



IRELAND

SELECTED ISSUES

July 2016

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Approved By
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PUBLIC EXPENDITURE EFFICIENCY IN IRELAND¹

A. Introduction

1. Ireland’s successful fiscal consolidation and growth turnaround have created fiscal space in the medium term under the SGP, but more efficient public spending could further increase the “effective” fiscal space. A more efficient delivery of public services could yield better outcomes for a given cost, or the same quality of outcome at a lower cost. It would also provide for contingency in case the assumptions underpinning the existing fiscal space calculations do not materialize and help rechannel fiscal resources toward their most productive use. More efficient public spending can also help support medium-term growth and make the economy more resilient to future shocks.

2. This paper reviews public expenditure efficiency in Ireland with a view to highlight areas for further improvement and suggest policies to this effect. Ireland’s nominal public expenditure is analyzed in a cross-country context,² while also taking into account differences in income per capita among countries to reflect the fact that richer countries generally tend to have a higher demand for public services. The structure of the paper is as follows: First, the paper presents recent trends and analysis of public expenditure by economic classification (e.g. current expenditure and capital expenditure), with the focus on infrastructure spending and on key components of the functional budget: social protection, health, and education. Then the paper highlights avenues for improvement in these areas. Finally, analytical measures of potential efficiency gains estimated using the Data Envelopment Approach will provide numerical illustrations of potential “efficiency gains” in two sectors, health and education. Health was chosen because it stands out as the only area where Ireland appears to spend more than the average of its EU peers, and education because of the rich set of indicators available to evaluate the quality of education outcomes (including, but not, only standardized academic tests).

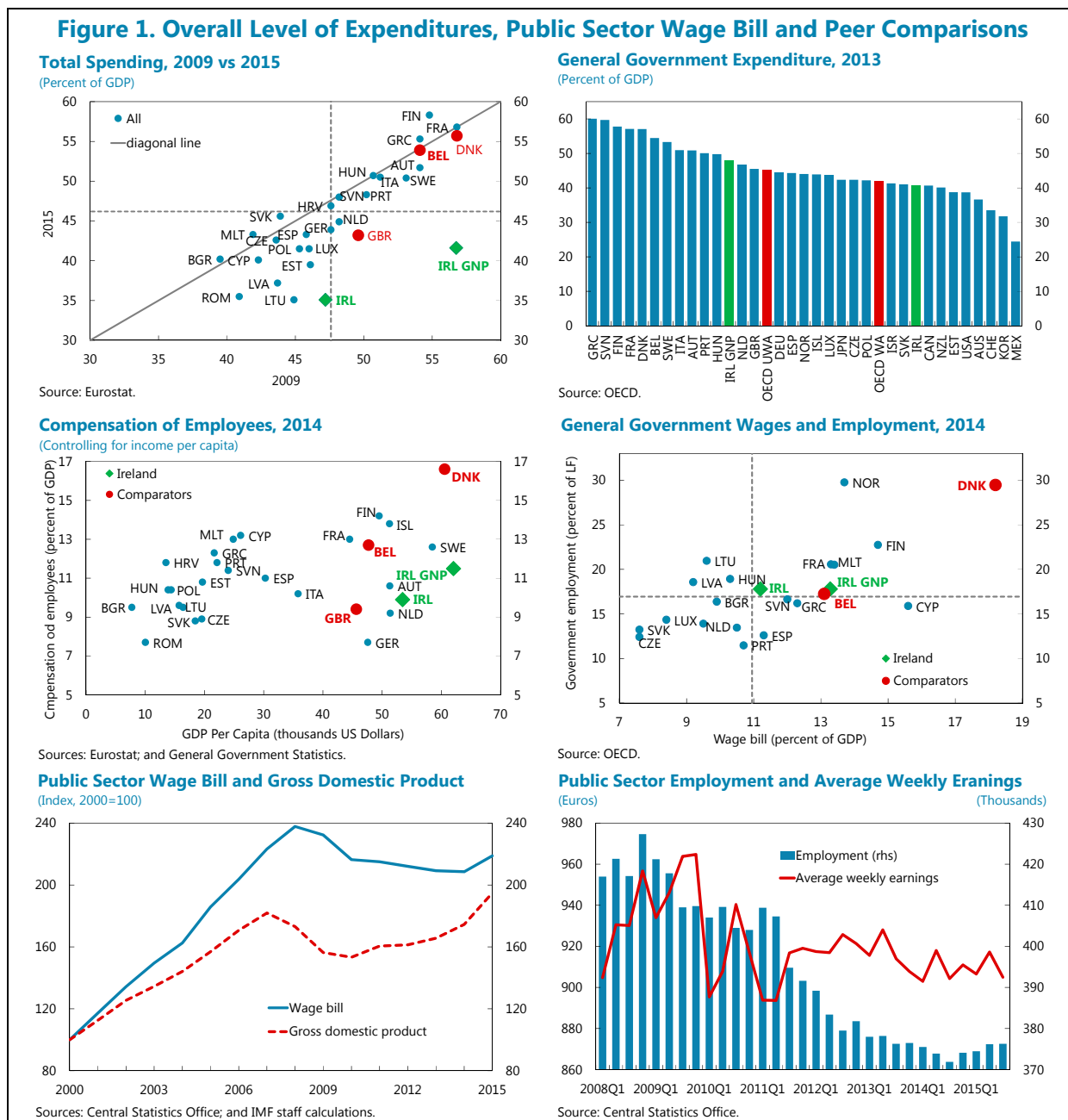
B. Public Expenditure by Economic Classification

3. The overall level of public expenditure places Ireland currently in the low-to-average spender category, depending on the yardstick and peer group used for comparison (Box 1). With a ratio of 35 percent of general government expenditure to GDP in 2015 (Table 1), Ireland is below the OECD countries average. When using GNP this ratio climbs to 42 percent, at about the OECD average but still below key European comparators. Ireland has recorded one of the largest decreases in expenditure to GDP ratio since the outbreak of the crisis between 2009 and 2014 (with Lithuania, Latvia and Romania) (Figure 1). Comparable countries in terms of income per capita

¹ Prepared by Alexandre Chailloux.

² The paper uses data from the public expenditure database assembled by the IMF’s Fiscal Affairs Department and combining Eurostat, OECD, UNESCO and CSO statistical resources. Comparator countries include a peer group comprising 28 European Union countries plus Iceland, Norway and Switzerland, and when relevant, broader set of OECD countries serves as a benchmark.

(Belgium, Denmark) have seen little change in spending or staged moderate decreases (United Kingdom). From a peak of about 45 percent ex-financial sector support measures in the years 2009-2011, total public spending has receded to about 35 percent of GDP in 2015. Expenditure reduction happened through a consolidation program of two thirds of targeted expenditure reductions and one third of revenue measures. The incremental reduction in the primary expenditure ratio to GDP was achieved through GDP growth.



Box 1. Benchmarking Expenditures Adequately: What Yardstick to Use?

As pointed out in Abbas (IMF, 2012), the assessment of Ireland's level of public expenditure can be ambiguous depending on whether public spending is presented as a ratio to Gross Domestic Product (GDP) or to Gross National Product (GNP). In particular, ratios to GDP may misrepresent the resources available to finance expenditures on a sustainable basis, at a time when the wedge between GDP and GNP (the income accruing to foreign-owned non-financial corporations) was widening, and strictly domestic sources of tax revenues dwindling. Since then the GDP/GNP wedge has stabilized, thanks notably to the vigorous recovery of domestic demand starting in 2013. In addition, recent trends in terms of revenue collection have also highlighted the dynamic contribution of foreign-owned corporations to corporation tax receipts. For this reason, the following analysis will highlight key metrics both in terms of ratio to GDP and GNP.

Table 1. Ireland: General Government Expenditure by Functional Classification

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Difference (2009-2015)	
	(percent of GDP)									(ppts of GDP)	(share of total exp consolidation)
Total expenditure	35.9	41.9	47.2	65.7	45.5	41.8	39.7	38.6	35.1	-12.1	100.0
Current spending	20.6	23.3	25.5	25.7	24.7	25.1	24.7	23.6	21.0	-4.5	37.2
Compensation of employees	10.1	11.3	12.2	11.6	11.0	10.8	10.4	9.9	9.1	-3.1	25.6
Goods and services	4.9	5.4	5.9	5.4	4.9	4.7	4.6	4.6	4.3	-1.6	13.2
Interest payments	1.0	1.3	2.0	3.0	3.4	4.1	4.3	4.0	3.1	1.1	-9.1
Subsidies	0.9	1.0	1.1	1.1	1.0	1.1	1.0	1.0	0.9	-0.2	1.7
Current transfers	1.6	1.9	1.6	1.6	1.5	1.4	1.6	1.4	1.2	-0.4	3.3
Social benefits	2.1	2.4	2.7	3.0	2.9	3.0	2.8	2.7	2.4	-0.3	2.5
Capital spending	5.6	7.0	7.3	25.6	7.1	2.9	2.4	2.7	3.4	-3.9	32.2
Gross fixed capital formation	4.6	5.3	3.7	3.3	2.4	2.1	1.9	2.1	1.8	-1.9	15.7
Capital transfers	1.0	1.7	3.6	22.3	4.7	0.8	0.5	0.6	1.6	-2.0	16.5

Sources: Eurostat; and IMF staff calculations.

4. The breakdown of functional expenditure show what makes Ireland a low spending country relative to its peers. The wage bill at 9.8 percent of GDP (Table 2) appears at the bottom of countries with comparable income per capita, and largely below some of the comparators (such as Denmark, Belgium, Finland or Sweden). Public investment as a share of GDP also puts Ireland at the bottom of the list, ranking last among a group of 38 OECD countries (Figure 2). Table 2 highlights (in red when spending is 30 percent above the EU-28 average, and in blue when it is below by the same amount) that Ireland spending is markedly above the EU average only for a limited set of expenditure items, namely interest payments (4.4 percent of GDP), some sub-components of the wage bill (health), and social benefits paid by the department of social protection (1.8 percent of GDP). In a functional perspective, three domains contribute the most to this overall difference. Social protection (about one quarter of the difference), education (one fifth of the difference) and health expenditures, that stand at odds with other types of expenditure at about 12 percent above the EU average.

Table 2. Public Spending in Ireland vs. European Union, 2014 1/
(Percent of GDP; economic and functional classification)

	Total expenditure	Current spending	Compensation of employees	Goods and services	Subsidies	Interest payments	Current transfers	Social benefits	Capital spending 2/
Total expenditure	38.3	35.7	9.8	4.6	1.0	4.0	1.4	2.7	2.6
General public services	6.1	5.9	0.6	0.3	0.0	4.0	0.9	0.0	0.2
Defence	0.4	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0
Public order and safety	1.4	1.4	1.0	0.4	0.0	0.0	0.0	0.0	0.0
Economic affairs	3.2	2.0	0.7	0.7	0.4	0.0	0.1	0.0	1.2
Environment protection	0.6	0.5	0.2	0.2	0.1	0.0	0.0	0.0	0.1
Housing and community amenities	0.7	0.4	0.1	0.2	0.0	0.0	0.0	0.0	0.3
Health	7.6	7.4	3.5	1.4	0.2	0.0	0.0	1.6	0.2
Recreation, culture and religion	0.8	0.7	0.2	0.3	0.1	0.0	0.0	0.0	0.1
Education	4.3	4.0	2.6	0.4	0.2	0.0	0.1	0.2	0.3
Social protection	13.2	13.1	0.7	0.6	0.0	0.0	0.2	0.9	0.1

Source: Eurostat; and IMF staff estimates.

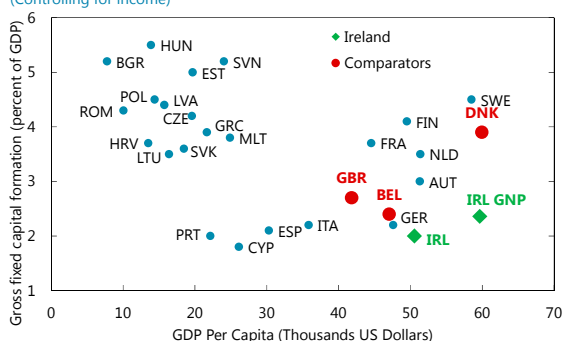
1/ Blue highlighted cells flag expenditure items coming out 30 percent below the EU average, and red highlight those 30 percent higher than the EU average.

2/ Capital spending includes gross capital formation and capital transfers.

Figure 2. Public Investment in International Context

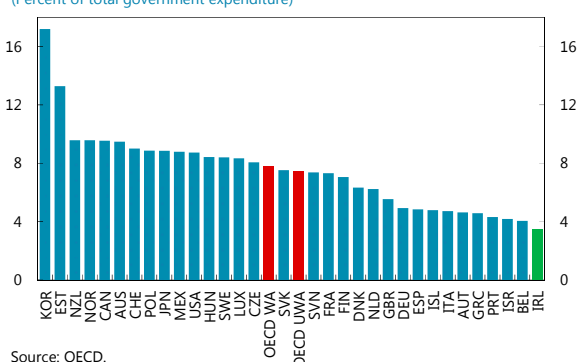
Gross Fixed Capital Formation, 2014

(Controlling for income)



Government Investment, 2014

(Percent of total government expenditure)



C. Public Expenditure Efficiency: Functional Spending Versus Key Outcomes

Public investment needs and infrastructure efficiency

5. Years of reduction in capital spending have brought public investment to a low point in Ireland. While the ongoing economic recovery has seen a sharp rebound in private investment from a low base, public investment in infrastructure has remained anemic at less than 2 percent of GDP. Ireland's openness to world trade and leading edge in some dynamic, high-value added segments of world trade creates a need for high quality infrastructure to support trade. Although the stock of public capital is high owing to substantial public investment in pre-crisis decades, calculations by the European Commission show that investment expenditure between 2013 and

2015 hardly sufficed to cover maintenance needs.³ The indicators available to assess the quality of Ireland core infrastructure (transport, telecom, logistical capacity) point to a mixed performance, generally above the EU median, but below comparable countries in terms of income per capita and of trade openness. The National Competitiveness Council, in its 2015 scorecard, flagged Infrastructure quality as a weak spot in Ireland’s trade competitiveness. The World Economic Forum (WEF) survey-based quality of infrastructure index places Ireland at the 27th rank out of 146 countries (and 15 among 23 European countries), and the 2016 “Review of Infrastructure in Ireland” —published by [Engineers Ireland](#)—gave a C rating⁴ (on a A to E scale) to energy, transport, water quality, waste management, and water supply infrastructures.

6. Ireland ranks well in terms of the quality of road network, but below average for quality of other core types of infrastructures. The power grid shows the 7th largest distribution losses in the EU. The need to restore water infrastructure is widely acknowledged and the investment plan developed by the new water utility Irish Waters will increase spending from €0.5 billion in 2016 to €0.8 billion in 2021. Trade supporting infrastructure (see port infrastructure quality and logistics index,⁵ Figure 3) is above EU median levels, but below European peers with a highly opened economy.⁶ Access to IT infrastructure (Internet, broadband) are at about the EU median but below countries with comparable income, at odds with Ireland’s status of IT exporting powerhouse, although most of the demand for IT infrastructure appears to be currently in Dublin (“Silicon Docks”), where bottlenecks to future investment plans are less of a concern.

³ Country Report Ireland, European Commission, February 2016, also Kennedy “Public Capital: Investment, Stocks and Depreciation”, IFAC, June 2016.

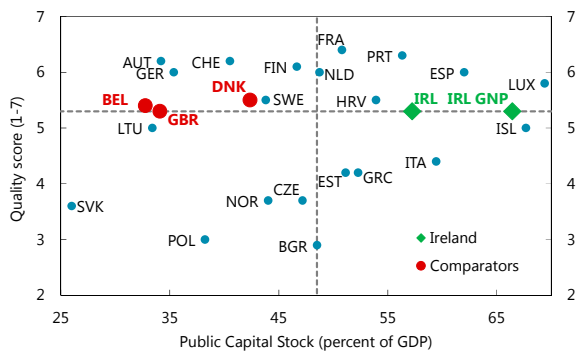
⁴ A C rating stands for “Inadequately maintained, and/or unable to meet peak demand, and requiring significant investment”.

⁵ The Quality of port infrastructure measures business executives’ perception of their country’s port facilities. Data are from the World Economic Forum’s Executive Opinion Survey, conducted for 30 years in collaboration with 150 partner institutes. Quality of port infrastructure index ranges from 1=extremely underdeveloped to 7=well developed and efficient by international standards. The Logistics Performance Index is based on surveys conducted by the World Bank in partnership with academic and international institutions and private companies and individuals engaged in international logistics. Quality of trade and transport-related infrastructure is ranked from 1=low to 5=high.

⁶ The somewhat weaker port quality relative to peers may be linked to a lower demand for port infrastructure as the pharma-chemical industry, that dominates goods exports, produces relatively light-weight items, while computer/financial services make up 30 percent of Irish exports.

Figure 3. Core Infrastructure Quality Outcomes

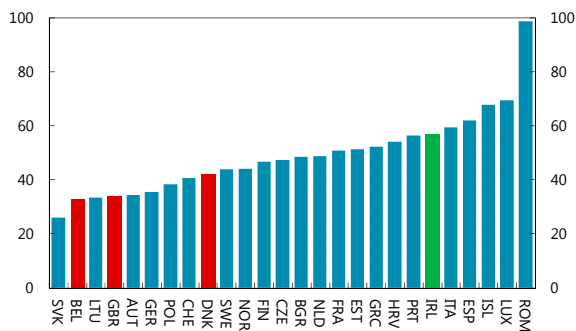
Public Capital Stock and Quality of Roads, 2012



Sources: Global Competitiveness Report; and IMF staff calculations.

Public Capital Stock, 2012

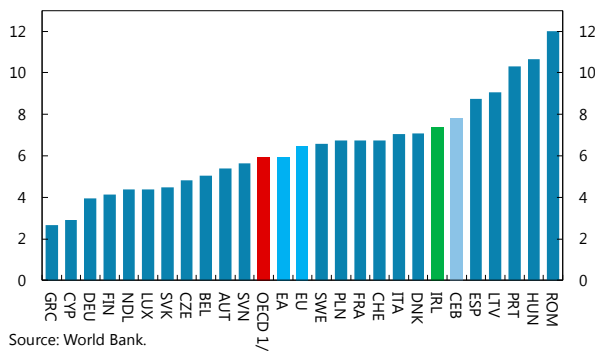
(Percent of GDP)



Source: Global Competitiveness Report.

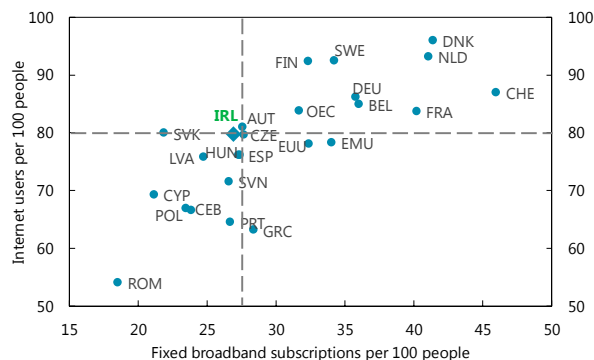
Electric Power Transmission and Distribution of Losses, 2014

(Percent of output)



Source: World Bank.
1/ High income OECD countries.

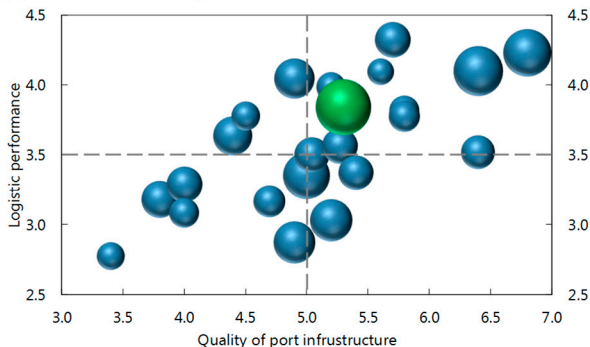
Internet and Broadband Usage, 2014



Source: World Bank.

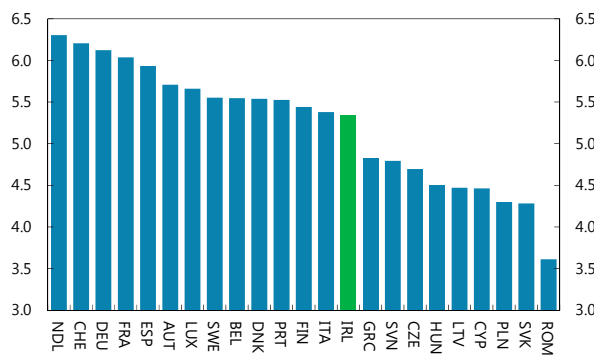
Port Infrastructure, Logistic Performance and Openness, 2015

(Openness index=bubble size)



Sources: World Bank; and World Economic Forum.

Infrastructure Quality Index, 2015



Source: World Economic Forum.

7. A broad consensus exists among stakeholders to raise infrastructure spending. The National Economic Dialogue in July 2015 (see also IBEC,⁷ National Competitiveness Council 2015) recommended restoring infrastructure spending as key to achieving sustainable growth in the medium-term. At the same time, the capital plan presented with Budget 2016 was generally deemed not sufficient. Questions also arise on whether the framework to set out an adequate long-term strategy is in place. The fall WEO 2014 chapter on public investment found that increased public infrastructure investment can raise output in both the short and long term when investment efficiency is high. Increasing efficiency is thus critical to mitigate the possible trade-off between higher output and higher public-debt-to-GDP ratios for debt financed projects. A key priority should be thus to raise the quality of infrastructure investment through: better project appraisal and selection, proper identification of infrastructure bottlenecks, centralized independent reviews, cost-benefit analysis, risk costing and improved project execution.

8. However, Ireland's public infrastructure investment framework needs to be strengthened. An ESRI study submitted in the context of the review of the public capital programme in 2014⁸ highlighted deficiencies in the public investment planning process in the last decade. It noted that while the 1993-1999 and 2000-2006 National Development plans had been built upon a complete series of targeted micro-economics and cost-benefit analysis, the 2006-2013 plan had been based on more limited evidence, for instance in the area of transport needs, leading to large projects whose value is now put into question (like the Western Rail Corridor, Phase 1). Going forward avoiding such mistakes will require meticulous evaluation and planning. As suggested by a recent ESRI study,¹⁹ a proper starting point to assess properly the stock of capital, detect infrastructure bottlenecks and evaluate maintenance needs would be to set up a centralized register of state assets, for which no central ledger exist. Regarding the regional dimension of infrastructure planning, a revision of National Spatial Strategy set out in 2006 should be undertaken.

Social protection

9. Social protection is the largest functional budget and represents about 40 percent of total expenditures (Figure 3). Social protection spending covering pensions, old age benefits, sickness and disability benefits, and other types of welfare transfers have increased during the crisis both in nominal terms and as a share of GDP, alongside the surge in unemployment and the increase in relative poverty and income inequality. Overall social protection spending in Ireland is lower than in other high-income European countries on both GDP or GNP metrics (Figure 3). This is partly explained by demographic factors: pension expenditures are about one third lower relative to peers because of the relative youth of Ireland's population and the smaller share of pensioners to the overall population.

⁷ IBEC policy brief, November 2015, John Carty and Neil Walker, "Does the Infrastructure and Capital Investment framework for 2016-21 go far enough?"

⁸ Submission to the Department of Public Expenditure and Reform on the review of the Public Capital Programme, Edgar Morgenroth, May 2014.

10. However, the lower level of social spending overall conceals the fact that non-pension benefits are higher than the EU average. For instance, sickness and disability benefits are higher as a share of GDP in Ireland than in the UK, Germany, or Belgium (Table 4), and have more than doubled as a share of GDP between 2000 and 2013 (Figure 4). Non-pension social protection spending is higher than in several peer countries and is at par with France, a high spending country for welfare expenditure. Distributional metrics (Figure 6), such as the share of social benefits going to the lowest and highest quintile in terms of income, suggest that welfare spending are less targeted than for the average of OECD countries.

Table 3. Share of Means-tested Social Benefits per Category for Ireland and Key Peer Countries, 2012 1/
(Percent of GDP)

	Social protection	Social insurance	Social assistance	Disability	Exclusion	Family & child	Health & sickness	Old age	Unemployment
Ireland	26.8	22.0	49.1	53.8	66.7	38.2	13.2	17.2	69.4
Belgium	5.1	0.4	25.5	21.7	75.0	0.0	0.0	1.0	0.0
Denmark	5.4	0.9	16.2	2.4	63.6	2.5	0.0	0.7	0.0
United Kingdom	14.4	6.1	48.2	42.1	50.0	10.5	2.2	7.9	42.9
France	10.9	3.9	39.7	19.0	100.0	19.2	0.0	3.9	5.0
Germany	12.0	3.6	41.3	26.1	100.0	37.5	1.0	0.0	50.0

Sources: Eurostat; and IMF staff calculations.

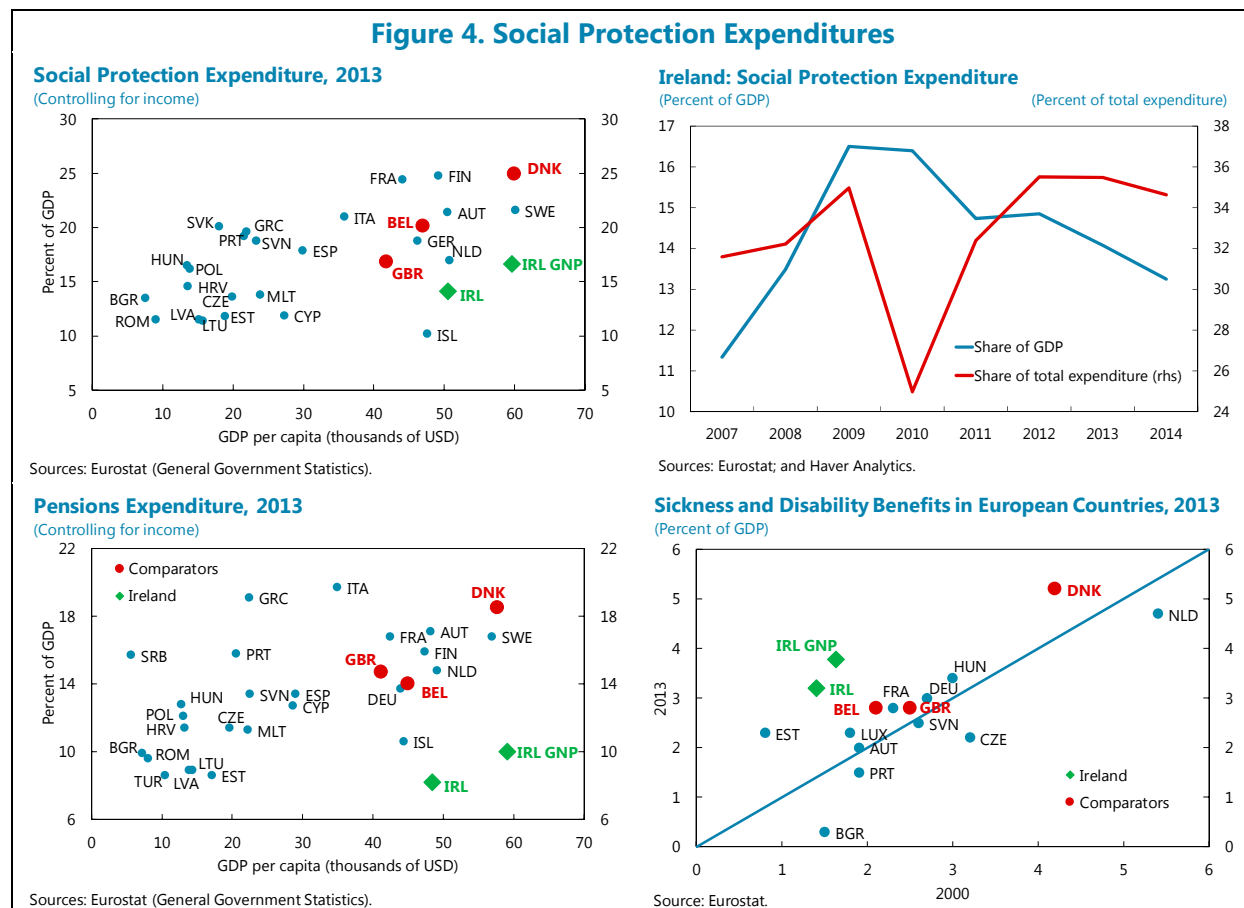
1/ ECA/SPEED only provides means tested benefit data for social assistance spending (which is an aggregate of non-contributory cash transfer programs and in-kind social assistance. Currently, does not include social care/services for most countries. Social assistance benefits include, inter alia: minimum-income programs, social pensions, disability benefits, family, child and birth allowances, heating, utility and housing benefits, war veteran benefits, and so on.)

Table 4. Social Protection Expenditures for Ireland and Key Peer Countries
(Percent of GDP, 2014)

	Social protection	Pensions	Pensions (excl. disability)	Old age benefits	Sickness & disability benefits	Non-pension social protection	Social exclusion
Ireland	15.7	8.4	5.2	4.1	3.2	7.3	0.7
Belgium	19.7	13.5	10.7	8.8	2.8	6.2	1.1
Denmark	25.1	13.5	8.3	8.3	5.2	11.6	1.9
United Kingdom	16.9	11.5	8.7	8.6	2.8	5.4	1.7
France	24.9	17.3	12.8	12.0	4.5	7.6	0.8
Germany	18.9	14.0	11	9.1	3.0	4.9	0.3

Sources: Eurostat; and IMF staff calculations.

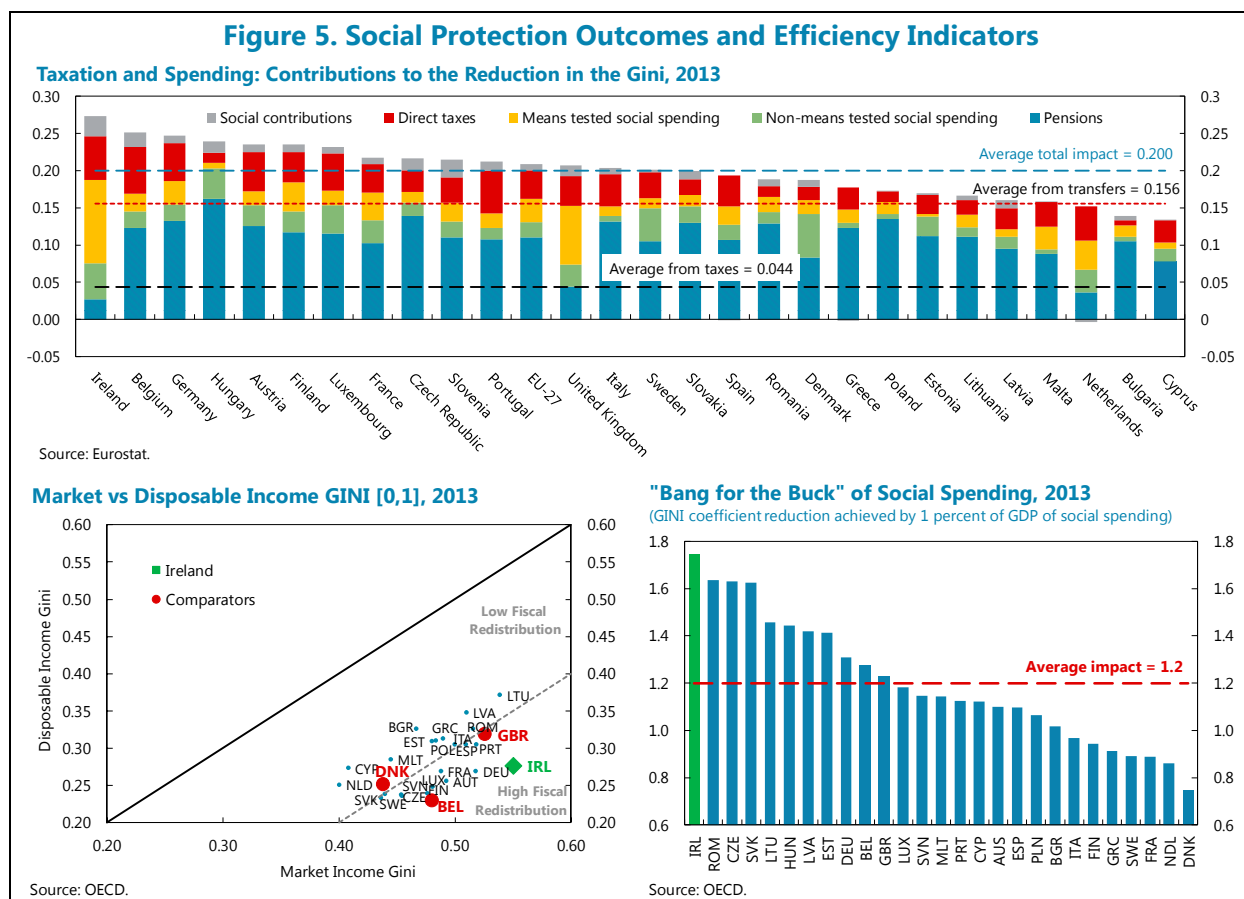
Figure 4. Social Protection Expenditures



11. Standard efficiency metrics suggest a very strong redistributive impact of social spending in Ireland. The Gini index reduction measure of efficiency of social spending⁹ puts Ireland on top of OECD countries for redistribution (Figure 5). The market income Gini index, which measures the concentration of income inequality pre-redistribution (maximum concentration puts the index at 1, absolute equality at zero), is reduced by 0.27 once calculated after social transfer, taxes and pensions. This the largest decrease among EU countries. Means-tested and non-means tested social transfers contribute to about two thirds of this reduction, direct taxes for about ¼, and pensions and social contributions the remainder. Another useful metric is the ratio of the amount of budget resources (as approximated by the ratio of social spending to GDP) used to achieve one unit of inequality reduction. This “bang for the buck” index¹⁰ of the efficiency of social spending suggests that Ireland, best performer among EU countries for this measure, is 45 percent more effective at reducing income inequality than EU countries on average.

⁹ Calculated by Eurostat using EUROMOD.

¹⁰ Calculated as the ratio of the Gini index reduction to the share of social protection expenditure in GDP, i.e. the amount of income inequality reduction achieved by 1 percent of GDP of social spending.

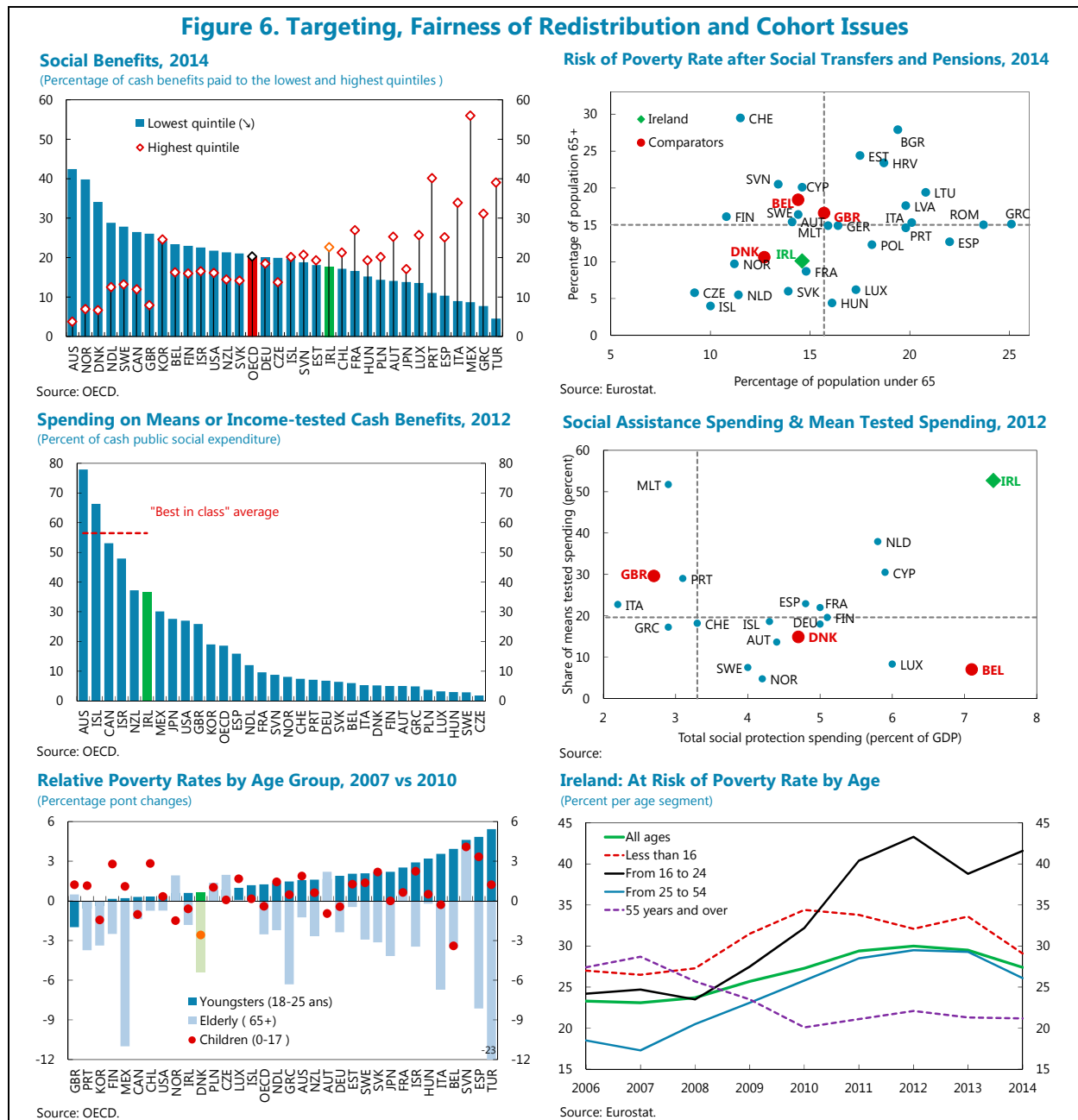


12. Despite a strong redistributive impact, the Irish welfare system has some gaps. In particular, certain cohorts most adversely affected during the crisis seem to benefit less from this redistribution. As a result, the absolute level of income inequality post-welfare transfers still remains high relative to comparator countries and somewhat close to the EU average (Figure 5, Chart 3).¹¹ This is related to the starting point, i.e. the fact that the market income Gini index for Ireland is the highest in the EU. The high efficiency of Ireland's redistribution still results in a level of absolute income inequality that is in the end average within its peer group, and higher than best-in-class comparators.

13. The relative level of poverty across age cohorts shows that some segments of the population are not benefiting as much from the social safety net as others (Figure 6). The targeting of social benefits toward the lowest income cohorts (lower quintile) does not seem to be as effective as for the average of the OECD. Despite a larger recourse to income testing than most continental European peers (Table 4) the amount of social spending channeled to the highest income quintile is larger than the amount transferred to the lowest quintile. The at-risk of poverty rate of the active population and younger cohorts is nearly twice that of pensioners. The relative poverty level of Irish youth has recorded the third largest increase among EU countries during the crisis, while at the same time the relative poverty level of the elderly had diminished by about

¹¹ The figure shows market income Gini and post-redistribution Gini index (Y axis).

8 percent. Young cohorts in the Irish society seem to bear a disproportionate burden from the crisis: the poverty risk (as measured by Eurostat: At Risk of Poverty index, AROPE) has increased markedly, nearly doubling for the 16 to 24 cohort, while it fell markedly for the elderly.



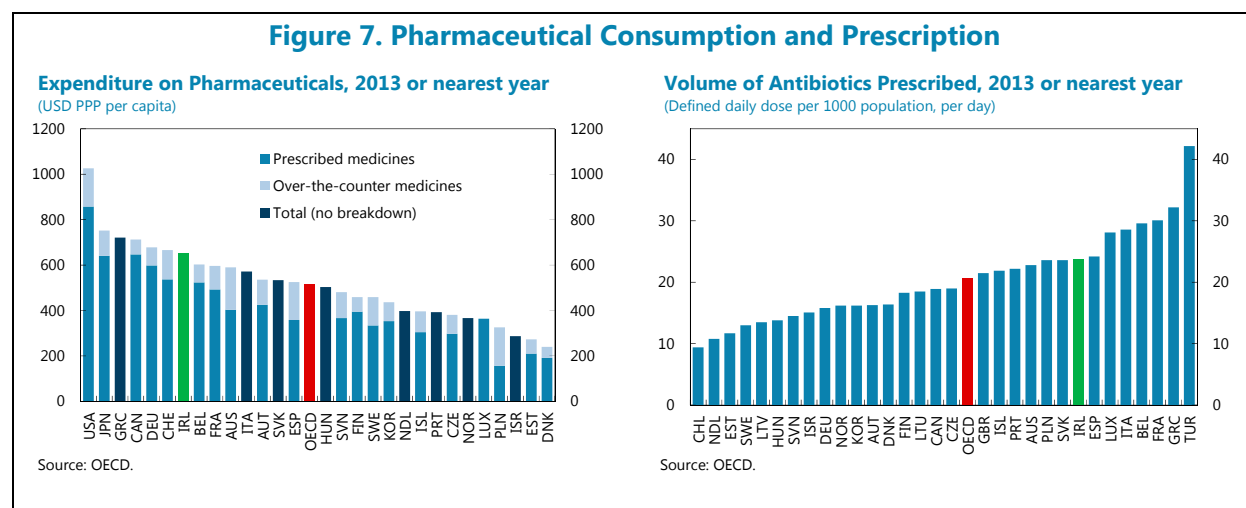
14. While social protection spending in Ireland is effective overall, there is scope to increase its efficiency. This could be achieved by increased targeting of social spending to most vulnerable and reduce transfers to high income households. OECD measures of targeting show that a larger share of cash social benefits go in Ireland to the higher quintile of income households (Figure 6). Furthermore, “best-in-class” OECD countries in terms of means testing (such as Canada, New Zealand, Israel and Iceland) means test about 55 percent of social benefit payments compared

to 35 percent for Ireland.¹² More means testing of exclusion benefits and of family and child benefits (Table 4) could help to even out the outcomes between the elderly and young unemployed, and between vulnerable families and those in high income buckets. More targeted social spending could usefully complement other policy actions aimed at reducing inequalities and making growth more inclusive, such as tax reform to eliminate income-tax related disincentives to work, or the education and training policy.

Health

15. Ireland has a relatively high level of health expenditure (Figure 8, Box 2). Health care spending represents about 7 percent of GDP, a level close to comparable EU high-income countries, despite a substantially more favorable demographic situation. When using GNP as yardstick spending comes out largely above Ireland's peers at about 8.5 percent. Although efforts have been made since 2009 to contain spending pressures, expenditure has grown steadily beyond planned budget envelopes in recent years and demand driven pressures are driving health expenditure steadily higher.

16. Health outcomes are generally in line with the EU average, but in part owing to the age structure of the population that is somewhat biasing the comparisons. In terms of health-adjusted life expectancy (HALE), Ireland at 71 years achieves a more efficient outcome than Germany, the Netherland and Norway, which for a similar age expectancy spends respectively 30, 33 and 65 percent more than Ireland per capita (PPP adjusted). Conversely, the UK, Greece, Portugal and Malta show a similar age expectancy with lower spending per capita. Yet, Ireland ranks particularly low (bottom third of OECD countries) on pharmaceutical and antibiotics consumption (Figure 7).



¹² Of note Eurostat has a different measure of means-tested social benefit payments for Ireland (26 percent), stemming from a slightly different calculation perimeter.

17. Health sector reform stood high on the agenda of structural policies undertaken during the EU program period. Although the commitment to contain the health expenditure drift has recorded mixed results, many key long-term structural reform initiatives have been launched to contain spending pressures and increase the efficiency of health care delivery. These reforms (Annex II) focused on three areas: (i) the building of an effective information system to improve the financial management of the sector and better implement health policy, (ii) the reform of the financing model of hospitals, and (iii) policies to reduce the cost of drugs.¹³

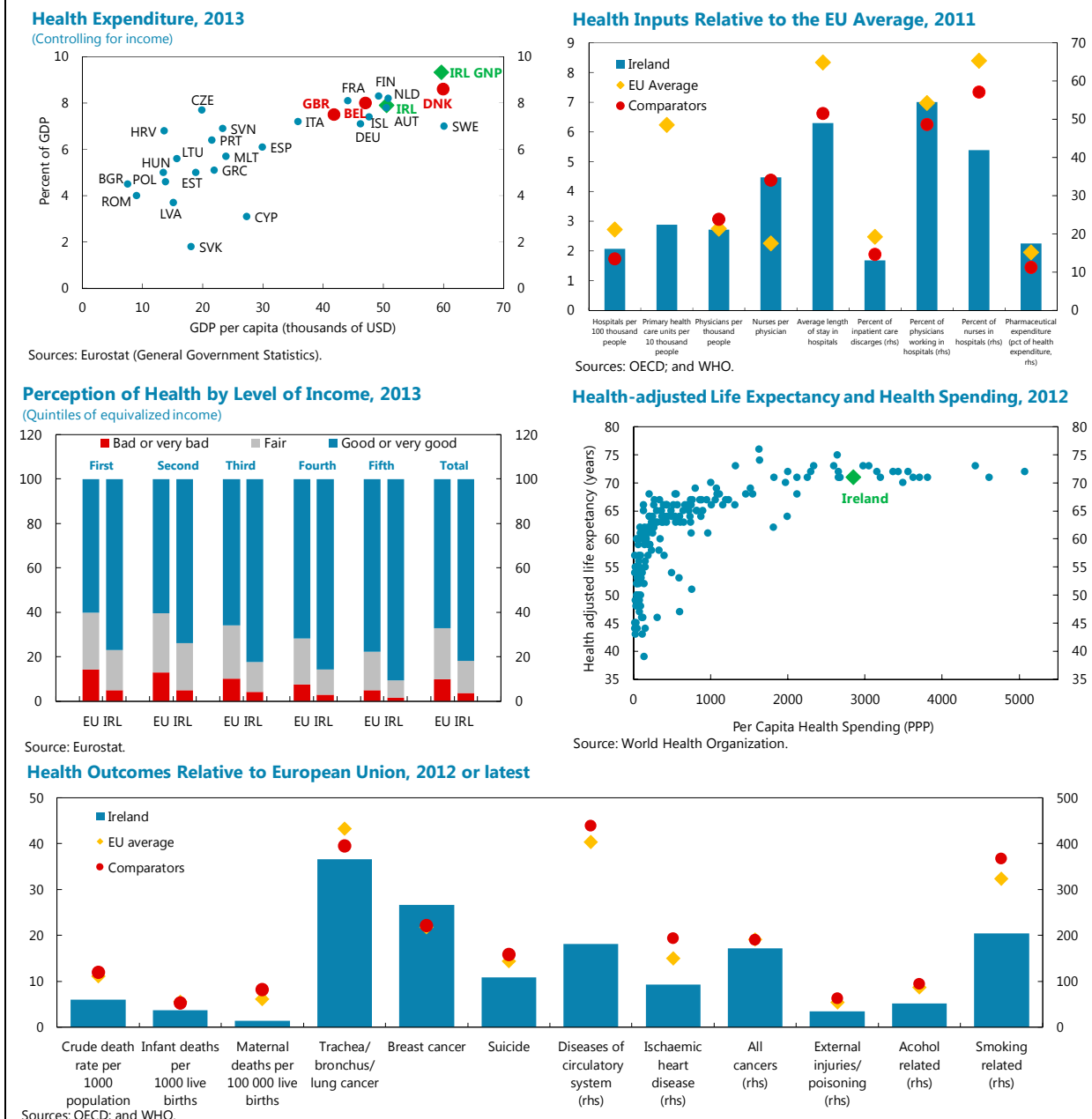
Box 2. Ireland's Health System

Health insurance and the delivery of health care function in Ireland as a two-tier system combining private and public delivery of health care. All users are eligible for a basic set of medical services, including hospital care, but full access to public health coverage is means-tested and restricted to a subset of the population (the "Medical Card" holders). Eligibility rule for different type of coverage by the public sector are complex and depend on age and economic circumstances, hence resulting in complex entitlement rules. In addition, private and public supply of health care sometimes interact, as private doctors can receive private patient visits in public hospital. Another feature is the weakness of primary care structure and the dominance of hospital-supplied health care. The announcement by the government of a gradual transition to Universal Health care, with the key milestone of free access to general practitioners for children under 6 and the elderly (about 40 percent of the population) since April 2015, will probably increase cost pressures going forward.

Health system main input and outcome. The Irish health system exhibits a smaller number of hospital per 100 thousand users than the EU average but more than its peer group. The number of primary health care unit, at 3 per 10,000 people stands at less than half of the EU average, pointing towards a system dominated by hospitals. The number of nurses per physician is about double the EU average, and the share of pharmaceutical expenditure in health spending is close to the EU average, but about 50 percent higher than comparator countries.

¹³ For a full overview of the Health sector reform refer the [8th review of the EFF Staff Report](#) "Box 1. Public Health Spending Over-Run: Sources and Policy Options" and to DoH, 2014, "[Future Health: A strategic Framework for Reform of the Health Service 2012-2015](#)".

Figure 8. Health Expenditure and Selected Outcomes



18. This comprehensive set of reforms should make an important contribution to increasing efficiency in the medium-term and contain spending pressures. Yet they are unlikely to have a meaningful impact in the short run, as demand-driven pressures will put pressure on the health budget. Achieving further savings in the area of pharmaceutical expenses would require negotiations with the pharmaceutical industry on on-patent and single supplier medicine and more use of the power afforded to authorities under new health regulations to influence pricing in the sector. The move towards a single-tier universal healthcare system will require further initiatives to increase the provision of primary care, and to relieve hospitals from provision of emergency care that is avoidable through better preventive primary care and screening.

Education

19. Ireland spends less than European peers on education, but outcome indicators point to satisfactory educational attainments (Figure 9). Education expenditure stood at 4.1 percent of GDP in 2014, (at 4.5 percent of GDP over the last decade)—0.6 percent less than the EU average. This lower-than average overall spending is achieved notwithstanding a high level of school enrollment in primary education (95 percent from age 4 and 100 percent) and the largely publicly funded nature of the educational system (81 percent funded from public sources, relative to a 69.7 percent average for OECD countries). Educational attainments are higher than the OECD average and have improved, despite stagnant budget and receding teacher-to-student ratio. 85 percent of people in the 25-34 cohort completed secondary education and 47 percent get tertiary education (one the highest level in the EU). Regarding students' academic performance as measured by the PISA tests,¹⁴ Ireland's students perform well above the EU average overall and favorably relative to peers with similar income per capita, ranking second for reading among EU-21 countries, sixth in science and eight in mathematics.

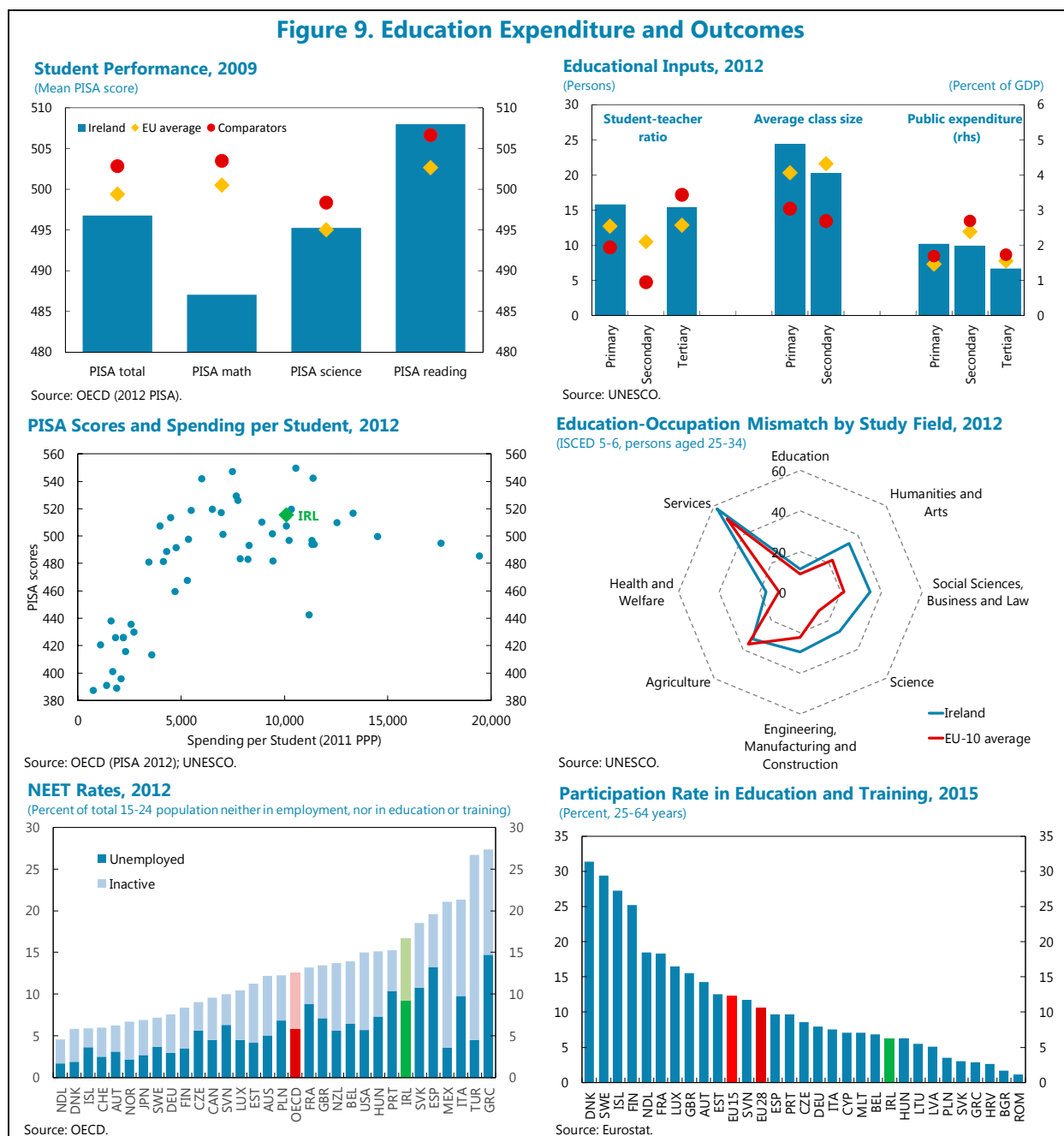
20. While cost effective, the Irish educational system may not be adequately suited to meet the needs of a growing and increasingly sophisticated knowledge-based economy. Positive outcome indicators conceal large skill mismatches in the labor market, pointing to reform needs in the field of numeracy, information technology (IT), and continuing education. Concerns have been expressed about the adequacy of the secondary school leaving certificate (e.g. for which computer science is not an eligible field). A number of indicators point to areas for potential improvement. As highlighted by the OECD,¹⁵ numeracy skills and problem solving skills in an information technology environment of Irish adults are well below the OECD average.¹⁶ Labor market employment-skill mismatches, as measured by the variance of the unemployment rate across sectors and skills are among the highest in the EU.¹⁷ UNESCO measures of skill mismatch per sector highlight broad deficiencies across sectors (Figure 9).

¹⁴ See Education at Glance 2015, OECD.

¹⁵ Ireland Economic Survey, OECD, November 2015.

¹⁶ Ireland is last but one for advanced skills in problem solving in an IT environment based on the OECD PIAAC survey on adult skills.

¹⁷ Ireland has the third highest unemployment rate dispersion across sectors according to EC calculations.



21. Reliance on inward migration to attract skilled workers may not always be an optimal solution. One such example is the medical profession. Ireland has the highest share of medical school graduates in the EU, but a below average number of general practitioners per habitant: a very large share of physicians and nurse trained in Ireland are practicing abroad, which could be a concern given the cost of training medical professionals. This pattern of “brain swap” through which Ireland exchanges highly skilled graduates for professionals trained overseas to meet the needs of some high-value added sectors may leave the country vulnerable to a hollowing-out of its skill base if inward flows appear more volatile and outward flows more durable.

22. Education sector reform should not aim to seek further savings, but instead to improve the education outcomes. Priority should be given to match continuing education supply to marketplace needs, increase students' math performance including through an increase in student-teacher ratio, and reform secondary education curriculum to increase numeracy and IT skills.

D. Potential Efficiency Gains in Healthcare and Education

23. A frontier analysis is employed to assess the potential efficiency gains in health and education spending. It is based on Data Envelopment Analysis (DEA).¹⁸ This approach relies on the calculation of a 'best practice' frontier comprising countries which display the optimal combination of inputs and outcomes (e.g. Japan has the highest standardized educational test scores for a comparatively modest amount of budget spending on education). The distance from the frontier provides for all countries an efficiency score that can be used to estimate potential gains by improving efficiency to best-performer levels. DEA calculation outcomes are influenced by sample selection and measurement issues, and outliers can have a substantial impact on efficiency scores.

24. The analysis focused on outcome metrics like health-adjusted expectancy or standardized educational test score to assess health and education spending efficiency. The use of outcomes is generally preferable to the use of outputs as they offer a better yardstick for the effectiveness of the health care and educational systems system in improving the health status and educational outcomes like literacy of quantitative skills. Output indicators can be misleading if the supply of public goods like education or health care gives rise to waste or misallocation of resources, or are not properly designed to achieve the human capital outcomes that are likely to benefit economic growth in the medium term.

25. Efficiency gains towards "best in class" countries could have a magnitude of about 3 percent of GDP. It is important to caution that DEA calculations (Table 5) are sensitive to sample selection rules and to the possible presence of outliers, hence sample selection is critical to ensure that cross-country input-outcome bundles are comparable. The use of an OECD sample helped ensure that the selected countries have somewhat similar institutional and economic

Table 5. Potential Effects as per DEA Analysis based on Different Samples of Comparators 1/

	Spending	Efficiency gains (1-theta) times spending				
	Percent of GDP	Sample 1	Sample 2	Sample 3	Sample 4	Average
Health spending	7.1	4.3	2.4	3.6	2.4	3.2
Education spending	4.1	1.8	0.5	1.7	...	1.3
Total	11.2	6.1	2.9	5.3	...	4.5

Sources: OECD; WHO; and IMF staff calculations.

1/ The first sample covers all countries listed in the World Health Organization HALE survey, and the countries surveyed by the OECD for PISA. The 2nd sample covers countries in this group in the same income quantile as Ireland, based on GNI per capita income data as of 2012 (last vintage available for PISA and WHO HALE data). The 3rd sample excludes countries outside of the EU. The 4th sample is defined as the 3rd with the exclusion of a large life expectancy outlier in the EU, Cyprus.

¹⁸ See Annex I. Approach developed by Farrell (1957), see also Charnes, Cooper, and Rhodes (1978).

features. Yet preliminary calculations showed that large income differences between countries, explaining different propensity to consume non-essential goods, could still bias the results. Consequently *ad hoc* adjustments were made to attenuate the impact of large outliers on the efficiency scores,¹⁹ or to achieve a better overall comparability (for instance by grouping more comparable EU countries): this refinement led to the narrower samples 2, 3 and 4. Different efficiency scores, using variants of these panels, suggest that total efficiency gains of up to 3 percent of GDP could be achieved in health and education (based on sample 2). Most of these gains would come from a more efficient health care provision services (2.4 percent of GDP), as Ireland appears quite close to the efficiency curve for education spending within this sample (only 0.5 percent of GDP potential savings). Potential efficiency savings calculated using cross sample average would be larger, at about 4.5 percent of GDP (3.2 percent of GDP for health, and 1.3 percent of GDP for education), but the magnitude of these potential gains is probably biased upwards by the large heterogeneity of the sample and also the presence of significant outliers.

E. Conclusion and Policy Recommendations

26. Evidence suggests that while Ireland is a low spending country it achieves a generally efficient use of public funds, with some key differences across sectors. While the overall space for budgetary savings appears limited, further spending efficiency could help contain cost pressures coming from the demographic challenge of an ageing population and improve the quality of public services. It could also help rechannel spending toward more productive uses, for instance by increasing public investment relative to current expenditure, and support the competitive position of the Irish economy and its growth potential. The following priorities are identified for key budget spending areas:

- **Social protection** is overall very effective at reducing inequalities, yet more granular indicators suggest that distributional issues and inequalities across age cohorts have become more acute as a result of the crisis. A greater recourse to means-testing and targeted measures to address youth unemployment could help make social protection even more efficient at a limited cost.
- **The health sector** is undergoing substantial reforms to increase spending efficiency, while maintaining high level of health outcomes. These reforms are likely to bear fruit gradually over time, but further savings could be achieved through better pricing arrangements with the pharmaceutical industry on on-patent and single-supplier medicine and through an increased provision of primary care. This would help reduce emergency care provided by hospitals and reap the efficiency benefits of more preventive primary care and screening.
- **For education spending**, efforts should focus on improving the quality and adequacy of the supply of education. This could be achieved through reducing skills mismatches and developing education that provides skills needed by an increasingly sophisticated knowledge-based economy.

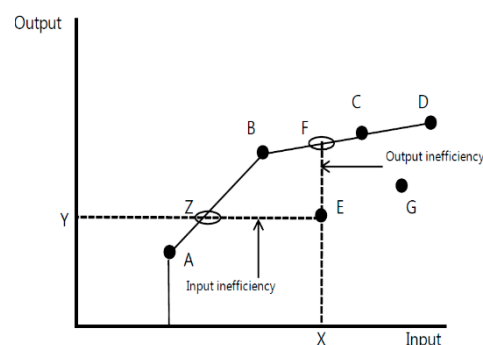
¹⁹ For instance Cyprus population's exceptional longevity may be related to specific idiosyncratic factors rather than to an efficient health system.

- **On infrastructure spending,** improving efficiency of public investment will require a strengthening of Ireland's public infrastructure investment framework. This includes better project appraisal and selection, proper identification of infrastructure bottlenecks, centralized independent reviews, cost-benefit analysis, risk costing, and improved project execution. Setting-up a centralized register of state assets and a revising the National Spatial Strategy set out in 2006 would be key milestones in this process.

Annex I. Data Envelopment Analysis

Data envelopment analysis (DEA) is a non-parametric approach, popularized by Charnes, Cooper and Rhodes (1978) that assesses the relative efficiency of decision making units (DMUs). Based on the assumption of a convex production possibilities set, an efficiency frontier is constructed as the linear combination of efficient or optimal input and outcome combinations in the cross-country sample using linear programming techniques (i.e., without imposing specific functional restrictions). The most efficient countries that lie on the frontier then 'envelope' the less efficient ones. The frontier provides a benchmark by which 'enveloped' observations can be judged based on their position relative to the frontier. By construction, countries on the frontier will have an efficiency score of one, whereas the 'enveloped' ones will have efficiency scores bound between zero and one. Efficiency gains can be defined as the amount by which input could be reduced while holding the level of output constant (input inefficiency), or as the amount by which output could be increased while holding the level of input constant (output inefficiency). Figure 1 illustrates an efficiency frontier that connects points A to D as these countries dominate other input-output pairs, such as countries E and G in the interior. The convexity assumption allows an inefficient input-output pair, such as point E to be assessed relative to a hypothetical position on the efficiency frontier, such as point Z by taking a linear combination of efficient country pairs, such as points A and B. In this manner, an input-based efficiency score that is bound between zero and one can be calculated as the ratio of YZ to YE.

Figure 1: DEA Efficiency Frontier



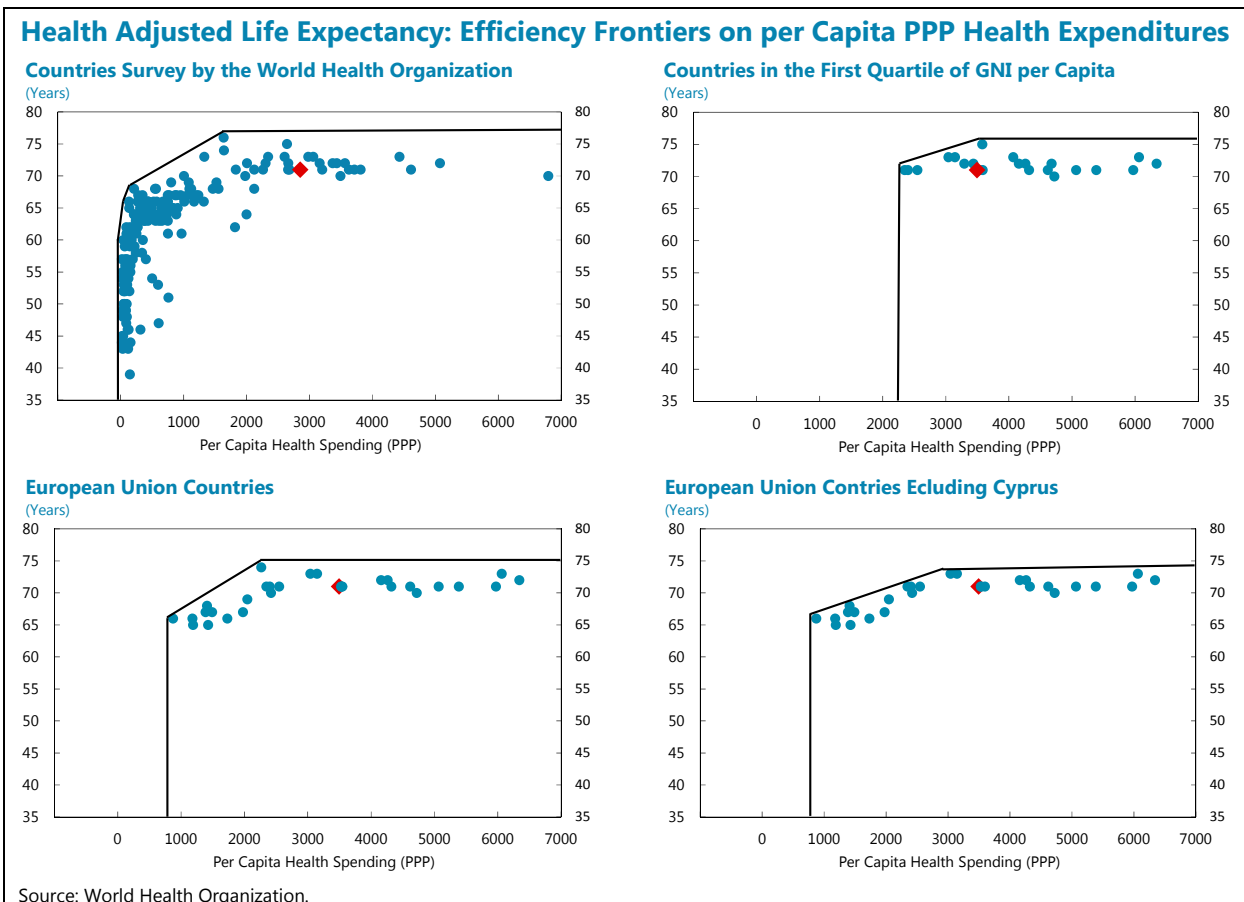
The score corresponds to the proportional reduction in spending consistent with relatively efficient production of a given outcome. Similarly, an output-based efficiency score for point E can be calculated as the ratio of XF to XE. As a non-parametric approach, the DEA is considered a powerful tool to assess spending efficiency as it does not require assumptions about unknown functional forms or complex distributional properties, which can help avoid some of the econometrics pitfalls. In addition, it is a simple, easy to explain, and allows to benchmark performance between countries. However, the methodology focuses on inputs and outcomes that can be quantified, and thus, it may overlook important factors that are harder to measure and affect outcomes—as such, it considers all deviations from the frontier explained by inefficiency rather than the result of omitted or uncontrollable variables. Further, it assumes that different combinations of the observed input-output bundles are feasible, such that any country could move to the frontier by freely accessing the technology of production and by being unhampered by the country's own idiosyncratic conditions.

Annex II. Health Sector Reforms

Key ongoing Health sector reforms.

- **The improvement of the information system (eHealth)** is a long-term project whose impact on the efficiency of health care delivery will take some years to materialize. The first milestone in this process, the setting-up of individual health identifiers (IHIs) was completed recently. Individual identifiers have been created for all the population and the rollout for operational use be achieved by end-2016. Once in place this system will allow the analysis of prescription behavior, health records and the supply of care against outcomes across hospitals and other health care units, allowing a better targeting of cost efficiency efforts where needed, allowing also a redeployment of resources where they are most needed and most effective.
- **The financing reform introduces an activity-based funding approach** (or “Money-follow-the-patient”). Hospitals were traditionally financed using a “block-funding” approach in which budgeting was based on top-down calculated envelopes. Together with the introduction of a common chart of account for all hospitals, activity-based funding will over time base budgeting on the actual consumption of health care, allowing better data collection (thanks to individual identifiers), more transparency and resource redeployment when adequate. While not primarily designed to reduce costs, it should support efficiency by identifying better pressure points, facilitating hospital specialization and allowing redeployment. The transition to new financing modalities is a stepwise process that will spread out over a number of years. Initiated on a shadow basis in a number of large hospitals it will be operationally deployed starting with inpatient care, and be later extended to ambulatory care.
- **Reducing expenditure on pharmaceuticals.** The measure introduced in 2013 and 2014 to change doctors’ prescription behavior have successfully increased the penetration of generic in volume terms, but the cost of on-patent drug is continuing to weigh on the overall cost. Generic medicines represent about 55 percent of total drug consumption in volume but only 26 in value (price) terms, and on-patent drugs 46 percent in volume terms but 76 percent of the total in value. Negotiations with the Irish Pharmaceutical Healthcare Association (IPHA) to renew the 3-year pricing agreement that expired in November 2015 to reduce the price of on-patent drugs have not been conclusive.

Annex III. Efficiency Frontiers on per Capita PPP Health Expenditures



Annex IV. Potential Efficiency Gains on Education

	Expenditure per student 1/	PISA score (math+reading) 2/	Theta sample 1 3/	Theta sample 2	Theta sample 3	Efficiency gains sample 1	Efficiency gains sample 2	Efficiency gains sample 3
Australia	92764	1016	0.55	0.87		0.45	0.13	
Austria	123921	995	0.36		0.41	0.64		0.59
Belgium	102615	1024	0.51	0.80	0.53	0.49	0.20	0.47
Canada	83089	1041	0.70	1.00		0.30	0.00	
Chile	45287	864	0.50		0.91	0.50		0.09
Czech Republic	60740	992	0.72		0.82	0.28		0.18
Denmark	103662	996	0.43		0.49	0.57		0.51
Estonia	56686	1037	1.00		1.00	0.00		0.00
Finland	92290	1043	0.63	0.90	1.00	0.37	0.10	0.00
France	86330	1000	0.53	0.92	0.59	0.47	0.08	0.41
Germany	85801	1021	0.61		0.63	0.39		0.37
Hungary	46121	966	0.78		1.00	0.22		0.00
Iceland	102851	975	0.38		0.46	0.62		0.54
Ireland	93967	1025	0.56	0.87	0.58	0.44	0.13	0.42
Israel	63783	952	0.51			0.49		
Italy	85337	975	0.46		0.56	0.54		0.44
Japan	88805	1074	0.76	1.00		0.24	0.00	
Korea	71574	1090	1.00			0.00		
Luxembourg	207841	978	0.19		0.23	0.81		0.77
Mexico	26796	837	0.82			0.18		
netherlands	96619	1034	0.58		0.58	0.42		0.42
New Zealand	83184	1012	0.59		0.64	0.41		0.36
Norway	125519	993	0.35		0.40	0.65		0.60
Poland	61796	1036	0.91		0.91	0.09		0.09
Portugal	69213	975	0.56		0.69	0.44		0.31
Slovakia	52395	944	0.58		0.86	0.42		0.14
Slovenia	97251	982	0.42		0.50	0.58		0.50
Spain	82184	972	0.46		0.57	0.54		0.43
Sweden	101155	962	0.35		0.45	0.65		0.55
Switzerland	139339	1040	0.41			0.59		
Turkey	24218	923	1.00			0.00		
Great Britain	97739	993	0.45	0.81	0.51	0.55	0.19	0.49
United States	115909	979	0.35			0.65		
Brazil	26446	802	0.79			0.21		
Russia	44704	957	0.76			0.24		

Sources: OECD; and IMF staff calculations.

1/ Expenditure per student as calculated by the OECD, PISA 2012, USD PPP.

2/ PISA scores as per the 2012 OECD survey are aggregated for math and reading.

3/ Three samples have been used for efficiency calculations using the DEA approach (see annex 1). The first sample covers all countries listed in the OECD PISA study. The 2nd sample covers countries in this group in the same income quantile as Ireland, based on GNI per capita income data as of 2012. The 3rd sample within the PISA survey excludes countries outside of the EU. Efficiency gains calculations in percentage are calculated as 1-theta. For instance Japan's calculated Theta in Sample 2 is 1 (that is the country is on the efficiency curve) so the potential efficiency gains are zero (1-theta).

Annex V. Potential Efficiency Gains on Health

	Total health spending per habitant 1/	Health-Adjusted Life Expectancy (HALE) 2/	Theta sample 1 3/	Theta sample 2	Theta sample 3	Theta sample 4	Efficiency gains sample 1	Efficiency gains sample 2	Efficiency gains sample 3	Efficiency gains sample 4
United States	8895	70	0.12	0.26			0.88	0.74		
United Kingdom	3495	71	0.39	0.67	0.50	0.67	0.61	0.33	0.50	0.33
Austria	5065	71	0.27	0.46	0.34	0.46	0.73	0.54	0.66	0.54
Belgium	4320	71	0.32	0.54	0.40	0.54	0.68	0.46	0.60	0.46
Denmark	4720	70	0.23	0.49	0.33	0.43	0.77	0.51	0.67	0.57
France	4260	72	0.39	0.62	0.45	0.63	0.61	0.38	0.55	0.37
Germany	4617	71	0.30	0.51	0.38	0.51	0.70	0.49	0.62	0.49
Italy	3040	73	0.65	0.97	0.69	1.00	0.35	0.03	0.31	0.00
Luxembourg	6341	72	0.26	0.42	0.30	0.42	0.74	0.58	0.70	0.58
Netherlands	5385	71	0.25	0.44	0.32	0.44	0.75	0.56	0.68	0.56
Norway	5970	71	0.23	0.39	0.29	0.39	0.77	0.61	0.71	0.61
Sweden	4158	72	0.40	0.64	0.46	0.65	0.60	0.36	0.54	0.35
Switzerland	6062	73	0.32	0.49	0.35	0.50	0.68	0.51	0.65	0.50
Canada	4676	72	0.36	0.57			0.64	0.43		
Japan	3578	75	0.72	1.00			0.28	0.00		
Finland	3545	71	0.39	0.65	0.49	0.65	0.61	0.35	0.51	0.35
Greece	2346	71	0.59	1.00	0.74	1.00	0.41	0.00	0.26	0.00
Iceland	3436	72	0.49	0.77			0.51	0.23		
Ireland	3529	71	0.39	0.66	0.49	0.66	0.61	0.34	0.51	0.34
Malta	2548	71	0.54	0.92	0.68	0.92	0.46	0.08	0.32	0.08
Portugal	2400	71	0.57	0.98	0.73	0.98	0.43	0.02	0.27	0.02
Spain	3145	73	0.63	0.94	0.67	0.97	0.37	0.06	0.33	0.03
Bulgaria	1177	66	0.20		0.74	0.74	0.80		0.26	0.26
Czech Rep.	2046	69	0.38		0.68	0.84	0.62		0.32	0.16
Slovak Republic	1977	67	0.18		0.53	0.58	0.82		0.47	0.42
Estonia	1385	67	0.26		0.76	0.82	0.74		0.24	0.18
Latvia	1188	65	0.17		0.72	0.72	0.83		0.28	0.28
Hungary	1729	66	0.14		0.50	0.50	0.86		0.50	0.50
Lithuania	1426	65	0.14		0.60	0.60	0.86		0.40	0.40
Croatia	1410	68	0.34		0.87	1.00	0.66		0.13	0.00
Slovenia	2420	70	0.44		0.65	0.84	0.56		0.35	0.16
The Former Yugoslav Republic of Macedonia	835	66	0.28				0.72			
Bosnia and Herzegovina	928	68	0.52				0.48			
Poland	1489	67	0.24		0.70	0.77	0.76		0.30	0.23
Romania	873	66	0.27		1.00	1.00	0.73		0.00	0.00

Sources: OECD; WHO; and IMF staff calculations.

1/ Total health spending per habitant, USD PPP, source OECD.

2/ Health-Adjusted Life Expectancy 2012, WHO .

3/ Four samples have been used for efficiency calculations using the DEA approach (see annex 1). The first sample covers all countries listed in the WHO HALE survey. The 2nd sample covers countries in this group in the same income quantile as Ireland, based on GNI per capita income data as of 2012. The 3rd sample excludes countries outside of the EU. The 4th sample is defined as the 3rd with the exclusion of a large life expectancy outlier in the EU, Cyprus. Efficiency gains calculations in percentage are calculated as 1-theta. For instance Japan,s calculated Theta in Sample 2 is 1 (that is the country is on the efficiency curve) so the potential efficiency gains are zero (1-theta).

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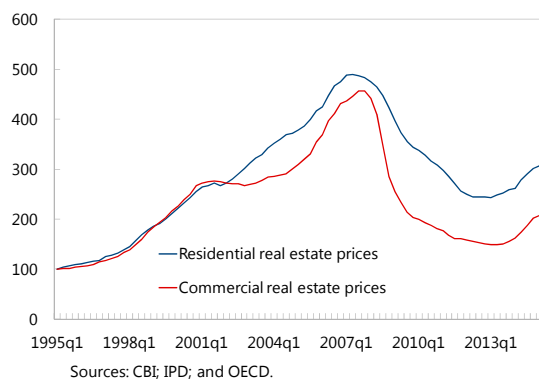
IRELAND: COMMERCIAL REAL ESTATE AND THE SUPERVISORY RESPONSE¹

A. Introduction

1. Commercial real estate (CRE) booms and busts have played a role in many financial crises. Most notably, the US and the UK financial crises in the late 1980s, the crisis in Nordic countries in the early 1990s, as well as the recent Irish and UK crises in 2008 were accompanied by booms and busts in the real estate sector.² Cyclical movements in commercial property prices often exhibit strong linkages with credit cycles due to the predominant reliance on debt financing and cross-country experience has shown that the performance of the commercial property sector affects the performance of the banking sector ([Bank lending and CRE](#)).

2. The Irish financial crisis was exacerbated by a build up of debt tied to investments in commercial property, a collapse of property valuations, and a sharp rise in non-performing loans. The CRE boom leading into the crisis was fueled by fast credit growth, funded by domestic bank loans and cross-border capital flows. Prices in the commercial real estate (CRE) sector doubled and total banking assets tripled from 2000 to 2007. When the crisis hit in late 2007, CRE prices subsequently fell by about 70 percent from their peak in 2007 and caused heavy loan losses on the development property portfolio acquired at the peak of the market ([Honohan Report](#)). As non-performing loans rose rapidly, banks required urgent recapitalization. Large CRE loans were transferred at a steep discount to par to National Asset Management Agency (NAMA) to the value of €42.2 billion³, and the authorities had to recapitalize the banking system in the amount of €64 billion (about 40 percent of GDP). Losses on commercial property accounted for over half of bank capital needs in the crisis.

Property Prices
(Index, 1995Q1=100)



¹ Prepared by Christopher Wilson and Vizhdan Boranova with input from Heedon Kang.

² CRE booms and busts have preceded banking crisis in developed countries ([ECB, 2000](#); [Davis, 1995](#)) and emerging market economies ([Collyns and Senhadji, 2002](#); [Davis, 1999](#); [Renaud and others, 2001](#)).

³ The assets were discounted by 57 percent face value. NAMA paid €31.8 billion for assets with a par value of €74 billion. In the context of this transaction, €5.6 billion of the purchase price was deemed to have been paid to the banks as State Aid as this constituted the amount paid in excess of market value.

3. Commercial property markets are now bouncing back rapidly from their lows suggesting a potential risk of return to the boom-bust with spillovers to the banking system.

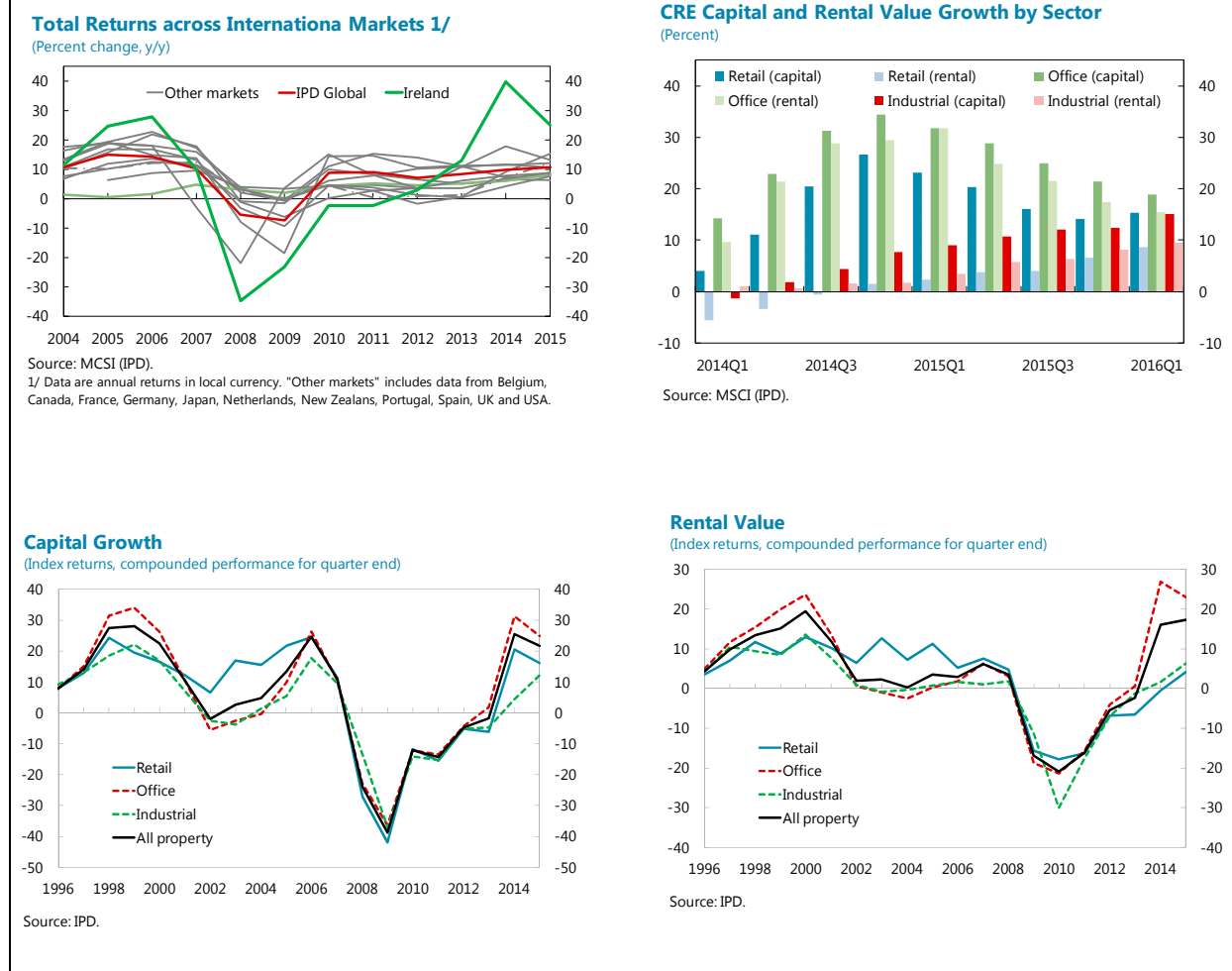
Since 2013, the Irish CRE market has performed strongly, characterized by buoyant investment volumes, and fast moving property prices and rental growth. A lag in new construction to meet demand has been driving vacancy rates down to historical lows and some indicators suggest valuations are entering a new boom phase.⁴ The unwinding of NAMA's holdings of property assets in the coming years could present lucrative lending opportunities for the banks in an effort to boost fees and earnings. Banks are increasing new credit to CRE in a sign that sentiment is shifting to take on greater exposure to this asset class and there is a risk that banks could increase their exposure to CRE while valuations are increasing, implying falling loan-to-value (LTV) ratios, allowing for greater leverage to be taken. This could erode lending standards and expose banks to greater vulnerabilities.

4. This note examines the potential spillover risks to individual banks and the banking system from CRE boom-bust cycles and surveys the potential policy responses. First, it looks at the current trends in the Irish CRE sector. Second, it examines the risks to banks and banking systems. Then, it looks at the microprudential and macroprudential responses by the Central Bank of Ireland and ECB in assessing and mitigating risks to banks from CRE exposures since the financial crisis. Lastly, it considers whether further policy measures are needed.

B. Recent Trends in Irish Commercial Real Estate

5. CRE price growth has been high in recent years and some indicators suggest valuations are entering a new boom period. Commercial property markets are bouncing back rapidly from their lows, as of 2015Q4 about 60 percent higher than the trough in 2013Q1, though still 48 percent below the peak levels. Capital values in the CRE sector have increased by 25 percent y-o-y since 2014Q2—the fastest growth since 1999—and Irish property has been one of the best performing asset classes in Europe during 2014 and 2015. Rental values have also been increasing rapidly at above 14 percent (y-o-y) during 2015, and are 41 percent higher than the trough in 2013. Performance in the Dublin office sector has been the most robust (Figures 1), and is now spreading beyond Dublin. Analysis of the deviation from a long-term trend of the price-to-rent ratio suggests that the CRE sector was moderately overvalued as of 2015Q3. The metric shows that the CRE prices were also exuberant before the crisis, growing significantly above the rental yield.

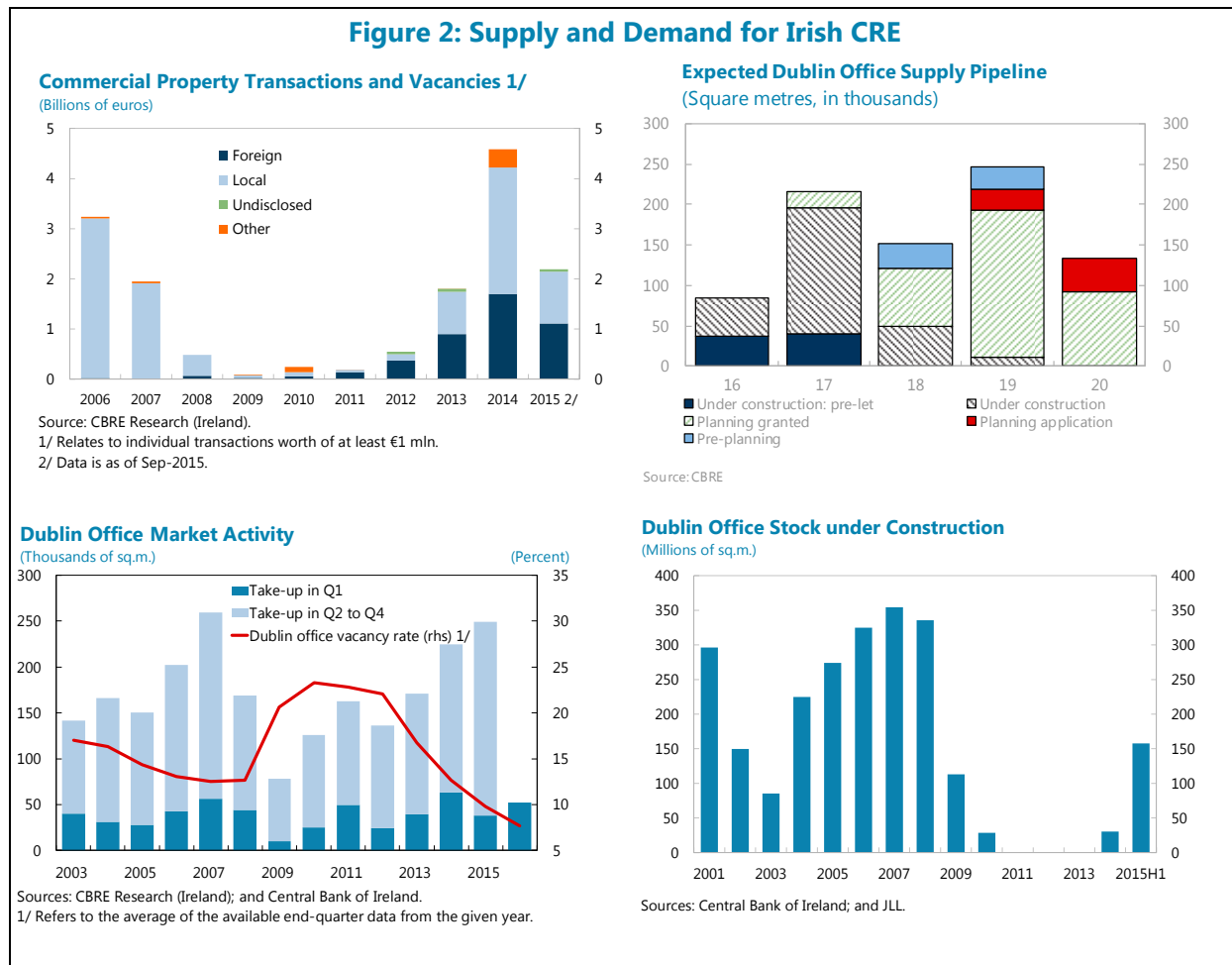
⁴ Analysis was conducted as part of the 2016 Ireland FSAP on the valuations of residential and commercial real estate. The results of the analysis was mixed and could not be definitive. The deviation from a long-term trend of the price-to-rent ratio suggests that the CRE sector was moderately overvalued as of 2015Q3, whereas using parametric methods (statistical filters, error correction models, and Markov regime switching model) CRE prices are near the long-run statistical trends.

Figure 1: Performance of the Commercial Real Estate (Compounded Performance)

6. A lack of new construction activity has contributed to supply shortages to meet demand. These supply imbalances are driving a large proportion of the gains in the CRE office subsector. The level of CRE stock under construction fell dramatically between 2008 and 2010, reflecting in part the low profitability margins in an environment of depressed prices, construction firms' stretched balance sheets, tighter lending standards by banks and thus limited access to funding by the construction sector. As a result, very little new office space has been delivered to the Dublin market for the last five years. While office development activity has increased in Dublin since 2014, planning statistics suggest that a meaningful increase in supply is unlikely until before 2017 ([CBRE Bi-monthly Report](#)). On the demand side, CBRE data show that the take-up⁵ of Dublin office space during the first three quarters of 2015 was at its highest level since 2007 (Figure 2) and the Dublin city centre vacancy rate has fallen from a peak of 24 percent in 2010 to 8.4 percent in September 2015.

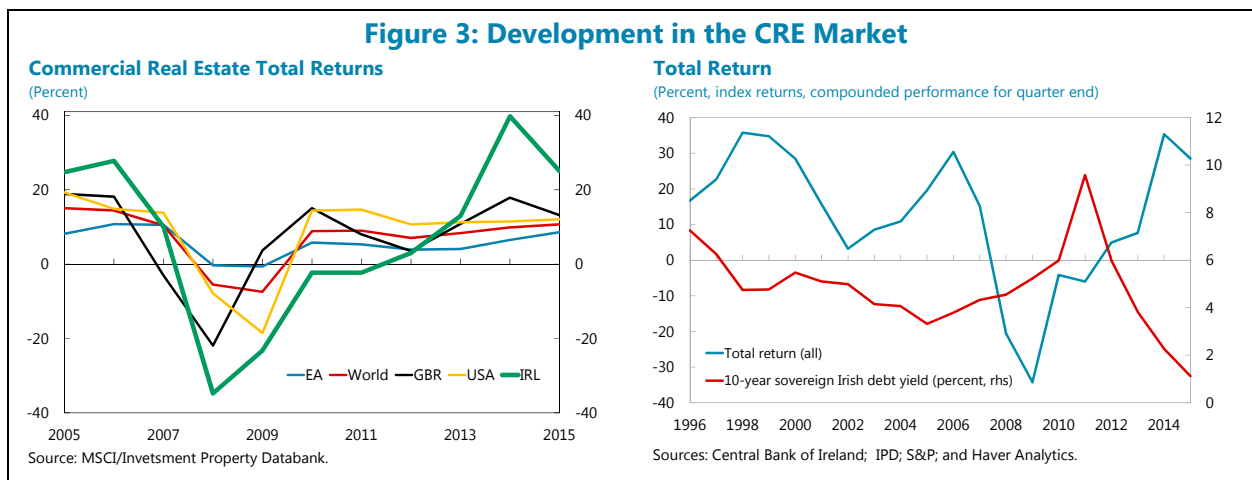
⁵ Take-up refers to all leasing activity in the office market.

Figure 2: Supply and Demand for Irish CRE

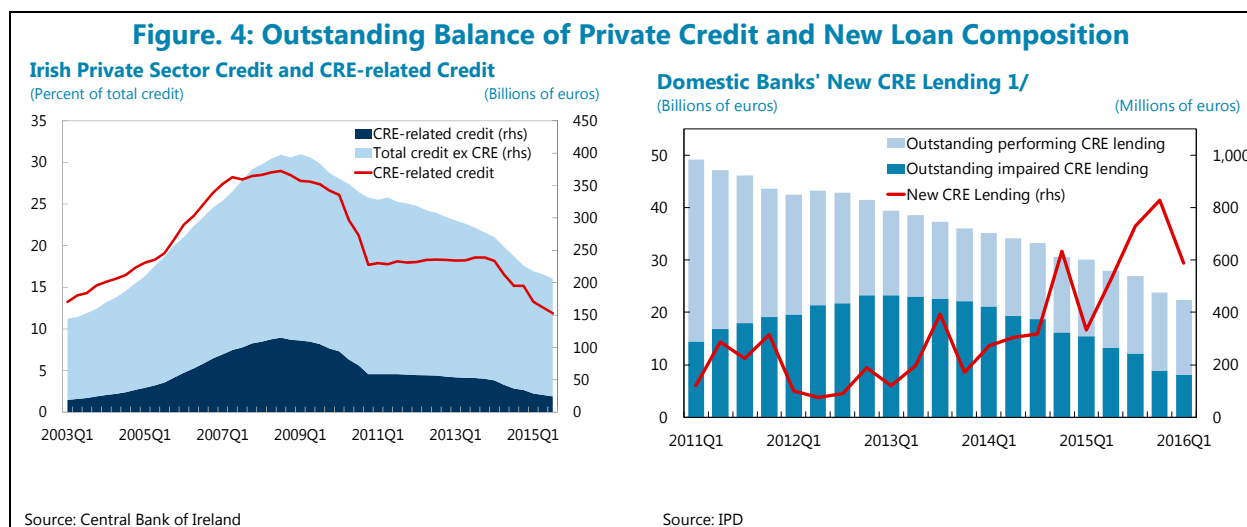


7. High CRE returns have attracted investors in the search for yield as interest rates remain low. Returns on 10-year Irish sovereign debt have trended down to a twenty-year low and the spread between total returns for CRE and the long-term sovereign bonds reached approximately 8.5 percentage points in 2015 (Figure 3). While capital and rental value growth have had a positive impact in terms of CRE returns, the relative strength of the former in recent quarters has seen initial yields fall below the longun average of 5 percent.⁶

⁶ Initial yield is calculated as the annualized returns generated by a portfolio, following the deduction of an estimate of annual recurring irrecoverable property outgoings, expressed as a percentage of the portfolio valuation (European Public Real Estate Association).



8. Investment in Irish commercial real estate has increased substantially with the majority from foreign direct investment (FDI). The value of investment in Irish commercial property reached €4.5bn in 2014, which was more than 2.5 times the 2013 figure and surpassed the previous high of 2006 by almost 40 percent. Unlike the pre-crisis period, the majority of investment activity is now being funded through foreign investment and equity funds, such as real estate investment trusts (REITs) as opposed to bank funded during the last boom cycle (Figure 4).⁷ Large foreign pension and insurance funds from the U.S., the U.K., and Germany have invested in the Irish CRE market, in part for balance sheet management, matching long-term liabilities with long-term assets. The domestic banking system has been reducing its overall exposure to CRE, yet the flow of new lending has slowly picked-up potentially signaling a greater appetite for CRE exposures.⁸



⁷ Property funds such as REITs allow smaller investors access to the market and additional liquidity with listed funds offering equity securities that can be bought and sold during market hours and some unlisted funds willing to return investments at a month's notice.

⁸ CRE represents approximately 15 percent of total bank exposures.

C. Risks to the Banking System from CRE and the Irish Financial Crisis

9. Financial system vulnerabilities associated with the CRE asset class are a result of cyclicity in valuations, leveraged structure, and high exposure to the economic cycle. CRE prices are highly cyclical in both an upturn and downturn.⁹ In an upturn, CRE market prices increase valuations, implying falling LTV ratios and improving credit metrics that allow for greater leverage to be taken on. Historic evidence suggests that increasing debt levels are not accompanied with equal increase in equity levels, making this sector increasingly vulnerable to an economic downturn. In a downturn, the cyclicity stems from the decline in occupancy rates and reduced cash flows to support debt payments. Sharp losses in valuations in turn imply an increase in LTV ratios that can reduce the ability of the entity to refinance and even a technical default as LTV covenants are broken. The structure of the debt is also a contributing factor to the historic volatility of this asset class, as CRE debt is often non-amortizing interest only debt with fixed maturity dates resulting in large bullet redemptions and significant roll-over risk.

10. Collateral valuations play an important component of the cyclicity of the commercial property market. As commercial property prices rise during a cyclical upswing, higher asset valuations strengthen the capital base of banks and other finance providers, increasing lending capacity. Moreover, collateral values rise, default rates fall and those loans that do default have higher recovery rates. That in turn also supports additional credit extension, pushing up prices further in a self-reinforcing cycle. This so-called ‘financial accelerator’ tends to operate until there is clear over-capacity in the sector. The whole process then moves into reverse.¹⁰ During the downswing, as corporate clients default and vacancy rates rise, lenders realizing collateral in a falling market place additional downward pressure on property prices. That lowers collateral values more broadly and in turn adds to the strain on other borrowers and lenders, reinforcing the downward spiral.

11. The downswing in prices and loan loss cycles in commercial real estate markets are usually stronger than in residential markets, for a number of reasons. First, construction cycles for commercial property are typically longer than for residential real estate. Second, the incentive for borrower default on a commercial real estate loan is higher than on a residential loan, given that households in default are still in need of housing. Third, loans for construction and development, which finance projects that are not yet cash-flow generating and are therefore higher risk, tend to form a material proportion of the banking sector’s commercial real estate portfolio. Fourth, the financing model for commercial property tends to contain a higher proportion of short-term or syndicated finance funding. That is subject to regular re-pricing and is inherently more procyclical than a longer-term amortizing residential mortgage. Lastly, commercial property valuations are typically marked to market at the same time as lending has LTV covenants: that combination can put loans in jeopardy when prices fall.

⁹ Financial Stability Board, Risks to Financial Stability from Commercial Real Estate, December 2009.

¹⁰ For a full discussion of the financial accelerator model see Bernanke, Gertler and Gilchrist (1998).

12. In the lead up to the Ireland financial crisis, banks played a crucial role in the financing of CRE. The CRE market was predominantly financed by domestic banks, UK banks and several other European banks; international equity investors had a limited presence in Ireland during this period. Banks lent for the purchase of land for development and existing buildings; they financed construction projects; they lent to non-banks and finance companies that in turn financed real estate; and they lent to non-financial firms based on real estate collateral. The risk appetite of the banks therefore had an impact on the behavior of property investments and transactions. On the other hand, the state of the CRE sector affected the performance of the banking sector.

13. Risks from CRE exposures in the Irish financial crisis significantly impacted the banks. Until late 2007, the Irish commercial property market grew rapidly, driven by strong demand and the capital value of commercial real estate increased by 70 percent during the five years up to September 2007—the peak of the market. When the crisis hit in late 2007, the proportion of non-performing real estate loans became high (a trend that was also observed for other loan portfolios) and banks required urgent recapitalization. Declining property prices increased the proportion of non-performing loans, leading to deterioration in banks’ balance sheets and weakened banks’ capital bases.¹¹ The National Asset Management Agency (NAMA) was established by the Irish Government in order to take on the role of a “bad bank” and was a key element of the solution to the banking crisis. NAMA took over mostly non-performing real estate-related loans from banks’ balance sheets, with the effect that bad assets did not continue to contaminate the remaining performing portfolios. NAMA took over a CRE-related portfolio of EUR 74 billion at a discount of 57 percent. The pricing of the assets that were taken over by NAMA was based on their potential long-term economic value, which effectively meant an indirect recapitalization of banks.

14. While new bank lending to CRE sector plays a lesser role nowadays than during the pre-crisis years, and CRE financing relies mostly on equity, an excessive CRE price increase could still pose a risk to the Irish banking sector. First, rising CRE prices could alter banks’ aversion and provide incentive for more risk-taking behavior, particularly as new lending is picking up and the unwinding of NAMA’s CRE portfolio will provide investment opportunities for banks. Second, even without further new CRE lending, sharp rise in CRE prices could bring about a subsequent reversal, which would hurt banks’ collateral values on the existing CRE stock of assets (which is still substantial) and could reduce capitalization. Third, banks could become increasingly exposed to REITs, and thus indirectly to the CRE market. Finally, a sharp volatility in CRE prices may also have supply side effects, as the construction sector takes property prices as a signal and adjusts production accordingly.

¹¹ David and Zhu (2004) conduct an analysis of the determination of commercial property prices and the interaction between commercial property prices and bank lending based on a sample of 17 developed economies.

D. Supervisory Response to Risks from CRE Since the Financial Crisis

15. Banking supervision in the run-up to the 2008-11 banking crisis had shortcomings in Ireland, making it a contributing factor to the crisis. Irish authorities conducted two critical postmortem reports that helped identify and analyze the most serious shortcomings in banking supervision.¹² The pre-crisis supervisory approach, for example, focused on process over outcomes, was unduly deferential and accommodating to the banking industry, and adopted a hands-off approach, particularly to credit risk. These are important lessons that have shaped the Central Bank's strengthening programs of its financial oversight functions in general, and banking supervision in particular.

16. On the European stage, the lessons of the global banking crisis resulted in an overhaul of regulation, supervision, and resolution. The Capital Requirements Directive (CRD IV)/Capital Requirements Regulation (CRR) came into force in 2014, and the Bank Resolution and Recovery Directive (BRRD) in 2015, both with some transitional provisions up to the end of the decade. The Single Supervisory Mechanism (SSM), led by the ECB, is operational since November 2014 and the SRB assumed its functions in January 2016. These new European regulations and institutional arrangements are designed to address the challenges of public banking oversight and resolution at a European level, in lieu of the national decision-making that prevailed until 2014.

17. Supervision of Irish banks is carried out by the Single Supervisory Mechanism (SSM) has been a 'game changer' for bank supervisors and practices.¹³ Significant Institutions (SIs) are directly supervised by the ECB and Less-Significant Institutions (LSIs) indirectly. For SIs, consisting of the larger banks operating in Ireland, a Joint Supervisory Team (JST), led by the ECB and consisting of both ECB and CBI supervisors directly supervise these firms. The SSM has further strengthened the prudential regulation and supervision of banks, enhancing consistency of supervisory practices across the euro area, and building on improvements in intrusive, outcomes-based supervision that had been on-going at the CBI. Concurrently, European legislative and regulatory developments have had a material impact on the role and approach of supervision of the banking sector in Ireland.

18. The response to the collapse of CRE prices during the crisis in Ireland has been far-reaching. First, banks have reduced their overall risk profile, significantly deleveraging and reducing their exposure to CRE (approximately by 15 percent of total assets). Second, the CBI has increased sector risk weights to reflect the higher inherent risk profile of CRE. Third, supervision has been

¹² See: "[The Irish Banking Crisis - Regulatory and Financial Stability Policy 2003-2008](#)" and "[Misjudging Risk: Causes of the Systemic Banking Crisis in Ireland.](#)"

¹³ The SSM officially entered into operation in November 2014. Supervision is performed by the ECB together with the national supervisory authorities of participating member states. For further information see: [ECB/SSM Guide to Banking Supervision.](#)

significantly strengthened through numerous measures.¹⁴ Fourth, improved CRE data collection is planned.

Capital

19. The regulatory capital treatment for Irish banks' exposure to CRE is set out in the Capital Requirements Regulation (CRR)¹⁵ where a range of options are available to determine risk-weights. The CRR allows banks to use either the standardized or IRB approach to determine risk weights for CRE. Under the standardized approach a 50 percent risk weight is permitted when certain strict criteria are met and 100 percent if criteria are not met. Under the IRB approach, banks are able to classify CRE as corporate asset class and the applied risk weight is a result of the applicable risk parameters: probability of default (PD), exposure at default (EAD) and LGD. If a bank is not able to estimate PDs (or meet certain requirements) the exposures are classified as specialized lending (SL) and banks apply prescribed supervisory risk- weights (see Annex III).

20. The CBI has applied a higher sector risk weight for CRE to reflect its inherent risk profile. Given the economic conditions prevailing at the time the CRD IV was introduced, it was determined that speculative CRE lending involved a higher risk and therefore should be subject to the higher capital surcharge. Under Article 128(2) of the CRR, exposures associated with particularly high risks were assigned a 150 percent risk weight. The LTV threshold for high-risk lending is 50 percent for mortgages secured by CRE. Mortgages with LTV ratios above these thresholds may be granted, but those with LTVs below the thresholds benefit from a more favorable risk weighting.

Microprudential supervision measures¹⁶

21. The microprudential activities associated with risks from CRE have been significantly enhanced since the Irish financial crisis. In assessing credit risk, the CBI/SSM consider all the components that determine potential credit losses, and in particular: the probability of a credit event (i.e. default), or correlated credit events, that mainly concerns the borrowers and their ability to repay relevant obligations; the size of exposures subject to credit risk; and the recovery rate of the credit exposures in the event of borrowers defaulting ([SREP Guidelines](#)).

22. In relation to supervision of Irish banks' exposure to CRE, the following activities have been performed since the crisis:

¹⁴ For example, Central Bank of Ireland has increased resources, adopted a more intrusive approach to supervision, and the implementation of the SSM.

¹⁵ Capital Requirements Regulation (EU) No 575/2013 of the European Parliament on the prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012. See <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=EN>.

¹⁶ A menu of potential microprudential supervisory measures to assess risks from CRE are outlined in Annex IV.

- **Supervisory Review and Evaluation Process (SREP).** The SSM SREP methodology is applied to the Irish banks to assess all material risks, including from CRE exposures. The SREP applies common standards of assessment for all EU banks to determine the appropriate regulatory capital and liquidity requirements for the credit institutions as well as guiding credit institution-specific areas of focus for the future Supervisory Engagement Plans (SEP).¹⁷ Credit risk is a key component of the SREP assessment and as a minimum considers: credit risk strategy and appetite; own funds requirement for credit risk; nature, size and composition of on- and off-balance sheet credit- related items; and, the risk-adjusted performance of the credit portfolio.
- **Thematic risk reviews.** Recent system-wide exercises on the supervision of banks' exposures to claims secured by commercial property include: 2013 balance sheet assessment, loan classification and provisioning with deep dive file reviews; the ECBs Asset Quality Review (AQR) and Comprehensive Assessment (CA),¹⁸ with deep dive file reviews; and Impairment provisioning review, 2014, as a follow-up from the AQR.
- **Credit risk onsite inspections.** Since the implementation of the SSM, the CBI has increased the frequency and loan sample sizes for credit risk inspections for SIs and LSIs. For SIs, credit inspections typically take 3 months end-to-end, while LSIs credit inspections typically take 8 weeks. Credit inspections typically include the sampling of loan files to assess: (i) the management of distressed credits, credit grading reliability/provision adequacy; and, (ii) new lending appetite/compliance with risk appetite and bank policies. For new lending this may include reviewing files where there has been high loan book growth/high levels of policy exceptions or risk appetite breaches. For distressed credits, the Credit Inspection Team typically review higher risk watch cases, and cases where there are concerns regarding provision coverage and/or high provision write-backs.
- **Ongoing supervision.** As part of the supervisory engagement model, the following tasks are undertaken: meetings are held with the chief executive officer (CEO), chief financial officer (CFO), chief risk officer (CRO), chairman of the board, external auditors and independent non-executive directors during which credit risks faced by the credit institution are discussed; assessments of governance, policies, controls, reporting and credit risk assessment etc.; regulatory reporting received on a quarterly frequency (EU reporting

¹⁷ This assessment follows the EBA SREP Guidelines, considering Business Model, Internal Governance & Risk Management, Risks to Capital and Risks to Liquidity, from the perspective of the supervisors' knowledge of the credit institution, a peer comparison, the macro-economic environment in which the credit institution operates, the credit institution's trajectory towards full implementation of the CRD IV/CRR capital and liquidity requirements and the SSMs risk tolerances.

¹⁸ The ECB together with national authorities carry out financial health checks of the banks it supervises directly. The assessment methodology usually comprises two main pillars: an asset quality review to enhance transparency of bank exposures, including the adequacy of asset and collateral valuation and related provisions and a stress test to test the resilience of bank's balance sheets. The AQR and CA was performed in 2014. For details see: [ECB Comprehensive Assessment](#).

templates - COREP and FINREP) are analyzed; financial statements are reviewed on an annual basis; and, analysis of stress testing and concentration risks.

- **Provisioning.** The CBI has increased the frequency and depth of on-site reviews of loan loss provisioning practices since the implementation of the SSM. Credit inspections completed on SIs in 2015 were heavily focused towards non-performing exposures (NPEs)/problem loans. Inspections involve deep loan file reviews including an assessment of the adequacy of loan loss provisions and provision write-backs. Examples of work performed include: reviews of distressed CRE loans to assess policies and procedures in place for the management of distressed credit; assessment, management and classification of distressed credit loans; collateral valuations methodology; adequacy of provisions (including write-backs); credit grading; and management information and reporting.
- **Revised guidelines for provisioning and valuations.** The CBI published guidelines in 2012 and 2013 for impairment provisioning and disclosure.¹⁹ The guidelines clarify expectations of banks when establishing policies and processes for loan loss provisioning.
- **Internal Models.** Thematic risk specialist teams within the ECB provide expert support to the work of JSTs/STs in model approval and on-going model supervision of Pillar I and Pillar II; Point in Time SREP quantification (Pillar II A) and in assessing/challenging Pillar II models (and others including provisioning models). Benchmarking exercises of IRB models has also been undertaken.

CRE Data collection

23. Authorities are planning to improve CRE data collection. The CBI and NAMA will co-fund the development of a CRE statistical system by 2018, which will be maintained by the CSO and give detailed information on sales and lease transactions, and construction activities, such as permissions, commencements, and completions. The CBI staff has made efforts to improve analyses on CRE market developments, which will need to continue with a support of sufficient resource allocation.

E. Conclusions and Recommendations

24. The response to collapse of CRE market bubble in Ireland since the crisis has been significant. Banks have deleveraged and de-risked their portfolios and credit underwriting standards are much more prudent. Capital requirements have been adjusted to take account for the higher inherent risk profile of CRE and supervisors have stepped up their efforts to gain a deeper understanding of risk and risk management. The implementation of the SSM and the new EU rules

¹⁹ See <https://www.centralbank.ie/regulation/industry-sectors/credit-institutions/Documents/Impairment%20Provisioning%20Guidelines%20May%202013.pdf>.

has helped to strengthen the overall approach to identifying and mitigating the risks to banks from CRE and other exposures.

25. Nevertheless, given that potential risks that CRE markets pose for the banking sector, a continued vigilance of CRE market developments is needed. As in other jurisdictions, CRE exposures played a significant role in causing destabilizing losses for banks in the recent Irish financial crisis. While banks are not currently overly exposed to the CRE sector, new lending is picking up and more investment opportunities will become available to banks as CRE construction picks up. Regular monitoring is needed as a way to identify early emerging risks and changes in industry dynamics especially as some indicators suggest valuations are entering a new boom period. While enhancements to regulations will help boost the resilience of banks and banking systems, consistency on the adoption and implementation of regulation is critical. Applying the full suite of supervisory measures forms the basis for an understanding of the risks stemming from CRE exposures and the platform for future measures if needed. A solid supervisory framework in Ireland lays the foundation to implement effective prudential supervision and over the last several years the CBI, together with the ECB, have increased resources and deployed them in on- and off-site supervision that is not only more pro-active than in the past but also directed towards systemic and emergent risks.²⁰

26. Based on the current conditions in the Irish CRE market, the following themes should be prioritized in the engagement with Irish banks:

- **Valuations and provisioning.** There is a need to ensure that prudent practices and conservative assumptions are applied to provisioning write backs given the pace of asset re-valuations recently seen and the risk that values could once again change abruptly.
- **Exposure to REITs.** Given the new role of REITs in the CRE market, the supervisor should assess the potential inter-linkages with the banking system. For example, supervisors should be verifying how banks are analyzing the risk of their exposures to REITs.
- **Accurate measurement of capital is needed.** International evidence shows significant differences in the denominator of bank capital ratios for IRB banks and material differences in bank's regulatory parameters—probability of default and loss given default.²¹ Given the majority of the larger Irish banks use IRB models, the supervisor should pay special attention

²⁰ The IMF conducted an FSAP update in 2016 which included an assessment of the banking sector. In addition, an assessment of compliance with the Basel Core Principles was conducted in 2013. See <http://www.imf.org/external/pubs/ft/scr/2014/cr14137.pdf>.

²¹ The BCBS conducted a fundamental review of the banking and trading book to confirm the accuracy of risk weighted assets. Results showed considerable variation in risk-weights by banks for the same portfolio of risks. The use of models was one factor that contributed to the differences. The European Banking Authority (EBA) also conducted analysis of variability in risk-weights. For a full description of the results see: [Review of Consistency of Risk Weighted Assets - European Banking Authority](#).

to the accurate estimation of risk-weights using benchmarking exercises to identify outliers e.g. EBA benchmarking exercise ([EBA Report on IRB Models](#)).

27. In addition to existing measures, the following measures could be deployed in the event systemic risks from CRE start emerging, including:

- **Countercyclical capital buffer.** The countercyclical capital buffer (CCyB) of Basel III aims to ensure that banking sector capital requirements take account of the macro-financial environment in which banks operate ([Basel III CCyB](#)). Its primary objective is to use a buffer of capital to achieve the broader macroprudential goal of protecting the banking sector from periods of excess aggregate credit growth that have often been associated with the build-up of system-wide risk. Due to its countercyclical nature, the countercyclical capital buffer regime may also help to lean against the build-up phase of the credit cycle in the first place. In downturns, the regime should help to reduce the risk that the supply of credit will be constrained by regulatory capital requirements that could undermine the performance of the real economy and result in additional credit losses in the banking system.
- **Time-varying limits (loan-to-value (LTV) and debt service coverage (DSC) ratio).**²² **Ceilings** on LTV ratios impose a cap on the size of a commercial real estate loan relative to the appraised value of a property and enforce a minimum down payment. Floors on the DSC ratios require net operating income to be a fixed multiple (higher than one) of the size of debt service payments, ensuring that the property has the necessary cash flow to cover the loan payment.²³ Lower LTVs and higher DSCs directly reduce demand for credit by limiting the market to new borrowers that satisfy the lending conditions. This in turn, contains a property price boom if it is financed by bank credit. An announcement of a tightening of the limits can also affect corporations' expectations of future commercial real prices if credible and large enough, and reduce speculative incentives that play a key role in real estate prices bubble dynamics.²⁴ Lower LTVs and higher DSCs can have a secondary benefit of reducing riskiness of the commercial real estate loan market and therefore enhance the resilience of the banking sector indirectly by increasing the quality of corporate credit.
- **Tax measures.** Taxes are a potential tool for authorities to discourage speculative investment in domestic property markets. Property taxes (either based on capital or market

²² For a full discussion on application of LTV and DCS measures for CRE, see IMF Staff Guidance note on macroprudential policy – detailed guidance on instruments 2014, <http://www.imf.org/external/np/pp/eng/2014/110614a.pdf>.

²³ DSCs can be complemented with a minimum capitalization rate which is a rate of return on a real estate investment property based on the expected income that the property will generate. It is calculated by dividing the income the property will generate (after fixed costs and variable costs) by the total value of the property.

²⁴ At the same time, the announcement can trigger a temporary increase in non-speculative lending as the borrowers will try to lock-in higher LTVs before they are implemented. This highlights the need for the announcement to be close to the implementation of the measures.

value, or annual rental value) and cyclical transactions taxes (such as capital gains taxes and registration fees) could help dampen the boom phase of a real estate cycle as well as discourage speculative activity.^{25 26}

- **Supply side.** A review of the extent to which a slow supply response also contributes to the price increase would be appropriate.

28. While the capital framework includes macroprudential measures to build resilience to excessive credit growth (e.g. CCyB), such measures are not warranted under current conditions. As a first step, supervisors should ensure banks are accurately measuring capital adequacy such as via assessments of pillar 1 capital, the pillar 2 process and SREP. Microprudential activities should help inform future policy making decisions, including macroprudential measures. Existing data gaps are important to fill in parallel with ongoing analysis of valuations and bank financing. Several factors suggest macroprudential measures are not warranted under current conditions: banks only play a minor role in financing CRE; there is no definitive evidence that valuations are over-stretched; data gaps need to be filled to ensure accurate calibration; a material increase is in the pipeline of new CRE stock to meet demand; and pillar 2 capital add-ons can be applied in a targeted way where banks take on too much risk.

²⁵ See Crowe et. al 2013.

²⁶ For example, in January 2013, Singapore introduced buyer's and seller's stamp duties as complementary to macroprudential measures due to concern about speculative activity by foreigners and domestic corporations. A Seller's Stamp Duty (SSD) of 15 percent on industrial property was imposed if sold within one year, 10 percent if within two years, and 5 percent if within three years. Higher buyer's stamp duty for these groups has been in place since 2009. Hong Kong also introduced a stamp duty on property transactions in an effort to contain upward pressure on property prices by raising borrowing costs. A special stamp duty was imposed in November 2010 which is added to the regular stamp duty rate.

Annex I. Valuation of Irish CRE Prices²⁷

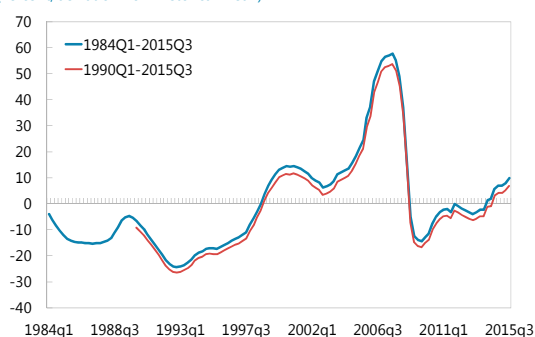
Analysis of Irish CRE property prices was conducted during the Ireland 2016 FSAP using two approaches: (i) non-parametric method (price-to-rent ratio, and (ii) parametric method statistical filters, error correction models, and Markov regime switching model. Overall, the results send mixed signals of the valuation of current CRE prices. While error correction models suggest a marginal undervaluation, the price-to-rent ratio and the MRSMs indicate an early warning of starting a new boom period.

The deviation from a long-term trend of the price-to-rent ratio suggests that the CRE sector was moderately overvalued as of 2015Q3.²⁸ The metric shows that the CRE prices were also exuberant before the crisis, growing significantly above the rental yield. The adjustment after the crisis was higher than that in the residential real estate (RRE) market. From 2014, the ratio breached the historical average again. The absolute level of overvaluation depends on the choice of the period over which the historical average is calculated.

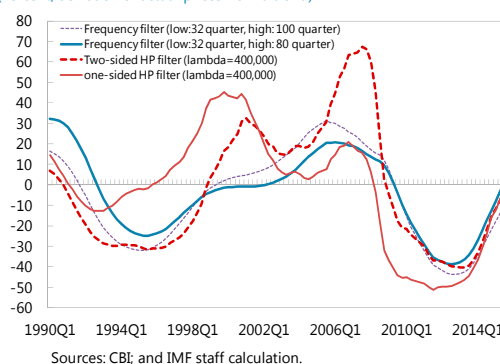
Results from HP and Band-pass filtering show that CRE prices are near the long-run statistical trends (text figure). Using either one-sided or two-sided HP filter, Irish CRE prices are estimated to be close to the trend. Isolating a component of house prices that lies within an 8-20 year interval, longer than a business cycle, a band-pass filter show that, as of 2015Q3, CRE prices were close to the equilibrium level in the range of +2 percent, while a frequency filter, which extracts components within an 8-25 years interval, indicates 8 percent of undervaluation.²⁹

Analyses with Markov regime switching models (MRSM) suggest that CRE markets entered into a high regime probability in the second half of 2013, which can be an early warning signal of another prolonged boom as shown in the last cycle. We allow two parameters in the above error correction

CRE Price-to-Rent Ratio
(Percent, deviation from historical mean)



CRE Price Valuation with Statistical Filters
(Percent, deviation of actual prices from a trend)



²⁷ Analysis of the valuation of CRE was undertaken by Heedon Kang as part of the Ireland 2016 FSAP.

²⁸ Price-to-income ratio in the CRE sector is not available.

²⁹ A full sample asymmetric band-filter is used, where the weights on leads and lags are allowed to differ. Because the CRE price index is non-stationary, it is assumed a unit root process with no detrending. Because the length of the latest boom-bust cycle of CRE prices was shorter than one of RRE prices, we use 8-20 or 8-25 years as the interval, instead of 8-30 years.

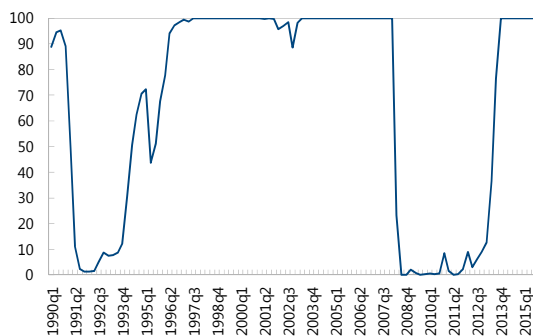
model, a constant term α_{S_t} and the coefficient of price-to-rent ratio γ_{S_t} , to change across two regimes ($S_1 = \text{high}$ or $S_2 = \text{low}$) or three regimes ($S_1 = \text{high}$, $S_2 = \text{normal}$, or $S_3 = \text{low}$). Unlike the MRSM for house prices, variance of the white noise term σ_ϵ^2 is not allowed to change over two states to let the maximum likelihood estimation converge. The probability of being in state $S_t = i$ at time t if CRE prices were in state $S_{t-1} = i$ at time $t - 1$ is p_{ii} .

- Two regimes (high or low): The latest boom-bust cycle in the CRE market lasted for 20 years, which is longer than a normal business cycle. The cycle started around 1993 and ended at 2013. The boom period almost coincided with one in the residential real estate (RRE) market. The estimated transition matrix shows that there is a long swing in the CRE market. That is, once the CRE market enters into a high regime, it tends to stay in the regime for a while: the expected duration of the high regime is estimated to be over nine years (33 quarters). The boom regime has occurred about 65 percent of the sample period 1990-2015, longer than the bust regime.
- Three regimes (high, normal, or low): The MRSM with three regimes appears to capture dynamics of the CRE market better than one with two regimes. It detects a temporary slow-down period between two high growth periods during 1993-2007. It also hints a recent “pick-up” of CRE prices in recent years, which was an early warning signal of a prolonged boom in the last cycle.

Evaluation of CRE Prices with Markov Regime Switching Models

Probability of High Regime

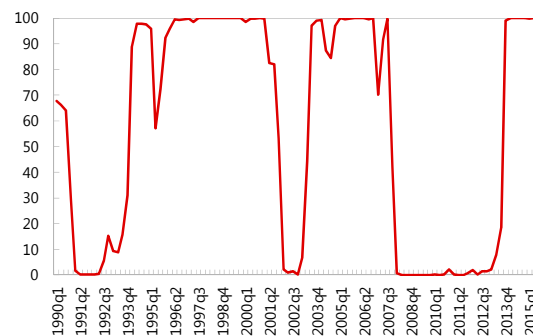
(Percent, number of states = 2)



Sources: CB; CEIC; and IMF staff calculation.

Probability of High Regime

(Percent, number of states = 3)



Sources: CB; OECD; CEIC; and IMF staff calculation.

Annex II. Treatment of CRE under Basel II

The Basel II framework permits two overall approaches to determine risk-weights for CRE exposures: the standardized and the Internal Ratings-Based (IRB) approach.

The standardized approach

Under the standardized approach, claims secured by commercial real estate are assigned a 100 percent risk-weight which recognizes that commercial property has been a cause of troubled assets in the banking industry over several decades.³⁰ However, the framework permits a lower risk-weight in exceptional circumstances such as (i) well-developed and long established markets; and (ii) mortgages on office and/or multi-purpose commercial premises and/or multi-tenanted commercial premises may have the potential to receive a preferential risk weight of 50 percent for the tranche of the loan that does not exceed the lower of 50 percent of the market value or 60 percent of the mortgage lending value of the property securing the loan. Any exposure beyond these limits will receive a 100 percent risk weight. This exceptional treatment will be subject to very strict conditions and in particular, two tests must be fulfilled:

- i. losses stemming from commercial real estate lending up to the lower of 50 percent of the market value or 60 percent of loan-to value (LTV) based on mortgage-lending-value (MLV) must not exceed 0.3 percent of the outstanding loans in any given year; and that
- ii. overall losses stemming from commercial real estate lending must not exceed 0.5 percent of the outstanding loans in any given year.

If either of these tests is not satisfied in a given year, the eligibility to use this treatment will cease and the original eligibility criteria would need to be satisfied again before it could be applied in the future. Countries applying such a treatment must publicly disclose that these and other additional conditions (that are available from the Basel Committee Secretariat) are met. When claims benefiting from such an exceptional treatment have fallen past due, they will be risk-weighted at 100 percent.

The IRB approach

For banks accredited to use the IRB approach, there are a number of options to classify the asset and assign risk-weights. First, the corporate asset class where a probability of default (PD), exposure at default (EAD), and loss given default (LGD) are assigned to each individual exposure based on the bank's credit risk grading system. Second, within the corporate asset class there are five sub-classes of specialized lending (SL) which are separately identified, two of which relate to commercial

³⁰ Basel Committee on Banking Supervision, International Convergence of Capital Measurement and Capital Standards, A revised Framework, June 2006, paragraph 74.

property: income producing real estate (IPRE) and high-volatility commercial real estate (HVCRE). Each treatment provides a separate set of requirements to determine the risk-weight.

Income-producing real estate (IPRE)³¹ refers to a method of providing funding to real estate (such as, office buildings to let, retail space, multifamily residential buildings, industrial or warehouse space, and hotels) where the prospects for repayment and recovery on the exposure depend primarily on the cash flows generated by the asset. The primary source of these cash flows would generally be lease or rental payments or the sale of the asset. HVCRE lending³² is the financing of commercial real estate that exhibits higher loss rate volatility (i.e. higher asset correlation) compared to other types of SL. Banks that do not meet the requirements for the estimation of PD under the corporate foundation approach for their SL assets are required to map their internal risk grades to five supervisory categories, each of which is associated with a specific unexpected loss risk weight – see below.³³

The SL categories: project finance, object finance, commodities finance, IPRE, and HVCRE

Supervisory categories and unexpected loss risk weights for IPRE is as follows:

Strong	Good	Satisfactory	Weak	Default
70%	90%	115%	250%	0%

Supervisory categories and unexpected loss risk weights for HVCRE is as follows:

Strong	Good	Satisfactory	Weak	Default
95%	120%	140%	250%	0%

³¹ Ibid, paragraph 226.

³² Ibid, paragraph 227.

³³ Ibid, paragraph 280.

Annex III. Capital Treatment of CRE under the Capital Requirements Regulation

For banks applying the standardized approach (SA) to determine risk-weighted assets, the Capital Requirements Regulation (CRR) allows a preferential treatment of 50 percent for exposures fully and completely secured by mortgages on CRE if certain criteria are met, including:

- (a) the value of the property shall not materially depend upon the credit quality of the borrower. Institutions may exclude situations where purely macro-economic factors affect both the value of the property and the performance of the borrower from their determination of the materiality of such dependence;
- (b) the risk of the borrower shall not materially depend upon the performance of the underlying property or project, but on the underlying capacity of the borrower to repay the debt from other sources, and as a consequence, the repayment of the facility shall not materially depend on any cash flow generated by the underlying property serving as collateral;
- (c) legal certainty of collateral pledged as collateral, value is monitored regularly (at least annually) and the valuation is conducted by an independent valuer at or less than the market value; and
- (d) the 50 percent risk weight shall be assigned to the part of the loan that does not exceed 50 percent of the market value of the property or 60 percent of the mortgage lending value of the property in question in those Member States that have laid down rigorous criteria for the assessment of the mortgage lending value in statutory or regulatory provisions.

If these criteria are not met, a 100 percent risk weight is applicable. The CRR permits a derogation from point (b) for exposures fully and completely secured by mortgages on commercial immovable property which is situated within the territory of a Member State, where the competent authority of that Member State has published evidence showing that a well developed and long-established commercial immovable property market is present in that territory with loss rates which do not exceed the following limits:

- (a) losses stemming from lending collateralized by commercial immovable property up to 50 percent of the market value or 60 percent of the mortgage lending value, unless otherwise determined under Article 124(2), do not exceed 0,3 percent of the outstanding loans collateralized by commercial immovable property;
- (b) overall losses stemming from lending collateralized by commercial immovable property do not exceed 0,5 percent of the outstanding loans collateralized by commercial immovable property.

For IRB banks, treatment is based broadly of two approaches: either classified as corporate or specialized lending (SL).

For SL exposures in respect of which an institution is not able to estimate PDs or the institutions' PD estimates do not meet certain minimum requirements, the institution assigns risk weights to these exposures in accordance with Table 1, as follows:

Table 1

Remaining maturity	Category 1	Category 2	Category 3	Category 4	Category 5
Less than 2.5 years	50%	70%	115%	250%	0%
Equal or more than 2.5 years	70%	90%	115%	250%	0%

In assigning risk weights to specialized lending exposures institutions shall take into account the following factors: financial strength, political and legal environment, transaction and/or asset characteristics, strength of the sponsor and developer, including any public private partnership income stream, and security package (CRR Article 153).

Annex IV. Microprudential Measures to Assess Risks Associated With CRE Exposures

In the international context, the major cause of serious banking problems continues to be directly related to weaknesses in banks' credit risk management.³⁴ Supervisors should therefore pay attention to banks' credit risk management to identify, measure, monitor, and control credit risk as well as to determine that they hold adequate capital against these risks ([Principles for the Management of Credit Risk](#)). Supervisors have a range of tools to assess the risks stemming from CRE and address the boom and bust cycle. The following are a suite of microprudential measures to assess risks associated with banks exposures to CRE:³⁵

- **Systemic risk monitoring.** Regular monitoring of the CRE industry is needed to identify early emerging risks, construction activity, sources of financing, and system exposures.
- **Industry outreach.** Industry outreach is a way for the supervisor and authorities to better understand the industry by “bringing all sides of the industry together” – developers, investors, lenders occupiers, surveyors, auctioneers, researchers and regulators – to discuss developments in the commercial property sector.
- **Assessment of credit risk underwriting standards.**³⁶ Sound credit risk underwriting standards should be assessed with intensive supervisory scrutiny. For example: whether banks are applying suitable underwriting that take account of portfolio risks and likely correlations between loans; reviewing the incentives and financial backing of developers to ensure that they retain sufficient ‘skin in the game’; and designing and utilizing more rigorous stress tests of land and collateral valuations so that LTV ratios and covenants are applied to stress-adjusted values.³⁷ Moreover, lessons from the changes in financing conditions for the CRE sector need to be properly evaluated ex ante e.g. liquidity in the commercial mortgage backed security market and possibilities of sources of contingent funding.
- **Monitor trends in collateral valuations.** Collateral valuations of CRE are an important aspect of risks to financial stability. While discretion is left to the national supervisor in the approval of IRB models, the Basel framework does provide some guidance to determine the

³⁴ Examples include: lax credit standards for borrowers and counterparties, poor portfolio risk management, or a lack of attention to changes in economic or other circumstances that can lead to deterioration in the credit standing of a bank's counterparties.

³⁵ In practice, many of these activities are interconnected, however, for this discussion they have been dealt with separately.

³⁶ The BCBS published a guide for sound credit risk assessment and valuation for loans. See <https://www.bis.org/publ/bcbs126.htm>.

³⁷ Financial Stability Board, Workshop on Commercial Real Estate (CRE) Underwriting, June 2013.

quality of CRE assets based on: market conditions, financial ratios (LTV, interest rate coverage), stress analysis, cash-flow predictability, asset characteristics, strength of sponsor, and security measures. Given that many of these guiding indicators of quality are potentially prone to pro-cyclicality, it is important supervisors to monitor bank policies.

- **Managing concentration risk and large exposure limits.** Banks should have adequate policies and processes to identify, measure, evaluate, monitor, report and control or mitigate concentrations from CRE asset class and apply internal limits to reflecting the bank's risk appetite, risk profile and capital strength.³⁸ Policies to limit sector concentrations should be well established and routinely reviewed in light of changing macroeconomic and market factors.
- **Prudent provisioning practices.** Accurate provisioning plays a crucial role in building resilience of a bank to credit risk losses. Adequate provisioning coverage for NPLs, valuations based on stressed collateral values at foreclosure and governance by the Board of Directors is needed. Furthermore, there is a need to ensure conservative assumptions are applied to provisioning write backs and clear policies for the upgrading of exposures from "nonperforming" to "performing".³⁹
- **On- and off-site supervision.** Supervisors should actively assess banks' and the banking system's exposure to CRE assets as part of routine offsite and onsite activities. CRE assets should be reported separately as part of the regulatory reporting framework and an integral part of ongoing monitoring. Supervisors should review bank underwriting standards on a regular basis (e.g. bi-annually), conduct thematic and targeted onsite examinations to perform file reviews as a way to verify application of credit underwriting standards, accuracy of credit risk grading systems, quality of hind-sighting and challenge by risk management to verify quantitative and qualitative inputs to credit assessments.
- **Pillar 2 capital add-ons.** As part of the annual supervisory review and evaluation process (SREP) of pillar II, supervisors assess all material risks that a bank is exposed to, including from CRE. Supervisors should conduct an assessment of a bank's inherent risk exposure from CRE as well as the quality of risk management. Supervisors have the opportunity to apply higher minimum capital requirements for individual banks where the risk profile warrants.
- **Verifying the accurate measurement of risk-weighted assets for CRE exposures through the capital framework.** For banks using the SA, supervisors should confirm that the appropriate risk weight is being applied, and where banks are applying a preferential risk

³⁸ Concentration risk is one of the key principles in the Basel Core Principles for Effective Banking Supervision (2012). See [Basel Core Principles](#).

³⁹ The BCBS published guidance on the prudential treatment of assets and definitions of NPLs and forbearance. See <http://www.bis.org/bcbs/publ/d367.htm>.

weight of 50 percent that the strict criteria laid down in the regulations are met.⁴⁰ For banks using the IRB approach for CRE, credit risk assessment models involve extensive judgment and effective model validation procedures are crucial ([BCBS Sound Credit Risk](#)). The BCBS published guidelines for back-testing counterparty credit risk models⁴¹ covering model validation, monitoring and back-testing. Analysis shows the IRB approach results in significant variability in risk weights.⁴²

⁴⁰ BCBS, 2006, see paragraphs 74 which states that “in view of the experience in numerous countries that commercial property lending has been recurring cause of troubled assets in the banking industry over the past few decades, the Committee holds the view that mortgages on commercial real estate do not, in principle, justify other than a 100 percent weighting of the loans secured”.

⁴¹ See <http://www.bis.org/publ/bcbs185.pdf>.

⁴² Analysis performed by the BCBS showed excessive variability in risk-weighted assets in the banking book. See <http://www.bis.org/bcbs/publ/d362.htm>. Analysis by the EBA shows that supervisory practices covering IRB models vary. See <https://www.eba.europa.eu/documents/10180/15947/20131217+Report+on+the+comparability+of+supervisory+rul es+and+practices.pdf>.

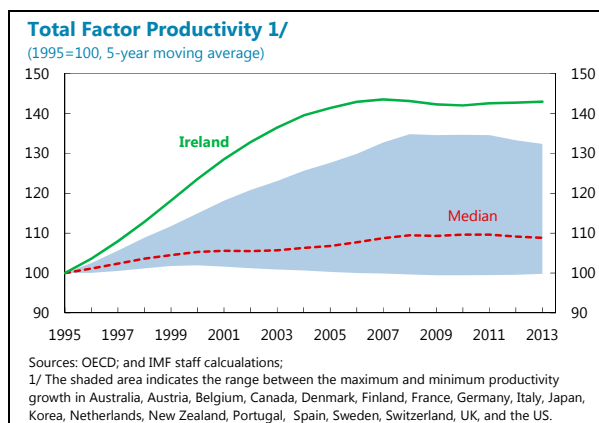
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FIRM-LEVEL PRODUCTIVITY AND ITS DETERMINANTS: THE IRISH CASE^{1,2}

A. Introduction

1. Ireland's total factor productivity (TFP) growth moderated significantly during the last decade. Ireland experienced an exceptionally high TFP growth of about 4 percent per annum during the 1990s, which was largely driven by substantial foreign direct investment inflows and a shift of capital and labor from agriculture and relatively low productivity manufacturing towards high-technology sectors (Cassidy, 2004).³ In early 2000s, however, Ireland's productivity growth started to weaken in line with the experience of many advanced economies, including the US whose technological development is commonly regarded as representing the world frontier (IMF, 2015). The rapid expansion of the construction sector, where productivity is generally low, also contributed to the deceleration of the aggregate TFP (OECD, 2011).



2. The moderation of the Irish productivity growth was affected by the financial crisis. The financial sector's meltdown, the significant deterioration in the non-financial corporate (NFC) sector's financial health, and the sizable fiscal consolidation, which was accompanied by a reduction in public sector's spending on research and development (R&D) are likely to have contributed to the moderation of productivity growth in Ireland in recent years as firms struggled to invest in productivity-enhancing projects, especially at the initial stages of the crisis. Moreover, global factors may have also played an important role as the recent moderation of productivity growth in most advanced economies (AE) has likely affected Ireland, given its high degree of openness and large presence of multinational companies.

3. The recent external and domestic developments may have affected Irish firms' productivity differently, reflecting in part their financial health, ability to access external financing, and reliance on public sector's R&D support. At just above one percent of GDP in 2013, the business sector's R&D expenditures in Ireland was below euro area average of 1.3 percent of GDP, and was largely driven by the activity of multinationals (European Commission, 2016).⁴ The R&D of domestic firms, however, remains weak as it is heavily reliant of public sector's R&D support,

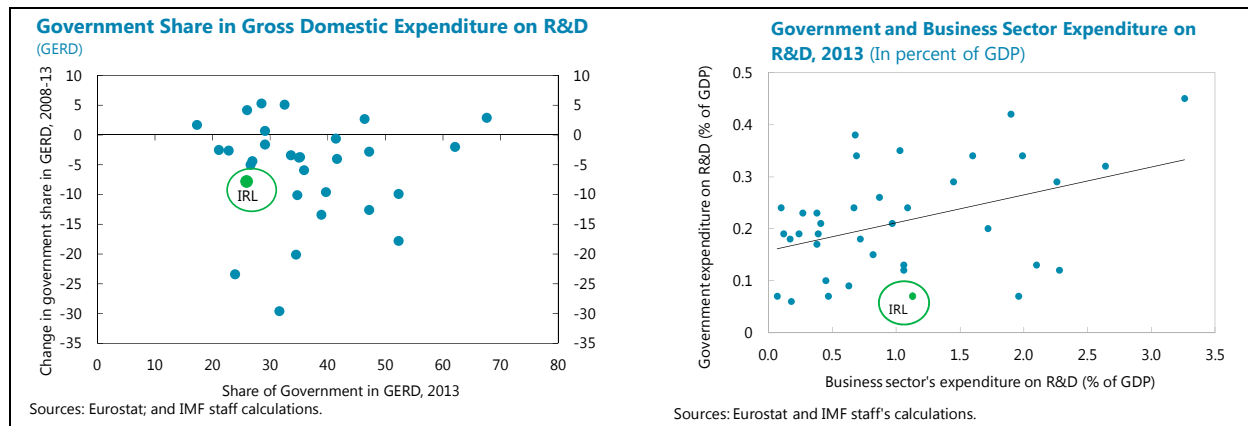
¹ Prepared by Nir Klein.

² I would like to thank Conor O'Toole and the participants of the workshop at the Central Bank of Ireland for their useful comments and suggestions.

³ TFP figures are based on OECD estimates available in <https://data.oecd.org/lprdy/multifactor-productivity.htm>.

⁴ Multinational enterprises account for about 70 percent of private R&D.

which declined significantly in recent years. This, together with the tight credit conditions, which constrained their ability to access financing and fund productivity-enhancing projects, and the limited linkages with multinationals, may suggest that TFP growth of SMEs has lagged behind that of multinationals (MNEs) in recent years.⁵



4. Against this background, the paper's objective is twofold. First, the paper uses firm-level data to evaluate how has TFP evolved in recent years and to what extent it differed by firm size, sectors, and regions. Particular focus is given to the post-crisis period (2009-14), in which the SME sector (enterprises with less than 250 employees) contracted in both value added and employment. The second objective is to identify firm-level factors that affect productivity growth over time. Identifying firm-level determinants is important to better understand the recent TFP dynamics and design policies to alleviate impediments and support long-term growth. The analysis controls for global and macroeconomic effects by assessing the impact of foreign-owned companies that operate in Ireland and by including a time dummy.

5. The paper is structured as follows: Section B describes the micro-level dataset and the methodology that is used to calculate TFP across firms. Section C presents some stylized facts that emerge from the firm-level data. Section D explores to what extent fast frontier technologies and innovations are diffused to other firms, and whether such patterns were disrupted by the financial crisis. Section E identifies the firm-level determinants of TFP controlling for global factors, macroeconomic, sectoral, and regional effects. Section F concludes.

⁵ The share of MNEs' business services that were acquired from domestic suppliers dropped to 20 percent in 2013 from 50 percent in 2000.

B. Data and Methodology

6. The analysis uses the ORBIS database of Bureau Van Dijck (BvD), which contains worldwide information on private and public firms. For Ireland, the sample used in this paper

includes all enterprises in manufacturing and services that have a complete record of the variables of interest. The sample covers the period 1995-2014, though the data is purged to exclude outliers. To increase the coverage of the sample, we follow Gal (2013) and internally impute the firms' value added by using their factor incomes, i.e., adding the cost of employees to EBITDA (Earnings Before Interest Taxes Depreciation and

Amortization), which captures the part of income that can be attributed to capital. With this computation, the aggregate value added of the total firms in the sample stands at just above €19.8 billion in 2013, equivalent to about 13½ percent of Ireland's gross value added in manufacturing and services (at factor cost).

Firm size (by number of employees)	Number of observations ¹	Number of firms ¹
Small (1-49)	14,062	4,650
<i>of which: foreign</i>	2,761	879
Medium (50-249)	3,869	1,279
<i>of which: foreign</i>	712	229
Large (>249)	1,364	436
<i>of which: foreign</i>	250	71
Total	19,295	5,932
Sources: BvD; and IMF staff calculations.		
1/ Figures in parentheses indicate the percentage in the sample.		

7. The sample provides a wide coverage of firms across different size, sectors, and ownership. Overall, the sample includes 19,295 observations of 5,932 firms, mostly of less than 50 employees (about 73 percent of the sample). Medium-sized and large firms account for 20 percent and 7 percent of the firms in the sample, respectively. The sample covers the period 1995-2014, though the vast majority of observations is concentrated in the period 2006-2013 (Table A1 in Annex I). The sectoral composition indicates that the majority of the observations (90 percent) relates to services, while manufacturing accounts for the rest (Table A2 in Annex I). The dataset also allows differentiating between domestic firms and subsidiaries of foreign corporations ("foreign firms" thereafter), whose TFP is more likely to be affected by external factors through their parent companies. Foreign firms account for about 20 percent of the total firms in the sample, with representation across all categories of firm size.

8. The dataset, however, has several shortcomings, suggesting that the results should be treated with some caution. First, the composition and number of the firms is not fixed over time, thus complicating inter-temporal comparisons. Second, due to limited number of observations in sub-sectors, the analysis groups the firms into two main categories: manufacturing and services. Such grouping may not fully capture the firms' idiosyncratic production functions in the various segments and thus may lead to possible TFP measurement errors. Lastly, the composition of the sample suggests that small firms are somewhat under-represented compared to their actual share in

the Irish economy. To mitigate this problem, we present the TFP patterns and estimations of the determinants of TFP growth by firm size.

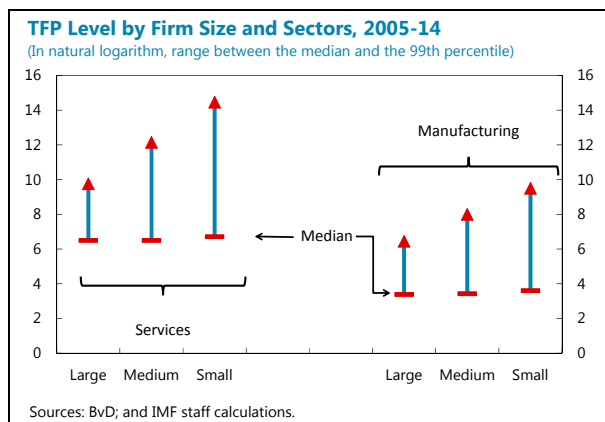
9. The literature offers several approaches to measure TFP at the firm level (summarized in Gal, 2013). These approaches range from various estimation techniques such as those used by Olley and Pakes (1996), Levinson and Petrin (2003), and Akerberg (2006) where unobserved productivity shocks are proxied by another state variables such as investment and immediate inputs, and Arellano and Bover (1995) and Blundell and Bond (1998) who utilized system GMM to tackle the possible endogeneity of the right-hand side variables by using their lagged values as instruments. In this paper, the recent TFP patterns among Irish firms are identified by calculating a Solow-type weighted average of inputs at firm level. The labor and capital elasticities at the firm level are proxied by the sectoral labor and capital shares taken from the EU KLEMS database.⁶ Since the data for Irish firms is rather limited and there is insufficient number of observations to analyze individual sectors by NACE classification, we group the sectors into two main categories (manufacturing and services), and deflate the nominal levels of value added and capital using sectoral deflators.⁷

C. Some Stylized Facts

10. The average level of productivity in services is significantly higher than in the manufacturing sector. The distribution of productivity among Irish firms and sub-sectors is wide.

Nevertheless, at the aggregate level, the analysis suggests that the average TFP in services is significantly higher than the average TFP in manufacturing, reflecting perhaps the prevalence the knowledge-intensive firms in the information and communication technologies (ICT) and financial services. In manufacturing, pharmaceutical firms are at the top end of the TFP distribution, but they account only 7½ percent of observations in this sector.

Interestingly, the analysis shows that the TFP of the median large firm is not significantly different from the TFP of the median small and medium-sized firms, while the level of TFP of the top small firms is well above that of larger firms in both the manufacturing and services sectors.⁸ From regional perspective, the analysis also shows that TFP in Leinster is significantly higher than in other



⁶ Industry labor and capital shares for Ireland are available only until 2007. However, they exhibit little variation over time.

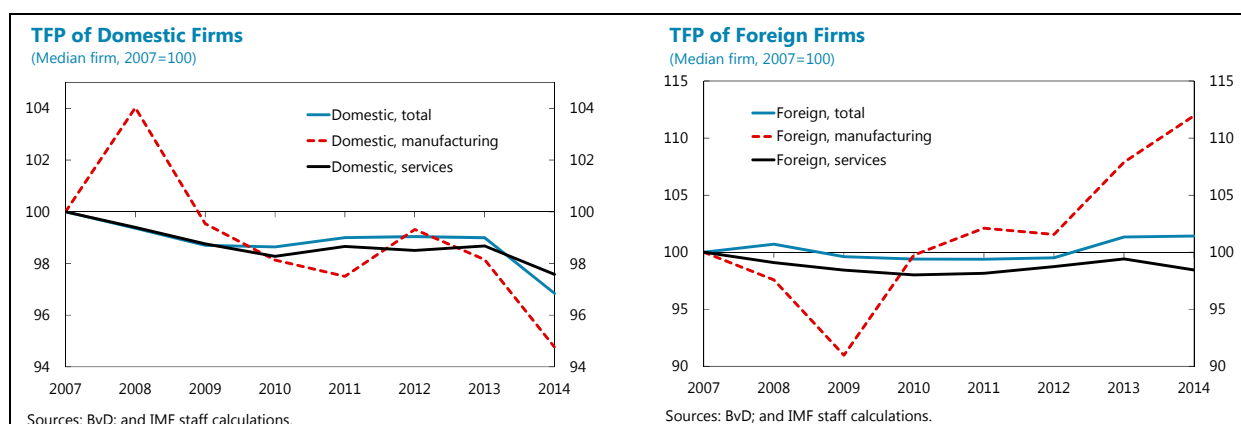
⁷ Agriculture and construction sectors were dropped from the sample due to the limited number and highly volatile values of input factors.

⁸ Labor productivity is positively correlated with the firm size, primarily reflecting the high capital-to-labor ratio among large firms.

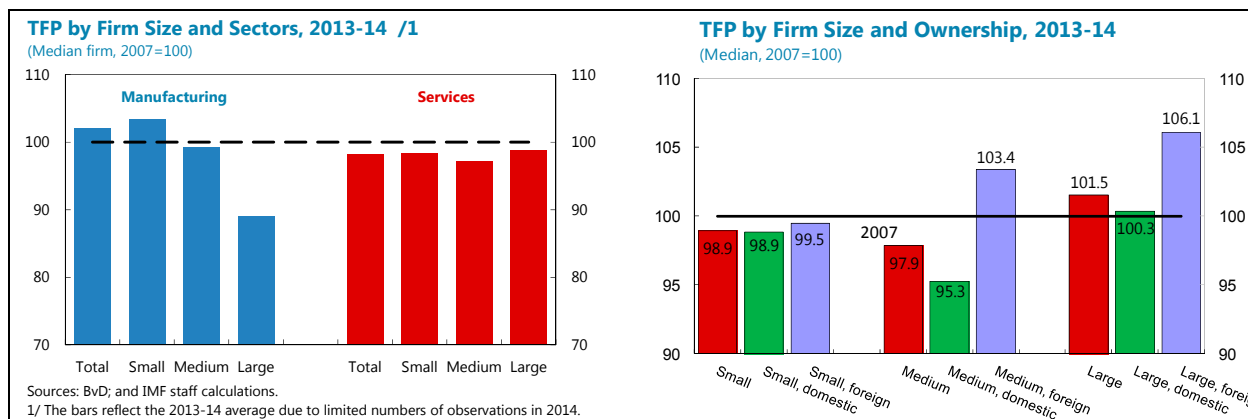
regions, reflecting perhaps the sectoral composition of firms in this region, including at around Dublin (Figure A1 in Annex I).

11. Productivity of domestic firms has lagged behind that of foreign firms in recent years.

While the average TFP of both domestic firm and foreign firms declined in the initial stages of the financial crisis, the TFP of the median domestic firm remained subdued in the following years, and even further declined in 2014. This pattern broadly reflects the TFP in both manufacturing and services. By contrast, the TFP of the median foreign-owned firm recovered in 2013-14, and at end-2014, it surpassed its 2007 level by 1½ percent. Moreover, the recovery of TFP among foreign-owned firms seems to be driven by the manufacturing sector where the productivity of the median firm surged by a cumulative 10 percent in 2010-2014, while the TFP of the median firm in services remained weak.



12. Productivity dynamics have diverged across different categories of firm size. The data suggests that TFP of the median large firm modestly exceeded its pre-crisis level at end-2014, largely on the back of improved productivity among large foreign-owned firms. Within the medium-sized firms, the different speed of recovery is also evident, as TFP of foreign subsidiaries in 2014 stood at about 3.4 percent above the 2007 level, while that of the median domestic firm remained at about 5 percent below its pre-crisis level. The TFP of the median small firm remained subdued in both domestic and foreign-owned groups, suggesting that small firms are more vulnerable to the effects of the financial crisis regardless of their type of ownership.



13. Overall, the pace of TFP recovery across sectors does not show a clear trend. In manufacturing, there seems to be a negative correlation between the firms' size and TFP growth during 2007-14. In particular, the data show that TFP of small firms has surpassed its 2007 level, while the TFP of large firms is still lagging behind. In services, however, the productivity of the median firm has not fully recovered from the crisis across all categories of firm size.⁹

D. Distance from the Frontier and Convergence

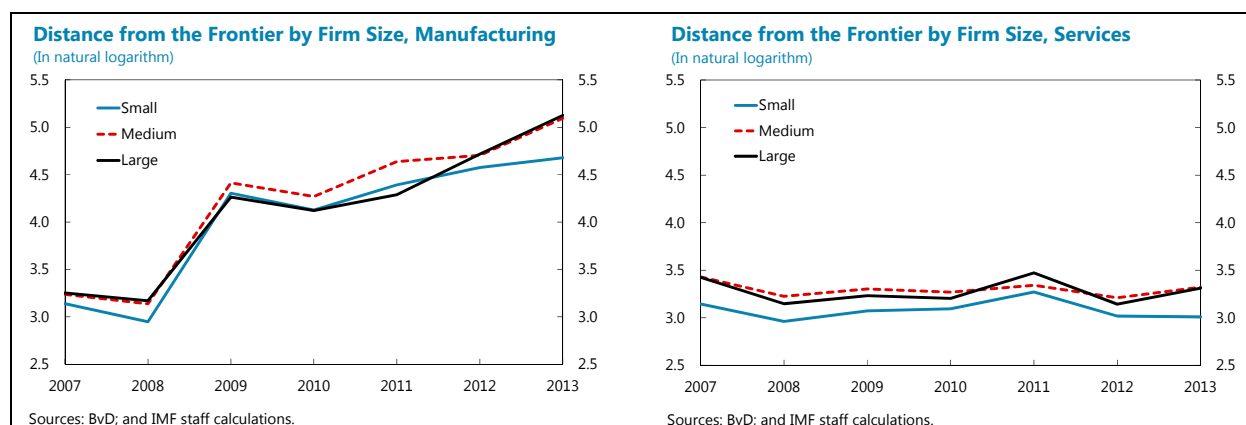
14. This section explores whether firms' TFP tends to gravitate towards the TFP at the frontier. In view of the wide distribution of TFP across Irish firms, this section focuses on the characteristics of the most productive firms and examines how the distance between them and the rest of the firms in each sector has changed in recent years. This analysis, which follows Andrews et al. (2015), could indicate whether and how fast frontier technologies and innovations are diffused to other firms, and whether such patterns were disrupted by global financial crisis. The frontier is calculated as TFP at the 99th percentile and is allowed to vary by year and by sector. For the period 2007-2014, the number of frontier firms is 95 and 13 in services and manufacturing, respectively.

	Manufacturing		Services	
	Frontier	Non-frontier	Frontier	Non-frontier
TFP (in natural logarithm)	5.4	3.6	8.4	6.6
Number of employees	1,559	539	796	77
Age (years)	42.6	23.3	29.6	15.2
Return on Equity (percent)	52.7	14.0	71.3	8.9
Debt to equity (percent)	184.9	87.7	148.5	65.8
Intangible fixed assets/fixed assets (percent)	4.1	3.2	10.4	2.3

Sources: BvD; and IMF staff calculations.

⁹ The number of firms that remained in the sample throughout 2007-2013 is relatively small (365); however, the evolution of the TFP across firm size and ownership is broadly consistent with the overall sample (see figures A2 and A3 in Annex I).

15. Table 2 reports the differences in average characteristics between frontier firms and non-frontier firms. It shows that firms at the frontier are, on average, 30-50 percent more productive compared with non-frontier firms, and they tend to be significantly larger and older compared with their peers. In addition, frontier firms are considerably more profitable than non-frontier firms and they are more leveraged, suggesting that they have greater access to finance. The high share of intangible fixed assets to total fixed assets held by frontier firms may indicate that they invest much more than their peers in innovation, patents, and new technologies, which could partly explain their high productivity. Interestingly, the data show that the share of frontier firms is similar for both foreign and domestic groups (about 0.2 percent).



16. The distance from the frontier varies across sectors and firm sizes. The distance from the frontier in manufacturing widened significantly since the onset of the global financial crisis across all categories of firm size, mainly due to an improved TFP among frontier firms and stagnation of TFP in the non-frontier ones. In 2013, the distance from the frontier peaked at about two thirds of the median TFP in this sector. By contrast, the distance from the frontier in services remained broadly flat as the TFP of both frontier and non-frontier firms remained broadly stable.

Sample	All firms		Small firms		Medium-sized firms		Large firms	
$d\ln TFP(-1)$	-0.215*	-0.215*	-0.212*	-0.212*	-0.199*	-0.199*	-0.313*	-0.287*
Distance-to-frontier(-1)	0.060*	0.084*	0.054*	0.063*	0.070**	0.065*	0.124*	0.299*
Distance-to-frontier(-1)		0.005		0.015		0.004		-0.090*
*Dum_Manufacturing								
Distance-to-frontier(-1)		-0.028**		-0.012		0.004		-0.206*
*Dum2009_14								
Dum_Manufacturing	-0.050*	-0.068	-0.060**	-0.111	-0.040	-0.057	-0.072*	0.250*
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
# of Observations	8,332	8,332	5,863	5,863	1,809	1,809	660	660
Adjusted R-square	0.08	0.08	0.07	0.07	0.09	0.09	0.217	0.256
* Indicates a significance level of 1 percent.								
** Indicates a significance level of 5 percent.								

17. Non-frontier firms gradually converge to the frontier, though the pace of convergence has slowed in the post-crisis period. The estimations, which are presented in Table 3, show that the coefficients of the distance-to-frontier are positive and significant. This indicates that non-frontier firms tend to converge to the frontier in their sectors, though the pace of convergence appears to be faster among large firms. The interaction of distance-to-frontier with *Dum2009_14*, which obtains a value of one in 2009-14 and zero otherwise, suggests that the pace of convergence has moderated since 2009. Furthermore, these specifications suggest that TFP growth in manufacturing firms is, on average, lower than that of firms in services, and from the interaction of the distance-to-frontier with the manufacturing dummy (*Dum_Manufacturing*) we can infer that the convergence of large firms in manufacturing to frontier is more gradual than the convergence speed of large firms in services.

E. Firm-level Determinants of TFP Growth

18. Next, the determinants of TFP growth at the firm-level are assessed. We regress TFP growth on several firm-level variables, controlling for macro-economic, regional, and sectoral effects. Firm-level factors include the firms' size, age (the "learning-by-doing" effect), financial health, access to finance, cash flow, innovation, and ownership. The latter, which identify foreign-owned companies, controls for the impact of global factors. The specifications also include a time dummy to control for macroeconomic effects. The description of the variables and their potential impact on TFP growth is discussed in Table A6 in Annex I.

19. We employ a system GMM (Arellano and Bover, 1995; Blundell and Bond, 1998). This methodology includes fixed effects and tackles endogeneity of the right-hand side variables by using their lagged values (in first differences and levels) as instruments. The consistency of the GMM estimator depends on the validity of the instruments, which is examined by means of the Hansen statistic of over-identifying restrictions.¹⁰ The validity of the instruments also requires the lack of second-order serial correlation in the first-differenced error term whereas, by construction, first-order correlation is expected even with an uncorrelated original error term. An additional test is therefore included to examine the null hypothesis of no second-order correlation in the residuals.

Estimation results

20. The estimation results of the various specifications are presented in Table 4. In all of the specifications the Arellano-Bond tests rejects the hypothesis that the errors are not auto-correlated in the first order (AR-1) as expected, but cannot reject this hypothesis for the second order (AR-2). The Hansen test p-values are higher than 10 percent, thus suggesting that the instruments are valid, i.e. uncorrelated with the error term.

¹⁰ Hansen statistic tests the hypothesis that the instruments are not correlated with the residuals.

21. The estimations show that the firms' TFP growth is affected by firm-level factors. In particular, the results indicate the following:

- **Age.** The positive and significant coefficient of *Age* indicates that younger firms enter the market with relatively lower TFP and, as experience is accumulated over time and production processes becomes more streamlined, TFP gains are realized.¹¹
- **Innovation.** Consistent with other studies, including Belhocine (2009), Corrado et al (2009), and Marrocu et al (2009), the results show that higher innovation activities, as measured by the ratio of intangible assets-to-total assets (*IFA_TA*), have a positive effect on TFP growth.
- **Access to finance and liquidity.** The coefficient of debt-to-total assets (*Debt_TA*) is positive and significant in all the specifications, suggesting that access to funding contributes to TFP growth by allowing firms fund productivity-enhancing projects and investment in human capital.¹² This finding is in line with other studies such as Siedchlag et al. (2014), who focused on SMEs and found that, in the absence of well functioning financial markets, the financial constraints faced by firms have a negative impact on their productivity.¹³ Consistent with this argument, the results also show that firms with lower cash flow as a share of operating revenue (*Cash flow*) have, on average, lower productivity gains.
- **Financial distress.** The firm's financial distress is measured by a dummy, which obtains a value of one if the firm's interest cover ratio (ICR) is below two, and zero otherwise. The estimations show that low ICR has a negative and significant contribution to productivity growth, as in these distressed situations firms' profitability is limited, and is mainly used to cover debt service obligations.
- **Ownership.** The empirical studies suggest that the relationship between foreign ownership and productivity is inconclusive. On one hand, foreign-ownership can lead to better production, management and marketing capabilities, which result in higher TFP. On the other hand, foreign-owned enterprises can have lower TFP, particularly if the parent companies keep their high value production at home, and leave lower value added assembly operations to their subsidiaries, which in turn employ lower skilled workers and older technologies (Harris and Moffat, 2011). The results in this study indeed show that the impact of ownership is ambivalent: the interaction of *foreign* with the firm size has a positive and strong impact on productivity growth among large and medium-sized firms and a negative effect among small firms. This may suggest that foreign-owned large and medium-sized firms are positioned higher in the value chain and thus are more knowledge-intensive compared to foreign-owned small firms.

¹¹ The possibility of a non-linear effect was tested but the coefficient of the squared age was not significant.

¹² The adverse effect associated with excess leverage is captured in the *ICR_2less* variable.

¹³ In an alternative specification we also found that the change in debt-to-asset ratio, which captures the firms' ability borrow, is also positively contributing to TFP growth, thus supporting the argument that financial constraints are affecting TFP growth.

- **Size.** In principle, firm size can exert two opposing influences on productivity growth. On one hand, larger firms tend to have access to a larger pool of technology and they normally benefit more from scale economies, thus their productivity can grow faster. On the other hand, they tend to be less flexible in their operations, which could have a negative impact on productivity. Our results, however, suggest that, other things being equal, productivity declines with size, as measured by both number of employees (Ln_N) and total assets ($Ln_RTassets$). This may suggest that most of the factors, which support higher productivity growth among large firms, are already captured by other variables in the regression, such as access to finance, innovation, and financial resilience. Furthermore, the robustness check (see below) suggests that the inverse relationship between size and productivity growth is significant only among small firms, perhaps reflecting the prevalence of highly productive start-ups in this group.
- **Sectoral and regional effects.** The analysis indicates that Leinster and Munster regions benefitted from a higher productivity growth than the rest of the regions. The coefficient of manufacturing is significant only in two out of six estimations, but the direction of the impact seems to be dependent on the chosen specification.

Table 4. Determinants of TFP Growth
Dependent variable: $\ln(TFP)$

	(1)	(2)	(3)	(4)	(5)	(6)
$Ln_RTassets$						-0.075*
Ln_N	-0.114*	-0.072*	-0.057***	-0.064**	-0.049***	
ICR_2less	-0.339*	-0.645*	-0.600*	-0.275*	-0.304*	-0.291*
Age	0.017**	0.001*	0.000	0.000	0.010*	0.009**
$Debt_TA$		0.031*	0.030*	0.053*		
IFA_TA			0.629**	0.755**	0.552***	1.078***
$Foreign$				-0.189**	-0.100**	-0.096**
$Foreign*Medium-Sized$				0.297*	0.142***	0.171**
$Foreign*Large$				0.397**	0.237*	0.299*
$Cash\ flow$	0.029*			0.026*	0.028*	0.027*
$Dum_Manufacturing$	-0.008	0.000	0.002**	0.078	-0.032*	0.037
$Connacht$	0.048	0.009	0.014	0.128	0.048	0.037
$Leinster$	0.180*	0.101*	0.053***	0.115**	0.116*	0.177*
$Munster$	0.122**	0.073**	0.065**	0.216*	0.110*	0.127*
$Constant$	-0.277*	0.281*	0.262*	-0.122*	-0.295	0.614*
Time dummies	yes	yes	yes	yes	yes	yes
# of observations	9,776	6,185	6,157	4,317	9,751	9,751
# of firms	3,165	2,269	2,266	1,597	3,159	3,159
AB test for AR-1	0.000	0.000	0.000	0.004	0.000	0.000
AB test for AR-2	0.215	0.158	0.182	0.431	0.187	0.169
Hansen test	0.546	0.137	0.830	0.877	0.670	0.232
* Indicates significance at 1 percent **indicates significance at 5 percent *** indicates significance at 10 percent.						

Robustness

22. For robustness, we perform two alternative estimations. In the first one, we split the period into two to assess whether there is a considerable difference between the pre-crisis period (1995-2008), and the following years (2009-2014). In the second set of estimations, we differentiate by firm size and estimate the regressions separately for small firms, medium-sized and large firms. The latter set of estimations addresses the concern regarding the possible bias that stems from under-representation of small firms in the sample.

23. The results are presented in Tables A4 and A5 in Annex I. The results for the two sub-periods (Table A4) show that the coefficients of financial distress (*ICR_2less*), leverage (*Debt_TA*) and liquidity (*cash flow*) remain significant in all of the specifications, while the positive effect of intangible assets-to-total assets is significant only in 2009-2014. The effect of size and ownership is significant only in the post-crisis period, but not in all the specifications. Moreover, firms in the manufacturing sector, seem to had a slower productivity growth in 2009-2014. The estimations by firms' size (Table A5) indicate that the effects of the financial distress (*ICR_2less*), access to finance (*Debt_TA*), and liquidity (*Cash flow*) remain significant in most of the specifications. Interestingly, the inverse relationship between firms' size and TFP growth is only evident among small firms, perhaps reflecting the high TFP growth among start ups. Also, the coefficient of the firms' age is significant only among small firms, suggesting that "learning-by-doing" effect is more important when small firms enter the market.

F. Conclusions

24. This study utilizes firm-level data to examine the TFP dynamics of Irish firms in recent years. The analysis suggests that the level of TFP in services is generally higher than in the manufacturing sector, and that TFP among the most productive small firms is higher than that of the most productive larger firms. Moreover, the analysis indicates that, in recent years, productivity growth was not homogeneous across sectors and categories of firm size. Specifically, the results show that the TFP growth of SMEs has lagged behind that of large firms, and that productivity growth of medium-sized and large foreign-owned firms outperformed their domestic peers, particularly in the manufacturing sector. In addition, the analysis suggests that, while there is evidence of diffusion of technologies and innovations from frontier firms towards non-frontier enterprises, the speed of convergence has decelerated in the post-crisis period (2009-2014), especially among large firms.

25. The study also finds that TFP growth is affected by firm-level factors. More specifically, it reveals that, on average, older firms have on average higher productivity growth than their peers, indicating that accumulation of knowledge and experience plays an important role in making the production process more efficient. The analysis also indicates that higher, leverage, which captures the firm's access to finance, and greater innovation activities (as measured by a higher share of

intangible asset in total assets) are positively correlated with higher TFP growth. Not surprisingly, financial distress is associated with lower productivity growth while higher liquidity seems to contribute to higher productivity growth. Ownership may also play a role, but the impact is not uniform across all categories of firm size. Large and medium-sized foreign-owned firms have on average higher TFP growth while small foreign-owned firms have lower productivity growth. This may suggest that the former firms are more knowledge-intensive and operate in the upstream part of the value chain while small foreign-owned firms are normally located at the low end of the value chain.

26. The analysis results suggest that there is room for policies to support TFP growth.

Domestic firms are still struggling to recover from the effects of the global financial crisis, and their TFP growth remains below the pre-crisis levels. Given that access to finance is critical to ensure adequate investment in innovative projects and thus enhance firms' TFP, broadening financing options for SMEs would be critical. At the same time, and in line with the OECD's policy recommendation, greater direct public sector support for SMEs' R&D would also improve productivity.¹⁴ As small firms have limited in-house R&D resources, greater collaboration with research institutions and academia can also foster higher productivity (including through education and training, innovation vouchers/grants, and establishment of science parks). Policies that motivate partnership between domestic and large foreign-owned enterprises can also increase productivity by capitalizing on their infrastructure, pool of knowledge, innovation activities, and access to international markets.¹⁵ Lastly, the negative impact of the firms' financial distress on productivity underlines the need for advancing the loan restructuring of distressed, but viable, firms.

¹⁴ Ireland's public support to business is skewed towards R&D tax credit, but young and small firms may not fully benefit from these schemes if they lack the upfront funds to start innovative projects (OECD, 2015). Moreover, IMF (2016) analysis shows that preferential tax treatment (patent boxes) are often not cost-effective in stimulating R&D, and in some cases they are just simply part of an aggressive tax competition strategy.

¹⁵ Policies to strengthen the linkages between SMEs and MNEs could include the removal of information and matching barriers, enhancement of SMEs' capabilities to meet MNEs' standards (e.g. for suppliers), and tax provision of tax incentives for MNEs to engage with domestic SMEs.

Annex I. Sample Coverage, Robustness Estimation Results, and Additional Figures

Table A1. Sample Coverage by Year						
Year	Small	Medium	Large	Total	Domestic	Foreign
1995	2	0	12	14	9	5
1996	3	0	13	16	10	6
1997	3	1	13	17	11	6
1998	1	0	14	15	10	5
1999	1	5	13	19	12	7
2000	1	1	15	17	10	7
2001	0	2	12	14	9	5
2002	1	0	5	6	4	2
2003	0	1	5	6	4	2
2004	0	0	3	3	3	0
2005	134	53	43	230	198	32
2006	957	370	153	1,480	1,188	292
2007	1,937	604	199	2,740	2,184	556
2008	2,106	596	175	2,877	2,300	577
2009	2,060	540	157	2,757	2,198	559
2010	1,969	502	154	2,625	2,121	504
2011	1,854	448	155	2,457	2,007	450
2012	1,572	399	115	2,086	1,711	375
2013	1,333	323	88	1,744	1,442	302
2014	128	24	20	172	141	31
Total	14,062	3,869	1,364	19,295	15,572	3,723

Table A2. Sample Coverage by Sectors and Firm Size				
	Small	Medium	Large	Total
Manufacturing	1,073	624	246	1,943
Services	12,989	3,245	1,118	17,352
Total	14,062	3,869	1,364	19,295

Table A3. Correlation Matrix

	<i>dlnTFP</i>	<i>ln_N</i>	<i>ICR_2less</i>	<i>Age</i>	<i>IFA_TA</i>	<i>Debt_TA</i>	<i>Foreign</i>	<i>Cash_flow</i>
<i>dlnTFP</i>	1							
<i>ln_N</i>	-0.020	1						
<i>ICR_2less</i>	-0.126	0.009	1					
<i>Age</i>	-0.035	0.067	0.057	1				
<i>IFA_TA</i>	0.023	0.216	0.020	-0.138	1			
<i>Debt_TA</i>	0.046	-0.048	0.112	-0.041	0.021	1		
<i>Foreign</i>	0.007	-0.004	-0.004	0.102	-0.016	-0.018	1	
<i>Cash_flow</i>	0.173	-0.132	-0.402	-0.002	0.033	-0.126	0.000	1

Table A4. Determinants of TFP Growth, System GMM*Dependent variable: dln(TFP)*

	Pre-crisis (1995-2008)			Post-crisis (2009-2014)		
<i>ln_N</i>	-0.033	-0.021	-0.034	-0.105***	-0.093*	-0.077
<i>ICR_2less</i>	-0.232*	-0.244*	-0.244*	-0.286*	-0.364*	-0.365*
<i>Age</i>	-0.002	-0.004**	0.006**	0.017**	0.046*	0.046*
<i>Debt_TA</i>	0.047*			0.080*		
<i>IFA_TA</i>	0.350	0.153	0.316	1.194**	1.233**	1.214**
<i>Foreign</i>	-0.041	-0.063*		-0.244**	-0.190*	-0.199*
<i>Foreign*Medium-Sized</i>	0.135	0.023		0.321**	0.053	
<i>Foreign*Large</i>	0.187	0.152		0.559**	0.479	
<i>Cash flow</i>	0.029*	0.031*	0.031*	0.028*	0.029*	0.029*
<i>Manufacturing sector</i>	-0.026	-0.067	-0.056	-0.036	-0.223**	-0.231**
<i>Connacht</i>	-0.122	-0.011	-0.115	0.191***	-0.040	-0.040
<i>Leinster</i>	0.049	0.054	0.062	0.208*	0.070	0.064
<i>Munster</i>	0.175**	0.139*	0.141*	0.223**	0.030	0.022
<i>Constant</i>	-0.150	-0.255*	-0.253*	-0.390	0.713*	-0.786*
Time dummies	yes	yes	yes	yes	yes	yes
# of observations	2,091	4,222	4,222	2,908	7,079	7,079
# of firms	1,119	2,211	2,211	1,219	2,590	2,590
AB test for AR-1	0.014	0.000	0.000	0.000	0.000	0.000
AB test for AR-2	0.720	0.428	0.425	0.822	0.239	0.246
Hansen test	0.999	0.998	0.996	0.103	0.207	0.233

* Indicates significance at 1 percent **indicates significance at 5 percent *** indicates significance at 10 percent.

Table A5. Determinants of TFP Growth, System GMM*Dependent variable: $\ln(TFP)$*

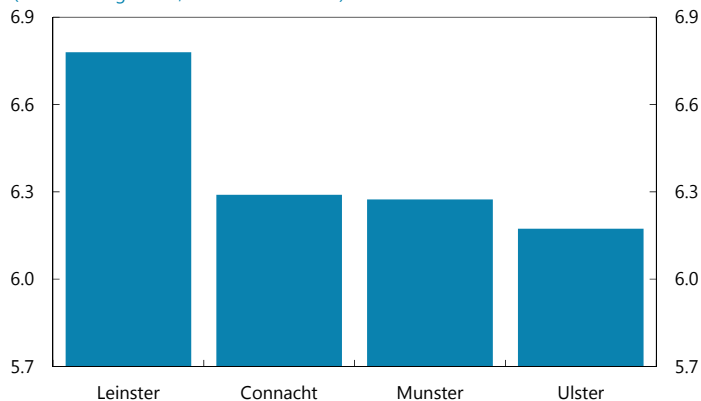
	Small		Medium		Large	
<i>Ln_N</i>	-0.238*	-0.326*	0.011	0.085	-0.038	-0.057
<i>ICR_2less</i>	-0.216*	-0.321	-0.283*	0.121	-0.321*	-0.246
<i>Age</i>	0.016**	-0.004	0.009	0.007	0.001	0.009
<i>Debt_TA</i>		0.045**		0.095		0.173*
<i>IFA_TA</i>	0.395		0.175		0.213	
<i>Foreign</i>	-0.058		-0.006		-0.021	
<i>Cash flow</i>	0.031*	0.035*	0.026*	0.030*	0.007***	0.007
<i>Manufacturing sector</i>	0.024	0.272**	-0.105	-0.376	-0.082***	-0.047
<i>Connacht</i>	0.056	0.330**	-0.023	0.124	-0.114	-0.074
<i>Leinster</i>	0.156*	0.209**	0.014	0.249	-0.004	0.001
<i>Munster</i>	0.125**	0.366*	0.102	0.188	-0.037	-0.065
<i>Constant</i>	-0.081	0.167	-0.423	-0.780	0.250	0.288
Time dummies	yes	yes	yes	yes	yes	yes
# of observations	6,922	2,115	1,912	1,375	917	827
# of firms	2,376	920	670	520	302	279
AB test for AR-1	0.000	0.018	0.000	0.022	0.002	0.011
AB test for AR-2	0.258	0.606	0.581	0.215	0.782	0.858
Hansen test	0.174	0.628	0.183	0.345	0.999	0.983

* Indicates significance at 1 percent **indicates significance at 5 percent *** indicates significance at 10 percent.

Figure 1. TFP Developments for Firms that Remained in the Sample Continuously during 2007-2013¹

TFP by Regions,

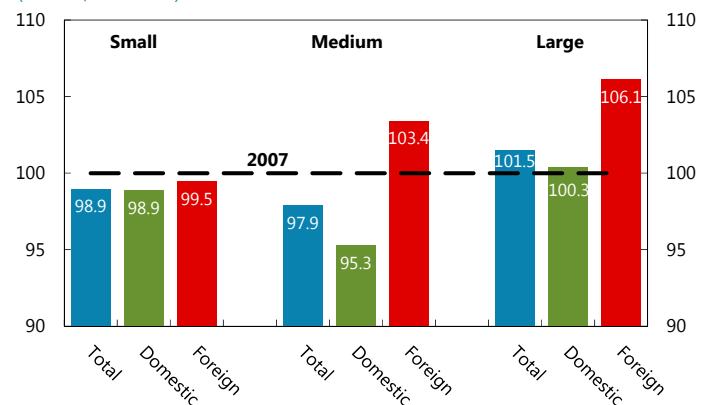
(In natural logarithm, median 2005-2014)



Sources: BvD; and IMF staff calculations.

TFP by Firm Size and Ownership, 2014

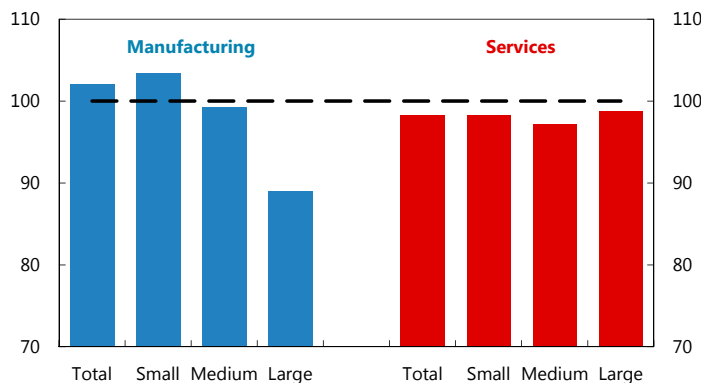
(Median, 2007=100)



Sources: BvD; and IMF staff calculations.

TFP by Firm Size and Sectors, 2013-14 /1

(Median firm, 2007=100)



Sources: BvD; and IMF staff calculations.

1/ The bars reflect the 2013-14 average due to limited numbers of observations in 2014.

¹ The number of firms that remained in the sample continuously in 2007-13 is 365, of which 279 are domestic.

Table A6. Firm-Level Determinants of TFP Growth

Variable name	Description	Channel	Potential effect	Literature
<i>dlnTFP</i>	First difference of the natural logarithm of TFP			
<i>Ln_N</i>	Natural logarithm of number of employees	Size	Firm size can exert two opposing influences on productivity. On one hand, larger firms tend to have access to a larger pool of technology and they normally benefit more from scale economies. On the other hand, they tend to be less flexible in their operations, which could have a negative impact on TFP.	Leung et al. (2008), Lee and Tang (2001), Rao and Tang (2000).
<i>Ln_RTassets</i>	Natural logarithm of total assets in real terms	Size	See above.	See above.
<i>Age</i>	Firm's age	Learning-by-doing	The firm's age may indicate whether older firms have higher TFP as managers and employees accumulate experience, and gain from learning-by-doing. Industrial evolution models suggest that young firms normally enter the industry at low productivity before growing and converging to the average productivity growth in the industry.	Jovanovic and Nyarko (1996), Jensen et al. (2001), Van Biesebroeck (2005).
<i>Debt_TA</i>	Total debt-to-total assets ratio	Access to finance	Limited access to finance may limit the firm's activities and ability to finance operating expenses, including on innovative projects, research and training, suggesting that access to external financing can play an important role in supporting productivity growth.	Gatti and Love (2008), Chen and Guariglia (2013), Levine and Warusawitharna (2014), Coricelli et al. (2010).
<i>Cash flow</i>	Cash flow as a share of operating revenue	liquidity	Similarly to access of finance channel, liquidity-constrained firms are less likely to invest in activities that results in higher TFP growth, particularly when external funding is limited.	Siedschlag et al. (2014)
<i>ICR_2less</i>	A dummy, which obtains a value of 1 if ICR is lower than 2, zero otherwise.	Financial health	An ICR that is lower than 2 indicates that the firm is approaching a financial distress, thus resources are likely to shift away from productive activities towards servicing the debt.	
<i>IFA_TA</i>	Intangible fixed assets-to-total assets ratio	Innovation	The firm's intangible assets, which include computerized information, innovative property, patent, license, copyright, and new architecture, are assets that provide future benefits through higher TFP growth.	Belhocine (2009) and Corrado et al. (2009) and Marrocu et al. (2011)
<i>Foreign</i>	A dummy, which obtains a value of 1 if the parent company is non-Irish. Zero otherwise.	Ownership	Foreign ownership can lead to high TFP growth as a result of knowledge spillovers and through better management and marketing capabilities. However, foreign-subidiaries may be expected to have lower level of TFP growth if their parent companies tend to keep their high value production at home and leave them with lower value added assembly operations.	Harris and Robinson (2003), Doms and Jensen (1998), Griffith and Simpson (2003), and Okamoto (1999).

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