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Director-General

The recovery in Europe appears to be firmer than many thought a few months ago, according to the winter forecast of the European Commission. It nonetheless remains partial, as reflected in the still high (though falling) unemployment rate and low number of hours worked, and in the persisting investment shortfall, translating into the relatively large current account surplus of the euro area. Risks around the central forecast scenario remain and uncertainties on the economic outlook persist both at the euro area level and globally.

The three topics covered in this issue of the Quarterly Report (non-performing loans and the macroeconomic environment; investment in intangible assets; price and non-price competitiveness) provide indications on policy areas and measures that can further strengthen the ongoing economic recovery in the euro area. Dealing with the high stock of NPLs on banks' balance sheets is key to support lending to the real economy and investment and thus GDP growth. At the same time, unlocking investment in intangible assets would importantly contribute to the recovery and support the Union's growth potential. Competitiveness also remains key in this respect, with non-price (quality) aspects assuming a particular importance for European companies.

Against the current macroeconomic context and outlook, low profitability in the banking sector is a critical issue that remains high on the agenda. Tackling the sources of low bank profitability is particularly important to create the right conditions for a rebound in investment, once aggregate demand will pick up more robustly. A crucial aspect in this respect, as already anticipated, is how to address the stock of non-performing loans (NPLs) on bank balance sheets.

High NPL levels negatively impact credit supply and demand, reducing lending to the real economy at a time where, on the contrary, support to the economic recovery is needed. As explained in Section I, a vicious circle can potentially set in between low asset quality, low bank profitability, rising capital requirements and constrained lending, negative effects on GDP growth and a worsening of the initial NPLs problem. Though showing causality of this dynamics is fraught with difficulties (as acknowledged in the analysis), persistently high NPLs in a number of euro area countries could be contributing to the sluggish nature of the recovery in the euro area as a whole. Taking decisive policy action to reduce NPLs would therefore be beneficial for growth.

While problems with NPLs differ significantly in intensity across Member States, potential spillover effects through highly integrated banking sectors in the Union cannot be neglected. These spillovers highlight the common interest in finding appropriate – and, where useful, common - policy solutions.

Completing the repair of the financial sector is key to ensuring that savings are appropriately channelled towards investment. Additionally, policies should be designed in a way to support investments, particularly in assets that can reasonably be expected to have a stronger impact on long-term growth potential and for which market failures would likely lead to underinvestment. Section II focuses on a specific type of investment, "Intangible assets" (i.e. computerized information, innovative software, economic competencies, design, organisation), which are at the core of competitive firms, and are thus vital to support economic growth. A steadily widening gap in investment in intangible assets has emerged in the EU vis-à-vis the US over the past 20 years. The empirical evidence suggests that increasing intangible investment to US levels would help to close the gap in total factor productivity (TFP) vis-à-vis the US. Identifying factors that hold back investments in

intangibles in Europe and devising solutions to unlock them is therefore particularly important to design policies which effectively increase the Union's growth potential.

Intangible assets differ from other assets as they take mainly the form of knowledge (which can be embodied in human capital), and hence are difficult to use as collateral. They can generate sizeable scale economies, quickly resulting in monopolistic situations. Investment in intangibles is exposed to more uncertainty and risks than other types of investment, making it relatively more difficult to find the appropriate funding to carry them out. At the same time, investment in these assets can bring high social returns, making it crucial to find the right balance among these various trade-offs.

Regulations ensuring well-functioning product, labour and capital markets are pivotal to enable the flexible reallocation of productive resources necessary to unlock investment in intangible assets. At the same time, it is crucial to ensure an appropriate mix between effective intellectual property right systems (to ensure sufficient returns to investment) and a properly designed and effectively enforced competition policy addressing rent seeking and monopoly powers. Public support, in particular for intangible assets with high social returns (like R&D), could help avoid underinvestment relative to what would be socially desirable. Improving the functioning of more risk-prone segments of the financial market could also help to channel the necessary funding to such investment. Finally, the provision of complementary infrastructure and policies related to human capital formation appear essential to support investment in intangibles.

While Section II focusses on investments in intangible assets as an important factor behind firms' competitiveness and the economy's growth potential, the key issue of competitiveness is taken up again in Section III under a different angle. Here the analysis focusses on the relative importance of various factors behind euro area countries' export performance (relative prices, dynamism of export markets, non-price factors). It is well-known from the economic literature that a "Kaldor paradox" can emerge, whereby the growth in a country's export market share is sometimes found to be positively correlated to growth in its unit labour costs, and that one explanation possibly lies in higher prices reflecting higher quality. The analysis in Section III confirms that growth in export quality is positively related to the export performance of euro area countries. Addressing weaknesses in non-price determinants of exports and investing in quality improvements can therefore strengthen competitiveness and increase exports, making them less sensitive to relative price changes and helping European companies thrive on international markets. Non-price aspects clearly represent an essential element of a successful competitiveness strategy for euro area countries and deserve both further analytical focus and policy attention.

I. A macroeconomic perspective on non-performing loans (NPLs)

This chapter focusses on the observation of high non-performing loans (NPLs) in the current context of a slow economic recovery. High levels of NPLs are a legacy of the crisis and a result of a protracted period of sluggish growth. They reflect the fact that credit risk in the economy is still high. This has an impact on both borrowers' risk aversion and banks' willingness to lend, which result in reduced lending at a time when support to the still modest economic recovery is greatly needed. The macroeconomic significance of NPLs arises from the potential of a vicious circle of low asset quality, low bank profitability, rising capital requirements and constrained lending, with negative effects on growth and a worsening of the initial NPL problems.

Through a comparative analysis across groups of EU countries, this section shows that Member States with high NPL ratios have also experienced below average economic growth, the most visible contractions in bank lending and investment ratios below the EU average. While showing causality is fraught with difficulties (as acknowledged in the analysis), these observations support the expectation of a nexus between NPLs and the contraction in bank lending and investment. Since persistently high NPLs in a number of Member States could be contributing to the currently sluggish nature of the recovery, more rapid progress with NPL resolution could help to break such a vicious circle.

In a deeply integrated area like the EU, particularly the euro area, with financial systems highly interconnected, problems with NPLs are likely to negatively impact on credit supply and economic growth not just in the affected Member States but also in the euro area as a whole (though it remains impossible to quantify exactly these channels of cross-border spillovers). These potential broader economic and spillover effects would therefore require not only undertaking important structural measures at Member States level but also, and importantly, a coordinated European approach to the NPL issue, in full respect of the current EU legal framework. This would go a long way in addressing the concerns explained in this analysis. ([1])

I.1. Introduction

The economic and financial crisis that started in 2008 has left scars on the banking sector of many EU countries in the form of elevated levels of non-performing loans (NPLs). ([2]) While the process of repairing bank balance sheets has been going on for the last few years, the overall ratio of NPLs to total loans remains high by historical standards. However, important differences between countries remain both across the EU and in the euro area, with the NPL ratio currently ranging from above 45% in Cyprus and Greece to a ratio between 1 and 2% in Luxembourg, Estonia and Finland. ([3])

Against this background, this section looks at developments in NPL ratios in the EU, and more specifically, it relies on comparative analysis of different groups of Member States to highlight correlations between NPLs on banks' balance sheets and the macroeconomic environment. ([4]) Indicative evidence of the cross-border banking exposure is then used to find indications of potential risks of cross-country spillover effects.

In sub-section I.2 the relationship between NPLs and the real economy is discussed from a theoretical point of view, with reference to the relevant economic literature. Sub-section I.3 describes the evolution of NPLs across Member States, based on which a categorisation of countries is proposed and used to run a comparative analysis.

([1]) This section was prepared by Katia Berti, Christian Engelen and Bořek Vašíček. The authors wish to thank Michael Thiel for constructive and useful comments on this section.

([2]) For the EU as a whole, the weighted average NPL ratio, in June 2016, stood at 5.5% of total on-balance loans and advances (based on the EBA harmonised NPL definition), having declined by less than 1 p.p. since the value first recorded two years and a half before, in December 2014 (when the EBA harmonised definition started being applied). See European Banking Authority (2016), 'Risk dashboard. Data as of Q2 2016', EBA, Department Oversight – Risk Analysis Unit; and European Banking Authority (2015), 'Risk dashboard. Data as of Q3 2015', EBA, Department Oversight – Risk Analysis Unit.

([3]) EBA harmonized definition of NPL, data as of June 2016.

([4]) Due to limitations in data availability, the analysis necessarily relies on simple correlations between the variables at stake, while associations discussed do not derive from a ceteris paribus type of analysis (i.e. controlling for the effects of other variables). Results should therefore be interpreted with caution.

The recent developments in bank lending and investment activity in different groups of Member States, divided according to NPLs ratios and dynamics, are the subject of sub-sections I.4-I.5 respectively. Finally, sub-section I.6 looks at cross-border banking exposures as an illustration of the potential risk of spillover effects related to the quality of bank balance sheets. Sub-section I.7 concludes.

I.2. NPLs and the real economy: a two-way relation

The health status of the financial sector in general, and the share of NPLs in banks' balance sheets in particular, are strongly inter-related with macroeconomic conditions. As well documented in the economic literature, difficult macroeconomic conditions tend to exert negative effects on the financial sector. ([5]) During recessions and periods of weak economic growth, corporates and households are more likely to fall behind with the repayment of their loans, leading to an increase in the share of NPLs in banks' balance sheets.

In turn, problems in the financial system, and in the banking sector in particular, can negatively impact on the macroeconomic context. ([6]) The existence and the size of this feedback effect is in general related to the extent to which banks can adequately continue fulfilling their role in channelling savings to investment, allocating risks and transmitting monetary policy impulses to the real economy.

Empirical studies ([7]) indeed tend to find a significant relationship between macroeconomic developments and asset quality and credit risk - a relationship that is generally found to be two-sided and highly non-linear. ([8]) Real GDP growth and lending conditions tend to be identified as common drivers of NPLs. Other determinants are nonetheless also identified, like past credit growth; share prices (that are likely correlated with prices of other assets used as collateral, namely housing); current account deficits (debt financed from abroad, with foreign creditors being less sensitive to domestic risks); and the exchange rate (for countries with lending in foreign currencies and significant currency mismatches). ([9]) On top of country-specific determinants of NPLs, some studies also point to bank-specific drivers, such as cost efficiency and the level of capital. ([10]) The evidence available for the euro area points to GDP growth and unemployment as the major drivers of NPLs, though bank-specific variables such as management quality and risk preferences are found to play a role as well. ([11])

Empirical studies show that the main channel of feedback effects from NPLs to macroeconomic developments appears to be subdued lending to the corporate sector, which, for instance, adversely affects the economic recovery after a downturn. ([12]) Additionally, an analysis on corporate-bank relationships conducted for European countries shows that corporate investment is significantly reduced both by a corporate's own debt overhang and by the weak

([5]) Demirguç-Kunt, A. and E. Detragiache (2005), 'The determinants of banking crises and developed countries', IMF Staff Papers, Vol. 45, No. 1, pp. 81–109; Jacobson, T., J. Linde and K. Roszbach (2005), 'Exploring interactions between real activity and the financial stance', Journal of Financial Stability, Vol. 1, No. 3, pp. 308–41.

([6]) European Commission (2016), 'Financial channels and economic activity in the euro area', Quarterly Report on the Euro Area, Vol. 15, No 2, pp. 19-31.

([7]) Unfortunately the empirical evidence on NPLs is constrained by data limitations in terms of restricted time coverage and cross-country comparability of figures due to differences in definitions. It is also inherently difficult to combine aggregated macroeconomic data with disaggregated lending data from individual financial institutions.

([8]) Claudio, B., M. Drehmann and K. Tsatsaronis (2014), 'Stress-testing macro stress testing: does it live up to expectations? ', Journal of Financial Stability, Vol. 12, pp. 3-15.

([9]) Espinoza, R.A. and A. Prasad (2010), 'Nonperforming loans in the GCC banking system and their macroeconomic effects', IMF Working Paper, No. 10/224; Beck, R., P. Jakubik and A. Piloiu (2015), 'Key Determinants of Non-performing Loans: New Evidence from a Global Sample', Open Economies Review, Vol. 26, pp. 525–550; Kauko, K. (2012), 'External deficits and non-performing loans in the recent financial crisis', Economics Letters, Vol. 115, pp. 196–199.

([10]) Berger, A. and R. DeYoung (1997), 'Problem loans and cost efficiency in commercial banks', Journal of Banking and Finance, Vol. 21, pp. 849–870; Louzis, D., A. Vouldis and V. Metaxas (2010), 'Macroeconomic and bank-specific determinants of non-performing loans in Greece: a comparative study of mortgage, business and consumer loan portfolios', Journal of Banking and Finance, Vol. 36, pp. 1012–1027.

([11]) Makri, V., A. Tsagkanos and A. Bellas (2014), 'Determinants of Non-Performing Loans: The Case of the Eurozone', PANOECONOMICUS, No. 2, pp. 193-206; Anastasiou, D., H. Louri and M. Tsionas (2016), 'Determinants of non-performing loans: Evidence from Euro-area countries', Finance Research Letters, forthcoming.

([12]) Bending, T., M. Berndt, F. Betz, P. Brutscher, O. Nelvin, D. Revoltella, T. Slacik and M. Wolski. (2014), 'Unlocking investment in Europe', EIB Report; Klein, N. (2013), 'Non-performing loans in CESEE: Determinants and impact on macroeconomic performance', IMF Working Paper, No. 13/72.

balance sheets of banks previously engaged in credit relations with the corporate. ([13])

Overall, while financial developments can affect macroeconomic developments via a variety of channels, two channels appear particularly important when it comes to NPLs. The first channel (the so-called bank balance sheet channel) works through the rationing of bank lending (thus credit supply) to the real economy due to capacity constraints in the underlying risk capital of banks. This channel also includes the effects generated by an increase in bank lending rates resulting from an increase in the credit riskiness of firms, and in changes in risk aversion in banking lending practices, which increase collateral requirements and result in higher rejection rates. The second channel (the so-called borrower balance-sheet channel) works through the impact on firms' and households' willingness to invest (credit demand) in times of perceived debt overhang. The latter effect is due to the need for economic agents to adjust impaired balance sheets (deleveraging) and possibly also to the expectation of less flexibility on the part of banks to accommodate temporary difficulties for borrowers, or increasingly demanding collateral requirements asked by banks.

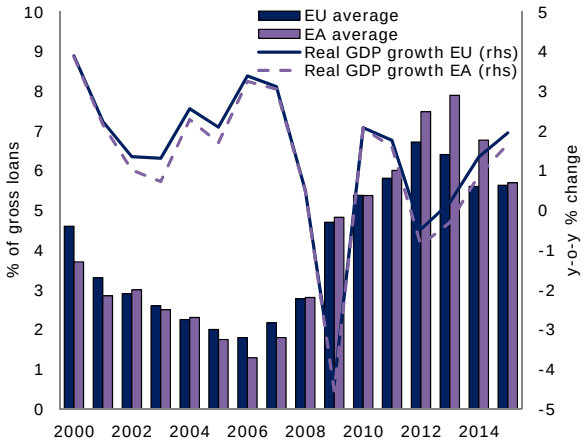
The effects referred to above can give rise to the emergence of a vicious circle in which low asset quality (i.e. high NPL ratios) and decreasing lending activity due to higher credit risk result in low bank profitability, which leads to insufficient growth in bank capital and subdued new lending to the real economy, negatively affecting GDP growth and thus leading to more NPLs. Such a situation can be additionally compounded by the need to strengthen capital due to a tightening of regulatory requirements and/or pressures for change in business models (e.g. to reduce overcapacities in banking systems), which is typical in a post-crisis situation when supervisory and capital requirement models are usually upgraded. The understanding of the mechanics at stake is particularly important in order to break such a vicious circle before it gets out of control with long-term effects.

([13]) Kalemli-Ozcan, L. Leaven and D. Moreno (2015), 'Debt overhang in Europe: Evidence from firm-bank-sovereign linkages', unpublished manuscript.

I.3. NPLs in EU Member States

While elevated NPL ratios are not a new phenomenon in EU Member States, the last economic and financial crisis was followed by a notable increase in NPLs in a number of countries. As already said, patterns of NPL developments have nonetheless varied significantly across Member States, reflecting different problems and cycles in national banking systems. ([14]) In addition, Member States have to different degrees pro-actively addressed the emerging NPL problems through policy measures, including legislative reforms, which also partly explains different developments across countries. ([15])

Graph I.1: **The evolution of the NPL ratio and real GDP growth, EU and EA**
(2000 - 2015)



Source: Worldbank, ECB, DG ECFIN calculations.

NPL ratios appear to have peaked in 2012/2013 for the EU/euro area respectively (see Graph I.1). Since then, in both cases, NPL ratios have fallen or have broadly stabilised, but remain more than twice higher than they were before the crisis (an average above 5.5% for both the EU and euro area in 2015, compared to an average at around or below 2% in 2007). Moreover, significant differences in the evolution of NPLs are observed within the euro area. The euro area countries that were relatively more stung by the debt crisis (Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain)

([14]) For a description of differences in financial cycle of European countries see: Schüler, Y. S., P. Hiebert, and T. A. Peltonen (2015), 'Characterising the financial cycle: a multivariate and time-varying approach', ECB Working Paper No. 1846.

([15]) Aiyar, S., W. Bergthaler, J. M. Garrido, A. Ilyina, A. Jobst, K. Kang, D. Kovtun, Y. Liu, D. Monaghan and M. Moretti (2015), 'A Strategy for Resolving Europe's Problem Loans', IMF Staff Discussion Notes, No. 15/19.

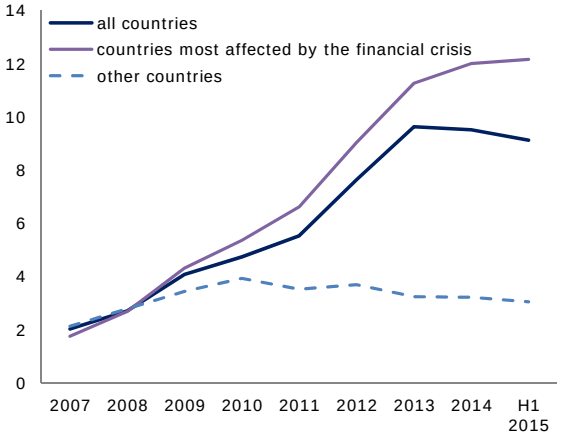
Table I.1: **Categories of EU Member States based on NPL level and evolution**

Category	Member States
Category 1: currently not showing high NPL ratios (<=10% of banks' loan portfolio) and not done so in the last 15 years	BE, DK, FI, DE, LU, NL, FR, SE, UK
Category 2: currently not showing a high NPL ratio (<=10% of banks' loan portfolio) but have done so in the last 15 years and/or NPL ratios rose strongly in a short period of time (at least a doubling between 2008 and 2013)	AT, EE, CZ, PL, HU, SK, ES, LV, LT
Category 3: currently showing a high NPL ratio (>10% of banks' loan portfolio)	BG, HR, CY, EL, IE, IT, MT, PT, RO, SI

Source: DG ECFIN.

experienced substantial increases in NPL ratios since 2010, lasting until recently, though at a decreasing marginal rate. For the other euro area countries, by contrast, a downward trend started as early as 2012. There seems to be therefore indicative evidence of the relationship between real economic developments and NPLs dynamics (see Graph I.2).

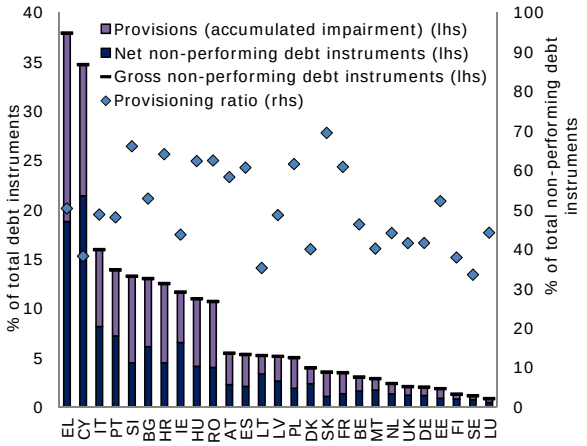
Graph I.2: **Impaired loan ratios for euro area significant banking groups**
(2007 – 2015H1,% of loans, median values)



(1) Based on publicly available data for a sample of 55 significant banking groups. Countries most affected by the crisis include Cyprus, Greece, Ireland, Italy, Portugal, Slovenia and Spain.
Source: ECB – Financial Stability Review (November 2015) based on SNL Financial.

It should be noted that provisioning ratios also differ significantly among countries, even for broadly similar NPL levels (see Graph I.3, which also reports 2015 levels of NPL ratios by country), leaving banks in some countries in a much more vulnerable situation than others, affecting in turn their capacity to lend.

Graph I.3: **NPLs per EU member state**
(2015)



Source: ECB and DG ECFIN calculations.

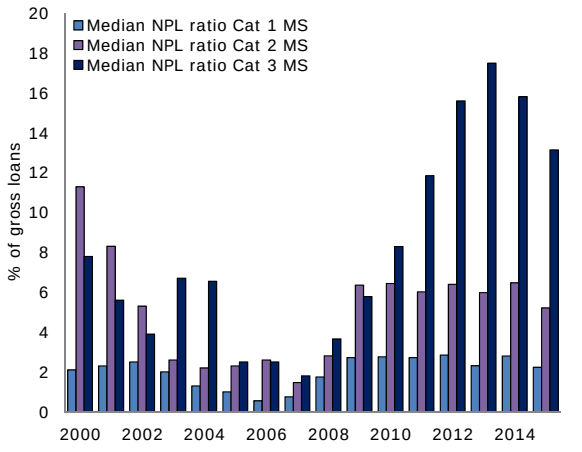
At present, EU Member States can be divided into three broad categories (see Table I.1) based on i) the current level of NPLs, and ii) the speed at which NPL ratios have evolved over the past (last 15 years). ([16]) A fast rising NPL ratio can have significant feedback effects on the macroeconomic environment, even when the NPL ratio itself does not reach an unusually high level. This is because, with rising NPLs, banks need to promptly increase their provisioning, which lowers profitability and/or weakens capital positions. In such cases banks will be more constrained in engaging in new lending until the appropriate provisioning level has been achieved and/or the capital position restored.

([16]) The threshold chosen for the NPL ratio is 10%. This level is admittedly chosen arbitrarily and might be considered relatively high in historical comparison. There are, however, a number of Member States that have crossed this threshold during the recent past. An NPL ratio of 10% or higher is nonetheless not necessarily creating the same level of pressure in all banking sectors. If banks have sufficient capital and other sources of profitable lending are available, coping with higher NPL ratios is easier compared to a situation where banks suffer from a weak capital position or lack profitable lending opportunities. This caveat should therefore be kept in mind.

This categorisation of countries is used to comparatively look at NPL developments and output gaps across groups, with the aim of highlighting possible correlations between the two.

NPL developments for the three groups of EU countries are displayed in Graph I.4. Member States in Category 3 experienced a sharp rise in NPL ratios during the crisis, followed by a visible decline over 2014-2015, which was nonetheless insufficient to bring the ratios down towards mean values. On the contrary, Member States in intermediate Category 2 who also saw a significant rise in NPLs in the first stage of the financial crisis (2008/2009) later experienced several years of stability before entering a gradual downward path in 2015. ([17])

Graph I.4: **NPL ratios in different categories of EU Member States**
(2000 - 2015,% of gross loans)

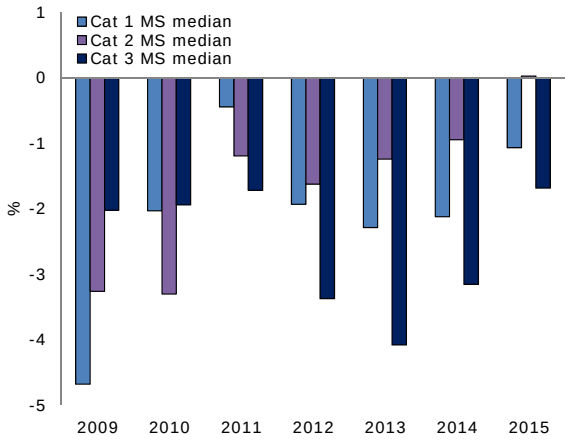


Source: ECB, World Bank, DG ECFIN calculations.

Finally, the median NPL ratio for Category 1 Member States recorded a milder increase in 2009, followed by broad stabilisation. A whole series of factors can of course lie behind these significant differences in NPL dynamics. These include different structural features across groups of countries, which facilitated the build-up of unsustainable loan exposures in the banking sector and/or have been hampering the timely resolution of NPLs, as well as differences in policy approaches (e.g. changing supervisory guidance, accounting requirements, or the establishment of public Asset Management Companies) adopted to address problems in the banking sector (e.g. in the context of a macroeconomic adjustment programme).

Graph I.5 points to a functional relationship between NPL ratios on banks' balance sheet and growth performance. Specifically, over the last five years, Member States with high NPL ratios (Category 3) have also experienced below average GDP growth. ([18]) These economies have shown a larger negative median output gap than the other categories of countries since 2011, when broad-based problems in euro area sovereign debt markets emerged. Category 1 Member States have also recorded a negative output gap, but to a much smaller scale than Category 3 countries and have recently shown a stronger economic recovery. Intermediate Category 2 countries have shown a steady recovery since the peak in negative output gaps in 2012 and eliminated their negative output gaps in 2015.

Graph I.5: **Output gap in different categories of EU Member States per NPL level and dynamics**
(2009 – 2015)



Source: Eurostat, DG ECFIN calculations.

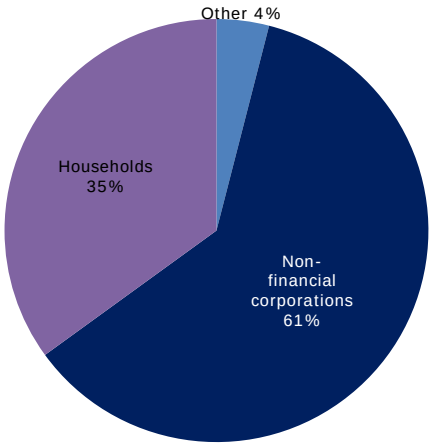
Beyond NPL dynamics, the distribution of NPLs across sectors is another interesting aspect to look at, also from the point of view of possible solutions. For instance, from an economic perspective, the realisation of value may be more

([17]) The difference with Category 3 countries can partly be explained by the fact that the latter also include programme countries with a more permanent impairment level.

([18]) As already mentioned, it is important to bear in mind that this type of analysis can only indicate coincidental developments between NPLs and the real economy, and not necessarily causality. Hence, the decisive question still remains as to what extent high NPLs ratios are merely a reflection of the unfavourable macroeconomic environment or also a determinant of weak GDP growth.

difficult in relation to non-financial corporations (NFCs, especially smaller ones where NPLs are unsecured), whereas NPLs for households are usually backed by real estate assets. ([19])

Graph I.6: **Composition of the stock of NPLs (%)**
(2015)



Source: ESRB Secretariat based on Consolidated Banking Data (ECB).

Aggregated data for the EU in Graph I.6 suggest that NPLs are considerably higher for loans to NFCs than for households. As far as NFCs are concerned, NPL ratios can also be expected to differ across productive sectors. Unfortunately, for most Member States, more disaggregated data on NPLs by sector are not publically available. An analysis for Spain and Portugal, for which such a breakdown of the data is available, is reported in Box I.1. The analysis suggests that (i) there is substantial heterogeneity in NPL ratios across productive sectors (identified by the statistical classification of economic activities by Eurostat, NACE 2) with construction and real estate services being the two most affected sectors in both countries; (ii) this cross-sector heterogeneity co-moves closely with the mean NPL ratio (i.e. it started to increase sharply in 2008); (iii) a clear link between NPLs and economic activity (measured by gross value added) is present also at the sector level.

([19]) The NPL ratio for HHs is skewed by the very high weight of mortgages in total HH lending. Defaults on mortgages are less likely, and also their drivers of default are likely to differ from the drivers of corporate default.

I.4. Developments in bank lending

As highlighted in sub-section I.2, one of the main channels through which high NPLs can have a negative feedback effect on the macroeconomic environment is through their impact on bank lending to the real economy. This possible impact of NPLs in terms of reduced credit supply is linked to several factors:

- **Lower available capital.** Because of their high risk weight, uncollateralised NPLs tie up substantial amounts of capital, which in turn reduce the room for expanding credit or raise the cost of doing so. ([20])

- **Lower profitability of banks.** The necessity of provisioning for NPLs reduces banks' net income and the reduced returns on NPLs also reduce profits. Reduced profits in turn result in fewer loans, other things being equal.

- **Higher funding costs.** Debt issued by banks with a high burden of distressed assets is perceived as riskier, and a premium is therefore required by bondholders. Uncertainty on the asset quality of individual banks may also limit their access to wholesale funding.

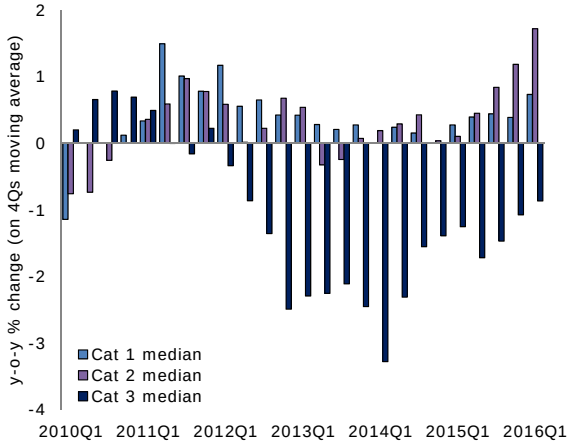
- **Monitoring and servicing costs**. The need to monitor distressed borrowers raises banks' operating costs.

Graphs I.7 and I.8 show how visible the contraction in bank lending has been to both NFCs and households respectively in Category 3 Member States, though it is not straightforward to disentangle the credit supply from the credit demand effects. ([21]) Some of this contraction might nonetheless also have been linked to a reduction of overcapacity in the banking sector from before the crisis, suggesting that the effect could be of a more enduring nature.

([20]) This holds particularly for banks using the standardised approach (SA) of credit risk measurement, whereas the bound capital for banks using the internal ratings-based (IRB) approach can be lower (if not addressed through higher requirements set by supervisors).

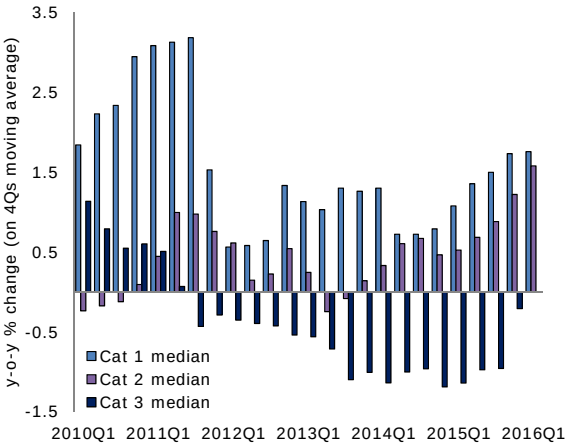
([21]) The Bank Lending Survey (BLS) by the ECB and the Survey on the Access to Finance of Enterprises (SAFE) by the Commission are generally used to distinguish between the two effects.

Graph I.7: **MFI lending to non-financial corporations, EU**
(2010Q1 – 2016Q1)



Source: ECB, DG ECFIN calculations.

Graph I.8: **MFI lending to households, EU**
(2010Q1 – 2016Q1)



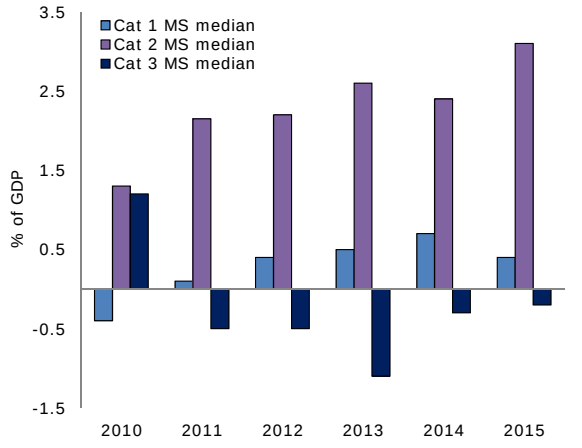
Source: ECB, DG ECFIN calculations.

The decrease in lending activities (still for Member States in Category 3) has been stronger for NFCs than for housholds. ([22]) It is noteworthy that this decrease in lending, especially to NFCs, seems to have taken place after the spike in NPL ratios (in 2013). The contraction seems to have taken place at the time when banks had to build up their provisioning in reaction to an increase in non-performing exposure in their loan book. In Category 2 Member States, lending to NFCs started to pick up again (since the first quarter of 2015) in line with a closing of the output gap and decreasing NPL ratios, thus highlighting remarkable differences in behaviour across categories of countries.

I.5. Developments in investment

The next step in our comparative analysis is to look at possible differences in terms of investment activity across the three groups of countries. The propensity to invest (i.e. the ratio of gross fixed capital formation to GDP) ([23]) is the result of the interaction of supply of savings and demand for investment, and hence is likely to also reflect information on credit supply and demand.

Graph I.9: **Deviation of investment ratio from EU average**
(2010 – 2015)



Source: Eurostat, DG ECFIN calculations.

As Graph I.9 suggests, Category 3 Member States show a below-average investment ratio, with the largest negative gap relative to EU average recorded in 2013, i.e. at the time of the peak in the NPL ratio for this group of countries. Category 2 Member States, on the contrary, show a strong recovery in their investment ratios after the initial impact of the crisis up to above EU average levels. These relatively higher levels of investment might be due to structural factors related to compositional effects (e.g. generally higher investment needs in Central and Eastern European

([22]) This might also reflect the average shorter residual maturities of corporate loan books, which translate into greater volatility of loan stocks and greater deleveraging opportunities compared to household mortgage lending.

([23]) Gross fixed capital formation is the most appropriate measure of investment activity as it measures the value added of an economy that is derived from the production, improvement or maintenance of fixed assets. It therefore excludes the purchase of financial assets and the purchases of land. Applied to the current context, it might understate the investment activity in Category 1 Member States, where a high share of the investment activity is generated in the residential real estate sector, including the buying and selling of land.

Member States, included in Category 2), but they might also be associated with a faster balance sheet repair of NFCs.

One crucial albeit complex question to address in this context is whether the presence of a high NPL ratio in the banking sector might have an influence on the demand side of investment, beyond the effects via lower bank lending. The common assumption is that the NPLs effects are already reflected in the availability and cost of bank lending (see Graph I.10 clearly indicating divergence of lending rates for NFCs in the EA countries affected by the financial crisis). However, problems associated with a high ratio of NPLs in the banking sector might also have a bearing on the investment planning of corporates before a concrete credit request is made. Specifically, there are several theoretical considerations that could result in an impact of high NPL ratios on NFCs' investment planning:

- **Profit sharing**: NFCs with existing arrears might have fewer incentives to invest in new projects when some of their debt is already in default as any upside from new projects would necessarily need to be shared.

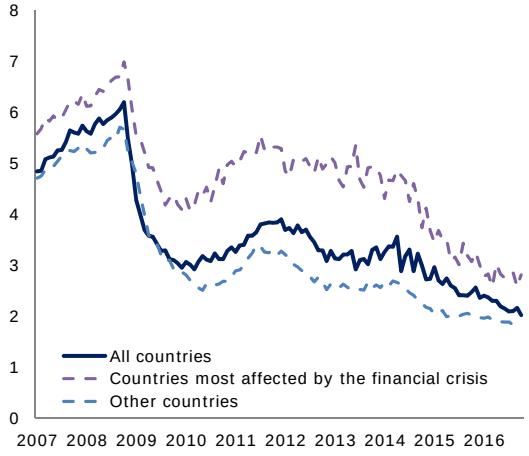
- **Adverse selection**: Higher bank lending costs discourage NFCs with strong balance sheets to turn to external sources of financing, while weaker NFCs with limited internal funds continue to seek external financing. This lowers the average quality of credit demand, affecting the signal banks get from NFCs seeking bank lending ('lemons problem'), hence increasing bank lending rates. NFCs without sufficient internal financing capacity might thus have an incentive to avoid large investment projects, which would oblige them to request bank lending.

- **Real financing costs**: Despite low nominal interest rates, real rates might be higher and weighing on credit demand (especially in Member States with very low inflation or deflation). ([24]) This adds to the effect of high perceived NFC credit risk and raises the requirements in terms of profitability of individual projects to be undertaken, thus making some investment projects non-viable from a financial perspective.

- **Risk aversion**: NFCs without existing arrears but heightened debt burden might be discouraged from investment by less leeway for banks to show flexibility in case of difficulties. Hence, NFCs might refrain from exposing themselves to the risk of becoming dependent on such flexibility by not engaging in possibly profitable but risky projects. This would amplify the already cyclical effect of the prudential treatment of risks.

Graph I.10: **Cost of borrowing for NFCs, EA (1)**

(Jan 2007-Oct 2016, in %)



(1)Countries most affected by the financial crisis include CY, GR, IE, IT, PT, SI and SK.
Source: ECB.

The above listed effects are admittedly unlikely to be the main driving force in determining the investment decision of NFCs, in particular in Member States where firms first have to restore their impaired balance sheets and therefore refrain from investing. Still, these effects might tacitly influence corporates' investment decisions. However, identifying this type of effects in aggregated macroeconomic data is difficult.

I.6. Possible spillover effects

One important element that should be considered when assessing the linkages between the quality of bank balance sheets (in general, and NPLs in particular) and the macroeconomic environment is the issue of cross-border spillovers. While there are strong benefits from financial integration in the EU in terms of risk diversification, in such a deeply integrated area, economic and financial difficulties

([24]) See: European Commission (2015), 'Revisiting the real interest rate mechanism', Quarterly Report on the Euro Area, Vol. 14, No 4, pp. 33-48.

in one Member State can also have a bearing on other Member States even outside of an acute crisis situation. In order to track potential cross-border spillover effects, empirical studies look at price measures, such as banking stock prices and credit default swap or even sovereign bond yields (as these are mostly held by the banking sector). ([25]) The existing evidence suggests the importance of co-movement between these measures, reflecting both the achieved degree of financial integration but also potential for unwelcomed cross-border spillovers. Another option that is pursued here is to use the quantity-based measure, namely cross-border bank exposures.

Spillovers across national borders can take place through different channels:

- **Macroeconomic effects:** These are the effects that emanate from the overall deterioration of the macroeconomic environment, reinforced by a possible negative feedback effect of NPLs on GDP growth. Subdued economic growth in one Member State eventually translates into less import demand (through the trade channel) and a deteriorating value of cross-border holdings of equity and debt of NFCs in the same country (through the financial channel), thus hitting other Member States too. Lower growth will also have an effect on public finances with a likely weakening of the sovereign debt risk profile, generating additional cross-border effects in the financial system. Cross-border effects can also be related to consumer confidence shocks, as these types of shocks affect domestic consumption and also have the potential to spill over across countries. ([26])

- **Cross-border lending effects:** Spillover effects can take place either via *domestic* bank lending or the lending of *foreign* banks. Spillovers via *domestic* banks occur when the increase in the NPL ratio in a foreign banking sector is affecting the loans handed out by domestic banks operating in that foreign market and these banks are subject to the same structural deficiencies that prevent a timely resolution of NPLs in the foreign country. In this case, the NPL exposure in the foreign market can tie up risk capital, which is not available for lending activities in the banks' home market. Spillovers via *foreign* banks, on the contrary, occur when banks in one Member State feel compelled to cut back their cross-border lending activities, due to the constraints they face because of high NPLs in their domestic loan book, and thereby reduce credit supply in other Member States. Unless the impact on lending in the home countries of the affected banks is compensated by an increase in lending from competitors, both channels lead to a situation in which problems associated with high NPLs in one Member States can have an impact on credit supply in other Member States.

While it is impossible to verify and quantify empirically the aforementioned channels of cross-border spillovers, ([27]) it is nevertheless possible to assess at least which Member States could be more vulnerable to such spillover effects due to a relative larger cross-border exposure of bank assets (Tables I.2 and I.3). However, the analysis is considerably weakened by the limited availability of suitable data to measure spillovers of lending. Consequently, the cross-border exposures should be understood as a *necessary* condition rather than a *sufficient* one for the NPL spillovers to take place.

Table I.2 provides an indication of *the vulnerability* of individual Member States *to spillovers via cross-border exposures of domestic banks*. On the basis of BIS data (on an ultimate risk basis) ([28]) the numbers describe the cross-border bank exposures from foreign banks (in percentage of GDP of their home Member State). Looking, for example, at Category 3 Member States, one finds that

([25]) See for example: Alter, A., and A. Beyer (2014), 'The dynamics of spillover effects during the European sovereign debt turmoil'. Journal of Banking & Finance, No. 42, pp. 134-153. Betz, F., N. Hautsch, T.A. Peltonen and M. Schienle, M. (2016), 'Systemic risk spillovers in the European banking and sovereign network', Journal of Financial Stability, Vol. 25, pp. 206-224. Claeys, P. and B. Vašíček, (2015), 'Systemic risk and the sovereign-bank default nexus: a network vector autoregression approach', Journal of Network Theory in Finance, Vol. 1, No. 4, pp. 27-72.

([26]) See: European Commission (2016), 'Confidence spillovers in the euro area', Quarterly Report on the Euro Area, Vol. 15, No 2, pp. 33-38.

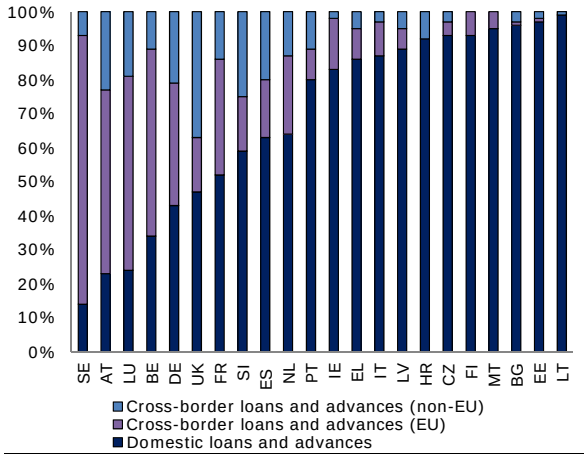
([27]) The existing data from the BIS (consolidated banking statistics), the ECB (CBC) and EBA (results of the stress tests / transparency exercise) do not allow a direct identification of cross-border NPLs on a bilateral basis. See also: EBA (2016): Report on the dynamics and drivers of non-performing exposures in the EU banking sector. This EBA report contains a cross-border exposure matrix, but the data is only related to a subsample of 166 banks.

([28]) On an ultimate risk basis, the exposure is only showing the cross-border net risk transfer (i.e. adjusted for guarantees and other forms for third-party risk transfer). This usually differs from the gross exposure (e.g. from an immediate borrower basis) and represents the most appropriate metric for cross-border risk exposure.

Romanian banks seem to exhibit an elevated exposure to Greece (measured in Romanian GDP); British banks seem to be exposed to Ireland; and German banks to Italy. While these exposures, being largely exposures vis-à-vis foreign affiliates, represent a welcome sign of banking integration across the EU, they could also have an unwelcome side-effect in the form of spillovers via domestic bank lending.

Table I.3 provides raw indications of the vulnerability to spillovers via *foreign* banks. ([29]) For example, a number of countries (especially Croatia, Austria, Hungary) appear to be particularly exposed to a change in lending policy by Italian banks. The analysis also shows that a high number of Member States could be exposed to spillover effects via banks from Member States, which do not have high NPL ratios. For example, the numbers show that Croatia, the Czech Republic and Slovakia could become particularly affected by a change in lending policy of Austrian banks. And Latvia, Lithuania, Estonia, Denmark and Finland could become considerably affected if Swedish banks were to cut back their cross-border activity.

Graph I.11: **NPLs by origin of loan provider, European union**
(March 2016)



(1) Data for CY, RO, PL, HU, SK and DK are not available. The banking data are partially consolidated. For details see EBA (2015): Decision of the European Banking Authority on reporting by competent authorities to the EBA.
Source: EBA.

The indications above seem to be consistent with recent EBA findings using a subset of 166 large banks (see Graph I.11). The EBA dataset provides a breakdown of NPLs in individual Member States between domestic and cross-border loans and advances (the latter allows one to distinguish between exposures vis-à-vis the rest of the EU and non-EU countries but not vis-à-vis individual countries). According to this dataset, the exposure to NPLs through banks' cross-border exposure is particularly pronounced for banks in Austria and Sweden (this can be either direct cross-border lending or indirectly via foreign subsidiaries). On the contrary, the bulk of NPLs for banks in smaller Member States, like Latvia, Estonia, Bulgaria and Malta, is related to domestic loans and advances.

I.7. Conclusions

This section has specifically put the focus on the macroeconomic importance of high NPL ratios in a number of EU Member States, which deserves particular attention in the current context of a slow economic recovery, with persistent, substantial slack in the economy. High levels of NPLs on bank balance sheets negatively impact credit supply and credit demand, reducing lending to the real economy at a time where, on the contrary, support to the still modest economic recovery would be needed. Monetary policy transmission in the euro area might also be negatively affected by elevated NPL ratios, in particular given the dominance of bank lending in the financing of European corporates.

Feedback effects from elevated NPLs on the macroeconomic environment can give rise to a vicious circle, whereby low asset quality results in low bank profitability, low capital buffers and constrained lending to the real economy, which in turn negatively affects GDP growth, worsening the initial problems with NPLs. This clearly highlights the importance of pro-active policy actions to break such vicious circles.

Though showing causality is fraught with difficulties, the comparative analysis across EU countries grouped according to the intensity of their NPL problems shows that, over the last five years, Member States with high NPL ratios have also experienced below average economic growth. These economies have displayed the most visible contraction in bank lending to both non-financial corporations and households. At the same time, the group of Member States experiencing the most severe problems with NPLs have also seen their investment ratios fall below the EU average. This indicative evidence points in the direction of an important nexus between NPLs and the

([29]) The analysis is considerably weakened by limited data availability.

contraction in bank lending and investment activities.

It is important to stress that the recent financial turmoil affected both credit demand (via the depth of the recession) and credit supply (via the adjustment in the banking sector), and it is very difficult to provide evidence on causality. Instead, it seems fair to say that both banking developments (NPLs, credit) and real developments (investment) are endogenous. Even acknowledging the difficulties in showing causality, as already stressed, it seems plausible that persistently high NPLs in a number of Member States can be a factor contributing to the currently sluggish nature of the recovery. Therefore, taking decisive policy action to reduce NPLs would be beneficial for growth.

Finally, it is important to recognize that in a deeply economically integrated area like the EU, and particularly the euro area, financial systems are also highly interconnected across borders. This means that problems with NPLs are likely to constrain credit supply and economic growth not just in the affected Member States but also in the euro area as a whole. The potential broader economic and spillover effects would therefore require not only undertaking important structural measures at Member States level but also, importantly, a coordinated European approach to the NPL issue. Obviously, any such common approach would have to comply with the current EU legal framework. Any short-term solutions would need to be complemented by more long-term reforms to enhance the performance of secondary markets for NPLs and the institutional environment for their resolution. This could go a long way in addressing the concerns explained in this analysis.

Table I.2: **Cross-border bank exposures (loans and advances) of domestic banks (1)**

(2015Q2)

Cross-border bank exposure (in % of GDP of home MS)

Member State to which exposure is held

	BG	HR	CY	GR	IE	IT	RO	SI	MT	PT	CZ	PL	HU	SK	ES	LV	LT	EE	AT	BE	DK	FI	DE	LU	NL	FR	SE	UK
BG		-	-	3.9	-		-	-	-	0.0	-	-	-	-	0.0	-	-	-	0.8	0.2	-	-	0.0	-	-	-	0.0	0.0
HR	-		-	0.0	-	1.2	-	-	-	0.0	-	-	-	-	0.0	-	-	-	5.0	0.0	-	-	-	-	-	-	0.0	0.0
CY	-	-		4.4	-	0.0	-	-	-	0.0	-	-	-	-	0.0	-	-	-	0.3	0.0	-	-	0.1	-	0.1	-	0.3	0.0
EL	-	-	-		-	0.0	-	-	-	0.1	-	-	-	-	0.1	-	-	-	0.0	0.0	-	-	0.2	-	0.2	0.0	-	0.1
IE	-	-	-	0.1		0.3	-	-	-	0.7	-	-	-	-	0.4	-	-	-	0.2	3.0	-	-	0.9	-	1.4	1.3	0.1	3.1
IT	-	-	-	0.1	0.6		-	-	-	2.8	-	-	-	-	3.3	-	-	-	1.5	1.7	-	-	2.6	-	3.4	10.1	0.1	1.1
RO	-	-	-	5.8	-	0.5		-	-	0.0	-	-	-	-	0.0	-	-	-	5.8	0.0	-	-	0.0	-	0.7	-	0.0	0.0
SI	-	-	-	-	-	-	-		-	0.0	-	-	-	-	0.0	-	-	-	1.3	0.0	-	-	0.0	-	-	-	0.0	0.0
MT	-	-	-	0.3	-	0.0	-	-		0.1	-	-	-	-	0.0	-	-	-	0.1	0.0	-	-	0.1	-	0.1	-	0.0	0.2
PT	-	-	-	0.0	-	0.1	-	-	-		-	-	-	-	4.5	-	-	-	0.1	0.1	-	-	0.4	-	0.4	0.5	0.0	0.3
CZ	-	-	-	0.0	-	0.8	-	-	-	0.0		-	-	-	0.0	-	-	-	11.9	6.7	-	-	0.2	-	-	1.2	0.0	0.2
PL	-	-	-	0.1	-	2.1	-	-	-	7.6	-		-	-	2.5	-	-	-	5.1	0.3	-	-	1.2	-	3.2	1.5	1.1	0.3
HU	-	-	-	0.0	-	0.7	-	-	-	0.1	-	-		-	0.0	-	-	-	3.9	1.6	-	-	0.2	-	-	-	0.0	0.1
SK	-	-	-	-	-		-	-	-	0.0	-	-	-		0.0	-	-	-	1.3	0.0	-	-	0.0	-	-	-	0.0	0.0
ES	-	-	-	0.0	1.0	2.0	-	-	-	5.7	-	-	-	-		-	-	-	0.6	1.5	-	0.0	2.3	-	4.6	3.9	0.2	1.0
LV	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	0.0		-	-	0.0	0.0	-	-	0.0	-	-	-	1.9	0.0
LT	-	-	-	-	-	-	-	-	-	0.0	-	-	-	-	0.0	-		-	0.0	0.0	-	-	0.0	-	-	-	2.5	0.0
EE	-	-	-	-	-	0.0	-	-	-	-	-	-	-	-	0.0	-	-		0.0	0.0	-	-	0.0	-	-	-	3.1	0.0
AT	-	-	-	0.1	-	4.1	-	-	-	0.0	-	-	-	-	0.3	-	-	-		0.3	-	0.2	1.3	-	1.2	0.5	0.2	0.2
BE	-	-	-	0.2	0.3	0.4	-	-	-	0.2	-	-	-	-	0.3	-	-	-	0.4		-	0.4	0.7	-		6.4	0.8	0.5
DK	-	-	-	0.0	-	0.1	-	-	-	0.1	-	-	-	-	0.3	-	-	-	0.3	0.1		0.2	0.4	-	0.6	0.3	33.6	0.3
FI	-	-	-	0.1	-	0.1	-	-	-	0.0	-	-	-	-	0.2	-	-	-	0.5	0.3	-		0.5	-	1.1	0.3	20.2	0.4
DE	-	-	-	0.9	0.4	9.3	-	-	-	0.9	-	-	-	-	3.4	-	-	-	9.0	1.9	-	1.4		-	19.0	5.9	11.5	4.8
LU	-	-	-	0.7	-	1.0	-	-	-	1.9	-	-	-	-	0.5	-	-	-	1.0	1.1	-	0.2	1.9		2.0	3.0	1.3	0.8
NL	-	-	-	0.1	0.9	0.9	-	-	-	3.8	-	-	-	-	1.1	-	-	-	1.3	4.4	-	0.9	2.2	-		3.5	1.9	3.2
FR	-	-	-	0.5	1.9	2.1	-	-	-	2.0	-	-	-	-	3.2	-	-	-	2.2	4.6	-	1.0	4.3	-	10.0		1.9	6.1
SE	-	-	-	0.0	0.3	0.1	-	-	-	0.0	-	-	-	-	0.3	-	-	-	0.3	0.1	-	1.6	0.7	-	0.7	0.6		0.5
UK	-	-	-	4.7	32.4	2.1	-	-	-	1.3	-	-	-	-	29.9	-	-	-	2.9	3.4	-	0.6	10.7	-	10.5	8.1	10.5	

(1) The colours differentiate different level of exposures where green describes low vulnerability (0-0.99% GDP), yellow medium vulnerability (1-4.99% GDP) and red high vulnerability (above 5% GDP).

Source: BIS consolidated banking statistics (ultimate risk basis), IMF, ECFIN calculations.

Table I.3: **Cross-border bank exposures (loans and advances) of foreign banks (1)**

(2015Q2)

Recipient MS of cross-border bank exposure (in % of GDP of recipient MS)

Home Member State of Banks	BG	HR	CY	GR	IE	IT	RO	SI	MT	PT	CZ	PL	HU	SK	ES	LV	LT	EE	AT	BE	DK	FI	DE	LU	NL	FR	SE	UK
BG	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CY	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IE	-	-	-	-		0.1	-	-	-	-	-	-	-	-	0.2	-	-	-	-	0.2	-	-	0.0	NA	0.3	0.2	0.1	3.0
IT	-	44.7	3.6	0.3	3.0		6.0	-	6.3	1.4	8.3	8.7	11.6	-	3.1	-	-	0.4	20.4	1.6	0.5	0.5	5.3	NA	2.2	1.6	0.4	1.7
RO	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SI	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MT	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PT	0.0	0.0	0.0	0.1	0.6	0.3	0.0	0.1	1.7		0.0	3.3	0.1	0.0	0.9	0.0	0.0	-	0.0	0.1	0.1	0.0	0.1	NA	1.0	0.2	0.0	0.1
CZ	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HU	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SK	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
ES	0.1	0.1	0.6	0.3	2.2	2.2	0.4	0.1	2.8	28.0	0.1	6.6	0.2	0.0		0.0	0.0	0.0	1.0	0.8	1.2	1.0	1.3	NA	1.8	1.6	0.7	15.7
LV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
LT	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
EE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AT	6.7	37.6	4.8	0.1	0.4	0.3	13.2	11.8	3.4	0.2	24.9	4.3	12.7	32.1	0.2	0.2	0.2	0.2		0.4	0.3	0.7	1.1	NA	0.7	0.3	0.2	0.5
BE	2.4	0.1	0.1	0.0	6.8	0.4	0.1	0.3	0.3	0.2	17.3	0.3	6.3	9.6	0.6	0.4	0.2	0.4	0.4		0.1	0.6	0.3	NA	2.7	0.9	0.1	0.7
DK	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA
FI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	-	0.1	0.2	0.2		0.1	NA	-	0.1	0.8	0.1
DE	0.1	-	15.7	2.6	14.1	4.7	0.5	3.8	26.5	7.3	2.9	9.0	4.8	2.1	6.4	1.2	1.1	0.8	11.9	5.0	4.5	6.5		NA	10.0	5.9	4.6	15.4
LU	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA
NL	-	-	3.9	0.6	5.2	1.4	3.3	-	7.6	1.5	-	5.3	-	-	2.9	-	-	-	2.5	-	1.4	3.6	4.5	NA		3.1	1.1	3.5
FR	-	-	-	0.5	15.6	13.4	-	-	-	6.1	15.9	8.0	-	-	8.0	-	-	-	3.6	34.6	2.8	3.3	4.4	NA	11.6		3.0	8.5
SE	0.0	0.0	7.6	-	0.3	0.0	0.0	0.0	0.8	0.0	0.1	1.2	0.1	0.1	0.1	35.0	30.7	69.0	0.2	0.8	57.0	42.7	1.8	NA	1.2	0.4		2.2
UK	0.0	0.3	5.7	1.3	38.2	1.5	0.0	0.8	51.3	4.6	2.6	1.5	1.2	0.2	2.1	0.2	0.1	0.0	1.4	2.9	2.3	3.9	3.8	NA	11.1	6.4	2.3	

(1) The colours differentiate different level of exposures where green describes low vulnerability (0-0.99% GDP), yellow medium vulnerability (1-4.99% GDP) and red high vulnerability (above 5% GDP).

Source: BIS consolidated banking statistics (ultimate risk basis), IMF, ECFIN calculations.

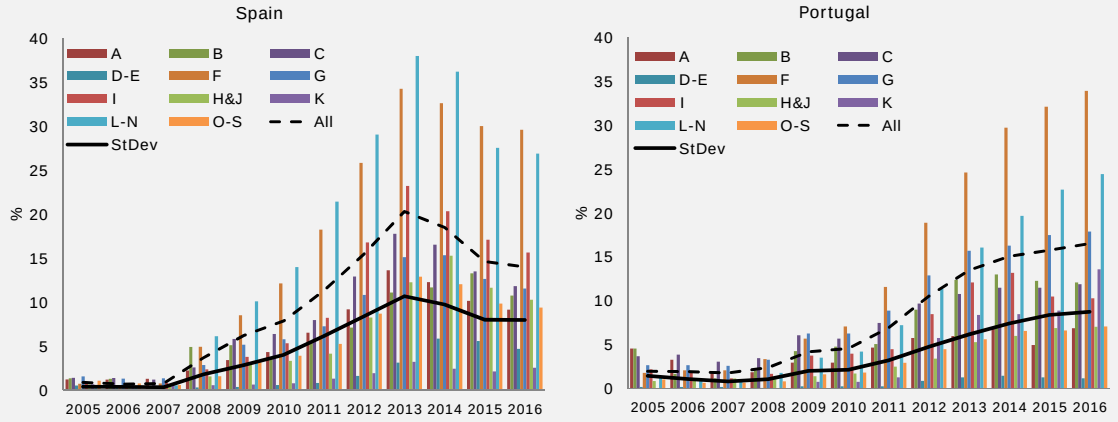
Box 1.1: NPL ratios by productive sector

In this Box we briefly present developments of NPL ratios by productive sector (NACE 2) for Spain and Portugal, two countries for which data are publicly available at this disaggregated level.

By looking at the data reported in Chart 1, a few observations stand out:

- Heterogeneity of NPL ratios across sectors appears to be substantial.
- In both Spain and Portugal, heterogeneity (measured by the standard deviation) started to increase alongside the mean NPL ratio in 2008, with the start of the financial crisis.
- In Spain the overall mean NPL ratio and the cross-sector heterogeneity peaked in 2013 and started decreasing afterwards (comprehensive bottom-up stress tests were performed in 2012, and consequently SAREB, the Spanish government-owned company responsible for managing distressed assets, was established), while in Portugal both the mean NPL ratio and heterogeneity are still on a mildly increasing path.
- For Spain, the highest NPL ratios by far were recorded in construction (code F) and in real estate, professional and support service activities (code L-N); in Portugal construction (code F) presents by far the highest NPL ratio too, followed at significant distance by real estate, professional and support service activities (code L-N). Hotels and restaurants (code I) in Spain and whole sale and retail trade (code G) in Portugal also present high NPL ratios, though generally significantly lower than the aforementioned sectors.

Chart 1: **NPL ratios by sector of economic activity, (Spain and Portugal) (1)**
(2005 – 2015)

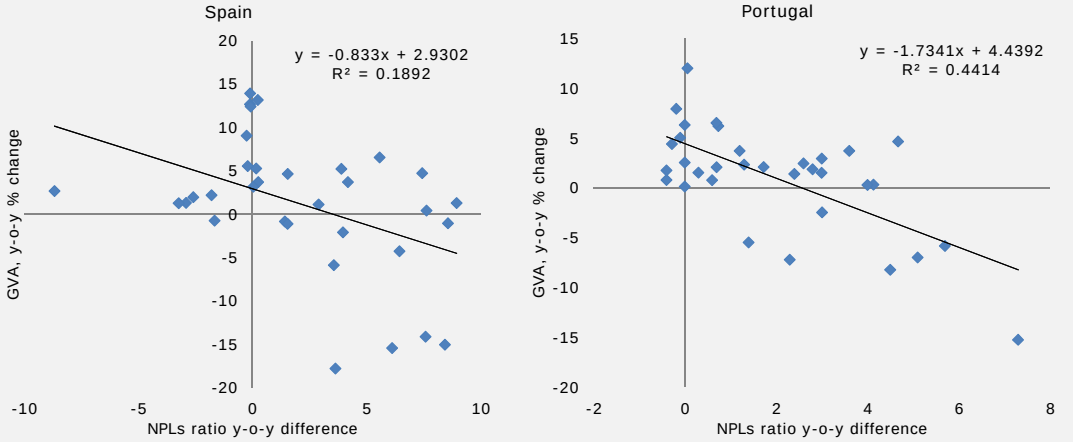


(1) The sectors of economic activity presented in the graph (by NACE Rev. 2) for both Spain and Portugal are: Agriculture, Forestry and Fishing (A), Mining and Quarrying (B), Manufacturing (C), Electricity, Gas, Steam and Air Conditioning (D), Construction (F), Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (G), Transportation and Storage (H), Accomodation and Food Service Activities (I), Information and Communication (J), Financial and Insurance Activities (K), Real Estate Activities (L), Professional, Scientific and Technical Activities (M), Administrative and Support Service Activities (N), Public Administration and Defence; Compulsory Social Security (O), Education (P), Human Health and Social Work Activities (Q), Arts, Entertainment and Recreation (R), Other Service Activities (S)
Source: *Banco de España and Banco de Portugal.*

Chart 2 below reports the change in NPL ratios (X-axis) against the annual percentage change in gross value added (Y-axis) for the three industries with the highest NPL ratios (on average for the past decade) in each of the two countries. From the chart it is evident that the negative relation between NPL ratios and economic activity found at aggregate level can be found also at sectorial level. Despite the large dispersion, arguably driven by the heterogeneity between the industries (the relation is much stronger if the scatter plot is drawn for some of these industries separately, especially for the ones with the highest NPL ratios), the negative association is very clear: the higher the NPL ratio, the lower the increase in gross value added.

Box (continued)

Chart 2: **Annual changes in NPL ratios and annual % changes in GVA for the sectors of economic activity with the highest NPL ratios, (Spain and Portugal) (1)**
(2005 – 2015)



(1) The sectors of economic activity presented in the graph (by NACE Rev. 2) for Spain are L-N (merged), F and I, while for Portugal they are F, L-N (merged) and G. (See also Chart 1 of this box for an analytical description of economic sectors of activity by NACE Rev.2).
Source: *Eurostat, Banco de España and Banco de Portugal.*

II. Unlocking investment in intangible assets in Europe

Intangible assets are at the heart of what makes firms competitive. They are vital for productivity and economic growth. A key question is whether the factors that tend to hold back investments in Europe are the same for tangible and intangible assets. Is there is a need for specific policy measures addressing intangible assets? This section reflects on the specifics of intangibles, groups relevant characteristics and relates investments in intangibles to a series of potential drivers and barriers.

To unlock investment in intangible assets, regulation enabling a flexible re-allocation of resources, in particular through well-functioning product, labour and capital markets, is pivotal. At the same time, there is a need for an appropriate mix of modern and effective intellectual property rights systems to ensure sufficient returns on investment and a competition policy addressing monopoly power and rent-seeking (together with effective enforcement). Access to finance for intangibles could be improved by amending financing schemes and enhancing the systematic reporting of investments, e.g. with new accounting and corporate disclosure standards. In the event of market failure, public intervention can play an important role by providing direct or indirect support, in particular for assets with high social returns (such as investment in R&D or in training), or ensuring sufficient investment in relevant physical infrastructure. The rise in the importance of intangible assets also means that it is important to get human capital policies right. Finally, we need to broaden our concept of knowledge creation – both in the context of national accounts and at the level of individual firms – to take in R&D, but also other forms of intangible capital, such as economic competence, training or design. In turn, we will need better means of measuring intangible capital. Corresponding policy initiatives are essential for Europe, in particular with a view to closing the investment gap in terms of intangible assets vis-à-*vis the United States, and thus stimulating total factor productivity and long-term growth. ([30])*

II.1. Introduction

Knowledge capital (notably 'intangible assets' that lack physical embodiment, such as computerised information - databases and software; innovative property - R&D and intellectual property rights (IPRs); economic competences – i.e. training, organisational capital and brand equity) ([31]) is at the core of what makes firms competitive, and thus vital for productivity and economic growth. However, due to the specific characteristics of intangibles, there is reason to believe that overall investments tend to remain below their social optimum.

This contribution looks at drivers of and barriers to investment in intangibles. It thus feeds into the ongoing thematic work on the third pillar of the Investment Plan for Europe. ([32]) It seeks to complement previous contributions by focusing on determinants of investments in intangible assets with a view to identifying factors that hold it back, and assessing the extent to which there are intangible-specific barriers. This is important given the need to design the most effective and efficient policy response.

The chapter is organised as follows:

Sub-section II.2 sets out relevant facts on intangibles according to the empirical and theoretical literature;

Sub-section II.3 reflects on the specific characteristics of intangibles;

Sub-section II.4 discusses corresponding drivers of and barriers to investment, with an emphasis on developing preliminary lessons that could help to guide policy;

([30]) This section was prepared by Anna Thum-Thysen, Peter Voigt, Christoph Maier (DG ECFIN), Benat Bilbao-Osorio and Diana Ognyanova (DG RTD).

([31]) This definition refers to Corrado, C., Hulten and D. Sichel (2005), 'Measuring capital and technology: an expanded framework', in *Measuring capital in the new economy*, C. Corrado, J. Haltiwanger and D. Sichel, eds., *Studies in Income and Wealth* 65, Chicago: The University of Chicago Press. Some of the corresponding investments are included in the NA measure of GFCF, especially 'computerised information' and some categories of 'innovative properties' (e.g. mineral exploration, R&D and IPRs). However, according to the system of national accounts, spending on other intangible assets is captured as 'expenditures' or 'intermediate consumption' rather than investment (in particular economic competences, training, new products and design).

([32]) https://ec.europa.eu/priorities/jobs-growth-and-investment/investment-plan_en

Sub-section II.5 reports on a series of empirical analyses aimed at testing the arguments put forward in sub-sections II.3 and II.4; and

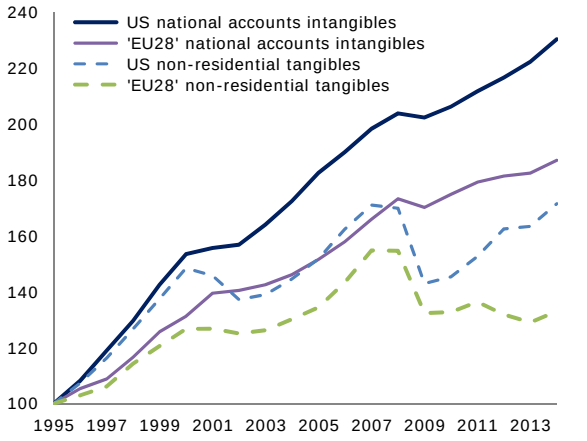
Sub-section II.6 summarises the main empirical findings and key policy messages.

II.2. Stylised facts

Economic growth in high-wage economies stems in good part from investment in knowledge creation. Such expenditures, collectively referred to as knowledge-based capital or 'intangible assets', are strategic investments that foster long-run growth potential. Higher levels of investment in such assets are generally associated with higher growth rates. ([33])

Evidence from available statistics suggests that investment in EU countries is gradually shifting from traditional physical (tangible) investment to intangible assets. ([34])

Graph II.1: **Non-residential intangible and tangible investments, EU-28 vs. USA**
(1995-2014, Index: 1995=100)



Source: Eurostat, Bureau of Economic Analysis (BEA).

This is not simply a result of the crisis. The trends had already been observed, e.g. for the UK, Germany, Sweden and the Netherlands, before 2007. They are driven *inter alia* by the shift from industry to services, the rise of the digital economy, changing global specialisations in production, and general technological progress. Overall, investment in intangible assets in the EU has been growing faster than tangible investment over the last 20 years (see Graph II.1). It has nonetheless been below the corresponding level in the USA and the gap has been widening steadily.

Growth-accounting exercises find that intangible capital has a substantial effect on growth of gross value added: the contribution of labour to output growth is tending to diminish, while the contribution of the capital component is increasing, so tangible and intangible capital deepening becomes the dominant source of output growth. Empirical findings indicate, moreover, that, in most of the countries observed, the contribution of total intangible assets to output growth is between one and three times that of tangible assets. ([35])

Further empirical analyses have shown that closing the gap in investment in intangible assets *vis-à-vis* the USA would help to close the total factor productivity (TFP) gap *vis-à-vis* the USA. Also, TFP values across countries (obtained as residuals) seem to vary less when one includes intangibles, so looking at intangibles will arguably improve our understanding of country-to-country TFP differentials. ([36])

However, investments in intangible assets tend to be underestimated. The system of national accounts captures only about half of all spending on intangible assets and corporate financial reports commonly provide only limited information on companies' investments in intangibles.

II.3. Economic characteristics of intangibles

Intangibles commonly share specific features that distinguish them from tangible assets. These are decisive for identifying barriers to investment and may justify policy intervention. The literature suggests a fairly long list of such characteristics. ([37]) For the sake of simplicity (though at the risk of

([33]) Jorgenson, D.W., and K.J. Stiroh, (2000), 'Raising the speed limit: US economic growth in the information age', *Brookings Papers on Economic Activity*, 1, 125–211; Oliner, S.D. and D.E. Sichel, (2000), 'The resurgence of growth in the late 1990s: Is information technology the story?', *Journal of Economic Perspectives*, 14, autumn, 3–22; Corrado, C., C. Hulten and D. Sichel (2009), 'Intangible capital and US economic growth', in *Review of Income and Wealth*, 55(3), 661-685; Roth, F. and A.-E. Thum (2013), 'Intangible capital and labour productivity growth: Panel evidence for the EU from 1998–2005', *Review of Income and Wealth,* 59 (3), 486 – 508.

([34]) INTAN-INVEST database (www.intan-invest.net).

([35]) ECFIN discussion paper (forthcoming).

([36]) Ibid.

([37]) Andrews, D. and A. de Serres (2012), 'Intangible assets, resource allocation and growth', *OECD Economics Department Working Papers* No. 989, OECD Publishing.

over-simplification), they can be grouped as follows:

(1) specific characteristics that may affect competition;

(2) risks, uncertainty and high sunk costs typically associated with intangibles; and

(3) synergies and complementarities among asset types.

Competition-related characteristics

Intangible assets have a series of specific features that tend to distort competition. Many types are characterised by limited appropriability and partial excludability. ([38]) For instance, property rights of intangible assets typically cannot be as clearly defined and well enforced as is the case with tangibles. Accordingly, firms struggle to deter 'free-riders' from benefiting from their investments in intangibles. Due to knowledge diffusion and externalities, social returns on intangible investment tend to be higher than the corresponding private returns, especially in cases of limited appropriability, which may lead to under-investment from a social perspective. For firms investing in intangibles (i.e. buying them in or producing them for their own use), some degree of rent-ensuring ([39]) may therefore be needed to increase the appropriability of the returns on innovation before knowledge diffusion takes place. ([40])

Separability ([41]) and transferability ([42]) facilitate the mobility of an asset in terms of ownership. In fact, they are pre-conditions for using assets as collateral and for salvaging value in the event of bankruptcy. While the market for patents and licensing agreements provides a means of acquiring codified and legally protected intangibles, firms cannot obtain tacit, human-capital-based assets, ([43]) or even codified but not legally protected intellectual assets, through such channels. In order to obtain intangible capital of this kind, businesses can engage either in corporate takeovers or selective recruitment (poaching) of specialists. However, both strategies entail significant risks, suggesting that the efficient allocation of intangible capital of a tacit nature is relatively more complex. ([44])

Many intangible assets display specific competition features related to the fact that they can be deployed simultaneously by multiple users (non-rivalry) ([45]) without engendering scarcity or diminishing their basic usefulness (e.g. software or designs). In terms of business-sector knowledge creation, intangibles tend to rival each other across, rather than within, firms; this generates increasing returns to scale (scalability) ([46]) and, ultimately, monopolistic competition. Positive network externalities can reinforce this phenomenon. ([47])

The net effect of these competition-related characteristics depends on the situation of the individual business, the competitive environment and the types of intangible asset the company is relying on / investing in. On the one hand, any investment in knowledge can have positive external effects. All intangible assets give rise to spill-over effects, which (together with the effects due to

([38]) An asset is characterised by limited appropriability or partial excludability if other businesses can benefit from it.

([39]) i.e. protecting IP, e.g. by means of patents, brands, design, copyright, etc.

([40]) Note, however, that some intangible assets can be generated internally by firms and remain inherently non-marketable. Their full value is arguably firm-specific, because they cannot be separated from the original unit of creation without some loss of value (Webster, E. and P.H. Jensen (2006), 'Investment in Intangible Capital: An Enterprise Perspective', *The Economic Record,* 82 (256)). Brand equity and (to a lesser extent) training are examples of this.

([41]) An asset is characterised as separable if it can be separated from the place of creation without loss of value.

([42]) Transferability refers here to the degree to which knowledge can be transferred across firms. This depends on whether knowledge is tacit or codified. Tacit knowledge could become transferable if it is embodied in human capital, for instance.

([43]) In fact, tacit knowledge lacks separability, which in turn undermines its transferability in cases of limited mobility of skilled labour. Intangible assets generate firm-specific value that depends on the firm's assets being kept together (see Hotchkiss, E.S., K. John, R.M. Mooradian and K.S. Thorburn (2008), 'Bankruptcy and the resolution of financial distress', *Handbook of Empirical Corporate Finance*, 2, 2-22, Elsevier; Gilson, S.C., K. John and L.H.P. Lang (1990), 'Troubled debt restructurings: An empirical study of private reorganization of firms in default', *Journal of Financial Economics* 27, 315-353), which suggests further limits with regard to separability.

([44]) Jennewein, K. (2005), 'Intellectual property management: The role of technology brands in the appropriation of technological innovation', Physica-Verlag HD: Heidelberg.

([45]) An asset can be used simultaneously by multiple users.

([46]) The initial cost incurred in creating intangible assets (developing new ideas, designs, etc.) may eventually not be re-incurred once combined with other inputs in the production of goods or services. This may give rise to increasing returns to scale, which are possibly reinforced by network externalities (particularly prevalent in intangible-intensive industries, such as ICT).

([47]) Positive network externalities arise when the value of a good or service increases with the number of users (e.g. subscribers to social or professional networks). This may lead to a winner-takes-all outcome, i.e. network effects can lead to cases of natural monopoly or create high barriers to entry, limiting competition in areas where competitive pressures would raise efficiency.

limited appropriability) mean that the investing firm must be aware *a priori* that competitors may (partly) benefit from their investment. This reduces incentives to invest *ex ante*. ([48]) On the other hand, the possibility of benefiting from economies of scale and eventually from a situation of monopolistic competition provides *ex ante* incentives to invest in intangibles.

Risks, sunk costs and uncertainty

Investment in intangibles is associated with risks, costs and uncertainties, as it commonly means entering uncharted territory, i.e. testing and verifying multiple options. This often involves failures and requires major upfront investment. Investment in intangible assets is prevalent throughout the innovation process, but particularly in the early stages of basic research (invention and experimentation), where sunk costs can be high and failures frequent (e.g. in the pharmaceuticals sector). Also, the production of intangible assets (especially tacit knowledge) is likely to be less certain than that of tangible capital, which is easier to replicate through standard routines. ([49]) Finally, common difficulties in verifying *ex ante* the ultimate value of investments in any intangible asset tend to lead to financial constraints.

Synergies and complementarities

Evidence suggests the existence of significant synergies and complementarities between types of intangible, and between intangible and tangible assets. In fact, some investments can be productive only if the appropriate complementary assets exist (e.g. ICT hardware + software + training). Accordingly, factors hindering investment in one type of asset may affect the productivity of (and probably also investment in) complementary assets.

Differences between intangible asset types

The economic characteristics outlined above are, to varying degrees, relevant for the majority of intangible asset types. However, there are also major differences between types, primarily between 'computerised information' ([50]) and 'innovative property' ([51]), on the one hand, and 'economic competences' ([52]), on the other. Assets in the first two categories are, for the most part, fully non-rival and only partly excludable, and they can generally be separated from the original firm without substantial loss of value (i.e. they tend to be tradable by means of market-based transactions). In addition, the corresponding type of knowledge capital can more easily be codified and protected through mechanisms that facilitate its transfer. In contrast, rivalry and excludability are more prevalent among the types of asset that reflect 'economic competences'. For instance, investment in brand equity and human capital generates assets that reflect a high degree of corporate or individual embodiment, in addition to often being firm-specific and thus not so easily separable. ([53])

Overall, almost all intangible asset types have characteristics that tend to distort competition. Also, risks, uncertainty and sunk costs appear to be relevant for all types (to varying degrees). As a result, identifying clear synergies and complementarities with other intangible and tangible assets is not straightforward and would require further investigation.

II.4. Investment in intangibles: drivers and barriers

The economic characteristics identified in the previous sub-section already suggest a range of drivers of and barriers to investment in intangibles. In this sub-section, we present the following non-exhaustive list of five drivers and barriers, drawing

([48]) Privately created knowledge tends to be subject to the forces of diffusion, which cannot be constrained in the same manner as physical assets (Brown, N.C., and M.D. Kimbrough (2008), 'An examination of differences in the excludability of tangible and intangible assets', *Harvard Business School Mimeo*); i.e. intangibles tend to diffuse beyond their place of creation, thus providing wider benefits. Rapid diffusion of knowledge may thus deny firms the market power required to price above marginal costs in order to recover the costs of knowledge creation. However, markets tend to fail in properly internalising the positive impact from this diffusion, notably on the productivity of investment in knowledge elsewhere.

([49]) Hunter, L.C., E. Webster and A. Wyatt (2005), 'Measuring Intangible Investment', *Melbourne Institute Working Paper Series*, No. 15/05, University of Melbourne.

([50]) Software and databases.

([51]) R&D, IP and IPRs, designs, mineral explorations, new services.

([52]) Training, brand equity, organisational investments, market research.

([53]) Among 'economic competences', investments in organisational capital stand out somewhat as being largely non-rival and scalable (within a firm), but less than fully excludable, although attempting to imitate and implement the business model of a successful rival firm is not a simple task. Also the relevance of spill-overs for this asset type is difficult to assess.

on the relevant literature ([54]) and the mapping of the characteristics in sub-section II.3:

(1) regulatory framework conditions;

(2) financial conditions;

(3) availability of human capital and knowledge stocks;

(4) availability of public support; and

(5) macro-economic conditions.

Some of the drivers and barriers are common to all intangibles. To the extent possible, the analysis is also broken down per asset type at the end of the sub-section.

Regulatory framework conditions

While efficient resource allocation is important for all types of investment, it is presumably more so in the case of intangibles, given the higher degree of uncertainty stemming from the often exploratory nature of the investment and the risk of its benefits being reaped by others. The greater uncertainty as to return on investment (as compared with tangible assets), given also the risk of quickly forming competition, means that commercialising an idea for a new product may require swift deployment of resources. ([55])

To the extent that the production of intangible goods requires investment in intangible assets and flexibility in the allocation of resources, eliminating impediments to entry and exit and to the quick deployment of resources (capital, including human capital, and labour) is more and more crucial. Apart from flexible product and labour market regulations, the development of capital markets, progress towards a European capital markets union ([56]), and a large internal market for goods and services can all help in this respect by facilitating a swift channelling of resources towards the most productive investments and facilitating the scale-up of companies.

Pro-competitive product market reforms can also foster knowledge diffusion, as recent empirical (firm-level) evidence suggests. ([57]) The growing productivity gap between technological leaders (frontier-setters) and laggard firms in many OECD countries may be driven by the difficulties being experienced by the latter in transiting to the economy of ideas, or the fact that they are largely sheltered from competition. In this respect, pro-competitive product market reforms can be expected to raise incentives for incumbent firms to adopt new technologies. Competition can also create incentives to improve management, technical and economic efficiency, thus increasing investment in organisational capital. ([58])

Competition policy should also address potential market failures and create incentives for companies to invest in intangible assets. In particular, it should take due account of the network effects inherent in intangible assets when identifying anti-competitive behaviour. ([59])

However, the relationship between flexible regulation and intangible investment may not be linear: some product market regulations provide innovators with incentives to invest by ensuring high *ex post* rents. ([60]) Similarly, some forms of employment protection may increase investment in human capital, e.g. firms have greater incentives to invest in training if workers are less likely to leave

([54]) Andrews, D. and A. de Serres (2012), 'Intangible assets, resource allocation and growth', *OECD Economics Department Working Papers* No. 989, OECD Publishing; Hao and Haskel (2011), 'Intangibles and product market reforms'; http://www.ceriba.org.uk/pub/CERIBA/IntangHaskelHaoXcountry/intangibles_crosscountry_Hao_Haskel_2March2011.pdf; European Commission (2013), *Flash Eurobarometer 369. Investing in intangibles: economic assets and innovation. Drivers for growth*; Montresor, S. and A. Vezzani (2014), 'Intangible investments and innovation propensity. Evidence from the Innobarometer 2013', *European Commission's Joint Research Centre - IPTS Working Papers on Corporate R&D and Innovation,* No 03/2014.

([55]) Andrews, D. and A. de Serres (2012), 'Intangible assets, resource allocation and growth', *OECD Economics Department Working Papers* No. 989, OECD Publishing.

([56]) EU-wide action to promote competition among national capital markets is estimated to be capable of freeing up to EUR 1.8 trillion in cash and deposits to invest cross-border in more profitable and riskier projects (Valiante, D. (2016), 'Europe's Untapped Capital Market: Rethinking integration after the great financial crisis', *CEPS Paperback*, London: Rowman & Littlefield International).

([57]) OECD (2016), 'Technological slowdown, technological divergence and public policy: A firm-level perspective', *OECD Economics Department Working Papers,* ECO/CPE/WP1(2016)26.

([58]) Hao and Haskel (2011), 'Intangibles and product market reforms'; http://www.ceriba.org.uk/pub/CERIBA/IntangHaskelHaoXcountry/intangibles_crosscountry_Hao_Haskel_2March2011.pdf

([59]) Andrews, D. and A. de Serres (2012), 'Intangible assets, resource allocation and growth', *OECD Economics Department Working Papers* No. 989, OECD Publishing.

([60]) *Ibid.*; Aghion, P., N. Bloom, R. Blundell, R. Griffith and P. Howitt (2005), 'Competition and Innovation: an Inverted-U Relationship', *The Quarterly Journal of Economics* 120(2), pp. 701-28, also provide evidence for an inverted U-shaped relationship between competition and innovation.

subsequently. ([61]) Such non-linearities suggest that an approach that favours low levels of product and labour market regulation needs to be complemented by appropriate measures, e.g. effective IPR systems (technological patents, industrial designs or brands), to improve the appropriation of returns, thus providing further incentives to invest in intangibles.

Financial conditions

The exploratory nature of investment in intangible assets and their generally lower verifiability and transferability (as compared with tangibles) affects firms' capacity to secure the necessary funding.

Financial conditions, such as interest rates, debt-to-equity ratio and leverage of the banking sector, are important drivers of all types of investment. However, even if intangible investments could ultimately be lucrative against prevailing market financing conditions, they might still not be financed or realised, as the private capital sector is sometimes unable to understand or assess the risks they may entail. Furthermore, investing firms frequently point to a lack of tangible collateral as an obstacle to accessing credit markets. ([62]) Improved accounting standards for the valuation of intangibles (in both corporate and national accounts) could facilitate companies' access to finance and help them to assess the value of their intangibles. The mechanisms for disclosing information on intangible assets in corporate reporting could be improved through narrative reporting, ([63]) as proposed by the OECD. ([64]) This is all the more important as evidence suggests that the market value of a firm tends increasingly to be driven by its productive stock of intangibles, rather than its tangible assets. ([65]) Lastly, the development of alternative sources of finance that are more likely to fund riskier or more uncertain investment, e.g. venture capital, crowd-funding and public-private co-financing (as indicated in the European Commission's Investment Plan), would also be helpful.

Human capital and knowledge stocks

The synergies or complementarities of intangible assets with other types of capital, such as human capital, can be an important driver of (or barrier to) investment in intangible assets.

As most types of intangible asset are human-capital intensive, a high level of generic skills (and, for some intangibles, tertiary or technical skills in particular) is a pre-requisite for successful intangible investment. For some assets, such as R&D, achieving a critical mass in terms of specific knowledge and skills accumulation is necessary to the achievement of optimal results. A strong science base is needed to allow new business R&D investments to 'build on the shoulders of giants', in terms of available public R&D/knowledge stock. ([66]) In this regard, public R&D can be seen as a major driver of business R&D investments and can play an even more important role in fostering business R&D than (direct and indirect) public funding. ([67]) The efficiency and effectiveness of public R&D could be improved, for instance, by using performance criteria when distributing institutional funding, and international peer review standards or competitive peer reviews when allocating project-based funding.

Public R&D also plays a crucial role in building knowledge stocks through strong business/science linkages and enhancing knowledge transfer: these are crucial to support for research and innovation capacity overall. A recent study found that, together with direct and indirect support for business R&D, investments in university research

([61]) Ibid.

([62]) Montresor, S. and A. Vezzani (2014), 'Intangible investments and innovation propensity. Evidence from the Innobarometer 2013', *European Commission's Joint Research Centre - IPTS Working Papers on Corporate R&D and Innovation*, No 03/2014.

([63]) Narrative reporting is a descriptive section in the annual reports (documents reporting on companies' activities throughout the preceding year) that uses non-financial information to give a picture of a firm's business, market position, strategy, performance and future prospects.

([64]) OECD (2012), 'Corporate reporting of intangible assets: a progress report', *OECD Publishing*.

([65]) The link between the market and book value of a company has weakened increasingly in recent decades (Lev, B. and F. Gu, (2016), 'The end of accounting and the path forward for investors and managers', *Wiley Finance Series*), while there is evidence of a positive correlation between the market value of a firm and its investment in intangible assets.

([66]) Caballero R. and A.B. Jaffe (1993), 'How high are the Giants Shoulders: An empirical assessment of knowledge spillovers and creative destruction in a model of economic growth', *NBER Macroeconomics Annual* 1993, Volume 8.

([67]) European Commission (2016a), 'Science, research and innovation performance of the EU. A contribution to the open innovation, open science, open to the World agenda'.

and high-skilled human capital, support for R&D cooperation increases private R&D. ([68])

Other forms of public intervention

Limited appropriability, spill-overs and other market failures (including the failure of capital markets properly to assess risks, costs and benefits) mean that investment in intangible assets requires public policy support.

Government intervention can mitigate market failures by lowering the risks and associated costs a company faces, directly through grants and public investment or indirectly through tax incentives. In particular, governments can stimulate investment in R&D by helping firms to access finance for R&D activities (e.g. through direct loans, loan guarantees, state-backed venture capital or public procurement). Recent evidence supports this finding, ([69]) although results differ in some cases – the ambiguity is partly attributable to the large array of policy instruments used to provide public support, ([70]) the effectiveness of which depends on many factors, including design and implementation, appropriate targeting and complementarity between instruments. Public support for private investment could also be extended to other types of intangible asset, such as firm-specific training or, potentially, computerised information. Lastly, direct public support includes investment in infrastructure, public R&D and the public education system.

Many EU Member States use their tax system to stimulate R&D and training. Such indirect instruments include (R&D) tax incentives, ([71]) which – depending on their design, administration and implementation ([72]) – are found to be effective in stimulating business investment in R&D.

Public policy can also help strengthen relevant links with the creation of knowledge hubs through cooperation programmes or intermediary institutions that can bring actors (e.g. public research centres, universities, private companies) together.

Lastly, it is important to bear in mind that the market failure argument and the related justification for public intervention may not hold for types of intangible that (unlike R&D, for example) are not characterised by potentially high social returns. This applies particularly where more investment is not socially desirable, e.g. investment in certain types of firm-specific economic competence, which can create barriers to entry and prevent competitors from accessing information and technology.

Macro-economic conditions

Macro-economic uncertainty is an obstacle for investment in general. However, as it is characterised by additional inherent risk, investment in intangible assets may be affected more by demand uncertainty. ([73]) It may also be affected by the sectoral composition of the economy. However, the evidence is mixed on whether a more service-oriented economy tends to be more intangible-intense. ([74]) One reason for this could be that the manufacturing sector involves an increasing volume of services that could indirectly increase the role of intangibles in the sector. Lastly, the degree of digitalisation of the economy can also determine investment in intangible assets.

The role of barriers and drivers by type of intangible asset

The drivers and barriers discussed above may affect different types of intangible asset differently. Direct public support and tax incentives, for instance, have been identified as being most useful

([68]) Becker, B. (2014), 'Public R&D Policies and private R&D investment, a survey of the empirical evidence', *Journal of Economic Surveys* 29 (5): 917–42.

([69]) Ibid.

([70]) Aristei D., A. Sterlacchini and F. Venturini (2015), 'The effects of public supports on business R&D: firm-level evidence across EU countries', *MPRA Paper* 64611, University Library of Munich, Germany.

([71]) The tax system as a whole (e.g. corporate income taxation) can also function as a driver of or barrier to intangible investment.

([72]) Criscuolo, C., M. Bajgar, S. Appelt and F. Galindo-Rueda (2016), 'R&D tax incentives: design and evidence', *OECD Publishing* DSTI/IND/STP(2016)1.

([73]) Bontempi, M. (2016), 'Investment–uncertainty relationship: differences between intangible and physical capital', *Economics of Innovation and New Technology*, 25(3). The author shows, on the basis of a theoretical model and Italian firm-level data, that uncertainty may delay R&D investment in particular, due to a caution effect whereby firms have an incentive to wait in the event of demand uncertainty.

([74]) Corrado, C., J. Haskel, C. Jona Lasinio and M. Iommi (2014), 'Intangibles and industry productivity growth: evidence from the EU', paper prepared for the *IARIW 33rd General Conference*, Rotterdam, The Netherlands, 24-30 August 2014. The authors find that investment in intangibles has grown more strongly in the services sector, while OECD (2013), 'New sources of growth: knowledge-based capital – synthesis report', *OECD Publishing* shows that in some countries investment in intangibles is higher in the manufacturing sector.

in the case of scientific R&D and firm-specific human capital, both of which are generally characterised by high social returns (relative to private returns). In the case of 'computerised information', public support may play a role in encouraging small and medium-sized enterprises to invest in new technologies. However, favourable tax treatment may remove a firm's incentive to grow further. ([75]) Public support should not target 'economic competences' that build monopoly rents, e.g. brand equity.

Financial conditions matter for all intangibles, as they are difficult to collateralise, but they may be more important for assets that are not easily transferable or verifiable, e.g. organisational capital. The regulatory framework should promote a competitive and flexible environment, but at the same time allow for sufficient IP protection to ensure that rents cover investment uncertainty. This holds mainly for the production of computerised information and innovative property; for most 'economic competences', which are mostly firm-specific, IP protection should be less of a focus.

Finally, different asset categories require different types of human capital: scientific R&D requires tertiary graduates, computer software needs technical skills and creative skills are required in design.

II.5. Empirical analysis

In this sub-section, we test the relevance of the above determinants. A regression analysis is performed, relating investments in intangible assets to a series of variables capturing the broad categories of drivers and barriers, i.e. regulatory framework (flexible markets), availability of human capital, other forms of public intervention and financial conditions. ([76]) Box II.1 describes the methodology used for this macro-level analysis, which is then complemented with further empirical (micro-level) evidence from the relevant literature in the area of R&D.

Table II.1 shows results per asset type from the regression model described in equation (4) in Box II.1. In particular, we distinguish between tangibles and intangibles, and between two sub-categories of intangibles:

(1) 'national accounts (NA) intangibles', which include private R&D, artistic originals, mineral exploration and computerised software. These are the intangibles included in the NA measure of gross fixed capital formation (GFCF); and

(2) 'non-NA intangibles', which include economic competences, design and new products. The NAs still count these as expenditure.

We also tested for further potential investment barriers separately to avoid multi-collinearity (see equation (4)). ([77]) When reading the results, one should bear in mind that the estimated coefficients refer to EU-15 country averages and therefore hide some country heterogeneity. The main findings are reported below.

First, tangible capital tends to be more sensitive than intangible capital to GDP developments; regression results show the accelerator term to hold more strongly for tangible capital. Potential reasons could be that:

(1) the general upswing in intangible investment resulting from a sectoral shift towards the knowledge economy is a more significant determining factor than the business cycle;

(2) the very long lags between the launch of the investment and the associated returns could imply that short-term cyclical fluctuations matter less (e.g. R&D activity in general); or

(3) demand for the goods or services, produced with intangible assets (e.g. pharmaceuticals) is relatively immune to cyclical fluctuations.

([75]) European Commission (2012), 'Tax reforms in EU Member States: tax policy challenges for economic growth and fiscal sustainability', *European Economy 6*.

([76]) Framework conditions were also tested with the share of the service sector in total value added. Findings suggest that investment in intangible assets is more strongly associated with the service economy. However, as evidence is mixed, this result would require further investigation.

([77]) Other indicators tested are indicators for alternative financing (venture capital, gross-operating surplus, debt-to-equity ratios and surplus-to-debt ratios of non-financial corporations), taxation indicators (corporate income tax rates, implicit tax rates), quality of IPRs, shares of SMEs and allocative efficiency. However, within the fixed effects model with robust error terms (robust to heteroscedasticity and intra-group correlation), these variables do not seem to be significantly correlated with investment in intangible assets. However, the standard robust estimation method used is also known to provide large standard errors in cases of small sample size.

Box II.1: Panel fixed-effects regression analysis of investment in intangible assets

To test the potential drivers of intangible investment empirically, we estimate an investment equation based on an accelerator model, (1) as described in IMF (2015). Investment in time t and country i I_{it} (intangible or tangible) is commonly modelled as a function of a desired capital stock K_{it}^{*}, potentially some lags thereof (to account for a slow adjustment of the capital stock to its desired level) and depreciation δ_i (see Oliner *et al.* 1995): (2)

$$I_{it} = \sum_{j=0}^{J} \omega_j \Delta K_{it-j}^{*} + \delta_i K_{it-1} \quad (1)$$

where j indicates the respective number of time lags.

Based on the accelerator model, which postulates that changes in capital are proportionally related to changes in economic output, we can write:

$$\Delta K_{it}^{*} = c\Delta Y_{it} \quad (2)$$

Inserting equation (2) in equation (1), dividing the equation by K_{it-1}, introducing an error term ε_{it} and a fixed effect γ_i, and lagging the output term by one year to somewhat correct endogeneity problems, yields the following econometric model:

$$\frac{I_{it}}{K_{it-1}} = \gamma_i + \sum_{j=1}^{N} \beta_{1j} \frac{\Delta GVA_{it-j}}{K_{it-1}} + \varepsilon_{it} \quad (3)$$

This model is augmented by other potential explanatory factors of investment, such as interest rates, debt-to-equity ratios, product market regulation, employment protection legislation, financial regulations, taxation, education, public investment, access to finance, etc., denoted by DRI_{it-1} (drivers):

$$\frac{I_{it}}{K_{it-1}} = \gamma_i + \sum_{j=1}^{N} \beta_{1j} \frac{\Delta GVA_{it-j}}{K_{it-1}} + \beta_2 DRI_{it-1} + \varepsilon_{it} \quad (4)$$

The model is estimated using a fixed-effect panel estimator with standard errors corrected for autocorrelation, heteroscedasticity and intra-group correlation, and is based on annual data for the EU-15 (3) Member States over the period 1995-2013 (the final sample size depends on the availability of data for measuring drivers of intangible investment). The data for intangible investment stem from experimental academic data from the INTAN-Invest database. (4) Data for the accelerator term and drivers of intangible investment are taken from various sources. (5)

(1) The accelerator describes the relation between an increase in income and a resulting increase in investment. As described in Knox (1970), the principle of accelerator postulates that, with increasing income, people's demand for consumer goods increases. Consequently, investment must increase to raise the productive capacity to meet the increased demand..

(2) IMF (2015) suggests adding a constant in equation (1). This specification was tested, but the constant was found to be insignificant. Similarly, further lags of the capital stock were tested, but, beyond the first lag, no significant results were found.

(3) Data for the total capital stocks in the business sector are not available for Luxembourg (in previous year prices) or Portugal; these Member States therefore had to be dropped from the sample.

(4) The INTAN-Invest.net database is a harmonised (open-access) database on macro-economic intangibles across a selection of countries, which complements the work done by the INNODRIVE and COINVEST–projects (both funded by the FP7 SSH programme). The updating of the database is based on voluntary cooperation by academic project partners.

(5) Eurostat, OECD, AMECO, World Bank and European Commission (DG RTD).

Secondly, all the dimensions that have been tested are significant, confirming the importance of drivers and barriers relating to the regulatory framework, financial conditions, human capital and other forms of public intervention. In particular, public R&D intensity and science/business linkages (in terms of public support provided), tertiary education (mirroring the availability of human capital), flexibility in product and labour markets (reflecting the regulatory framework) and

Table II.1: **Fixed-effect regressions, introducing selected determinants per category (public support, availability of human capital, finance and regulation), by asset type**

	Total intangibles				NA-intangibles	Non-NA intangibles	Tangibles
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Accelerator term	0.121***	0.126***	0.119***	0.00885	0.0771***	0.0444***	0.336***
	(0.0287)	(0.0192)	(0.0194)	(0.0427)	(0.0195)	(0.0125)	(0.0402)
Tertiary education	0.000744***				0.000363**	0.000381***	0.000238
	(0.000200)				(0.000152)	(8.74e-05)	(0.000415)
Interest rate	-0.000667**				-0.000502**	-0.000165*	-0.00200***
	(0.000274)				(0.000214)	(8.10e-05)	(0.000240)
EPL	-0.00643***				-0.000292	-0.00613***	0.00203
	(0.00160)				(0.00231)	(0.00165)	(0.00214)
PMR		-0.00673*					
		(0.00331)					
Public R&D intensity			0.0338***				
			(0.0106)				
Debt-to-equity				-0.000704*			
				(0.000372)			
Constant	0.0539***	0.0614***	0.0272***	0.0545***	0.0242**	0.0297***	0.0788***
	(0.00587)	(0.00521)	(0.00713)	(0.00206)	(0.00796)	(0.00563)	(0.00552)
Country dummies	yes	yes	yes	yes	yes	yes	yes
Time trend	insignificant	correlated	correlated	correlated	insignificant	insignificant	yes
Crisis control	yes	yes	yes	yes	yes	yes	yes
Observations	194	195	219	213	194	194	194
R-squared	0.487	0.182	0.199	0.124	0.362	0.512	0.696
Number of countries	13	13	13	13	13	13	13

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(1) When controlling for additional variables the time trend becomes insignificant for all asset types apart from tangible capital which is characterised by a negative trend. For reasons of multi-collinearity we drop the trend from those regressions for which the trend is insignificant or highly correlated with trending variables (i.e. we believe that the variables included in the model jointly explain more than the trend). Explanatory variables are added in lag-form as described in Box II.1.
(2) NA-intangibles refer to those intangible asset types that are included in the national accounts' measure of Gross Fixed Capital Formation (GFCF), namely computerized information and some categories of innovative properties (e.g. mineral exploration, R&D and intellectual property rights). Non-NA intangibles refer to those intangible asset types that are captured as expenditure or intermediate consumption in the national accounts.
Source: Own calculations based on various databases.

the long-term interest rate and debt-to-equity ratio (capturing financial conditions) are all statistically significant determinants of investments in intangibles.

Thirdly, drivers of investment in tangible and intangible assets differ significantly. ([78]) Our measures of financial conditions seem generally to matter more for tangible than for intangible capital. ([79]) This might be because intangible capital tends to be financed from internal funds and venture capital, rather than other external funds (partly because it lacks the type of collateral that would allow easy external funding). Tangible capital also appears to be more cyclical than intangible capital, which implies a stronger correlation with cyclical variables such as financial indicators. When one compares the effect of financial variables across intangible asset types, the results suggest that the long-term interest rate matters statistically more for NA than for non-NA intangibles. This could be read as an indication that R&D and computerised information (the main asset categories included in NA intangibles) could be financed by external funds, provided there were enough elements to reduce the uncertainty surrounding such investments. Specific action

([78]) Some of these results are shown in Table II.1; the other results are available on request.
([79]) This applies especially to the interest rate, but also to the leverage of the banking sector and the debt-to-equity ratio of financial corporations.

could therefore serve to broaden funding opportunities beyond the usual internal sources.

The (product and labour market) regulatory framework is found to matter more for intangibles than for tangibles, which corroborates previous findings in the literature. ([80]) Most measures used as proxies for the regulatory framework are found to have statistically significant effects on intangible investment and have the expected signs. Less flexibility) in product market regulation is associated with lower investment in intangible capital, while proximity to the country with the lowest regulatory stringency (in terms of *Doing Business* indicators) is associated with higher investment in intangibles. Equally, regression results indicate that regulations that support job transitions and self-employment are closely associated with investment in intangible capital. Given the identified positive relationship between intangible capital and skills, measures that support the acquisition of new skills and lifelong learning could also enhance investment in intangibles. Results suggest that employment protection legislation is more strongly associated with non-NA intangibles (i.e. economic competences, design and new products) than with NA intangibles, which would appear to indicate that flexible resource allocation is particularly important for uncertain investments with short maturities, e.g. new products and design.

Of the public intervention measures tested in the model, evidence suggests that tertiary education is vital for investment in (both NA and non-NA) intangibles, while it does not seem to have a significant effect on tangible investment. This may be because intangible capital is potentially more skills-intensive than tangible capital. Also, skills mismatch is found to matter negatively (in the case of under-qualification) and positively (in the case of over-qualification) for intangible investment. Other types of skill, such as vocational training, generic cognitive and non-cognitive skills, could also play a role, in particular for non-NA intangibles (this could be subject to further analysis). Intangible assets include firm-specific human capital, which is bound to be correlated with tertiary education and qualifications, but the result captures more than this correlation, as it applies also to NA intangibles (which do not include training).

The results also indicate that public R&D intensity seems to matter most for NA intangibles. This finding is intuitive, as NA intangibles include private R&D, which is known to benefit greatly from public R&D (see sub-section II.4). Science/business linkages, as proxied by public-private co-publications, appear to matter for (NA and non-NA) intangible investment.

The evidence confirms strong complementarities between intangible and tangible assets. This holds in terms of simple correlations and also when controlling for the accelerator effect and other controls in the regressions. The latter ([81]) show a strong relationship between tangible and intangible capital, while complementarity among intangibles seems weaker.

Further evidence, including micro-level analysis for R&D investment, generally confirms the above results, but adds some more nuanced insights and allows us to measure the micro-economic features of investment in intangible assets. For instance, there is evidence that the relationship between employment protection legislation and R&D investment depends on wage-bargaining schemes and the type of industry. ([82]) There is additional evidence for the importance of alternative funding schemes, such as venture capital, complementing the findings that financial conditions matter. ([83]) The literature further suggests that corporate skills (in addition to tertiary education) are a driver of R&D investment. ([84]) Finally, policies in favour of science/business linkages and R&D tax incentives also appear to play a role, although their effects depend ultimately on policy design. ([85])

([80]) Hao and Haskel (2011), 'Intangibles and product market reforms'; http://www.ceriba.org.uk/pub/CERIBA/IntangHaskelHaoXcountry/intangibles_crosscountry_Hao_Haskel_2March2011.pdf

([81]) The complementarities derived from the regression analysis should cautiously be interpreted as correlations.

([82]) Bassanini, A. and E. Ernst (2002), 'Labour market institutions. Product market regulation and innovation. Cross country evidence', *Economic Department Working Papers* 316, OECD.

([83]) Kortum S. and J. Lerner (2000), 'Assessing the contribution of venture capital to innovation', Boston University and National Bureau of Economic Research, *RAND Journal of Economics*, 31 (4).

([84]) Piva M. and M. Vivarelli (2007), 'Corporate skills as an *ex ante* incentive to R&D investment', *IZA Working Papers* 2562.

([85]) Becker, B. (2014), 'Public R&D policies and private R&D investment. A survey of the empirical evidence', *Journal of Economic Surveys* 29 (5): 917–42.

II.6. Concluding remarks and policy implications

Policy implications of the above analysis go well beyond the intangible sector. For instance, as regards closing the gap between Europe and the United States in terms of investment in intangible assets, and accelerating TFP through the emergence of the knowledge economy and stimulating long-term growth, we can draw the following conclusions:

- All four sets of investment drivers that were identified appear to be relevant for intangibles. Some key drivers and barriers appear to affect tangible and intangible assets differently: human capital, public investment in R&D and higher education, and regulation matter more for intangible assets, while financial conditions and GDP developments tend to have a stronger effect on tangible investment. Also, due to the synergies between tangible and intangible assets, but also between intangible asset types, a barrier to investment that is relevant for one asset type may indirectly impede investment in other assets. Training and human capital formation appear to be essential for investment in intangible assets. Policy measures to tackle barriers to such investment should focus on these areas.

- Policy-makers need to strike a balance between promoting flexible and competitive markets and the need constantly to modernise IPRs. Given the uncertain nature of intangibles, regulation enabling the flexible and swift allocation of resources and flexible markets is pivotal for investment in them. Also, knowledge diffusion can be improved by pro-competitive regulations. Well-functioning markets are essential and policy needs to ensure conducive framework conditions in this respect. However, appropriability is also an important issue for investment in intangibles and IPRs are an increasingly important framework condition for investment in knowledge-based capital. IPR rules need to be constantly modernised to keep pace with technological change and factor in the needs of intangible-intense industries. To protect and encourage innovation, there is therefore a fundamental need for an appropriate blend of modern/effective IPR systems (to ensure sufficient returns on investment) and regulatory and competition policies addressing monopoly power and rent-seeking (together with effective enforcement).

- Knowledge-based industries raise new issues for competition policy, particularly through network effects, which may play an important role in the digital economy. Non-rivalry of intangible assets (within a firm) may lead to increasing returns to scale and ultimately monopolistic competition. Positive network externalities (where the value of and demand for goods or services increase with the number of network users) can reinforce this phenomenon. Due to these specific characteristics of intangible assets, there is a risk of investment remaining below the social optimum if such monopolies are allowed to develop.

- Access to finance could be improved through greater availability of risk–prone capital and better information on the assets being developed. The crowding-in of private investments should be fostered, in order to meet common challenges affecting investment in intangibles (higher uncertainty, significant sunk costs, lack of 'second-hand' markets for intangible assets). Efforts could be made to amend financing schemes. Effective measures could include stimulating early-stage equity finance, venture capital and crowd funding. Consideration could be given to the use of European Fund for Strategic Investments in this regard. It is also important to improve the systematic reporting of investments in all relevant intangibles. This may improve access to finance (with capitalised intangibles being used as collateral), corporate governance and market transparency. New accounting and corporate disclosure standards could support the market value of firms investing in intangible assets.

- Investment in intangible assets and the creation of a knowledge-based economy could be stimulated by means of direct public support (e.g. investing in public R&D and building a strong science base), tailoring taxation schemes accordingly, public procurement ([86]) and promoting business/science linkages and

([86]) See in this regard also the comprehensive analyses conducted in the context of the INTAN and SPINTAN FP7 projects; www.INTAN-Invest.net and www.SPINTAN.net

knowledge transfer. If tax policy instruments to support business investment in intangibles are to be effective and crowding-out to be avoided, the careful design, administration, implementation and regular evaluation of such instruments are of paramount importance.

- It is crucial to invest, and stimulate investment, in tertiary education, skills and training. Growing investment in intangibles makes it even more important to get human capital policies right, as they may have profound implications for employment and earnings inequality. Clearly, a knowledge-based economy tends to reward certain types of skill, including corporate skills, and those who perform non-routine manual and cognitive tasks (as well as the investors who ultimately own much of the intangibles). ([87])

- Complementarities between intangible assets and physical capital are also important, and this calls for both public- and private-sector action to deliver key infrastructures. Some intangible assets can only be productive in combination with a tangible asset. Consequently, drivers of or barriers to investment in one type of asset may have an equal effect on investment in the complementary asset.

- Lastly, we need a fuller understanding of intangibles as a source of macro-economic growth, and corresponding means of measuring knowledge creation and intangible capital (including R&D and taking account of the complementarity and synergies with other intangibles, such as computerised information and economic competences). Policy-makers could help, e.g. by developing common measurement guidelines to be applied by statistical offices. ([88])

([87]) OECD (2013), New sources of growth: knowledge-based capital – synthesis report.

([88]) The OECD encourages countries to develop additional measures via satellite accounts so as to maintain the international comparability of GDP (*ibid*).

III. Assessing the price and non-price competitiveness of the euro area

Countries' export performance is broadly affected by three types of factors: relative prices, dynamism of export markets and non-price competitiveness. This section discusses the limits of traditional measures like the real effective exchange rate in capturing price competition and then focuses on the other determinants of competitiveness. We show that specialisation in markets with more dynamic demand can be relevant in the short run, but on average what matters most is the combination of price factors and the other non-price factors. To shed more light on non-price competition, we introduce an indicator of export quality, which defines the quality of euro area countries' exports in relative terms vis à vis their main competitors. We show that growth in export quality is indeed positively related to the export performance of euro area countries. This suggests that further work is needed to better understand and disentangle the drivers of competitiveness, but also that a successful competitiveness strategy needs to take into account both price and non-price aspects([89]).

III.1. Introduction

This section discusses the developments of euro area countries' export performance, with a focus on non-price competitiveness. External competitiveness is a broad concept and a variety of indicators would need to be used to assess it comprehensively. Nevertheless, the single aggregate measure of external competitiveness commonly used is the growth in export market shares ('EMS').

Broadly speaking, the disparity in export performance across countries can be explained by three types of factors: price competitiveness, dynamism of export markets and other non-price factors.

First of all, international competitiveness is affected by a **country's industrial costs relative to other exporters**([90]). For this reason, cost/price factors have received a lot of attention from policymakers, analysts and researchers. When analysing the drivers of export performance on the price/cost side, the real effective exchange rate (REER) is often used as a summary measure. However, the REER gives only a partial view of the drivers of competitiveness, since it only focuses on the price side and has additional weaknesses, as discussed later in this section.

Second, the **strength of foreign demand** is also an important driver of export performance: other things being equal, countries exporting in more dynamic geographic and product markets will see their EMS grow. However, as discussed later, this factor can be taken as exogenous, at least in the short run.

The available empirical evidence nonetheless shows that the two aforementioned traditional factors can only partly explain export performance. Thus, other factors shaping a country's competitiveness on the non-price side need to be also taken into account([91]). These factors, which encompass many of the facets driving export performance beyond prices and foreign demand, include: quality, tastes, participation in global value chains, logistics services and infrastructure in general, and institutional factors such as EMU membership([92]).

Against this background, this section discusses the export performance of the euro area, distinguishing between cost- (price-) and non-cost (non-price) competitiveness and focusing especially on the latter. In Sub-section III.2 we present some stylised facts on export market share growth in the euro area in the period 2001-2015. Sub-section III.3 focuses on price competitiveness, discussing challenges to its 'correct' measurement and the weaknesses of the REER. Sub-sections III.4 and III.5 focus on non-price competitiveness. Sub-section III.4 presents a standard, very intuitive, shift-share decomposition of export market share growth. The purpose is to separate the effect of

([89]) This section was prepared by Gaetano D'Adamo. The author wishes to thank Kristian Orsini for constructive and useful comments on this section.

([90]) See also Kaldor, N. (1971), 'Conflicts in national economic objectives', *Economic Journal*, Vol.81, 1-16.

([91]) See, for example, Benkovskis, K. and J. Wörz, (2014), 'What drives the market share changes? Price versus non-price factors', *Working Paper Series*, 1640, European Central Bank.

([92]) See Monteagudo, J. (2010), 'Assessing the sources of non-price competitiveness in the euro area', *Quarterly report on the euro area*, Vol. 9, No 2.

specialisation and foreign demand from the underlying export performance. Sub-section III.5 presents an indicator of export quality based on Vandenbussche (2014) and analyses its relationship with euro area countries' export performance. Sub-section III.6 provides the conclusions.

III.2. Stylised facts on EMS growth

As a first step to assess how euro area countries' export competitiveness has developed recently, this sub-section presents developments in euro area countries' EMS over the period 2001-2015. The focus is on three sub-periods: pre-crisis (2000-2008), crisis (2009-2012) and 'adjustment' (2013-2015)([93]). The aim is to verify whether a common pattern can be identified, at least within groups of countries, which could feed into the discussion that follows.

Table III.1: **Average annual EMS change rate in sub-periods (1)**

Country	2001-2008	2009-2012	2013-2015
Austria	1.09%	-5.68%	0.57%
Belgium	0.08%	-5.15%	-0.13%
Cyprus	-3.55%	-1.70%	6.40%
Estonia	5.05%	5.18%	-5.20%
Finland	-1.95%	-9.75%	-3.17%
France	-2.81%	-5.38%	5.03%
Germany	0.91%	-4.58%	1.67%
Greece	2.25%	-0.23%	-3.70%
Ireland	-5.06%	-6.48%	6.10%
Italy	-1.28%	-5.50%	0.53%
Latvia	9.84%	5.73%	0.23%
Lithuania	13.01%	4.20%	-1.50%
Luxembourg	-1.56%	-9.10%	0.77%
Malta	-8.45%	17.50%	-19.10%
Netherlands	0.39%	-3.18%	-1.90%
Portugal	-0.29%	-3.10%	1.90%
Slovakia	12.24%	-0.09%	1.57%
Slovenia	4.03%	-5.59%	2.99%
Spain	-0.20%	-3.12%	2.66%

(1)EMS are calculated as the share of a country's exports (both within and outside the euro area) in total world imports.
Source: UN Comtrade and DG ECFIN calculations.

Table III.1 shows the total percentage change in EMS for euro area countries in the three sub-periods mentioned above. The table shows some important stylised facts. First, in the **pre-crisis period**, 10 euro area countries out of 19 gained EMS. These gains were particularly concentrated in central and eastern European countries, which showed the highest EMS increases. This is mostly due to increased trade with the rest of the EU due to EU membership and access to the single market([94]). Moreover, while most 'core euro area' countries (Austria, Belgium, Germany, and the Netherlands) also gained EMS, this was not the case for Italy and France. Finally, Greece also gained EMS while losses were quite small for Portugal and Spain, which confirms the view that poor export performance was not at the root of the well-known accumulation of external imbalances in those three countries.

Second, turning to the **crisis period**, the picture is in some sense reversed: the large majority of countries lost market share (except for Estonia, Latvia, Lithuania and Malta). This was largely due to the depth of the crisis in the EU, which is the main export market for euro area countries, as will be discussed in sub-section III.4.

Third, focusing on the **adjustment period** (the last column of Table III.1), the picture has somewhat improved, with 12 countries out of 19 having gained EMS. Among them are some euro area countries heavily hit by the crisis (Cyprus, Portugal, Spain and, to a lesser extent, Italy). This suggests that a good export performance has contributed to the rebalancing process in these countries. In spite of some common factors (as mentioned for the crisis period), euro area countries euro area countries' export performance differed widely from country to country. The following discussion aims to shed light on these differences and open the way for more in-depth analysis.

III.3. Measuring price competitiveness: a challenging task

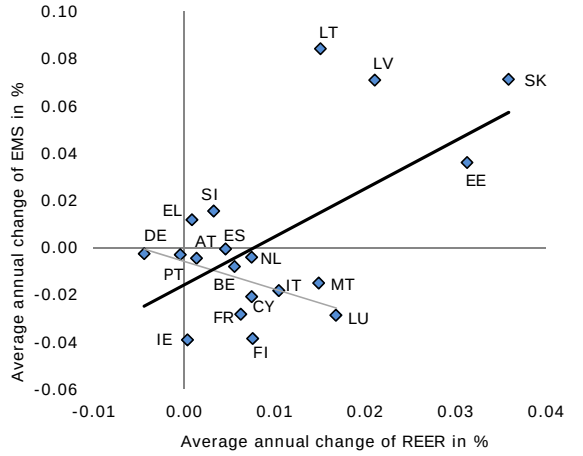
The most common summary measure of drivers of price (or cost) competitiveness is the real effective exchange rate (REER). The reason is simple: REER data are widely available and generally updated in a timely way and the concept is also well-known to many non-experts. However,

([93]) There might be differences between countries in the definition of the sub-periods: for example, for some countries, 2013 was still a crisis year. The figures therefore give only a general indication of the situation.

([94]) This is especially the case for Lithuania, Latvia, Slovakia and Slovenia, where the pre-crisis increase in EMS was mostly due to an increase in their intra-EU EMS.

measuring price competitiveness simply by using the REER can lead to results that are, to some extent, counterintuitive: the stylised fact that the industrial countries' growth in EMS was sometimes found to be uncorrelated or even *positively* correlated to their growth in unit labour costs (ULCs) or relative prices gave rise to what is known as the '*Kaldor Paradox*'. One explanation for this paradox is that higher prices might actually reflect higher quality which, in turn, might imply higher wages, as we will discuss in sub-section III.5([95]). As a result, cost competitiveness per se should not be seen as the only determinant of trade performance, especially for countries that export more diversified, high-quality goods and for countries that are undergoing a rapid process of integration with international markets.

Graph III.1: **REER and EMS average annual change in the euro area (1)**
(2001 – 2014, in %)



(1) The black line is the trend line for the whole euro area. The grey line is obtained by excluding EE, LV, LT and SK.
Source: AMECO, UN Comtrade and DG ECFIN calculations

Observing data from euro area countries gives some idea of the issue. Graph III.1 below plots the average annual change in export market shares in euro area countries in the period 2001-2014 against the average annual real appreciation or depreciation. Export market shares are calculated using data from Comtrade and therefore only cover manufacturing exports. The real effective exchange rate is the one based on unit labour costs. As shown in Graph III.1, including all 19 euro area countries, the relationship between REER and EMS growth seems to be positive, as shown by the black line. However, this is due to the strong export performance registered by four catching-up central and eastern European countries, i.e. the Baltic states (Estonia, Lithuania and Latvia) and Slovakia, despite the fact that their REERs have appreciated substantially. When we drop these four outliers, the correlation is negative, as shown by the gray line and as one would expect at the outset, although far from one ([96]).

In sum, the relationship between the REER and EMS growth is often weak, and this is due to country-specific factors that have to be taken into account. The weakness of this relationship is, however, also due to the fact that the REER is constructed based on some very restrictive assumptions. First of all, weights derived from gross trade data ignore the importance of vertical integration in trade([97]). This means that changes in the price basket would have the same effect on the REER whether it is for a final good or an intermediate good. However, at the outset we would expect that the price elasticity of demand would be lower for intermediate goods([98]). Moreover, the REER assumes that changes in the price of goods of foreign competitors have the same impact on the index, but in practice this is unlikely to be the case. For example, this assumption implies that the elasticity of substitution between German and Italian cars is the same as the elasticity of substitution between German cars and cars produced in any other country of the world([99]). This is a very strong assumption, which translates into the fact that, on the basis of the REER, the relevance of a country (or a good) in price competition is only related to its weight in other countries' exports. This critique is valid for all commonly used measures of the REER, such as the ULC-based and the export prices-based REER.

The critique of the restrictive assumptions at the basis of the REER have resulted in a sub-category

([95]) See also Fagerberg, J. (2002), 'Technology, growth and competitiveness', selected essays. Cheltenham, UK, Edward Elgar.

([96]) Excluding Estonia, Lithuania, Latvia and Slovakia, the correlation is equal to -0.40 over the period 2001-2014.

([97]) Vertical integration implies that different stages of the production of a good are performed in different countries. In this case, the exported good is therefore not entirely domestically produced.

([98]) For example, for economies at the end of the production chain, some imports (components) and exports (final goods) become complements. In this case, the depreciation of the home currency does not necessarily lead to a decrease in imports.

([99]) For a discussion of this, see Spilimbergo, A. and A. Vamvakidis (2003), 'Real effective exchange rate and the constant elasticity of substitution assumption', *Journal of International Economics*, 60(2), 337-354.

of literature aimed at producing REER indicators that are not subject to the same type of assumptions. For example, studies have been produced that try to better account for vertical integration and global value chains and the sectoral dimension([100]). However, these new and promising REERs are not yet available on a systematic basis.

Estimates of the elasticity of exports to the real exchange rate vary quite a lot in the literature and across countries. In particular, for the euro area, recent estimates([101]) suggest that the long-term elasticity of exports to the REER is close to 0.8 in absolute value. However, the 'true' price elasticity of exports might actually be underestimated by the REER. When micro data are used, estimated export elasticities are in fact substantially higher([102]). For example, in Imbs and Méjean (2010), estimated export elasticities range between 0.9 and 2.25 depending on the countries considered (rich open economies tend to post low absolute values, whereas developing countries have higher estimates)([103]). Where does this large cross-country variation in responsiveness of exports to prices come from? The response is in the microeconomic structure of the economies and in the nature of the goods exported. Recent work in this area using firm-level data has shown that the elasticity of exports to exchange rate changes is substantially different across firms and is related to firm size and productivity. In particular, smaller firms have a price elasticity of exports that is up to four times as big as that of large firms; similarly, the export price elasticity of the least productive firms is almost three times as big as that of the most productive ones([104]). Finally, the demand for goods that are more diversified and of higher quality will most certainly react less to price changes. This discussion shows that measuring price competitiveness is a complex task, and that using the right measure and level of disaggregation are equally crucial in order to assess how far it affects export performance.

([100]) Some recent examples are Bems, R. and R. C. Johnson (2012), 'Value-added exchange rates', NBER Working Papers, No 18498 and Patel, N., Z. Wang, and S. J. Wei (2014), 'Global value chains and effective exchange rates at the country-sector level', *NBER Working Papers*, No 20236; for sectoral REERs, Mehrez G., L. Fernández Vilaseca and J. Monteagudo (2014), 'A competitiveness measure based on sectoral Unit Labour Costs', *Quarterly report on the euro area*, Vol. 13, No 2.

([101]) See Balta, N., K. Fischer, P. Nikolov and L. Vilmi (2014), 'Member States' vulnerability to exchange rate changes', *Quarterly report on the euro area*, Vol. 13, No 3.

([102]) See Berthou, A. and F. di Mauro (2015), 'Exchange rate devalutations: when they can work and why', http://voxeu.org/article/exchange-rate-devaluations-when-they-can-work-and-why.

([103]) Imbs, J., I. Méjean (2010) 'Trade elasticities: a final report for the European Commission', *European Economy Economic Papers*, No 432.

([104]) See Berthou, and di Mauro (2015), cit.

III.4. A shift-share decomposition of export market share changes

As anticipated in the introduction, one additional factor affecting export performance is the type of specialisation. This is rather the result of a favourable composition of a country's export basket, which means that the country is exporting products that have more dynamic demand than the average, and/or it is exporting to countries which are particularly dynamic. For this reason, as stated in the introduction, the contribution of this factor to export market share growth is exogenous, at least in the short run, and should be analysed separately([105]).

A more precise account of export performance therefore has to distinguish between the specialisation component and the underlying performance component. To illustrate this, this sub-section contains a decomposition of export market share growth using a shift-share approach ([106]). In particular, we employ two types of shift-share decompositions: geographical decomposition and sectoral/product decomposition (see Box III.1 for the technical details). The decomposition will also enable us to identify the relative importance of these two components.

In the geographical decomposition, EMS growth is broken down into two parts: a country's **initial geographic specialisation** (IG) and a country's **market share gain in geographical markets** (MSGG). IG measures the dynamism of destination markets or the extent to which export performance is driven by a favourable geographical specialisation of exports. A destination country is considered 'dynamic' if its total imports grow faster than world imports. The other component, MSGG, measures how a country performs in its

([105]) As time passes, however, exporters might redirect their products to more dynamic countries, or specialise in more dynamic products. Therefore, in the long run, geographic and product specialisation are endogenous.

([106]) See Irigoyen, J.M., J. Monteagudo and A. Rutkowski (2012) 'A closer look at some drivers of trade performance at Member State level', *Quarterly report on the euro area*, Vol.11, No 2. For a similar approach, see also Cheptea, A., G. Gaulier and S. Zignago (2005), 'World Trade Competitiveness: a disaggregated view by Shift-Share analysis', *CEPII Working Paper*, No 2005-23.

Box III.1: Decomposition of EMS

The growth rate of the export market share is defined as

$$g = \frac{g^e - g^*}{1+g^*} \quad \text{(B.1)}$$

Where g^e is the country's export growth rate and g^* is the world import growth rate (proxied by global exports). A positive value indicates that the country is increasing its global market share. A negative value means that its global market share is decreasing. Two approaches for the decomposition of export market share growth are used here: a geographical decomposition and a product (or sectoral) decomposition.

Geographical decomposition

$$g = \frac{\sum_i w_i^e (g_i^* - g^*)}{1+g^*} + \frac{\sum_i w_i^e (g_i^e - g_i^*)}{1+g^*} = g_{IG} + g_{MSGG} \quad \text{(B.2)}$$

where w_i^e is the share of exports from country e to destination country i in total exports of country e at the beginning of the period,
g_i^e is the growth rate of exports from country e to destination country i (of all products), and
g_i^* is the growth rate of total imports of destination country i (proxied as global exports to country i).

Product Decomposition

$$g = \frac{\sum_s w_s^e (g_s^* - g^*)}{1+g^*} + \frac{\sum_s w_s^e (g_s^e - g_s^*)}{1+g^*} = g_{IP} + g_{MSGP} \quad \text{(B.3)}$$

Where w_s^e is the share of exports from country e in sector s in total exports of country e at the beginning of the period,
g_s^e is the growth rate of exports from country e in sector s (to all destinations), and
g_s^* is the growth rate of global imports (proxied by exports) in sector s.

Interpretation of the EMS decompositions

In both decompositions, the total growth in export market share is divided into two components: the dynamism of the destination markets (g_{IG}^e; g_{IP}^e) and the performance in the destination markets (g_{MSGG} ; g_{MSGP}).

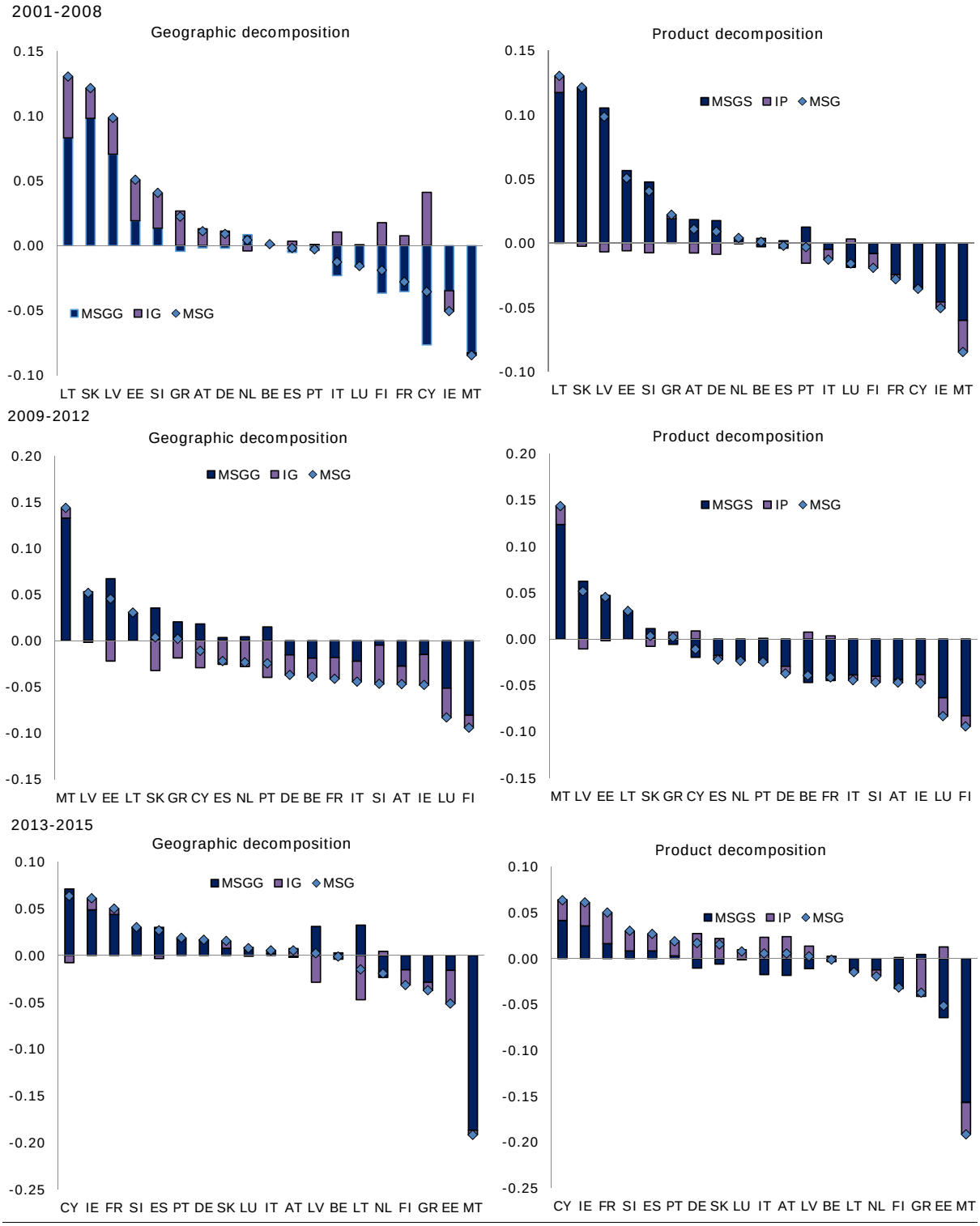
The former is an 'exogenous' component because a country's EMS can grow or fall because total imports in its destination markets (from a geographic or product point of view) grow more or less than world imports, and that depends on product-specific or partner country-specific demand factors.

The latter is an 'endogenous' component because a country's total EMS can grow or fall because its EMS within its destination markets (from a geographic or product point of view) grows or falls, i.e. it performs better or worse than its competitors.

individual geographical destinations, i.e. how successful a country has been in lifting its export growth above market growth in destination countries. MSGG is therefore affected by both price and non-price competitiveness drivers of exports.

Similarly, in the sectoral/product decomposition, EMS growth can be split in two components, the **initial product specialisation** (IP) and **market share gains in product markets** (MSGP). Similarly to what was discussed above, IP measures the dynamism of destination markets or the extent to which export performance is driven by a favourable product specialisation of exports. MSGP shows then how successful a country has been in gaining market shares on average across the products' markets.

Graph III.2: **Shift-share decomposition of EMS growth (1)**
(2001 - 2015)



(1) MSG= average annual market share gain; IG= change in EMS due to dynamic geographical specialisation; MSGG= market share gain within geographical markets; IP= change in EMS due to dynamic product specialisation; MSGG= market share gain within product markets. See Box III.1 for details.
Source: UN Comtrade and DG ECFIN calculations

The initial specialisation terms (i.e. IG and IP) are driven by foreign demand, while the market share gain, or 'performance', terms (i.e. MSGG and MSGP), reflect other forms of competitiveness.

This latter component can be seen as the outcome of a country's firms' export strategy within geographical or product markets, e.g. competitive or non-competitive prices, sufficient or insufficient customisation to local tastes and high or low quality of products.

In order to calculate export market shares and perform the shift-share decomposition, annual data on exports from the UN Comtrade database for all the available 2-digit HS product categories are used. Graph III.2 shows the average annual growth in EMS for each euro area country in the three sub-periods identified in sub-section III.2, i.e. 2001-2008, 2009-2012 and 2013-2015. First of all, the total change in EMS is mostly explained by the 'performance' components, i.e. MSGG (in the geographic decomposition) and MSGP (in the product decomposition), and this is relatively more the case in the product decomposition([107]). Using a back-of-the-envelope calculation, , MSGG explains on average about 75 % of total EMS changes in the geographical decomposition across the sub-periods, while in the product decomposition MSGP explains about 85 %.

Second, the relevance (and the sign) of the dynamism of geographic and product markets (i.e. IG and IP) is quite different in each sub-period. This reflects the fact that specialisation does indeed change over time due to firms' export strategies. In the crisis period, while the performance components (MSGG and MSGP) still explain the bulk of export performance on average, the specialisation components were more relevant than in the previous period. In particular, the initial geographic specialisation explains about 40 % of total export market share gains or losses during the crisis and is negative for 16 countries out of 19. This reflects, in most cases, the depth of the crisis in the EU, which is the main destination market for euro area countries' exports. Focusing on the period 2013-2015, it is interesting to see that the product specialisation not only contributed positively to EMS growth for 13 countries out of 19, but also accounts for about 43 % of total EMS changes. While a detailed explanation of the causes of this goes beyond the scope of this article, it may signal that in the post-crisis scenario euro area firms were able to reposition themselves by exporting products with more dynamic demand.

In what follows, we focus on the 'performance' component of export market share growth (i.e. MSGG and MSGP), keeping in mind that it captures both price and non-price competitiveness. In particular, in the next sub-section we introduce some indicators of non-price competitiveness based on export quality and related to this 'performance' component.

III.5. Export quality and trade performance

We mentioned in the introduction that non-price competitiveness is a broad concept which encompasses many different determinants of export performance in addition to the specialisation effects previously discussed: export quality, tastes, integration in global value chains and institutional factors. In this sub-section, the focus is on one of these determinants, presenting an indicator of export quality that is based on Vandenbussche (2014), and showing how quality improvements indeed seem to be related to gains in export market shares([108]).

Why is quality important? The simple answer is that it is the other side of the coin of costs when looking at export prices. While changes in both production costs and quality would affect prices in the same direction, there is one key difference between them. When production costs increase, prices increase too (unless the producer can decrease its profit margins). Other things being equal, this will reduce the demand for the good (i.e. it will cause a movement along the demand curve). By contrast, when quality increases the price of a product could also rise, but this will not necessarily mean a decline in demand (i.e. there will be a shift of the demand curve)([109]). The overall effect on demand will therefore depend on the interplay of income and substitution effects.

It should be clear from this short discussion that identifying the quality of a good with its price can be misleading, because a higher price might reflect higher costs instead of higher quality. Against this

([107]) The available data do not allow us to combine the product and geographical decompositions, which are therefore presented separately in Graph III.2.

([108]) For a description of the theoretical model and the empirical approach, see Vandenbussche, H. (2014), 'Quality in exports', *European Economy Economic Papers*, No 528.

([109]) However, in some cases quality improvements may result in price decreases, in particular if they contribute to reducing production costs.

Box III.2: A measure of export quality

The calculation of the indicators of export quality used in this chapter is based on the theoretical background and empirical approach described in Vandenbussche (2014).

Quality indicators are constructed using data coming from two sources. First, we use Comext (Eurostat) trade flows at product (CN8) level to obtain unit values as a proxy for prices. Second, we use information from the firm-level dataset ORBIS to obtain a proxy for country-product costs.

In the empirical analysis, only the CN8 products for which sufficient information on the cost side is available, exported to the EU market (EU-28) by each European member state, and by China, the US and Japan, are considered. This results in 31 countries of origin whose export products we can compare within the same product market and results on average, in about 6 000 exported products for each EU Member State and its main world competitors, i.e. the US, Japan, China.

To construct this set of quality indicators, we compute for each product (CN8) exported by a country to the EU market, its normalised quality rank based on the method explained in Vandenbussche (2014) and outlined in this section. In each narrowly defined product category (CN8), exports of 31 countries of origin (EU Member States, the US, China, Japan) exporting to the EU are compared. A quality rank of 1 reflects the highest quality in the EU market for a particular 'country of origin-product', while a rank of 0 is the lowest quality rank. It is important to note that when assigning a quality rank to a product, we also consider the number of other countries exporting the same product.

To obtain a country-product cost measure, the 4-digit NACE Rev. 2 primary Industry classification of ORBIS for firms in the country of origin is first matched with the CN8 product classification (via CPA codes) to which a particular product belongs, in order to have an idea of the cost of each exported product. Our cost data are variable costs data, consisting of both wage costs and material costs. Due to different accounting practices and data availability, for some countries the cost of goods sold was used instead of wage costs and material costs. This was the case for China, Cyprus, Denmark, the UK, Greece, Ireland, Japan, Lithuania, Malta, the US, Latvia and Netherlands.

One caveat is that ORBIS does not report all the very small firms and thus has a bias towards larger firms. However, since exporters tend to be larger firms, we expect variable costs estimates coming from this data to be a good proxy. To take this potential bias into account, the variable cost of the median firm in the sector is considered as a proxy for the costs of all the CN8 products that map onto this industry classification. Arguably, the median is less influenced by outliers than the average. Thus, for each country in our sample (all EU countries, the US, China and Japan) and for each 4-digit NACE sector that CN8 products map onto, the cost level of the median firm for that country-sector is taken to be a proxy for the marginal cost of a country-product variety exported by that particular country. The indicators are based only on CN8 products that map onto the NACE-R2 in manufacturing (sectors 10 to 32).

background, the indicator presented in this sub-section measures quality in the following way:

first of all, for a narrowly-defined product category, the mark-up over production costs is calculated for firms in a specific country;

second, within a specific product and destination market, a quality rank is established, i.e. products are ranked from the highest to the lowest mark-up.

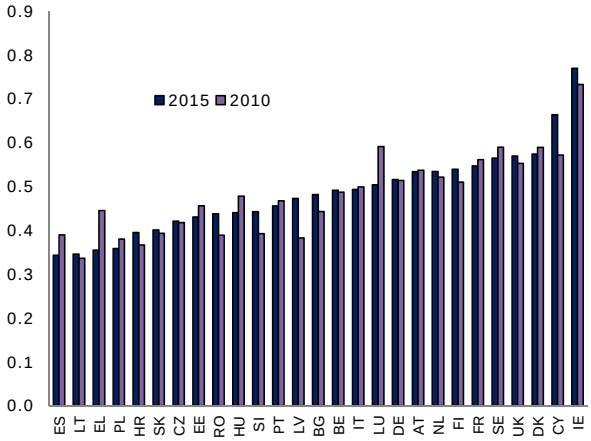
The underlying assumption is that for very similar products in a competitive environment, if a producer is able to extract a higher mark-up, this means that the quality of its products is higher.

The quality indicator takes values from 0 (lowest possible quality, relative to the other countries) to 1 (highest possible quality). The indicator is therefore of a purely ordinal nature([110]). The data then allow us to calculate, for each country, the average quality rank of its exports (i.e. a measure of the 'aggregate' export quality calculated as an average rank across all destinations and all products), and the distribution of exports across quality ranks, from low quality (i.e. with an average rank below 0.2) to top quality (average rank above 0.8).

([110]) Box III.2 summarises the data sources and the methodology for the calculation of the quality indicators.

Graph III.3 shows the average quality rank of euro area countries, comparing, for illustrative purposes, the situation between 2010 and 2015([111]). Average export quality declined in Spain, Greece, Estonia and Luxembourg and, to a lesser extent, in Austria, Portugal, Italy and France. A fall in the average export quality rank can either be due to a worsening of the quality of exported products or to a composition effect, where the volume of total exports increases due to higher exports of low-quality products, and thus their share increases.

Graph III.3: **Average export quality rank of euro area countries (1)**
(2010 and 2015)



Source: DG ECFIN calculations based on Comext (Eurostat) and ORBIS data

Do changes in quality affect export performance? In Graph III.4 quality improvements are plotted against the market share gains in both geographical and product markets, MSGG and MSGP, which were introduced in sub-section III.4. To do so, two measures of quality improvements are used: the (annual) change in the average quality rank and the (annual) change in the share of exports in the top quality rank (i.e. percentage of exported products with an average rank above 0.8, based on their value).

As the trend lines show, the correlation is indeed positive([112]). In spite of the presence of some dispersion around the trend, this positive correlation is confirmed when we exclude the four 'catching-up outliers' identified in sub-section III.4, i.e. Slovakia, Estonia, Latvia and Lithuania. There is nonetheless some inertia in the quality indicators, that is, they tend to change little over time, which makes it more difficult to capture their impact on exports.

Moving forward, a simple econometric analysis is performed to corroborate the descriptive result showed in Graph III.4. Using annual data at country level, the 'performance' component of the shift-share decomposition (in particular, MSGP) is regressed on the change in the quality indicators, controlling for the (lagged) growth rate of the REER. However, as discussed in sub-section III.3, the REER has a number of limitations and might actually underestimate the importance of price competitiveness. Results are reported in Table III.2.

Table III.2: **Quality, real exchange rate and export performance**

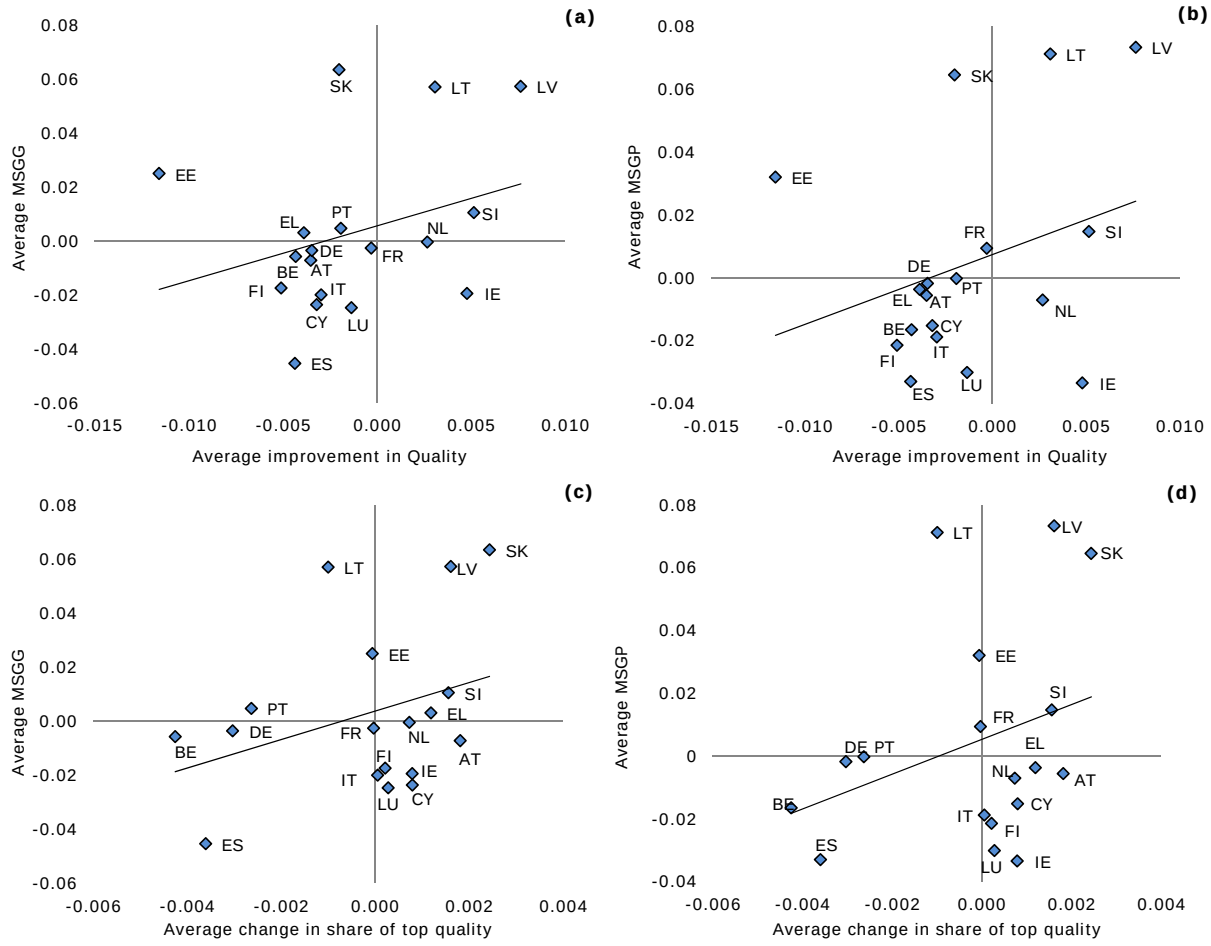
	Average Quality Rank	Share of exports in the top quality rank
DREERt-1	-0.359*** (0.140)	-0.370*** (0.139)
DQUALITY	0.213* (0.122)	0.178** (0.076)
Country Fixed Effects	Yes	Yes
N. Obs.	134	134
R-squared	0.09	0.1

(1) Dependent variable is the market share gain in product markets (MSGP). The sample period is 2006-2015, since data on quality is available only from 2005. Robust standard errors are in parenthesis.
Source: AMECO, ECFIN and author's calculations

The descriptive results displayed on a cross-sectional basis in Graph III.4, are confirmed in the regression results in Table III.2, where quality improvements (defined as either an increase in the average export quality or an increase in the share of exports in the highest quality rank) are positively related to export performance([113]). At the beginning of this sub-section, we mentioned that increases in quality, despite pushing prices up, may have a positive impact on export performance as they shift the demand curve outwards. While a more thorough analysis would require the empirical analysis to be performed at a more disaggregated

([111]) Since year-by-year changes are generally not large, it makes more sense to compare quality developments in the medium term.
([112]) The correlation ranges from 0.30 (in the case of MSGP and the average quality rank growth) to 0.34 (MSGG and increase in the share of top quality exports).
([113]) Results are confirmed when using the export price REER and the consumer price index-based REER instead of the ULC-based REER. Moreover, they are also confirmed when using, for the share of exports in the top quality rank, an estimator based on the number of products exported in each quality rank instead of their value, which should rule out potential sources of endogeneity.

Graph III.4: **Quality of exports and export performance**



(1) increase in the average quality rank plotted against market share growth in geographical markets (MSGG, panel (a)) and in product markets (MSGP, panel (b)); increase in the share of top quality exports plotted against market share growth in geographical (panel (c)) and product market (panel (d)).
Source: ORBIS, Comext, Comtrade, ECFIN calculations

level, these results appear promising and corroborate this hypothesis([114]).

III.6. Conclusions: towards an accurate measurement of price- and non-price competitiveness

This section has discussed some of the factors that might be at the root of the differences in export performance across euro area countries since 2001. Challenges in measuring cost/price competitiveness were highlighted. While a negative relationship can be observed between real exchange rate appreciations and export performance in the euro area, the weaknesses of the REER that have been discussed in this section suggest that it might not fully capture the importance of price competition. Further work in this direction, using highly disaggregated data, is therefore of crucial importance.

Despite the diversity in the specialisation of euro area countries' exports, both price- and non-price competitiveness appear to matter. From a normative perspective, this implies that a successful export strategy has to take both aspects into account. On the one hand, real devaluation could be the best short-term strategy in countries with large imbalances and having also experienced wage increases that are not in line with productivity (although this would not necessarily the best strategy to gain competitiveness in a sustainable, long-run way). This is especially true for countries exporting less diversified goods and, more generally, goods with more price-elastic demand. On the other hand, non-price competitiveness

([114]) Empirical work is currently ongoing to investigate more deeply the quantification of the role of non-price factors in affecting export performance in euro area countries.

plays a crucial role, especially for countries with lower price elasticity of exports. In particular, addressing weaknesses in non-price determinants of exports and investing in quality improvements can both increase exports and make them less sensitive to relative price changes.

Robust measurement of these different components of competitiveness and their impact on trade performance is important from a policy perspective. Hence more empirical work is needed, at a highly disaggregated level.

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