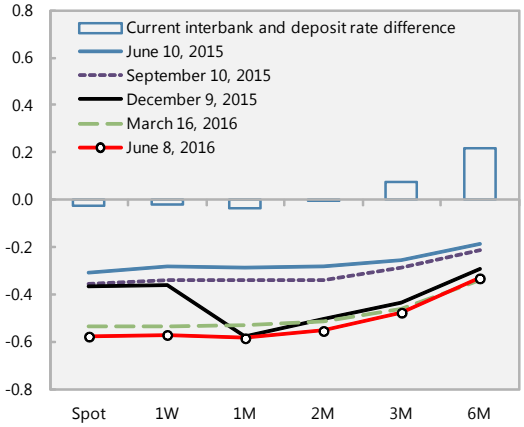
Appendix III. Monetary Conditions in Countries with NIRP

Figure A1. Marginal Policy Rate (Central Bank Deposit Rate) and Money Market Rates

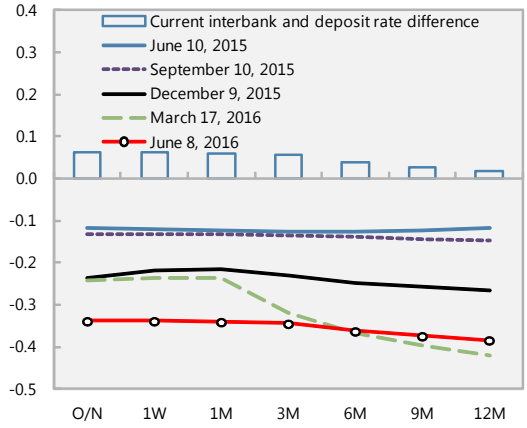
Denmark: Interbank Interest Rate Term Structure (Percent, effective yields)



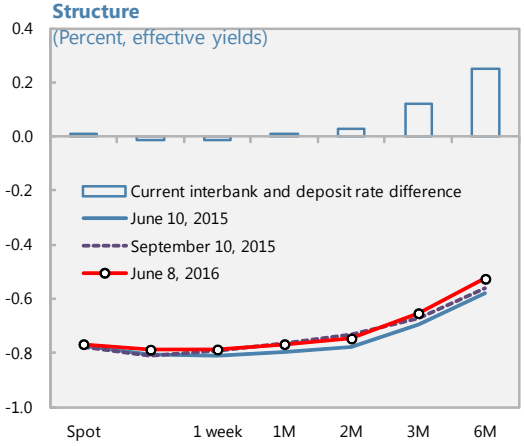
Sweden: Interbank Interest Rate Term Structure (Percent, effective yields)



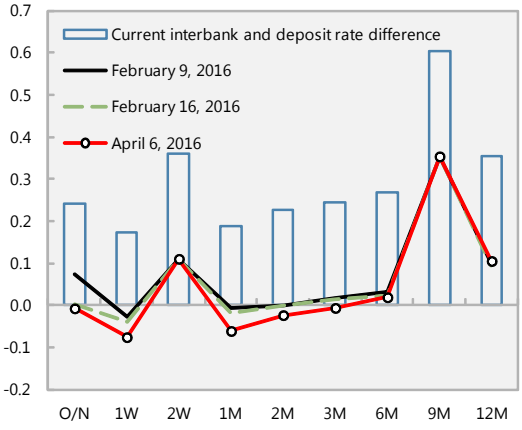
Euro Area: EONIA Term Structure (Percent, effective yields)



Switzerland: Interbank Libor Rate Term Structure (Percent, effective yields)



Japan: Interbank Interest Rate Term Structure (Percent, effective yields)



Hungary: Interbank Interest Rate Term Structure (Percent, effective yields)

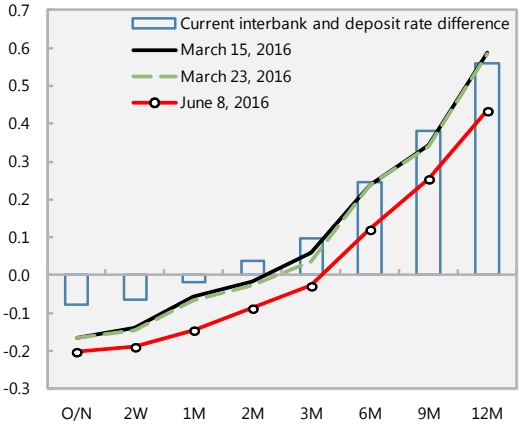
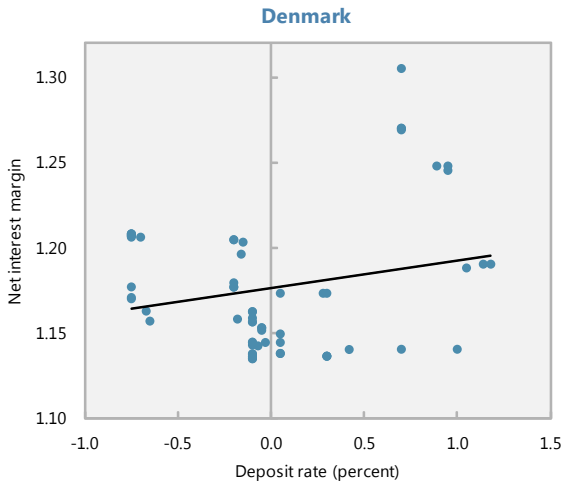
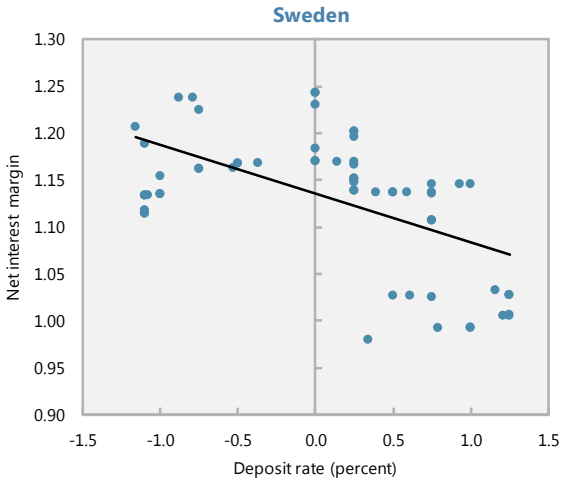


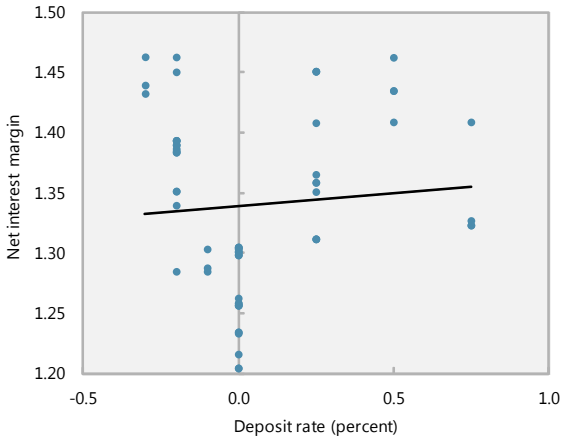
Figure A2. Marginal Policy Rate (Central Bank Deposit Rate) and Bank Net Interest Margin, January 2010–February 2016



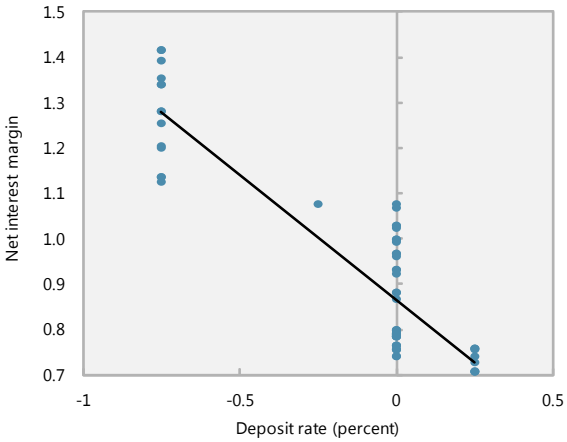
Source: Bloomberg, L.P.; Haver Analytics.



Source: Bloomberg, L.P.; Haver Analytics.

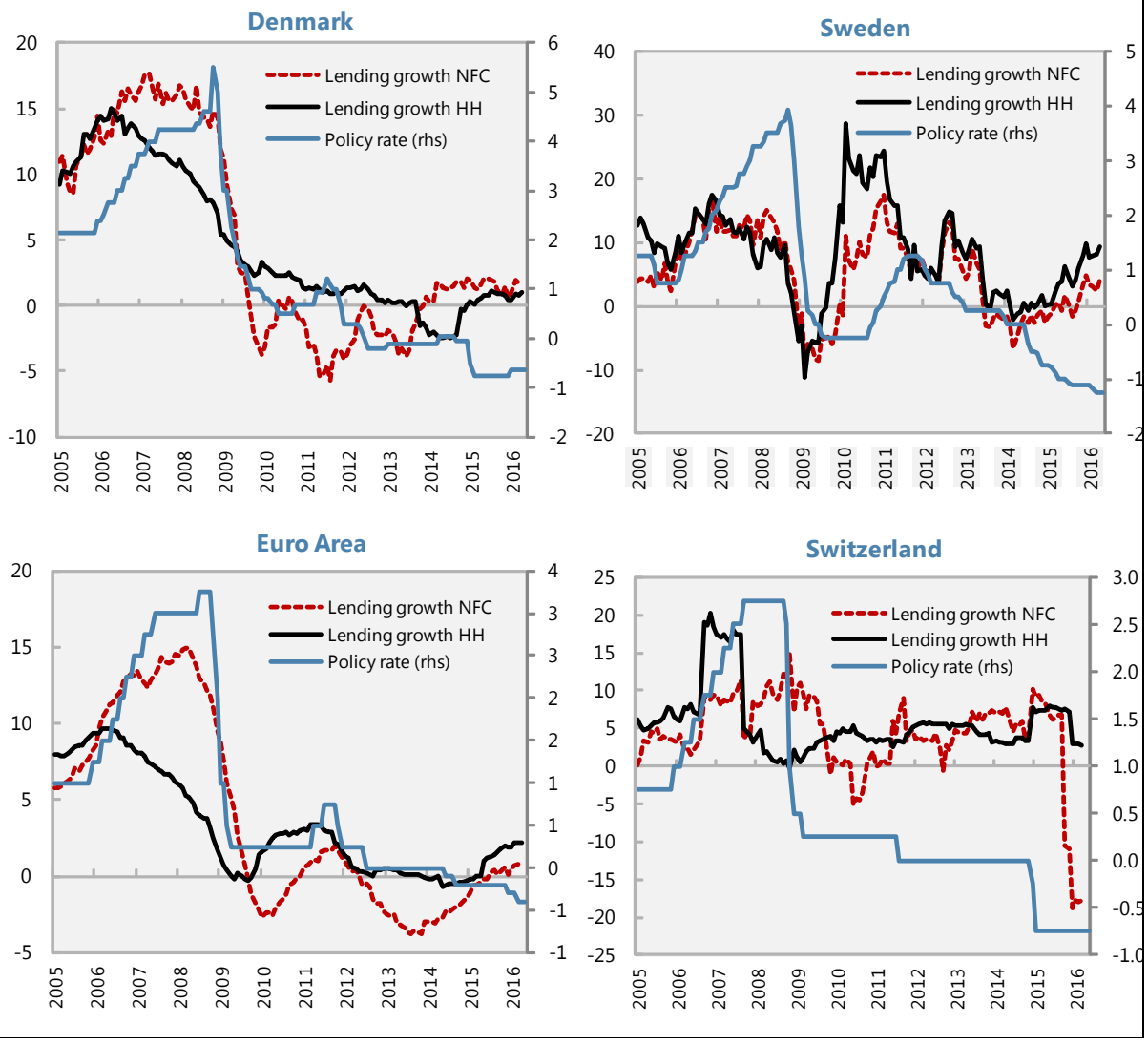


Source: Bloomberg, L.P.; Haver Analytics.



Source: Bloomberg, L.P.; Haver Analytics.

Figure A3. Marginal Policy Rate (Central Bank Deposit Rate) and Credit Growth, January 2005–June 2016



COMPREHENSIVE, MORE BALANCED POLICIES TO STRENGTHEN THE EURO AREA[1]

A. Context and Motivation

1. **Despite the strengthening recovery, the medium-term outlook for the euro area remains subdued.** Growth is forecast at only a little over 1½ percent for the next five years and inflation at just 1.7 percent in 2021, with public debt and unemployment remaining at high levels for some time. Current accounts have improved for many countries, but external imbalances within the euro area remain sizeable and the growing surpluses of the large creditor countries are contributing to global imbalances. Slow progress in addressing crisis legacies combined with low inflation and growth leave the euro area vulnerable to shocks and risk of stagnation. The policy mix so far has relied heavily on monetary easing while policy buffers at the country level are limited, reflecting the large buildup of public debt in some countries.

2. **A more balanced and comprehensive approach to strengthen growth can capitalize on important synergies.** Combining continued ECB support, use of available fiscal space, centralized investment, balance sheet cleanup, and vigorous implementation of product and labor market reforms would have several benefits:

- *Faster closing of the output gap.* Greater demand support to close the output gap more quickly would raise overall euro area inflation and reduce real interest rates across the zone. Lower real interest rates would give a boost to investment and facilitate deleveraging. Faster cleanup of banks' balance sheets would enhance the effectiveness of monetary policy by lowering borrowing costs and encouraging investment.

- *Higher multipliers near the zero lower bound.* Fiscal support that boosts private investment can be especially effective at or near the zero lower bound where crowding out effects are smaller (Blanchard, Erceg, and Lindé 2016 and others).[2] Lower real interest rates from greater demand support can also lead to a temporary boost in competitiveness, although real exchange rate effects should unwind over time as inflation and real interest rates pick up.

- *Better targeting of fiscal support.* Fiscal space within the euro area is limited and unevenly distributed such that countries most in need are generally constrained by high levels of debt. Countries with fiscal space could use it, but benefits for the broader euro area will depend mainly on spillovers. Compared to national fiscal policy, centralized investment schemes can help overcome fiscal space constraints and also provide more targeted demand support to

[1] Prepared by James John and Tao Wu with assistance from Jesse Siminitz (all EUR), and in collaboration with Benjamin Hunt and Susanna Mursula (both RES). We appreciate helpful comments from euro area country teams in EUR, and counterparts at the European Commission and ECB.

[2] There is a large literature suggesting that fiscal multiplier tends to be considerably higher in or near a liquidity trap than in normal times, for instance, Eggertsson (2008); Christiano, Eichenbaum, and Rebelo (2011); Woodford (2011), and Belinga and Ngouana (2015).

countries with large output gaps while mitigating the impact on country debt burdens. This would also help reduce debt burdens and rebuild fiscal buffers.

- *Higher potential growth.* Structural reforms would boost longer-term potential growth and reduce unemployment. They also can have near-term demand benefits as higher productivity and expectations of stronger future growth bring forward investment. This would also support monetary policy in closing the output gap more quickly.

- *Positive external spillovers*. Stronger domestic demand in the euro area would generate positive spillovers globally both for growth and inflation.

3. **Objective.** This paper uses model-based analysis to examine the potential benefits of a more balanced, comprehensive policy strategy. The paper also considers how such a comprehensive approach could be effective in countering a prolonged stagnation scenario of low growth and inflation.

B. Simulation of More Balanced, Comprehensive Policies

4. **EUROMOD simulations.** To examine the possible impact of a more balanced and comprehensive approach, the EUROMOD component of the IMF's Flexible System of Global Models (FSGM) to illustrate several policy scenarios is used.[3] The simulations use the April 2016 World Economic Outlook (WEO) projections through 2021 as a baseline. The analysis focuses on the euro area and the largest euro area members states (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Spain, the Netherlands, and Portugal), as well as the impact on the rest of the world.[4]

5. **A more balanced and comprehensive strategy would include**:

a) *Monetary policy* is assumed to reflect current ECB policy measures. The policy rate is maintained at the current low level through 2021 and asset purchases under quantitative easing (QE) continue through March 2017.[5]

b) *Use of available fiscal space and flexibility under the SGP framework*. This assumes a fiscal expansion of about 0.2 percent of euro area GDP annually in 2017–2018 with slightly more of the stimulus in the second year, for a total of 0.4 percent relative to the April 2016 WEO.

[3] For more detail, see Andrle, Michal et al, "The Flexible System of Global Models," IMF Working Paper (WP/15/64), March 2015.

[4] For Spain, the April 2016 WEO baseline projections do not include the higher-than-expected fiscal deficit in 2015 of 5.1 percent of GDP, implying upward revisions to the path of the fiscal deficit and public debt under current policies.

[5] The interest rate assumptions are in line with market expectations as reflected in the EONIA forward curve while the asset purchase assumption is consistent the ECB Governing Council's forward guidance, whereby asset purchases of €80 billion per month are expected to continue through the end of March 2017 or until there is a sustained adjustment in the path of inflation consistent with the Governing Council's price stability objective.

- *Fiscal space.* Germany uses its fiscal space to increase spending on public investment, transfers, and to a lesser extent, government consumption by 0.6 percent of national GDP during 2017–18 (equivalent to 0.2 percent of euro area GDP).

- *Use of SGP flexibility.* A fiscal relaxation of 0.5 percent of national GDP to cover the cost of structural reforms or investment is assumed over 2017–18 (0.25 percent of national GDP each year) except for countries under the Excessive Deficit Procedure (EDP) and Italy which has already utilized fully such flexibility.[6] This would amount to 0.2 percent of euro area GDP.

c) *Implementation of centralized investment* through the European Fund for Strategic Investment (EFSI) would result in additional private investment of 0.2 percent of euro area GDP each year for 2017-2021. The total amount is assumed to be distributed across member countries proportional to the size of their economies and is assumed not to affect national public debt, consistent with the design of the EFSI, which would use public guarantees to catalyze private investment.

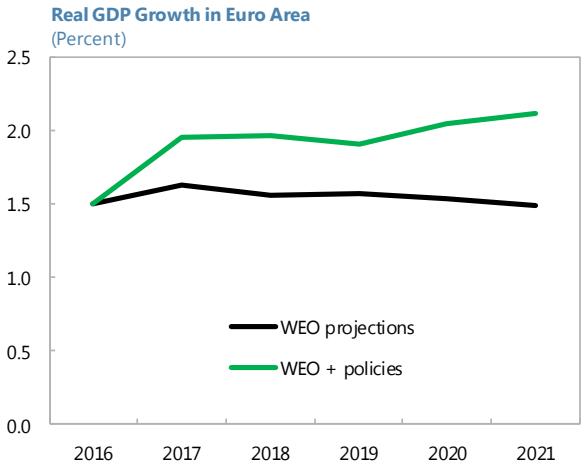
d) *Strengthening bank and corporate balance sheets.* Reducing the stock of non-performing loans would gradually lower corporate borrowing costs, by 4 to 6 basis points in different member states in 2017 with declines becoming larger over time and eventually reaching 22-30 basis points in 2021.[7]

e) *Structural reforms.* Product and labor market reforms outlined in the 2014 G20 Comprehensive Growth Strategy would be implemented gradually. These would raise the level of total factor productivity (TFP) for the euro area relative to the baseline by about 0.1 percent in 2018 and by 0.8 percent in 2021. TFP increases would vary across countries, with France, Italy, and Spain enjoying the largest gains.

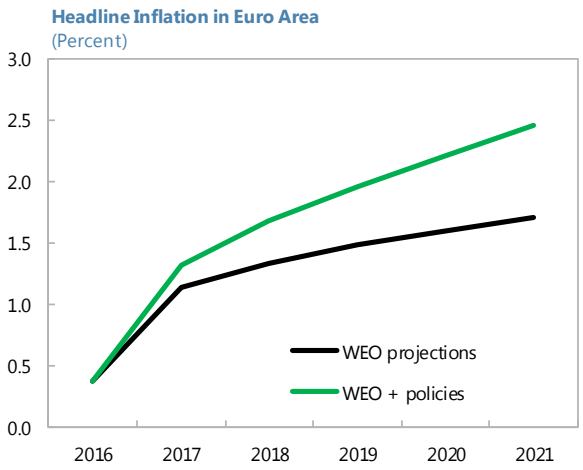
6. **The growth and inflation benefits of a more balanced policy strategy are substantial.** Real growth for the euro area would increase by an average of more than 0.4 percentage point per year to average 2.0 percent over 2017-21, compared to only a little above 1½ percent in the baseline. Headline inflation would pick up over time and, on average, would be about 0.5 percentage point higher over 2017–21. In 2019 inflation would be slightly below 2 percent—consistent with the ECB's objective of close to but below 2 percent—compared to a baseline forecast of only 1.7 percent by 2021 (chart).

[6] For illustrative purposes, apart from Italy, use of SGP flexibility is assumed for all five of the non-EDP countries covered in EUROMOD, although in practice some of these countries might not meet all of the criteria specified by the European Commission.

[7] The corporate borrowing cost reduction figures are calibrated based on the elasticity of changes in credit risk premiums in each euro area country between August 2014 and June 2015 to the observed write-off rates during the same time period (coinciding with the sample cut-off date of data obtained from the 2015 EBA Transparency Exercise).

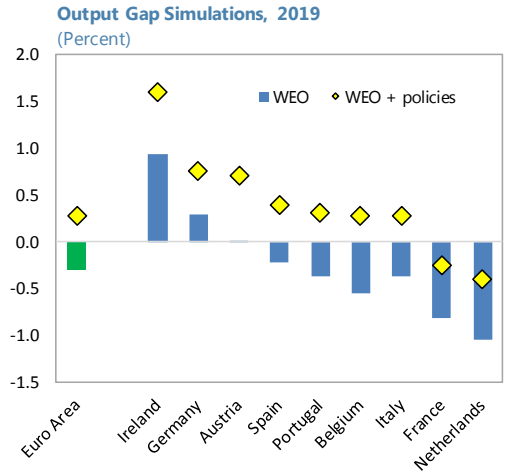


Sources: IMF, World Economic Outlook; and IMF staff calculations.



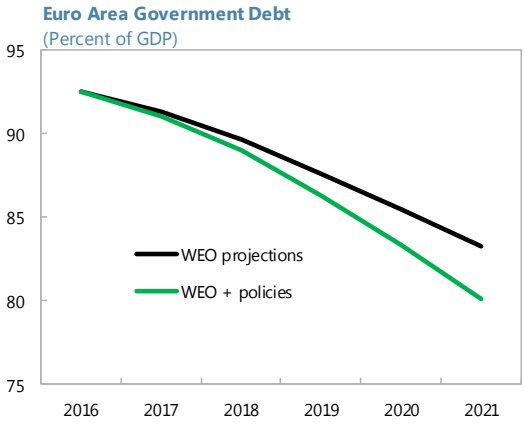
Sources: IMF, World Economic Outlook; and IMF staff calculations.

7. **Stronger growth would help output reach potential earlier.** While the output gap would turn positive in the baseline only in 2021, implementation of comprehensive policies would more than close the output gap by 2019, when it would reach 0.3 percent (chart). All countries see upward movements, but this means some countries that were near or above zero are pushed farther away from balance, especially Ireland, Germany, and Austria (chart), reflecting in part the distribution of stimulus.

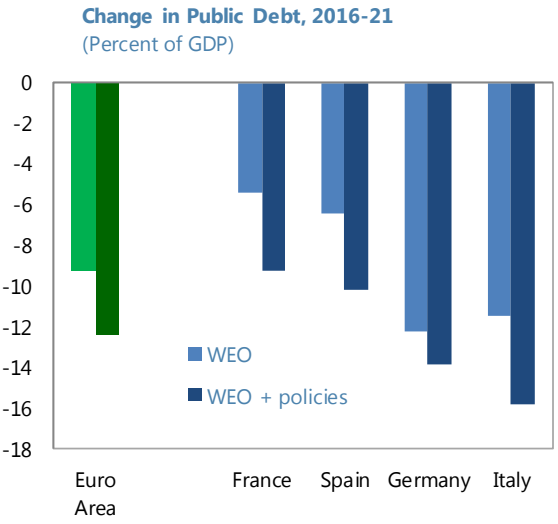


Sources: IMF, World Economic Outlook; and IMF staff calculations.

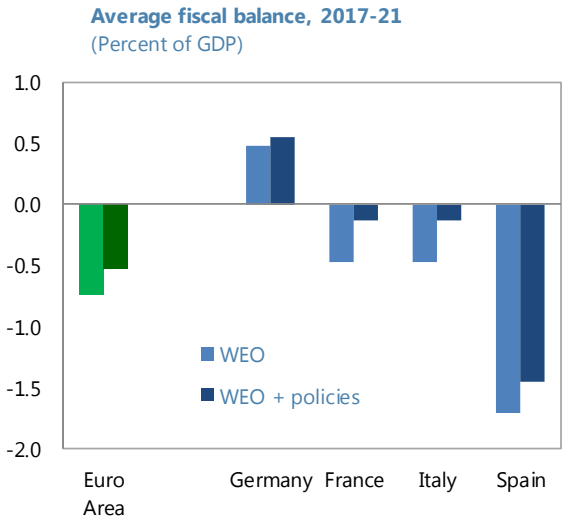
8. **Higher growth and inflation would lower debt levels and help rebuild key fiscal buffers**. Aggregate euro area public debt in the baseline is forecast to fall from 92½ percent of euro area GDP in 2016 to 83 percent by 2021. With comprehensive policy support, euro area public debt would be 3 percentage points lower by 2021 relative to the baseline, with high debt countries experiencing average declines more than one percentage point larger (charts). Deficits in high debt countries would also be, on average, about 0.4 percent of GDP lower, which would help rebuild policy buffers against future shocks. While this scenario analysis considers only expansionary policies (i.e., largely the use of fiscal space, SGP flexibility, and centralized investment) and finds substantial benefits, further work could examine the tradeoffs involved in combining these stimulus measures with the further fiscal adjustment recommended for high debt countries and whether this policy mix could achieve even faster debt reduction in these cases.



Sources: IMF, World Economic Outlook; and IMF staff calculations.

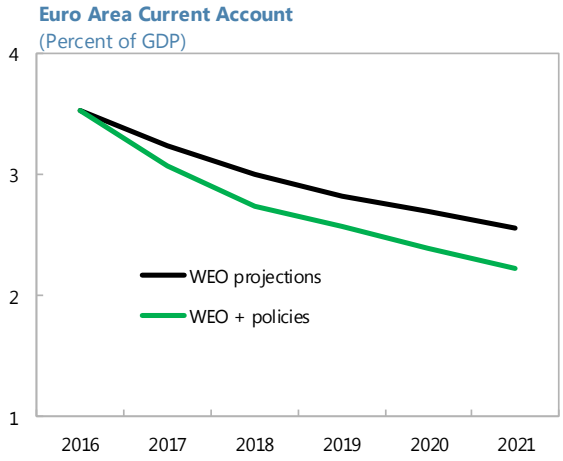


Sources: IMF, World Economic Outlook; and IMF staff calculations.



Sources: IMF, World Economic Outlook; and IMF staff calculations.

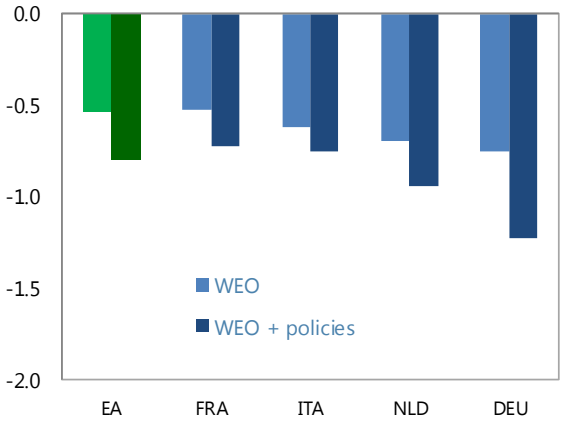
9. **More balanced policies would also generate positive external spillovers.** Stronger domestic demand would accelerate the fall in the current account already projected in the baseline. The euro area current account surplus would be a little more than 0.3 percent of GDP lower than the baseline by 2021 (chart), bringing the surplus to 2.2 percent. This would have spillover benefits for the rest of the world as seen in higher real exports (0.4 percent) and real output (0.1 percent) in 2021. The spillovers to other EU countries would be especially large due to close trade links.



Sources: IMF, World Economic Outlook; and IMF staff calculations.

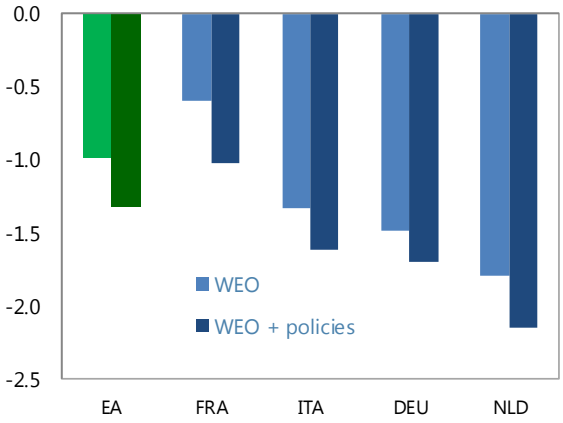
10. **More spending in surplus countries can narrow external imbalances within the euro area.** Fiscal stimulus in Germany during 2017–18 contributes to reducing its current account relative to the baseline by much more than in other euro area countries (e.g., 0.5 percent of GDP versus 0.2 percent of GDP for France and 0.1 percent of GDP for Italy as shown in the chart), which would help narrow external imbalances within the euro area. After 2018, however, changes in current account balances relative to the baseline are more similar across countries (chart).

Change in Currrent Account Balance, 2016-18
(Percent of GDP)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

Change in Currrent Account Balance, 2016-21
(Percent of GDP)

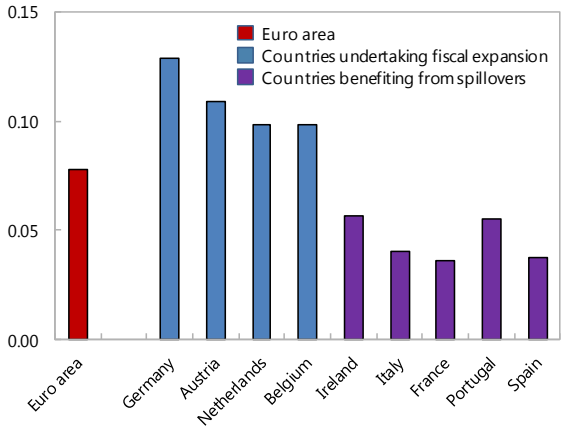


Sources: IMF, World Economic Outlook; and IMF staff calculations.

This reflects the winding down of stimulus in Germany and the strengthening of demand in countries with weaker external positions. Structural reforms that raise private spending in surplus countries and improve productivity and the relative competitiveness of net external debtor countries could help narrow external imbalances within the euro area, but these competitiveness gains may take longer to realize, beyond the forecast horizon.

11. **Fiscal expansion, although unevenly distributed, has important spillover benefits.** Given high debt levels in many euro area economies, only a handful of countries are assumed to use fiscal space (including via SGP flexibility), with the bulk of the stimulus coming from Germany. Although other countries do not undertake direct stimulus, these countries do benefit from positive growth spillovers (chart). A fiscal expansion of 0.2 percent of euro area GDP in 2017 by countries undertaking supportive fiscal policies raises their average GDP level by a little more than 0.1 percent that year, and also raises the GDP level of other countries by an average of 0.04 percent.

Impact of Fiscal Stimulus on Real GDP, 2017 (Percent)



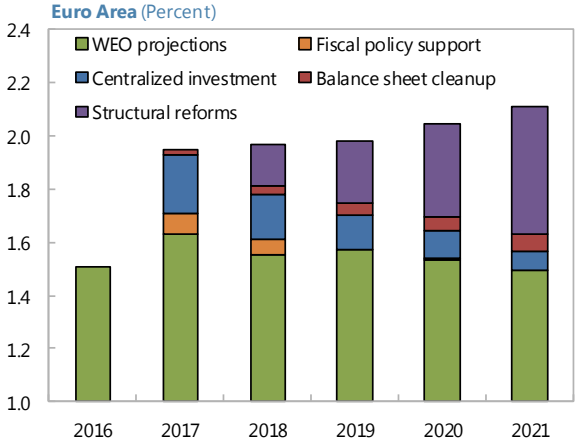
Sources: IMF, World Economic Outlook; and IMF staff calculations.

12. **To sum up, centralized investment plays an important role throughout, fiscal stimulus is fairly powerful when used, and structural reforms are critical to longer-term growth prospects (charts).**

- Centralized investment in the scenario accounts for the largest growth impact in the first two years, with an estimated multiplier of around one, consistent with estimates of multipliers at or near the zero lower bound. Centralized investment particularly benefits countries with larger output gaps and no fiscal space, and contributes importantly to the closing of the output gap for the euro area as whole, serving as the main driver for higher inflation.

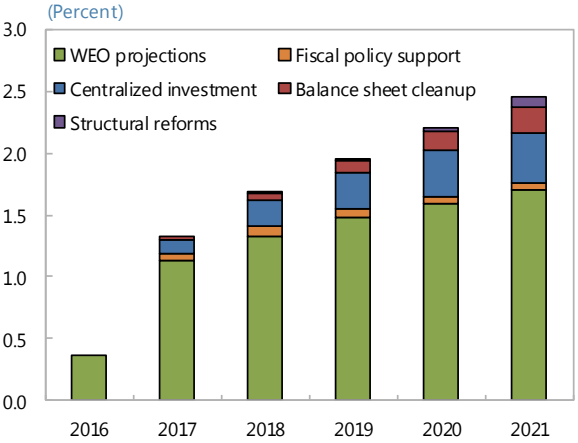
- Fiscal policy support is strongest in 2017–2018 when stimulus is implemented. The smaller multiplier for fiscal policy compared to centralized investment reflects some fiscal spending on lower multiplier transfers rather than investment.
- Structural reforms kick in over time, lifting economic activity by more than 0.3 percentage point on average over 2019–21, and are crucial to sustaining higher growth and debt sustainability in the longer term. Without action on the structural front, growth would fall to a level only slightly higher than in the baseline. The 1 percent improvement in potential output in 2021 is almost entirely due to the impact of increases in productivity and labor market participation with 90 percent of the gain from structural reforms, with the remainder coming mainly from higher investment).[8]
- Cleanup of bank and corporate balance sheets has a moderate positive impact on growth, but plays a larger role in raising inflation via the decline in corporate borrowing rates, which encourages borrowing and investment.

Policy Scenario Decomposition Real GDP Growth in Euro Area (Percent)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

Policy Scenario Decomposition Inflation in Euro Area (Percent)

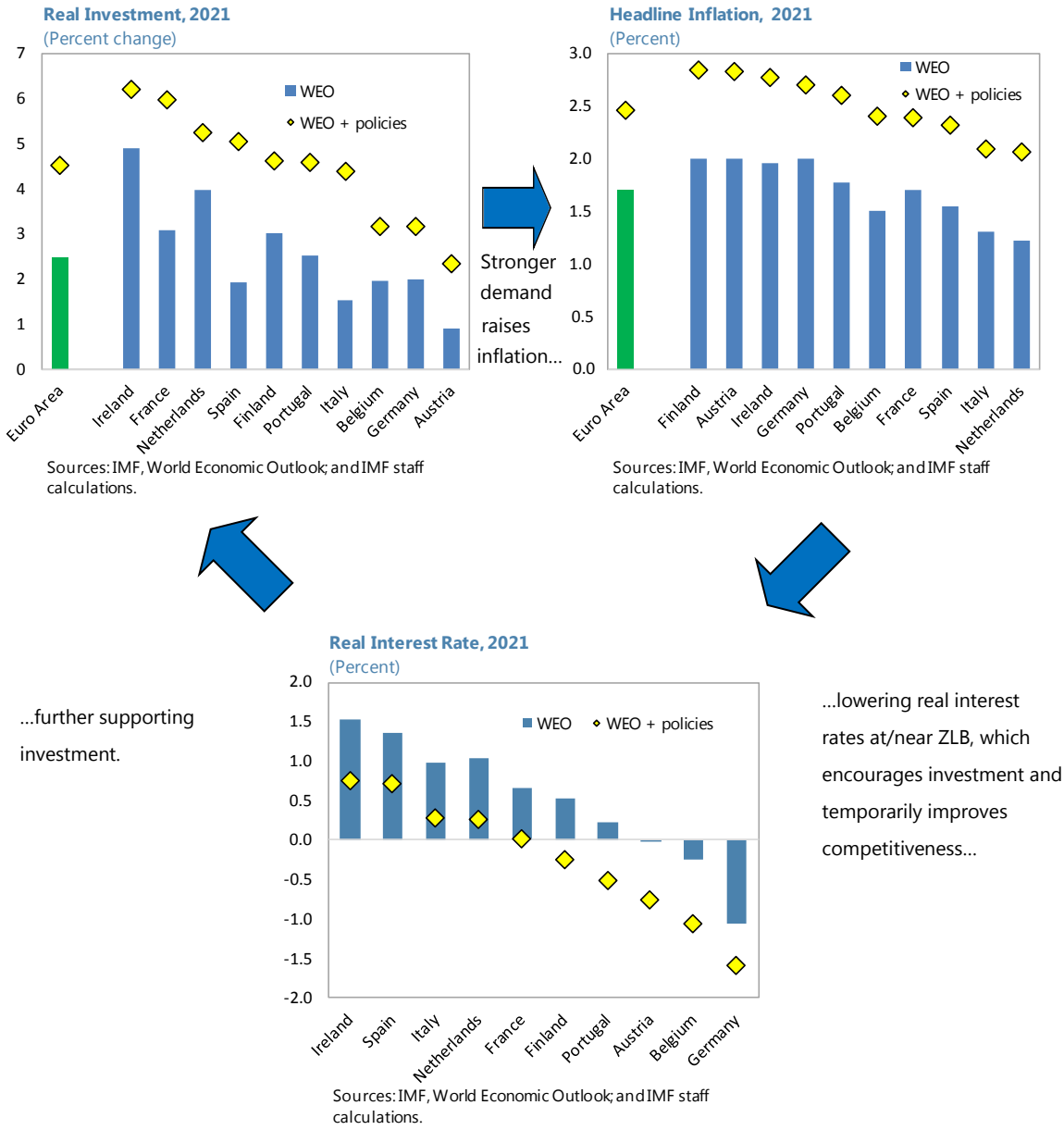


Sources: IMF, World Economic Outlook; and IMF staff calculations.

13. **Comprehensive policies are more effective due to the synergies in a low-inflation, low-interest rate environment** (Figure 1). Centralized investment and fiscal stimulus raise domestic demand, particularly investment, which narrows the output gap and raises inflation. With monetary policy remaining accommodative at or near the zero lower bound, higher inflation translates into lower real interest rates, helping to "crowd in" investment. Lower real interest rates also temporarily weaken the nominal exchange rate, providing a temporary boost to competitiveness and investment, but over time, the real exchange rate should appreciate as prices and the real interest rate recover. Balance sheet cleanup reduces real interest rates via lower credit risk premia. Structural reforms further spur growth in the near term by improving confidence and bringing forward investment, especially in some weaker economies, and lift potential growth and support fiscal sustainability over the long run.

[8] The analysis assumes two years before structural reforms are implemented. If, due to political or other factors, it took longer to implement reforms or if they were not fully implemented, the impact would be smaller.

Figure 1. Policy Synergies in a Low-inflation/Low-interest Rate Environment

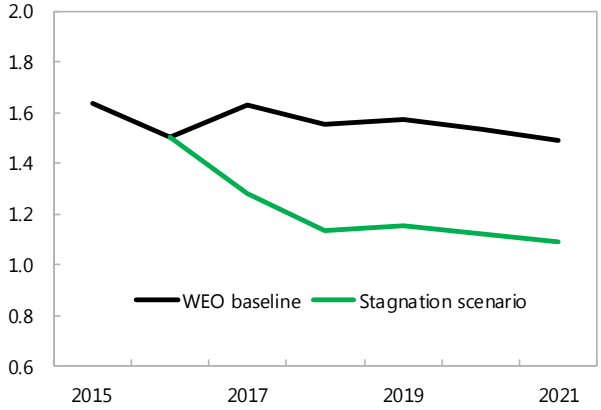


C. Stagnation and a Policy Response Scenario

14. **More balanced, comprehensive policies could also be effective in countering stagnation risks.** For a stagnation scenario, it is assumed that private investment shocks (possibly triggered by weaker external demand, lower expected future output, or heightened uncertainty) combined with higher risk premia (reflecting, for example, renewed financial fragmentation and balance sheet concerns), and weaker productivity push the euro area into a low-growth, low-inflation equilibrium.[63] Hysteresis would set in, reducing potential output, and with the output gap remaining open, inflation would remain positive but well below the price stability objective.[64]

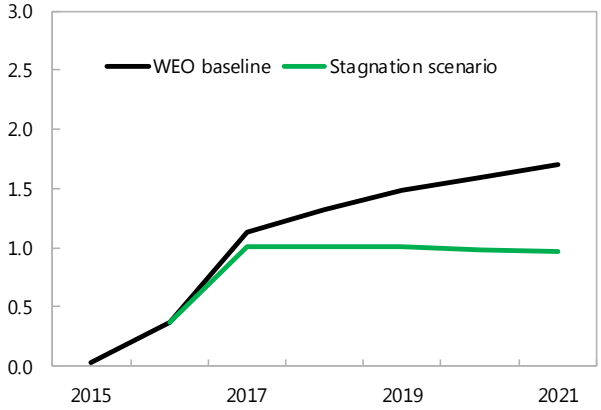
15. **Under the stagnation scenario, the euro area would experience prolonged low growth and inflation.** Compared to investment growth of 2½–3 percent in the baseline, the rate of capital expansion would fall to only ½ percent by 2021, and the level of investment then would be about 6 percent lower than in the baseline. Led by weaker investment, GDP growth would be about 1.1 percent in the medium term, or about 0.4 percentage point lower than the baseline, while inflation would average just 1 percent for 2017–21 (charts). The output gap would widen initially by 0.2 percentage point and be negative 0.7 percent in 2021. Moreover, slower productivity growth and reduced investment over the medium-term would lower potential growth and push up unemployment by 0.4 percentage point in 2021.

Euro Area: GDP Growth Simulations
(Percent)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

Euro Area: Inflation Simulations
(Percent)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

16. **The downturn would erode already limited fiscal buffers.** Government deficits would be ¼ percentage point higher on average during 2017–21, and public debt-to-GDP for the euro area

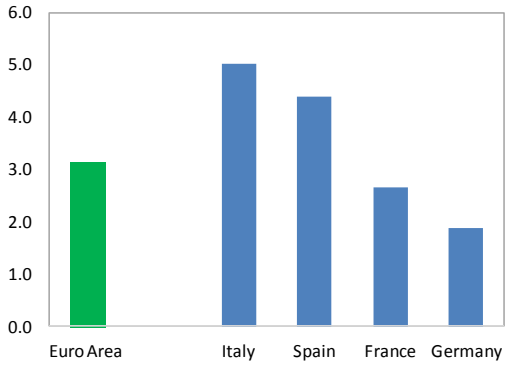
[63] Specifically, for 2017–21, investment would be ¼ percentage point lower each year, sovereign and corporate risk premia in high-debt countries (Greece, Ireland, Italy, Portugal, and Spain) would be 75 basis points higher, and the total factor productivity growth rate would be 0.1 percentage point lower each year.

[64] For further discussion of a stagnation scenario, please see: Lin, Huidan, "Risks of Stagnation in the Euro Area," January 2016, IMF Working Paper WP/16/9.

would rise by 3 percentage points to 86 percent of GDP. The increase would be noticeably larger for high-debt countries (+7 percentage points for Portugal, +5 percentage points for Italy).

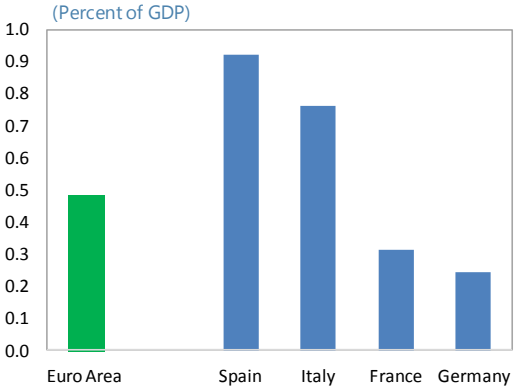
17. **Lower growth in the euro area would generate negative spillovers for the global economy**. By 2021, global output would be 0.4 percentage point lower than under the baseline, and the euro area current account surplus would be 0.5 percent of GDP higher with real imports almost 3 percent lower (chart). Other EU countries' exports would be particularly affected, while real exports for the rest of the world would be 0.4 percent lower (chart). In addition to reduced trade, lower growth and inflation in the euro area could also have confidence and financial spillover effects for the world.

Stagnation Impact on Government Debt, 2021
(Percent of GDP)



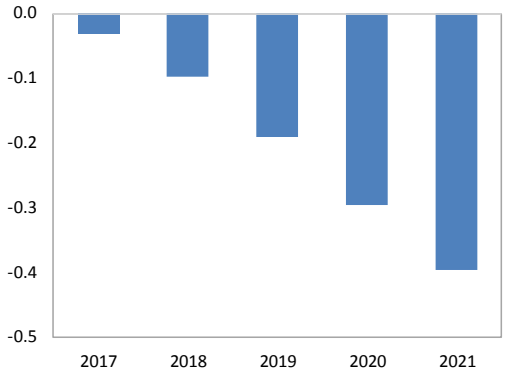
Sources: IMF, World Economic Outlook; and IMF staff calculations.

Stagnation Impact on Current Account Balance, 2021
(Percent of GDP)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

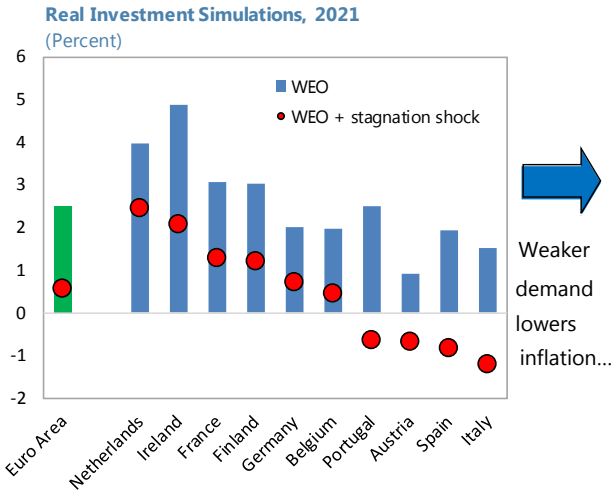
Impact on Rest of World Real Export Growth
(Percent)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

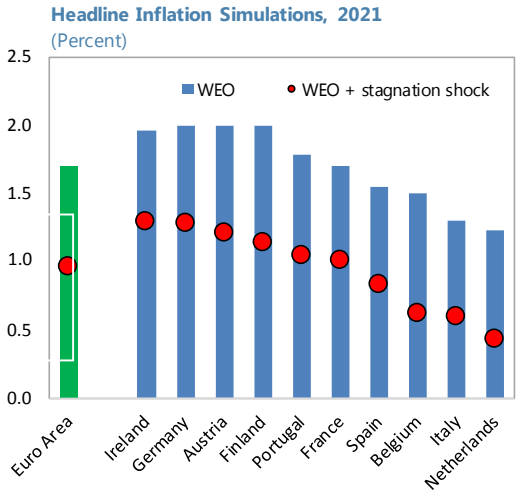
18. **Limits to policies would contribute to negative feedback loops that exacerbate the downturn.** The positive policy synergies shown earlier in Figure 1 are thrown into reverse in a downturn (Figure 2). Weaker demand, especially investment, causes inflation to fall, which raises real interest rates and contributes to real exchange rate appreciation. The burden on monetary policy to address tightening financial conditions and lower inflation would increase. With higher real borrowing costs and weaker competitiveness, investment would fall further.

Figure 2. Negative Feedback Loop in a Downturn



Sources: IMF, World Economic Outlook; and IMF staff calculations.

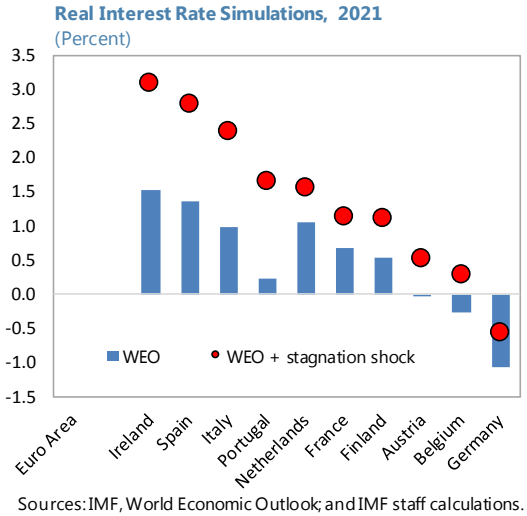
Weaker demand lowers inflation...



Sources: IMF, World Economic Outlook; and IMF staff calculations.

...raising real interest rates, and worsening competitiveness...

...further discouraging investment.



Sources: IMF, World Economic Outlook; and IMF staff calculations.

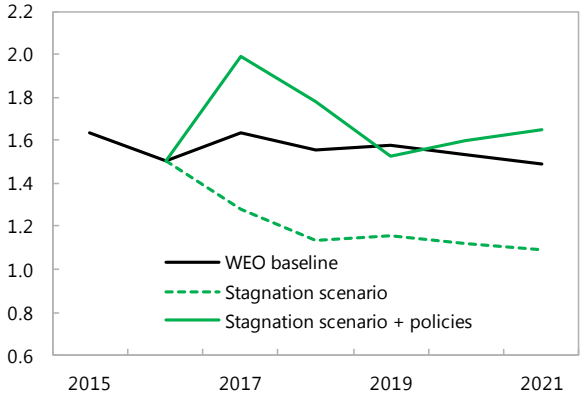
19. **A similar strategy of more balanced and comprehensive policies can help address this more severe downturn.** Here it is assumed the main components of the policy mix remain the same with two additions:

a) *Additional monetary policy support*. This includes a one-year extension of the Expanded Asset Purchase Program (APP) until March 2018 at the same rate of monthly purchases as in the baseline (€80 billion each month).

b) *Slightly larger and more targeted centralized investment*. In addition to the EFSI-induced centralized investment of 0.2 percent of euro area GDP each year for 2017–21 included in the scenario above, additional centralized investment of 0.1 percent of euro area GDP each year for 2017 and 2018 is assumed. Moreover, only member states projected to have negative output gaps greater than one percent in 2017 in the baseline will receive additional centralized investment spending, with the amount proportional to the countries' share in the aggregate negative output gap in the euro area.

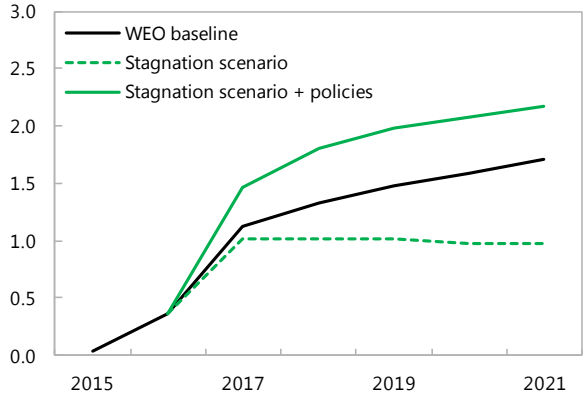
20. **The analysis suggests a more comprehensive and balanced policy mix would offset the downturn** (charts and table). Overall, the policy package would restore most variables to the level in the WEO baseline, and for some indicators, it would go further. Given some frontloading and an increase in policy measures, growth would exceed that under the WEO baseline in 2017 and 2018, reaching 2.0 and 1.8 percent for those years, before returning to a path a little over 1½ percent, which is similar to the WEO baseline. The output gap would be closed by 2018, which is much earlier than the WEO baseline (2021). Closing the output gap raises inflation, which would exceed that under the WEO baseline. Inflation would reach 1.5 percent in 2017, 1.8 percent in 2018, and 2 percent in 2019. Relative to the WEO baseline, in 2021 euro area public debt would be 2 percent of GDP lower at 81 percent of GDP, thus slightly enhancing fiscal policy buffers. The current account surplus would be the same (2.6 percent of GDP).

Euro Area: GDP Growth Simulations
(Percent)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

Euro Area: Inflation Simulations
(Percent)



Sources: IMF, World Economic Outlook; and IMF staff calculations.

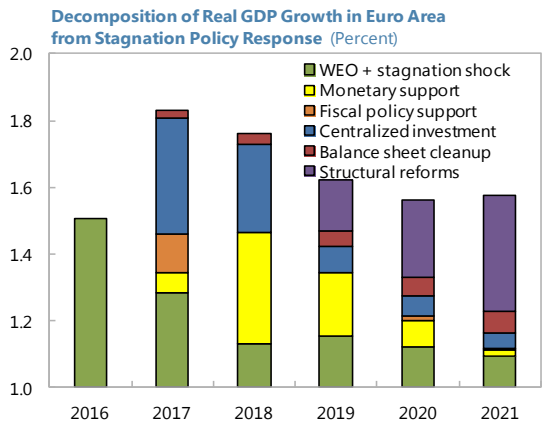
Table. Euro Area Scenarios

	Real Growth (percent)			Inflation (HICP) (percent)			Output Gap (percent of potential GDP)		
	2017	2018	2021	2017	2018	2021	2017	2018	2021
April 2016 WEO	1.6	1.6	1.5	1.1	1.3	1.7	-1.0	-0.6	0.1
Upside	1.9	2.0	2.1	1.3	1.7	2.5	-0.6	0.0	0.9
Stagnation scenario	1.3	1.1	1.1	1.0	1.0	1.0	-1.2	-1.0	-0.7
Stagnation scenario plus policies	2.0	1.8	1.6	1.5	1.8	2.2	-0.4	0.2	0.5

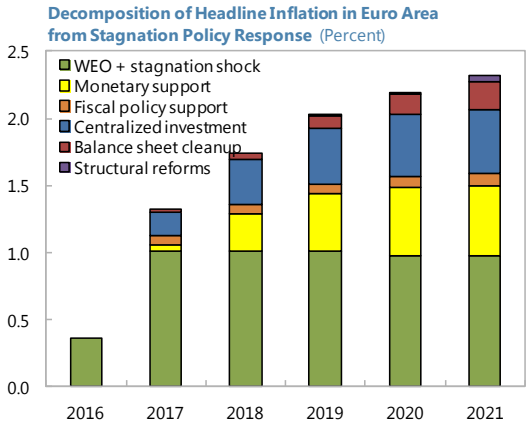
	Fiscal Deficit (percent of GDP)			Government Debt (percent of GDP)			Current Account (percent of GDP)		
	2017	2018	2021	2017	2018	2021	2017	2018	2021
April 2016 WEO	-1.4	-0.9	-0.3	91.3	89.7	83.2	3.2	3.0	2.6
Upside	-1.4	-0.9	0.1	91.1	89.0	80.1	3.1	2.7	2.2
Stagnation scenario	-1.5	-1.1	-0.7	91.7	90.6	86.4	3.4	3.3	3.0
Stagnation scenario plus policies	-1.2	-0.7	-0.1	90.9	88.7	80.9	3.1	2.8	2.6

Source: Fund staff calculations.

21. **The synergies from combined policies would play an important role in restoring growth and inflation.** Similar to the earlier scenario, centralized investment and fiscal policy are key to addressing the immediate aftermath of the shock. As before, without action on structural measures, longer-term growth would suffer, falling back to only a little above that in the stagnation scenario. What stands out in this simulation is the effect of additional monetary policy support. The one-year extension of asset purchases has a large effect on growth in 2018 as well as a sizeable and persistent impact on inflation alongside centralized investment as the other key factor. This is not entirely consistent with recent experience, though substantial monetary easing may have prevented even lower inflation outcomes in recent years.

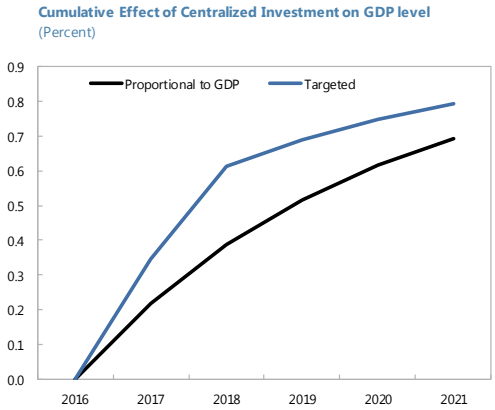


Sources: IMF, World Economic Outlook; and IMF staff calculations.



Sources: IMF, World Economic Outlook; and IMF staff calculations.

22. **Targeting centralized investment toward countries with larger output gaps enhances the effectiveness of stimulus.** Even though the size of the additional centralized investment assumed in the policies to counter stagnation is small (a total of 0.2 percent of euro area GDP over 2017–18), targeting the stimulus toward countries with larger output gaps has a significant impact, raising the cumulative output level by another 0.22 percentage point in 2018 (chart). This implies a multiplier around 16 percent higher than for untargeted centralized investment, underscoring the efficiency of targeted demand support from the center.



Source: IMF staff calculations.

D. Conclusions

23. **A more balanced, comprehensive policy strategy can raise growth and inflation significantly in the euro area, with positive spillovers globally.** Model simulations show that a strategy encompassing continued monetary accommodation, use of fiscal space and SGP flexibility, centralized investment, cleanup of bank and corporate balance sheets, and structural reforms can significantly raise growth and inflation relative to the baseline, and could effectively counter a prolonged downturn. The strong positive impact reflects important synergies in the current low-inflation, low-interest rate environment. Pursuing a comprehensive strategy would help reduce public debt levels and rebuild fiscal buffers. It would also have positive spillovers for the rest of the world through stronger import demand and inflation in the euro area. Targeting support to weaker countries would enhance the impact, but use of fiscal space by stronger countries still has positive growth spillovers, and could also help narrow internal imbalances within the euro area.

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