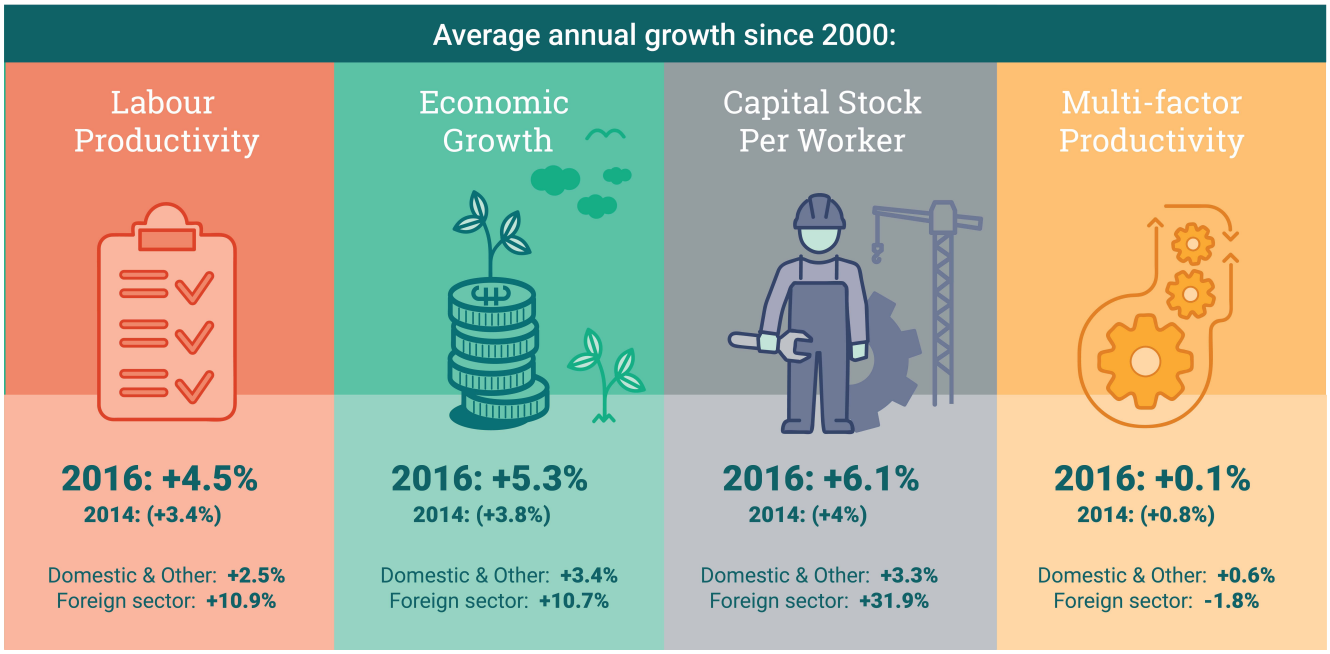
An Phríomh-Oifig Staidrimh
Central Statistics Office

An Phríomh-Oifig Staidrimh Central Statistics Office

Productivity in Ireland 2016



Glossary of Terms

The following terms will be used throughout the publication with a more detailed description of the terminology used to be found in the Appendix.

Capital Input
Capital input is the flow of capital services multiplied by the two-period average of the capital share of GVA. This publication terms capital input as capital services in charts for clarity.

Capital Intensity and Capital Deepening
Capital intensity is capital services per hour worked. Capital deepening is however, the growth in capital services per hour worked.

Capital Productivity
The efficiency at which capital services are utilised in producing output of goods and services, measured as output produced per unit of capital services input.

Capital Services
The flow of services derived from physical assets and intellectual property used to produce output. It is calculated by multiplying the user cost of the assets (this is the price of the capital service or the rental price of a capital good) by the capital stock.

Capital Stock and Productive Stock
Capital stock refers to the amount of capital in the economy. The productive stock is the net constant capital stock.

Constant Prices
Values that have been adjusted to remove the effects of price changes over time, therefore, allowing for meaningful comparison of values from different time periods.

Current Prices
The market value of an item in the period being measured that has not been adjusted to remove the effects of inflation over time.

Domestic and Other Sector
This refers to all sectors not categorised as Foreign sector (see definition of Foreign sector below).

Foreign Sector
These sectors dominated by foreign MNEs include the following: Chemicals and Chemical Products (NACE 20), Software and Communications (NACE 58-63), Reproduction of recorded media, Pharmaceutical products, Electrical equipment and Medical supplies (NACE 18.2, 21, 26, 27, and 32.5).

Gross Value Added (GVA)
GVA is the difference between the value of goods and services produced and the cost of raw materials and other inputs that are used up in the production process. It is closely related to GDP and excludes taxes and subsidies on products and production.

Labour Compensation per Employee
Labour compensation per employee is defined as compensation of employees in national currency divided by the number of employees. Labour compensation of employed persons is the sum of gross wages and salaries and of employers' social security contributions.

Labour Input
Labour input is the change in hours worked multiplied by the two-period average of the labour share of GVA. Hours worked include the hours worked by employees and self-employed.

Labour Productivity
Labour productivity measures output in the economy relative to hours worked. It is calculated as Gross Value Added divided by hours worked.

Multi-factor productivity

Multi-factor productivity (MFP) reflects the overall efficiency with which labour and capital inputs are used together in the production process. Changes in MFP reflect the effects of changes in management practices, brand names, organisational change, general knowledge, network effects, spillovers from production factors, adjustment costs, economies of scale, the effects of imperfect competition and measurement errors. Growth in MFP is measured as a residual, i.e. that part of GVA growth that cannot be explained by changes in labour and capital inputs. In simple terms therefore, if labour and capital inputs remained unchanged between two periods, any changes in output would reflect changes in MFP. This indicator is measured as an index and in annual growth rates.

Nominal Unit Labour Cost

Nominal unit labour cost (ULC) measures employee compensation relative to real labour productivity. Growth in an economy's unit labour cost suggests that the cost of labour in the economy is rising relative to labour productivity, decreasing competitiveness. On the other hand, a decline in unit labour cost suggests that the cost of labour is declining relative to labour productivity, increasing competitiveness.

Executive Summary

This annual publication by the CSO aims to help users understand productivity in the globally-integrated Irish economy. The publication goes beyond basic labour productivity analysis to examine the impact of all inputs (labour, capital, multi-factor productivity) on Irish productivity.

Key findings for the period 2000 to 2016:

1. Labour productivity grew at an average annual rate of 4.5 percent over this sixteen year period. However, when the period of 2015- 2016 is excluded labour productivity grew by 3.4 percent.

2. In the year 2016, labour productivity grew by 2 percent.

3. Multi-factor productivity for the entire period increased marginally by 0.1 percent. However, when the period of 2015-2016 is excluded, the result is 0.8 percent which compares favourably with other EU countries.

4. The industry sector showed the fastest growth in average annual labour productivity growth over the period 2000 to 2016.

5. Ireland's capital stock per employee has increased from €150,000 per employee to €378,000 per employee between 2000 and 2016, an increase of 152 percent.

Foreign v Domestic and Other sector breakdown in the Irish economy - Key Results

1. In the Domestic and Other sector average annual labour productivity grew at around 2.5 percent for the period to 2014 and also for the entire period to 2016. However, for the Foreign sector the average annual growth rate was 7 percent to 2014 and almost 11 percent for the entire period.

2. Capital stock per worker for the Foreign sector increased by an average annual growth rate of 6.9 percent. When the period is extended to 2016 the growth rate increases substantially to almost 32 percent. For the Domestic and Other sector, the growth in capital stock per worker is around 3.5 percent for both the periods to 2014 and for the entire period to 2016.

3. For multi-factor productivity in the Domestic and Other sectors, the average annual growth is 0.6 percent for the period to 2016 and 0.3 percent for the period to 2014. Foreign sector MFP shows major changes between the two periods with an average annual result of -1.8 percent to 2016 and +1.7 percent for the period to 2014. This is explained by the substantial negative MFP result for 2015.

International Comparisons - Key Results:

1. The Domestic and Other sector experienced the largest increase in labour productivity of 2.5 percent among the original 15 EU member states that joined the EU prior to 2004. The Foreign sector in the Irish economy had average annual labour productivity growth of 10.9 percent.

2. Despite having had one of the highest levels of growth in nominal ULC from 2000 to 2008, Ireland is the only country in the EU to have had a cumulative fall in nominal unit labour cost over the entire period 2000 to 2016.

3. The EU average annual growth in capital stocks per worker from 2000 to 2016 was 0.6 percent. For the Irish Domestic and Other sector, the equivalent growth rate was 3.3 percent and for the Foreign sector was almost 32 percent. The rate of increase in capital stocks in Ireland for both the Foreign sector and the Domestic and Other sector was higher than for any country in the EU for which data are available.

As this is the first publication on productivity the results are considered experimental. A case could be made for alternative presentations in these results such as the exclusion of the non-market sector or the exclusion of dwellings from the asset base. There could also be additional analysis by quality of labour or a more detailed analysis by economic sector or by asset type. The results in the CSO Statbank tables will enable many of these alternative presentations. More generally we look forward to a meaningful

engagement with our stakeholders once these results have been fully considered in order to set priorities for future productivity analysis.

Introduction

Productivity measures the efficiency with which an economy transforms inputs into outputs. This first publication by CSO[1] on productivity in Ireland presents indicators of productivity in the Irish economy. Productivity growth which drives the change in value added is explained in terms of labour productivity, capital services and multi-factor productivity. Labour productivity is the contribution of hours worked to changes in value added, while capital services measure the contribution of the stock of capital to changes in productivity. Multi-factor productivity, critically, measures the impact of improvements in production methods on productivity.

The framework used in this analysis draws heavily on the System of National Accounts (SNA). Measures of value added, capital and labour inputs and their compensation as factors of production largely draw on data previously published by CSO in meeting the requirements of ESA 2010 - the European version of the latest SNA standards.

Productivity is usually measured in terms of growth from one period to the next or over longer periods, e.g. between decades. Increases in productivity growth are generally associated with improvement in living standards. However, in the case of the Irish economy a note of caution has to be sounded; because of the high concentration of foreign-owned Multinational Corporations, there are instances of very high productivity growth that result in a limited spillover into the Domestic and Other sector of the economy. To address this challenge, each chapter in this publication uses the two-sector model of the economy covering the Foreign and the Domestic and Other sector, as presented in the CSO national accounts publication *Gross Value Added for Foreign-owned Multinational Enterprises and other Sectors*. Analyses of the conventional ten-sector model of the economy are also included.

The first part of the publication presents productivity growth since 2000 by the principal economic sectors, by ownership (Foreign and Domestic and Other sectors) and also presents the results analysed by the three main factor inputs – capital input, labour input and multi-factor productivity (MFP).

Part two of the publication explains the growth in labour productivity from a sectoral perspective. Firstly, it describes the changes in labour productivity in terms of hours worked and gross value added produced. It then illustrates how labour productivity has evolved in the Foreign sector and the Domestic and Other sector of the economy. Finally, it explains how labour productivity has evolved in the ten (A10) main sectors of the economy.

The third part of the publication describes the developments in labour productivity caused by changes in capital intensity of labour, that is capital deepening and MFP. The capital intensity of labour is the amount of capital used in the economy per hour worked.

In part four, an analysis of unit labour costs is presented for comparison purposes as an alternative measure of labour productivity. The results align closely with the labour productivity results in previous sections.

Part five presents a comprehensive productivity analysis that examines growth in the economy in terms of labour, capital and MFP. It follows the same sectoral presentation format as earlier parts of this publication.

The sixth part of the publication focuses on the importance of capital in the Irish economy. It explains the growth in capital stocks in Ireland in an international context. A newly developed measure of capital for the Irish economy, capital services, is also described.

The results in this publication are preliminary and are based on new work by the CSO to help users understand the impact that the highly globally-integrated nature of the Irish economy has on productivity measures. The data used in the analyses can be found in Statbank, the CSO's databank, and can be used to create further productivity analysis. The main productivity indicators can be found in the Tables chapter of this publication. Further information on the methodology used in the publication can be found in the appendix.

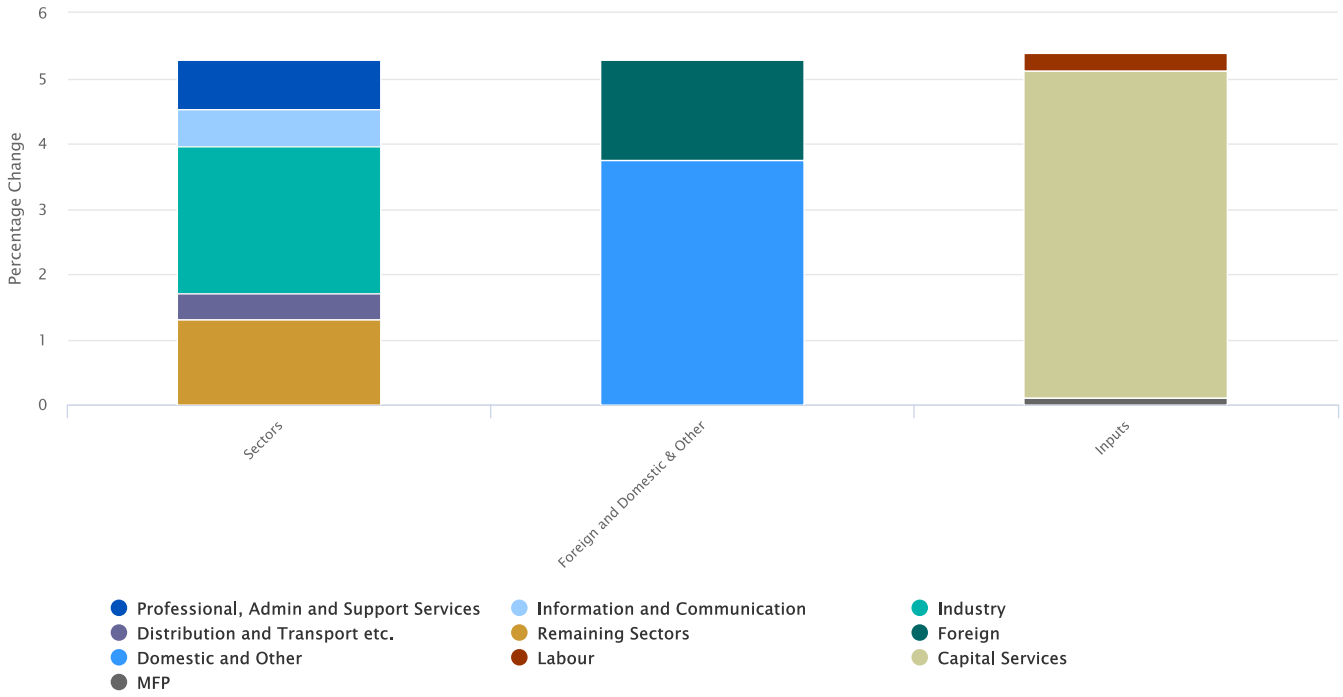
---

[1]We would like to acknowledge the contribution of our former colleague Luke Rehill to earlier versions of this work.

Sources of Economic Growth

The following section is an overview of the underlying trends in economic growth in Ireland over the period of 2000 to 2016. An analysis of the contributions to growth by principal economic sector, by Foreign sector and Domestic and Other sector, and by inputs, i.e. labour, capital and MFP is provided.

Figure 1.1 Sources of Growth: 2000 – 2016



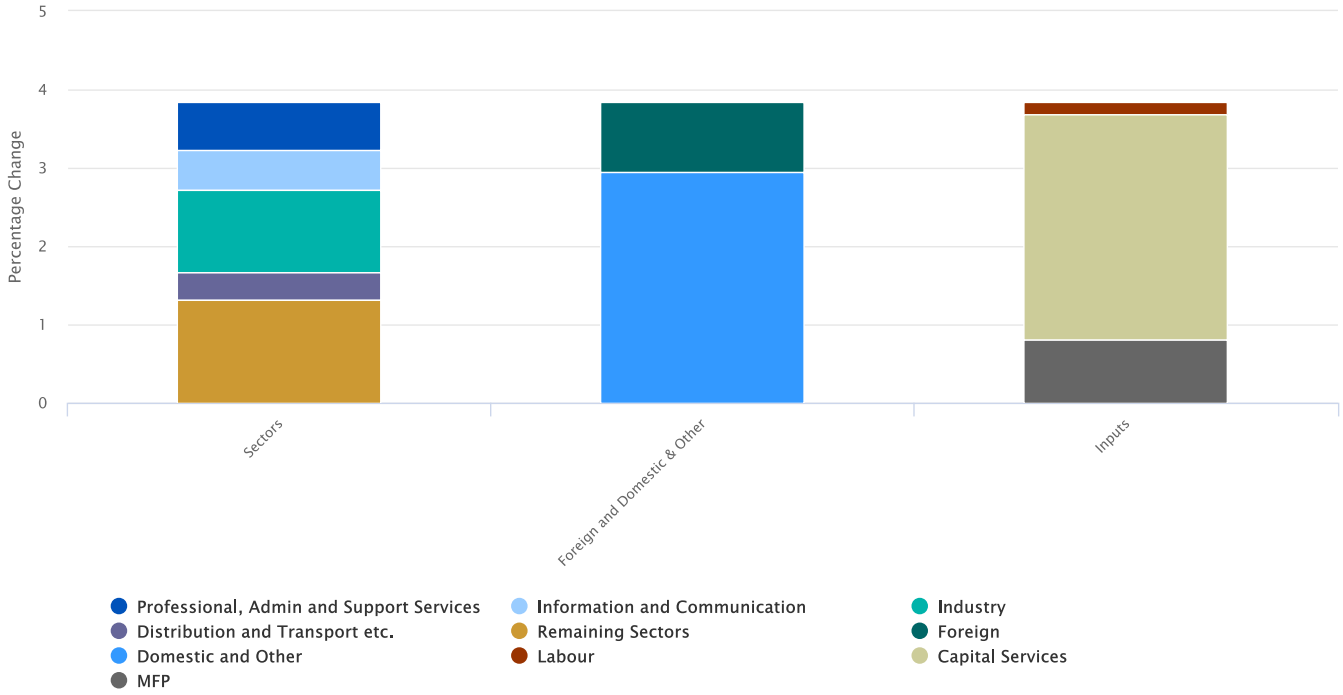
Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results, Gross Value Added for Foreign-owned Multinational Enterprises and Other Sectors Annual Results

Get the data: StatBank N1604, StatBank N1623, Statbank PIA01

Over the period to 2016, gross value added grew annually at an average of 5.3 percent. A breakdown by sector indicates that the largest source of this growth has been from Industry (NACE sectors A-E). The second largest contributor to growth has been the Remaining sectors[1]. Professional, Administrative and Support Services sector (M and N) is the third largest. Information and Communication (J) was fourth and Distribution, transport, hotels and restaurants was fifth in terms of economic growth. For the Foreign and Domestic and Other sectors analysis, the contribution of the Domestic and Other sector increased by 3.4 percent and the Foreign sector increased by 10.7 percent. However, the contribution to overall economic growth from the Domestic and Other sector is significantly greater than for the Foreign sector. This publication also breaks down economic growth by inputs; capital input (measured as capital services) was responsible for almost all GVA growth during the period. This was followed by a small increase in labour input, while multi-factor productivity growth was slightly positive at 0.1 percent.

Figure 1.2 Sources of Growth: 2000 – 2014



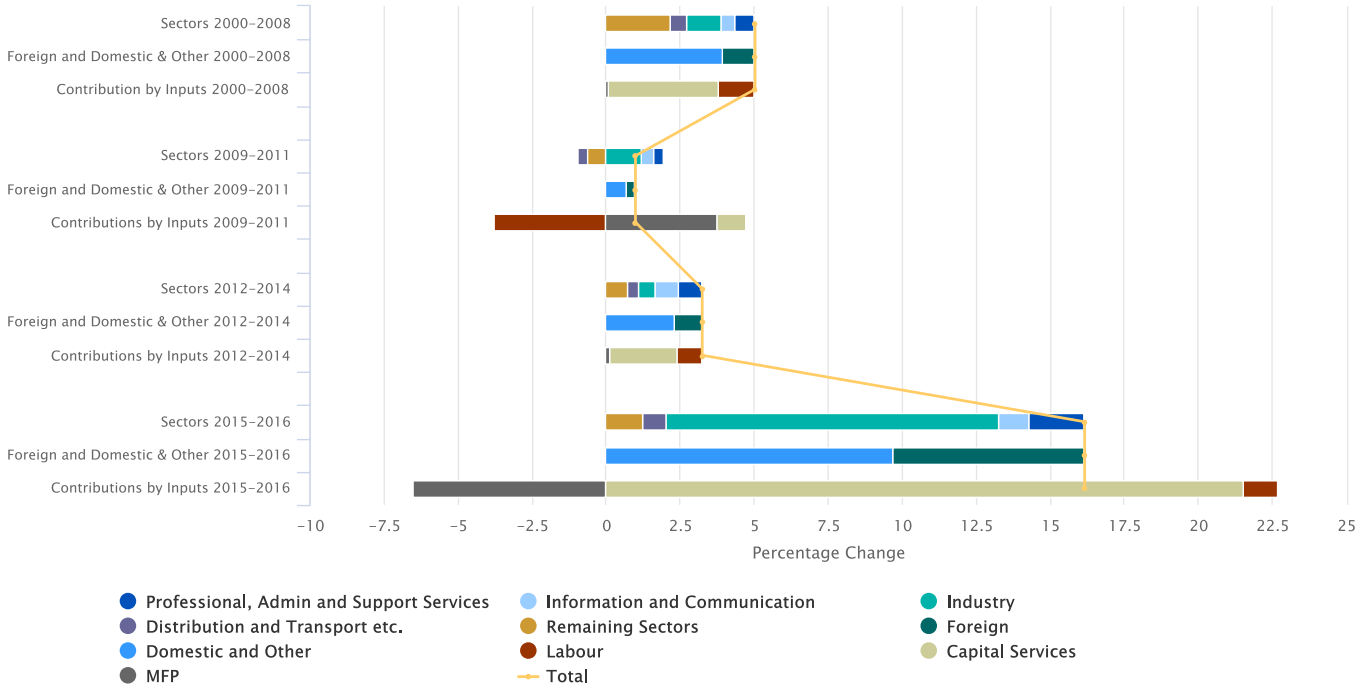
Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results, Gross Value Added for Foreign-owned Multinational Enterprises and Other Sectors Annual Results

Get the data: Statbank N1604, Statbank N1623, Statbank PIA01

Significantly, when the years 2015 and 2016 are excluded, the overall average annual growth in the economy for 2000 to 2014 falls to 3.8 percent from 5.3 percent for the entire period. For the Foreign sector, average annual growth amounts to 6.2 percent for the period to 2014. The Domestic and Other sector recorded a more moderate increase of 3 percent for the same period. On the inputs side, there is a positive contribution to productivity growth by MFP of 0.8 percent and a reduced impact from capital input.

Figure 1.3 Sources of Growth: Year Groupings



Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results, Gross Value Added for Foreign-owned Multinational Enterprises and Other Sectors Annual Results

Get the data: StatBank N1604, StatBank N1623, StatBank PIA01

To better understand the developments in productivity in the economy, the chart above presents the sixteen-year period broken out by stages in the economic cycle. The first section covers the period of the 'Celtic Tiger' and includes the onset of the recession in 2008. The second part covers the downturn

years and this is followed by the return to growth in the economy. The period of 2015 to 2016 is presented separately because of the extreme changes that occurred in 2015.

The period 2000 to 2008, prior to the recession, was characterised by sustained economic growth of over five percent. This growth was concentrated in the Domestic and Other sectors, reflecting the importance of Construction over the period. Capital services explain most of the improvements in productivity over the period, with labour playing only a small part.

Economic growth considerably weakened to an average annual growth rate of around 2 percent for the period 2009 to 2011. From a sectoral perspective, Industry was relatively unchanged over the three-year period at 1.2 percent. Professional, Admin and Support services and the Information and Communication sector remained positive, while Distribution and Transport and the Remaining sectors were negative. Growth in the Domestic and Other sector and in the Foreign sector was positive in the period. Capital services and MFP increased by an average of four percent over the period, but was offset by a fall in labour input.

The period from 2012 to 2014 saw positive average growth in all four main sectors of the economy, driven by increased capital services. There was significant growth in both the Foreign sector and the Domestic and Other sector.

The period 2015 and 2016 was dominated by a major increase in the industrial sector due to the relocation of large multinational companies to Ireland. From a productivity perspective, this was associated with a dramatic increase in capital services and a corresponding fall in multi-factor productivity as a consequence of labour input remaining unchanged.

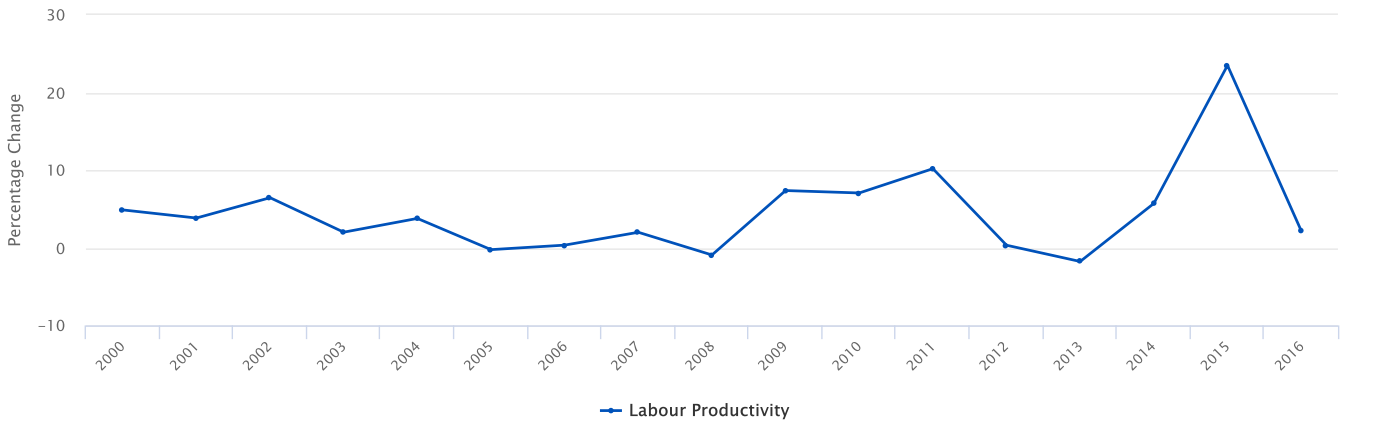
---

[1]The Remaining sector includes Agriculture, Construction, Finance and Insurance, Real Estate, Public Admin Health & Education, Arts and Culture.

Labour Productivity - Sectoral Contributions

This section provides an overview of labour productivity in the Irish economy, as measured by GVA per hour worked. Labour productivity is presented in terms of the overall economy, the Domestic and Other sector and the Foreign sector. An analysis of Ireland's relative labour productivity position with its EU counterparts is also presented.

Figure 2.1 Labour Productivity



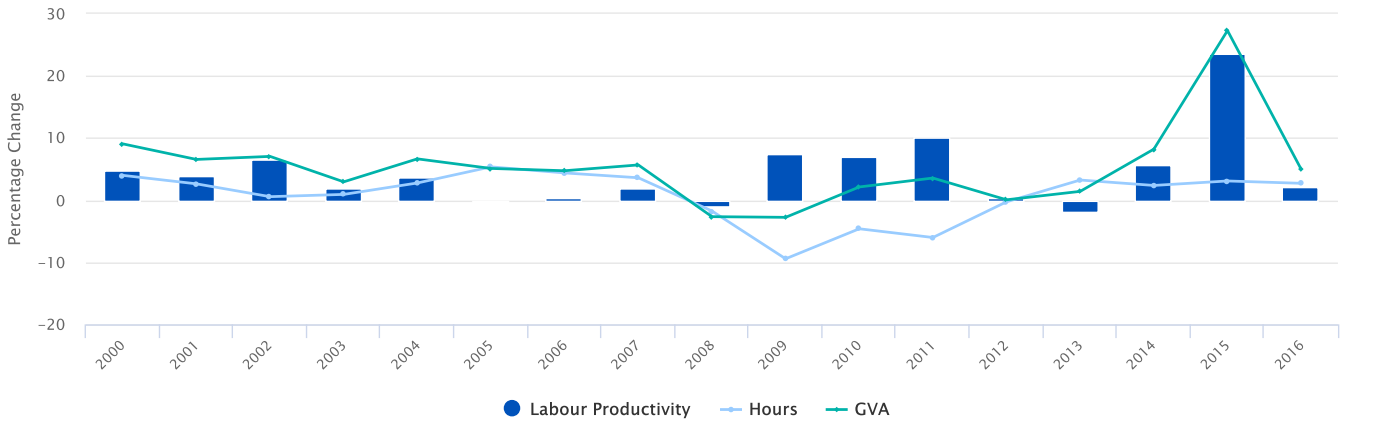
Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results

Get the data: StatBank N1604, StatBank PIA01

Overall labour productivity for the period 2000 to 2016 increased by an annual average of 4.5 percent (3.4 percent for 2000 to 2014). For the year 2016, the result is 2 percent. There was a gradual downward trend in labour productivity from 2000 to 2008. The post-crash period was characterised by strong increases in labour productivity due to the layoffs of workers, particularly in sectors such as Construction, Real Estate and Distribution, Transport, Hotels and Restaurants. A short period of labour hoarding by employers in 2008 was followed by these large layoffs of employees in the wake of the collapse in the Construction sector in 2008. The extreme globalisation-related events of 2015 in the Irish economy result in a further spike in labour productivity in the period 2014 to 2016.

Figure 2.2 Overall Labour Productivity: Hours and GVA



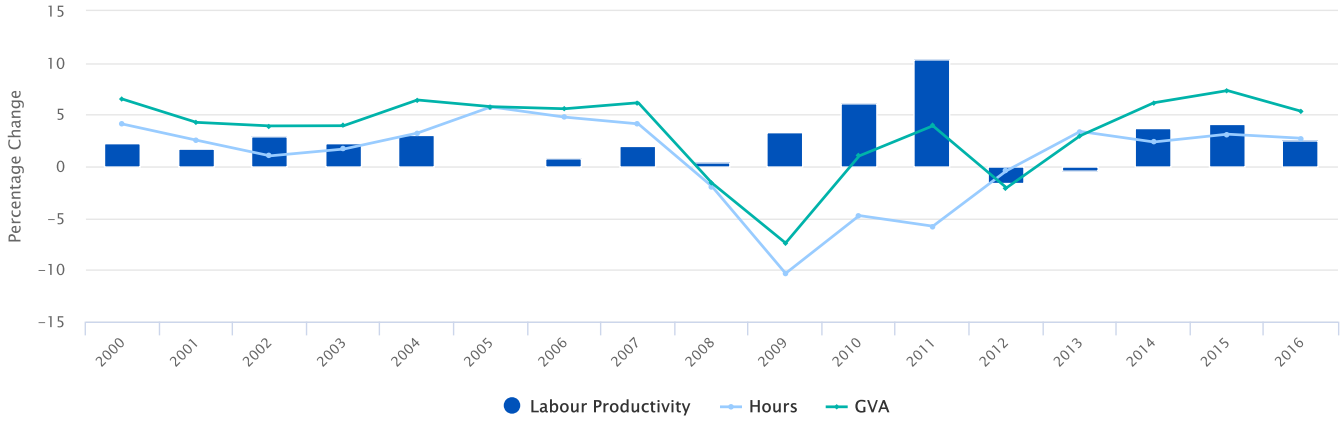
Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA01

As mentioned above, labour productivity showed a gradual downward trend in the period 2000 to 2008. In overall terms, GVA growth and growth in hours and employment all rose at rates of close to five percent. The year 2008 shows evidence of labour hoarding, with GVA growth declining faster than hours worked, resulting in falling labour productivity. The substantial productivity improvement between 2009 and 2011 was due to hours worked falling at a faster pace than GVA, while in 2010 and 2011 hours worked actually increased but GVA increased at a faster rate.

Labour productivity growth is practically unchanged in 2012 due to negligible growth in GVA and labour hours. However, labour productivity declined in 2013 as labour growth outstripped that of GVA in 2013. GVA grew by 26 percent in 2015 as a result of major globalisation events causing a 23 percent increase in labour productivity, i.e. change in total GVA per hour worked. GVA growth substantially exceeded labour growth in 2014 and 2016, which explains the increased labour productivity.

Figure 2.3 Domestic and Other Sector Labour Productivity: Hours and GVA

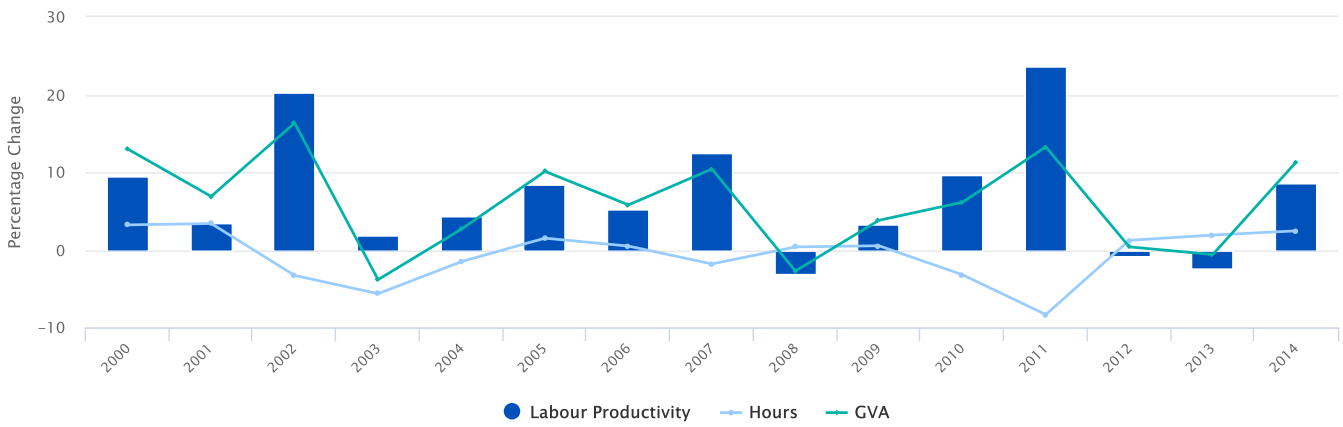


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

The chart above shows labour productivity for the Domestic and Other sector of the economy. Labour productivity grew relatively consistently between 2000 and 2004 as a result of GVA continually exceeding increases in labour hours worked. There was a significant fall in labour productivity growth between 2005 and 2008, explained largely by the developments in the Real Estate and Construction sectors. Productivity growth was zero in 2005 as a result of hours and GVA both growing at 6 percent. In the following years, labour hours declined while GVA growth remained stable, resulting in lower levels of productivity growth. Labour hours worked fell from 2008 to 2012. The fall was particularly sharp in 2009 with a decline of over 10 percent. GVA growth declined in 2008 and 2009 and was positive in 2010 and 2011, resulting in positive labour productivity growth. GVA declined at a faster rate than labour hours in 2012, causing falls in productivity, while the fall in productivity in 2013 was a result of labour growth exceeding growth in GVA. Labour productivity growth has tended to be higher in the period since 2014.

Figure 2.4 Foreign Sector Labour Productivity: Hours and GVA to 2014

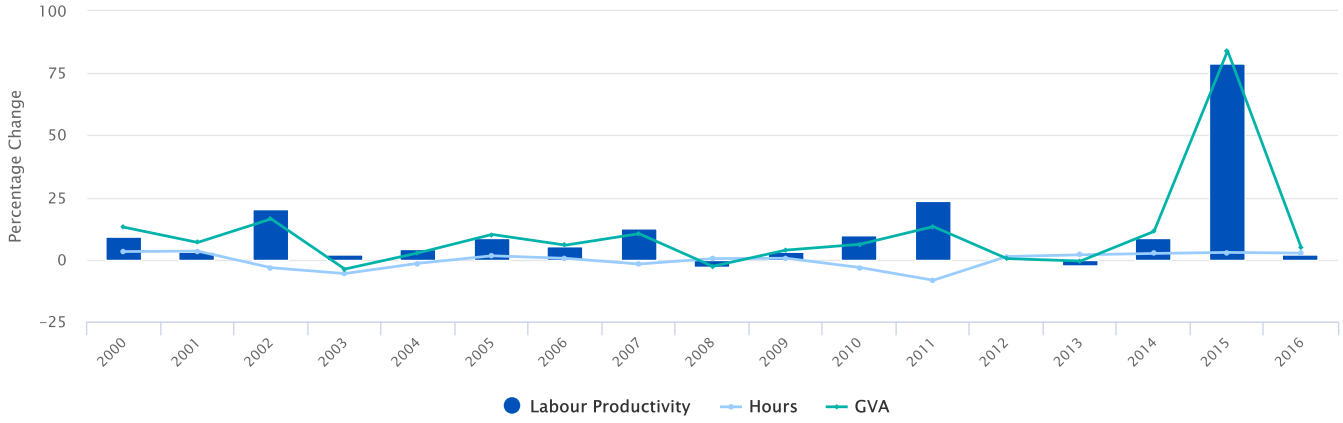


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

For the Foreign sector, labour productivity up to 2014 has followed a very different pattern compared to the Domestic and Other sector (see above). Productivity growth in the Foreign-dominated sector has been significantly higher than the Domestic and Other sector, due to the high concentration of multinational enterprises (MNEs) operating in this sector. Labour productivity grew by over 20 percent in 2002 and 2011, and in both cases this growth was caused by a fall in labour hours and increases in GVA. The Foreign sector had a sharp decline in productivity growth in 2003, probably due to the end of the dotcom bubble, as many of the foreign MNEs were technology firms.

Figure 2.5 Foreign Sector Labour Productivity: Hours and GVA to 2016

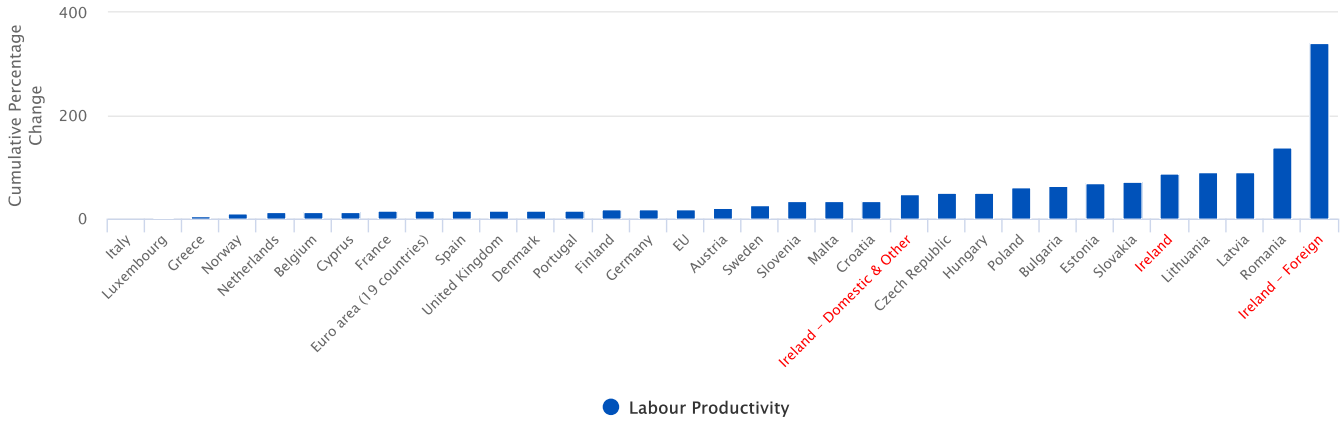


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

Extreme results for labour productivity are observed in 2015 where growth of 80 percent occurred in the Foreign-dominated sector. This is explained by the relocation of large multinational companies to Ireland.

Figure 2.6 Cumulative Labour Productivity Growth: 2000 – 2016



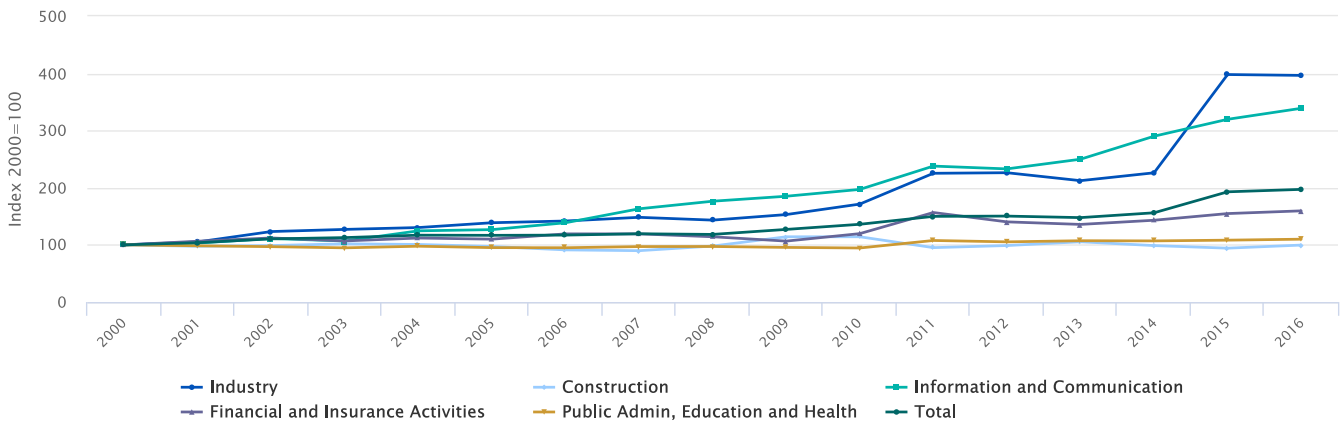
Source: CSO Ireland

Get the data: Eurostat

Irish labour productivity grew by the fourth-largest amount in the EU28 since 2000. Higher results were recorded for post-2004 accession countries Lithuania, Latvia and Romania.

The Domestic and Other sector experienced the largest increase in labour productivity among the 15 EU member states that joined the EU prior to 2004. The Foreign sector in the Irish economy had cumulative growth that was far larger than the overall growth in any EU country.

Figure 2.7 Labour Productivity: Main Sectors



Source: CSO Ireland

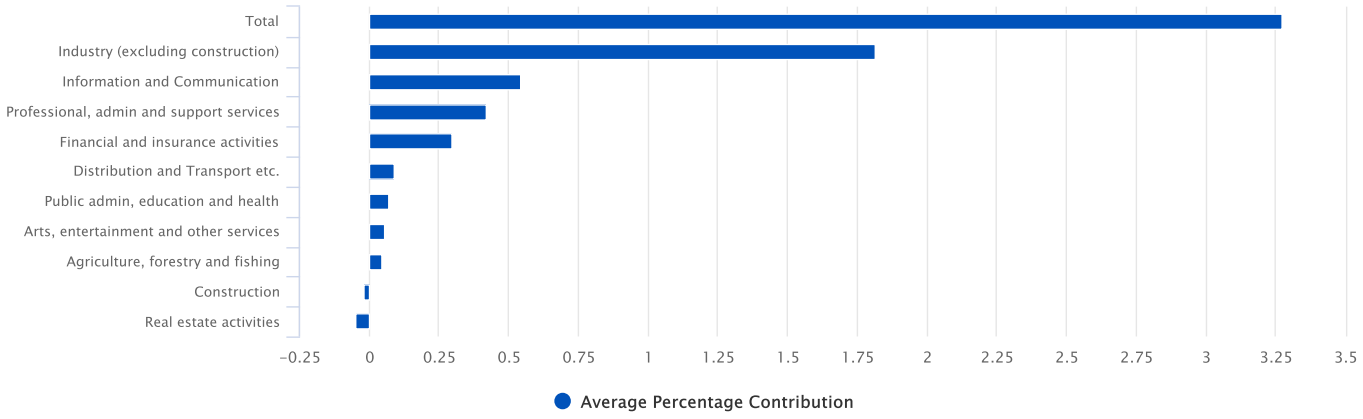
Get the data: StatBank N1604, StatBank PIA03

Labour productivity growth has not been uniform across the sectors of the economy during the period 2000 to 2016. Industry and Information and Communication have seen significant rises in labour productivity over this period, with the result that the Industry sector has become four times more

productive in 2016 than in 2000, while the Information and Communication sector is three times more productive. In this period, labour productivity in Financial and Insurance activities increased by just over 50 percent, while productivity in Public Admin, Education and Health increased by nine percent. Construction has seen almost no change in productivity over this entire period. In overall terms, GVA per hour worked for the whole economy has doubled between 2000 and 2016.

A large proportion of the growth in labour productivity associated with the Industry sector occurred between 2014 and 2016, driven by the globalisation events in 2015. Information and Communication was the second-largest growing sector, with labour productivity increasing by a factor of 2.5 between 2000 and 2016. Labour productivity in the Financial Services sector increased by less than the overall economy and Public Admin, Education and Health remained relatively steady over the period.

Figure 2.8 Contribution to Labour Productivity Growth: 2000 – 2014

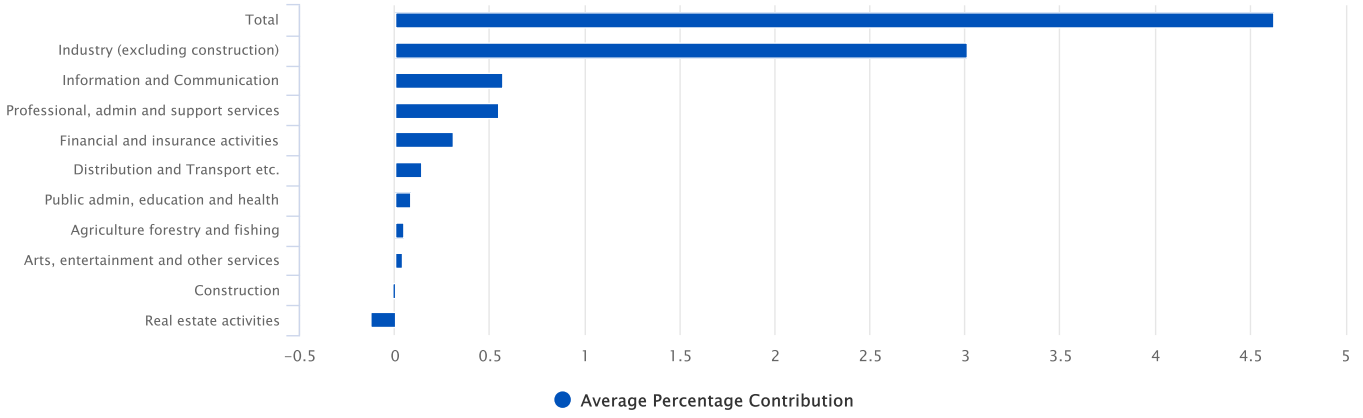


Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA03

The charts above and below show average annual contributions to total labour productivity (GVA per hour) growth in the whole economy, using the standard ten-sector presentation of the economy. Industry made the largest contribution to overall labour productivity growth over the period up to 2014. This was followed by Information and Communication and by Professional, Administration and Support services. Real Estate made a slightly less negative contribution to growth in the period up to 2014 than in the period up to 2016. The Arts and Entertainment sector made a bigger contribution than the Agricultural sector to growth in the period to 2014 than in the period to 2016.

Figure 2.9 Contribution to Labour Productivity Growth: 2000 – 2016



Source: CSO Ireland

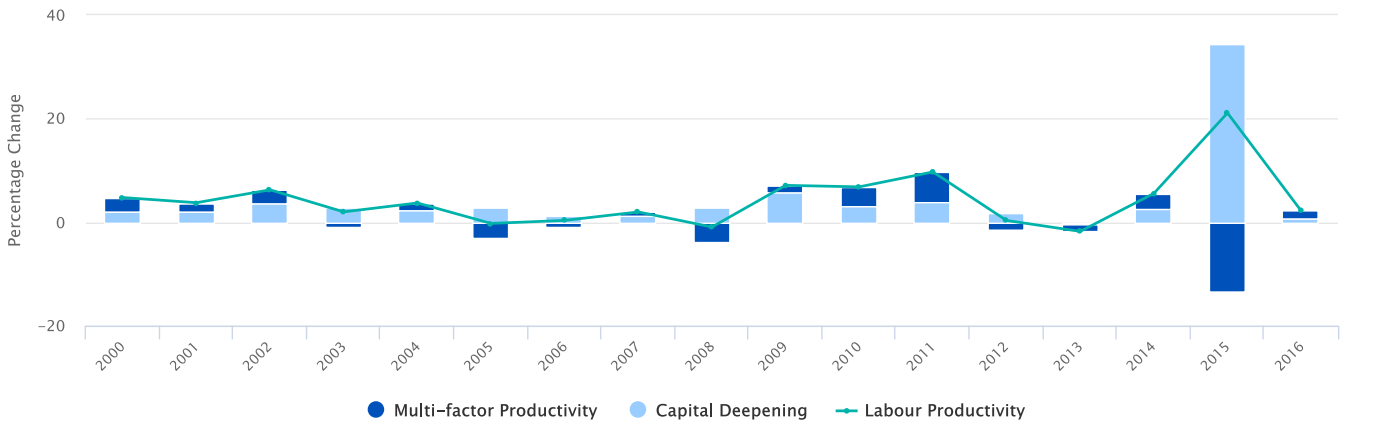
Get the data: StatBank N1604, StatBank PIA03

In the period to 2016, Industry has made the largest average contribution to total productivity growth, followed by Information and Communication and Professional, Admin and Support Services, although the large additions from GVA to Industry in 2015 should be noted. The only negative contribution to total productivity growth over the period was from the Real Estate sector, while the Construction sector contributed very little over the entire period.

Labour Productivity - Breakdown by MFP and Capital

To develop the analysis of labour productivity in the Irish economy, this section continues the focus on labour productivity through the framework of capital deepening and MFP. This supplements the basic measure of labour productivity presented in the previous section.

Figure 3.1 Overall Labour Productivity Breakdown



Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results

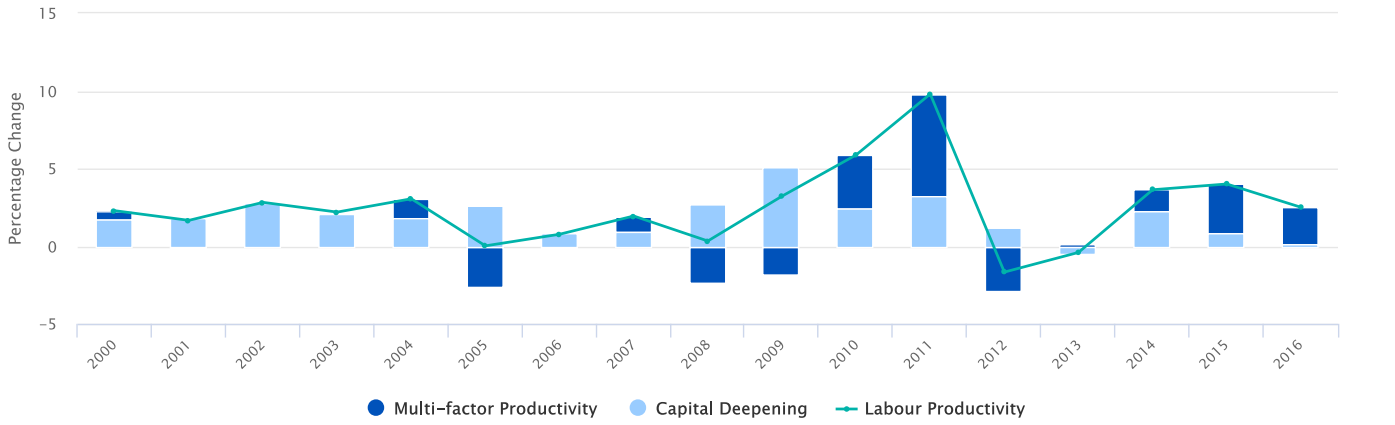
Get the data: StatBank N1604, StatBank PIA01

The figure above shows labour productivity analysed by MFP and capital deepening. Capital deepening is growth in the capital intensity of labour (the amount of capital available per hour worked).

Irish labour productivity has been characterised by strong growth for most of the period, explained by increases in capital deepening and MFP. The declines in labour productivity in 2005, 2008 and 2012 have also been associated with increased capital deepening, although they have been offset by falls in multi-factor productivity.

Ireland's growth in labour productivity from 2000 to 2004 was the result of increases in both MFP and capital. The year 2003 saw a slight fall in MFP but this was offset by capital deepening. MFP was also negative over the years 2005, 2006, 2008, 2012, 2013 and 2015. Although it was partly offset by capital deepening in these years, it resulted in labour productivity declines, particularly in the year 2015.

Figure 3.2 Domestic and Other Labour Productivity Breakdown

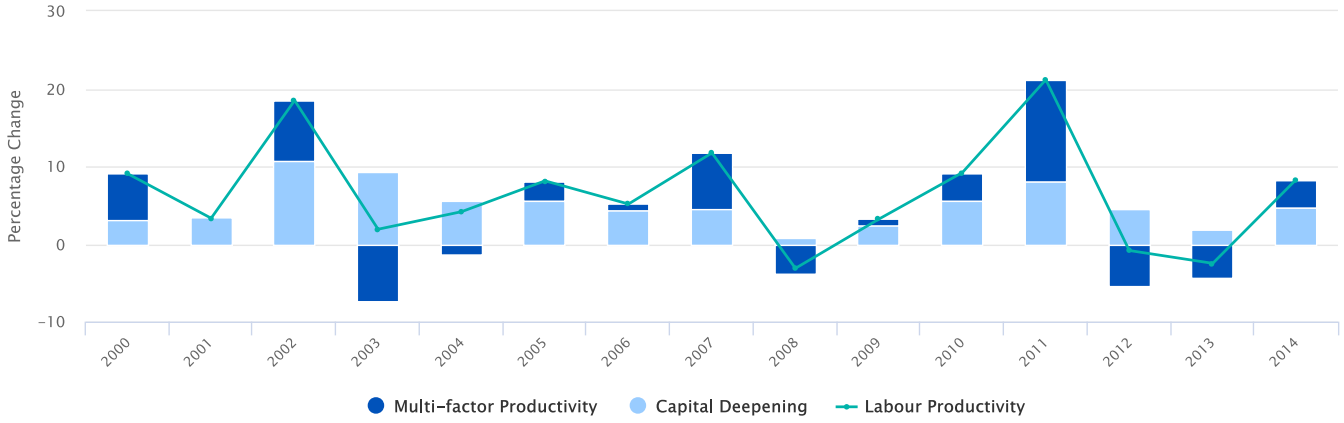


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

Labour productivity growth in the Domestic and Other sector was characterised by increases in capital deepening in the period up to 2008. Labour productivity growth remained positive for the period up to 2004 in line with the economic performance associated with the Celtic Tiger. This was followed by a decline in 2005 because of a fall in MFP. Since 2008, labour productivity growth has followed an increasing path until 2011, mainly due to increased capital deepening and increased MFP in the latter years. However, 2012 saw a substantial fall in labour productivity, which was driven mainly by a fall in MFP. Since 2013, in line with improvements in economic growth, labour productivity growth has remained positive, with MFP the main driving force behind the sustained increase until 2016, i.e. improvements in how inputs are used to produce GVA.

Figure 3.3 Foreign Labour Productivity Breakdown: 2000 – 2014

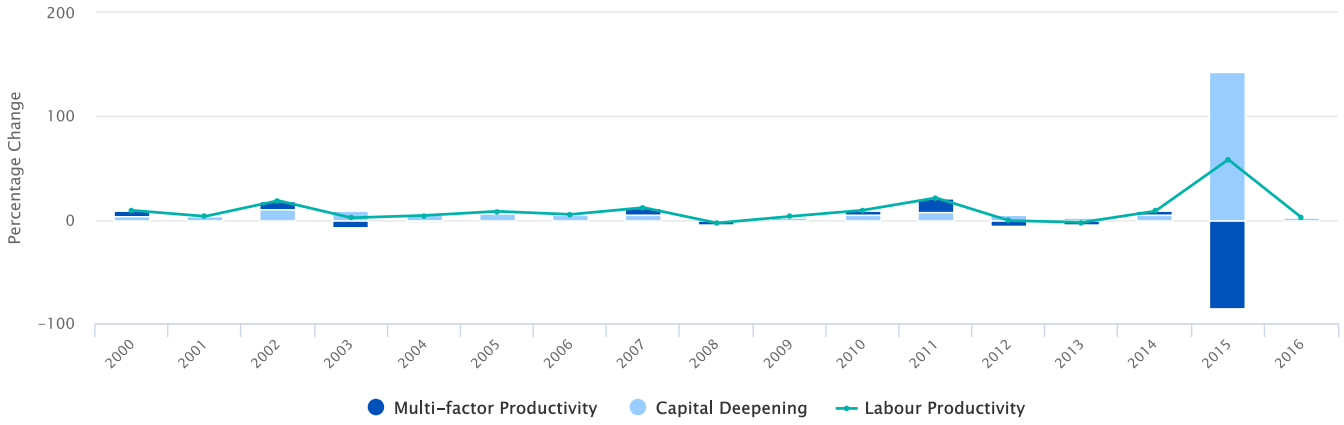


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

In line with the Domestic and Other sector, most of the increases in labour productivity in the Foreign sector have come from capital deepening. Prior to 2008, labour productivity growth was characterised mainly by capital deepening. In 2008, with the onset of the recession, labour productivity fell due mainly to a fall in MFP, as workers were laid off and production fell in the economy. In comparison to the Domestic and Other sector, labour productivity growth increased up until 2011, driven by increasing contributions from MFP and capital deepening. Labour productivity declined in 2012 and declined further in 2013, due to a fall in MFP. In 2014, labour productivity increased, due to increased capital deepening.

Figure 3.4 Foreign Labour Productivity Breakdown: 2000 – 2016

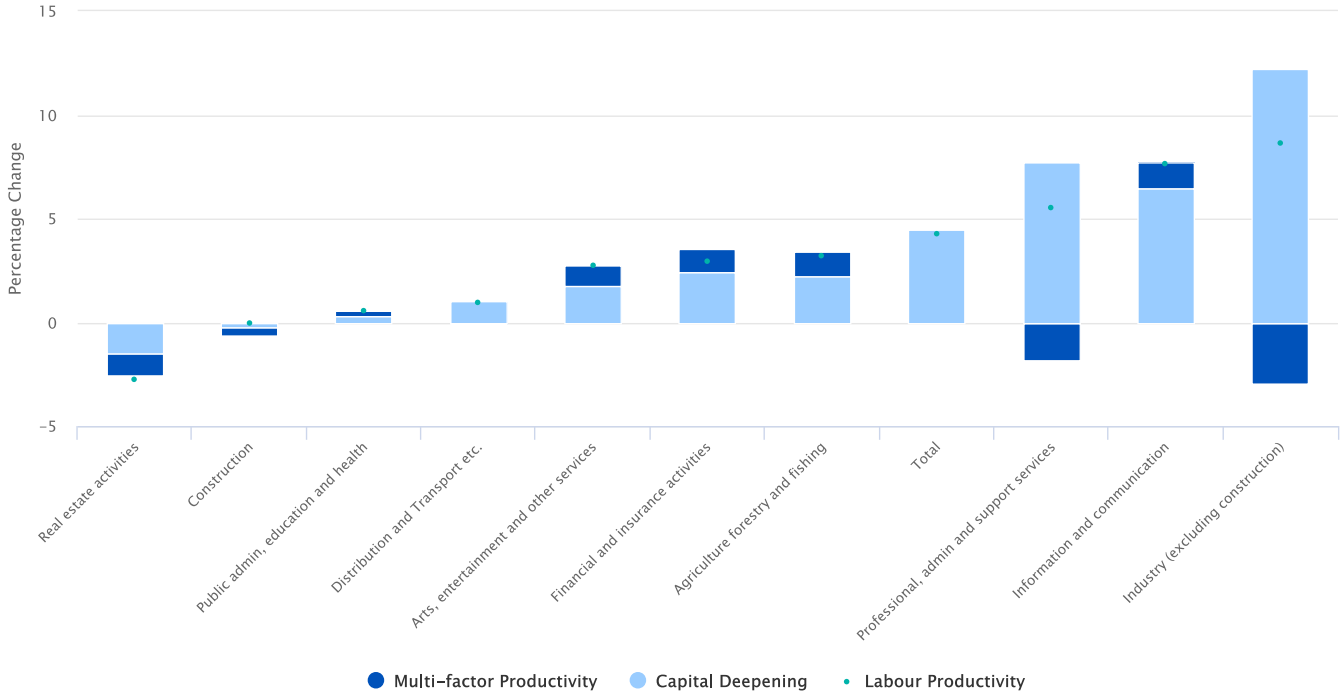


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

The chart above shows a breakdown of labour productivity with the years 2015 and 2016 included. There was a 58 percent increase in labour productivity due to a 143 percent increase in capital intensity of labour and an 85 percent fall in multi-factor productivity in 2015. These results were due to significant increases in multinational activity in the Irish economy with large additions to GVA taking place in the form of contract manufacturing and aircraft leasing. The year 2016 saw an increase in labour productivity of 2 percent, which reflected results in line with the series prior to 2015.

Figure 3.5 Average Annual Labour Productivity Growth by Sector: 2000 – 2016



Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA03

The figure above displays average annual labour productivity growth over the period, with the Industry sector showing the fastest growth. Information and Communication, Professional, Admin and Support Services and Finance and Insurance have also shown strong growth in labour productivity. These industries have accounted for a substantial share of aggregate capital deepening during the period, with MFP growth, particularly in the Information and Communication sector also playing a role. Construction and Real Estate activities have experienced negative labour productivity growth over the period.

Unit Labour Cost: Labour Productivity in Context

Figure 4.1 Nominal Unit Labour Cost

Source: CSO Ireland

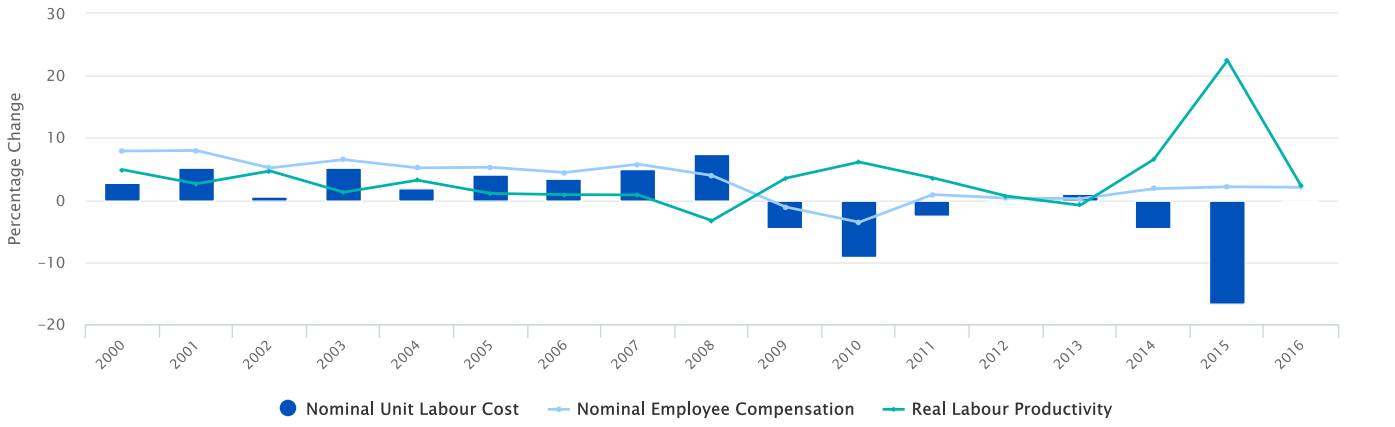
Source publication: National Income & Expenditure Annual Results, Macroeconomic Scoreboard

Get the data: StatBank PIA01

Nominal unit labour costs (ULC), which are explained in more detail in the Appendix, are comparable to labour productivity trends. Nominal unit labour cost measures nominal hourly employee compensation relative to real labour productivity. Growth in an economy's unit labour cost suggests that nominal employee income is rising relative to real labour productivity, resulting in decreased competitiveness. On the other hand, a decline in unit labour cost suggests that nominal labour compensation is declining relative to labour productivity, resulting in increased competitiveness.

The cost of labour in Ireland increased rapidly relative to overall output from 2000 to 2008. Since 2009, however, nominal unit labour costs have declined substantially to just under ninety percent of their 2000 level.

Figure 4.2 Overall Nominal Unit Labour Cost: Labour Cost and Productivity

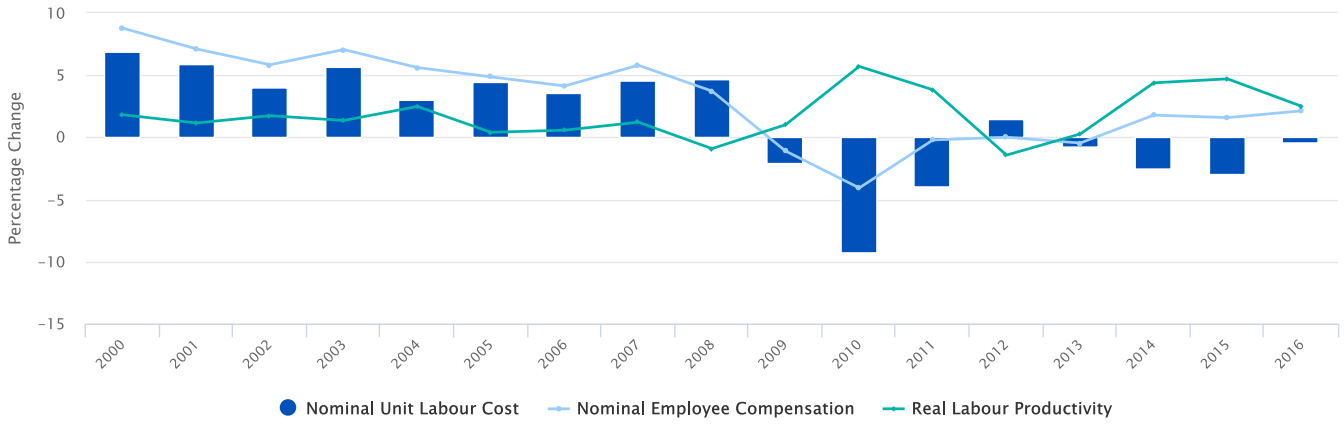


Source: CSO Ireland

Get the data: StatBank PIA02

The above chart explains the relationship between nominal employee compensation and labour productivity. Labour compensation per employee increased at a much faster rate than output relative to total employment from 2000 to 2007. This resulted in growth rates in nominal ULC that were often close to five percent. Labour compensation continued to increase in 2008 (although at a lower rate), while output relative to total employment fell. This resulted in the largest increase in nominal ULC of over seven percent. Since 2009, real output relative to total employment has had major increases. Labour compensation, which initially declined in 2009 and 2010, has grown. Since 2011 growth in nominal labour compensation has turned positive and since 2014 compensation has increased at a rate of two percent.

Figure 4.3 Domestic and Other Sector Nominal Unit Labour Cost: Labour Cost and Productivity

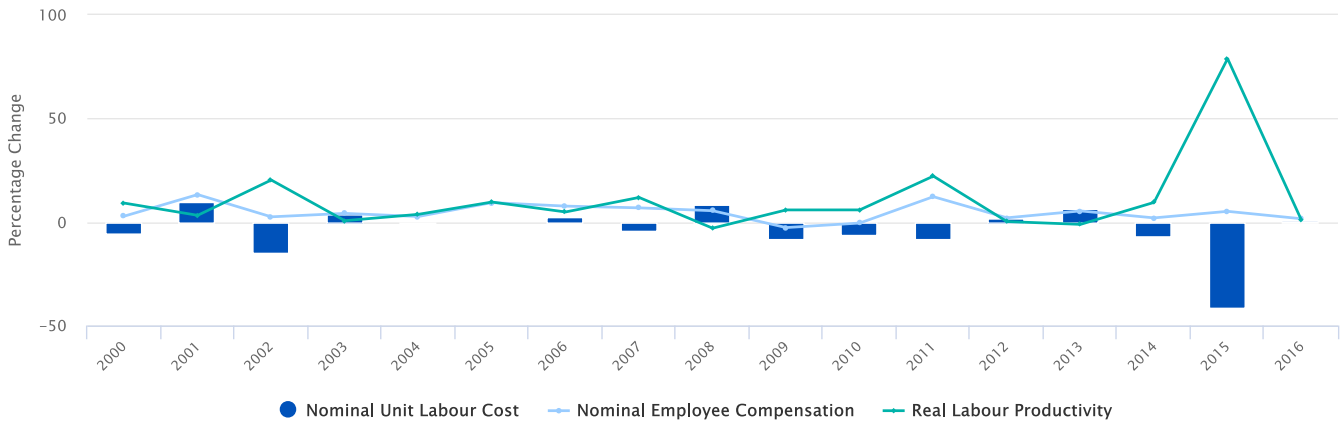


Source: CSO Ireland

Get the data: StatBank PIA02

Nominal unit labour cost for the Domestic and Other sector grew consistently at a rate of close to five percent between 2000 and 2008. This was a result of nominal employee compensation increasing well above real labour productivity throughout. From 2009 to 2011, nominal unit labour cost declined as a result of increased labour productivity and falls in labour compensation. Nominal unit labour cost fell again from 2014 to 2016. However, this time employee compensation increased with real labour productivity increasing at an even greater rate.

Figure 4.4 Foreign Sector Nominal Unit Labour Cost: Labour Cost and Productivity to 2016

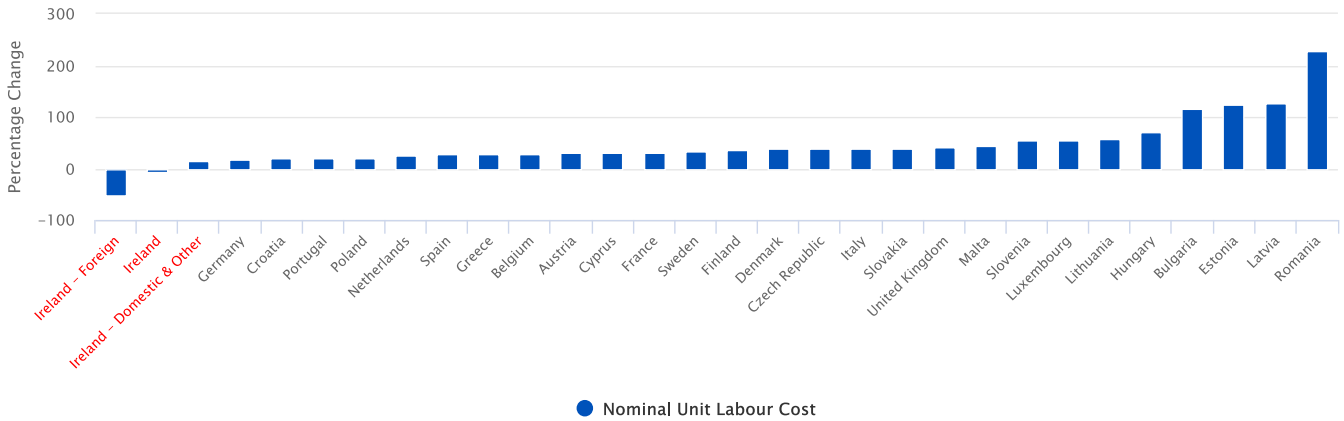


Source: CSO Ireland

Get the data: StatBank PIA02

Changes in nominal unit labour cost have been far more volatile for the Foreign sector than the Domestic and Other sector. The Foreign sector has had large and intermittent decreases and increases in nominal unit labour cost. For example, in 2002 there was a 15 percent decrease in ULC, and the years 2009 and 2010 were the only years that had falls in employee compensation. Moreover, nominal unit labour cost fell by over 40 percent in 2015 as a result of a major increase in labour productivity due to the extraordinary growth rate in that year.

Figure 4.5 Nominal Unit Labour Cost: 2000 – 2016



Source: CSO Ireland

Source publication: Macroeconomic Scoreboard

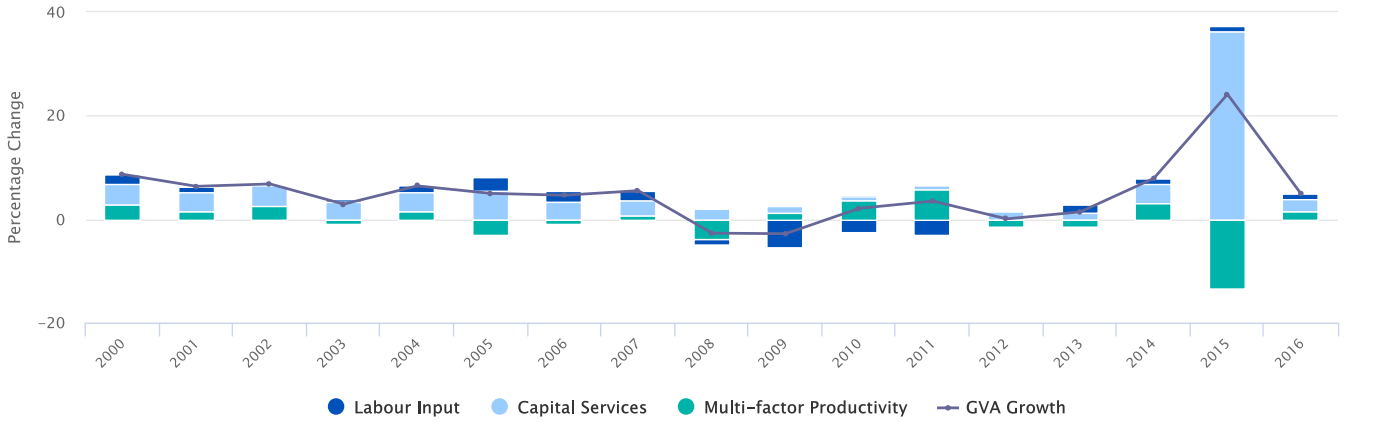
Get the data: Eurostat

This chart compares cumulative growth in nominal ULC for Ireland compared to the rest of the EU. Despite having had one of the highest levels of growth in nominal ULC from 2000 to 2008, Ireland is the only country in the EU to have had a cumulative fall in nominal unit labour cost over the entire period. This negative result is driven by developments in the Foreign sector of the Irish economy, in particular the dramatic additions to GVA in 2015. The Domestic and Other sector on its own has had the lowest increase in nominal unit labour cost relative to the rest of the EU.

Inputs to Economic Growth by Year

The following section provides a more detailed analysis of GVA growth in the Irish economy by labour and capital input, as well as by MFP. This section also provides further information on growth by industry and by sector, as well as country comparisons.

Figure 5.1 Overall GVA Growth by Inputs



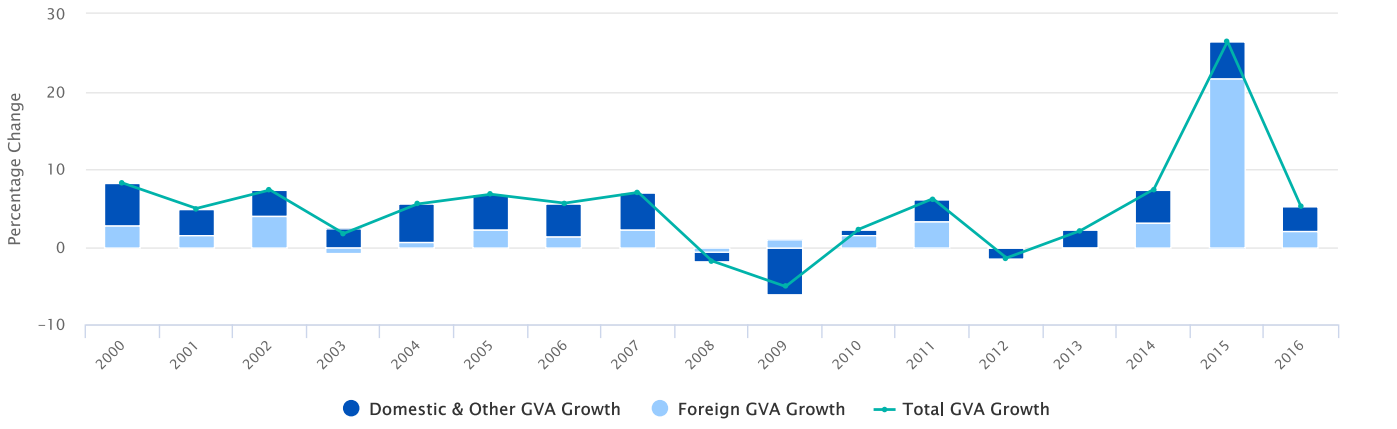
Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results

Get the data: StatBank N1604, StatBank PIA01

The above figure decomposes annual GVA growth into capital services, labour input and multi-factor productivity. GVA growth from 2000 to 2007 was mainly driven by capital services. In 2008, the first year of the recession, there were falls in multi-factor productivity, a common initial occurrence in recessions. The second year of recession, 2009, was associated with labour input falling more than GVA, linked to large falls in hours worked in that year. In the same year, capital services and multi-factor productivity increased slightly. The economy returned to growth in 2010 and 2011 but labour input continued to decline, resulting in increases in multi-factor productivity during these years. GVA growth remained stable in the year 2012 and 2013, before increasing significantly in 2015. This large increase was due to a level shift in activity driven by multinational activity, as previously discussed. A more stable level of growth was observed in 2016.

Figure 5.2 Foreign and Domestic and Other GVA Growth



Source: CSO Ireland

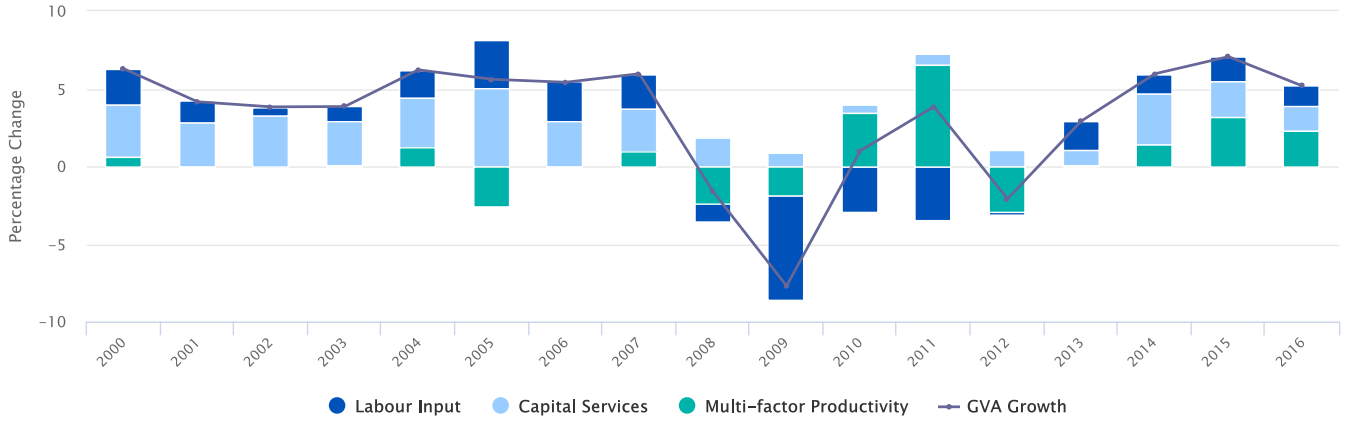
Source publication: National Income & Expenditure Annual Results, Gross Value Added for Foreign-owned Multinational Enterprises and Other Sectors Annual Results

Get the data: StatBank N1623

The chart above shows real GVA growth split into sectors dominated by Foreign-owned and Domestic and Other sectors. Irish economic growth from 2000 to 2007 was driven mainly by the Domestic and Other sector. Ireland experienced negative economic growth in both the Domestic and Other sector and in the Foreign sector in 2008, although the contraction was concentrated in the Domestic and Other sector. Ireland's positive economic growth in 2009 came entirely from the Foreign sector, while growth in the Domestic and Other sector continued to be negative. In 2010, Irish economic growth came mainly from the Foreign sector, while it came mainly from the Domestic and Other sector in 2011. Domestic and Other sector growth in 2012 was again negative, while Foreign growth was almost non-existent. The years 2013 and 2014 were dominated by growth in the Domestic and Other sector. The substantial jump in GVA in 2015 is largely due to the relocation of large multinational companies to Ireland, in particular where their net exports are now attributable to Ireland. Ireland's Domestic and Other growth has averaged six percent in 2015 and 2016.

*See Glossary of Terms or the Appendix for more information on the Foreign-owned Multinational Enterprise dominated sectors.

Figure 5.3 Domestic and Other Sector: GVA Growth by Inputs

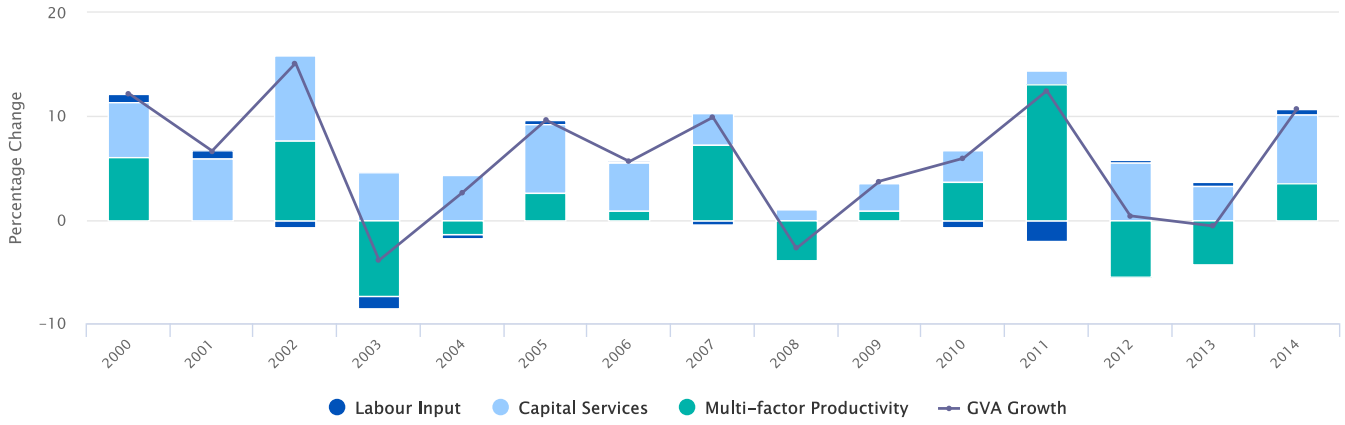


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

In the chart above, the Domestic and Other sector of the economy is decomposed by factor inputs. The high rates of growth in the Domestic and Other sector from 2000 to 2007 have been driven mainly by capital services. Increases in labour inputs of between 0.5 percent and three percent are also observed. Labour contributed negatively to GVA growth from 2009 to 2012 with overall compensation of employees declining due to falling labour hours and job losses. The growth in the Domestic and Other sector since 2013 has seen large contributions from capital services, while also showing positive growth in labour input.

Figure 5.4 Foreign Sector GVA Growth by Inputs: 2000 – 2014

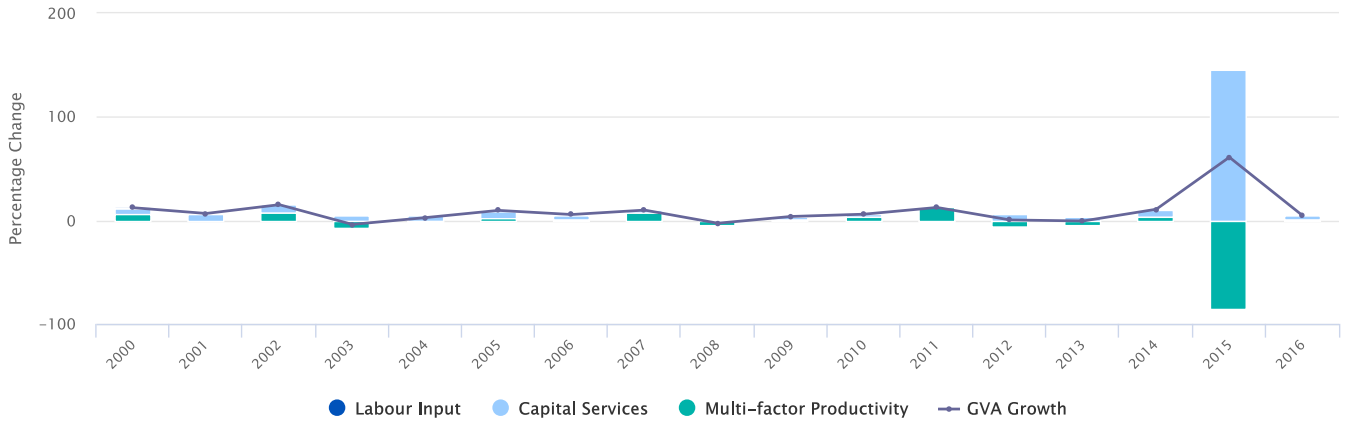


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

Growth in the Foreign-dominated sector of the Irish economy up to 2014 has come almost entirely from capital services and multi-factor productivity. Gross value added in the Irish economy has grown at a much greater rate in the Foreign-dominated sector than the Domestic and Other sector and has followed a different cyclical pattern. The Foreign-dominated sector of the Irish economy experienced a recession in 2003 due to the dotcom bubble. This was associated with falling multi-factor productivity and, to a much lesser extent, labour input. The Foreign-dominated sector also experienced negative growth in 2008 as a result of the global financial crisis and a third instance of negative growth in 2013, which was preceded by low growth in 2012.

Figure 5.5 Foreign Sector GVA Growth by Inputs: 2000 – 2016

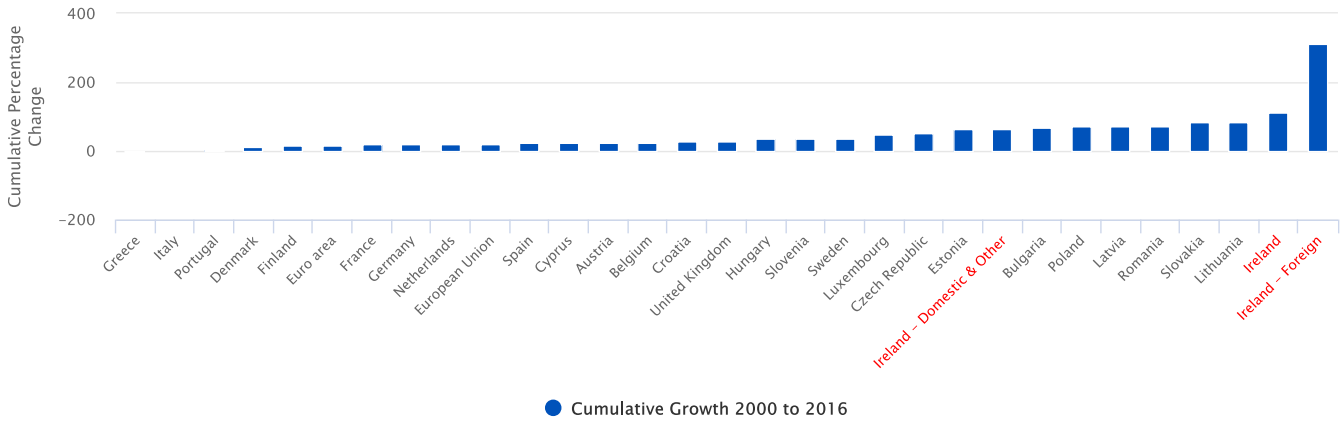


Source: CSO Ireland

Get the data: StatBank N1623, StatBank PIA02

The chart above shows the sources of GVA growth in the Foreign-dominated sector with the years 2015 and 2016 included. The 2015 growth rate is mostly due to significant corporate relocations of entire balance sheets dominated by intellectual property products by Foreign-owned multinationals. Significant exports involving contract manufacturing abroad drove the very strong GVA results for 2015. This surge in growth is presented in the chart above in the form of a significant increase in capital services and a related fall in multi-factor productivity.

Figure 5.6 Real GVA Growth: 2000 – 2016



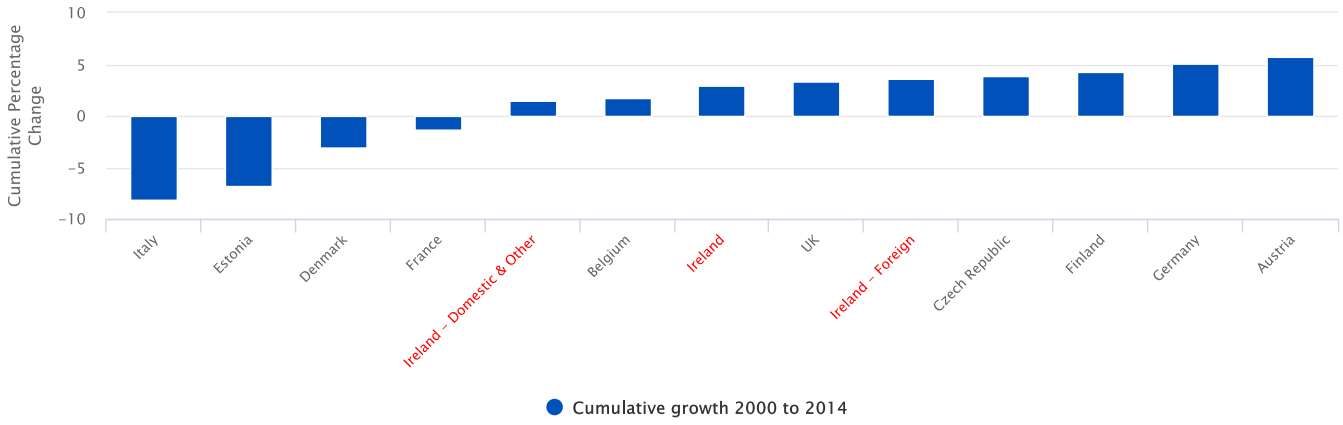
Source: CSO Ireland

Source publication: National Income & Expenditure Annual Results

Get the data: Eurostat

The above figure highlights Ireland's position in real GVA growth terms relative to its European counterparts. Looking at Ireland as a whole, cumulative growth in real GVA increased by over 100 percent over the period 2000-2016. This large growth in real GVA places Ireland at the top of the distribution. Real GVA growth for Ireland's Domestic and Other sector is also at a relatively high position in the distribution. Like the cumulative labour productivity growth shown in the previous chapter, the Foreign sector in the Irish economy had cumulative growth that was far larger than the growth in any other EU country, due to the large influx of activities relating to contract manufacturing and aircraft leasing.

Figure 5.7 Multi-factor Productivity Growth: 2000 – 2014

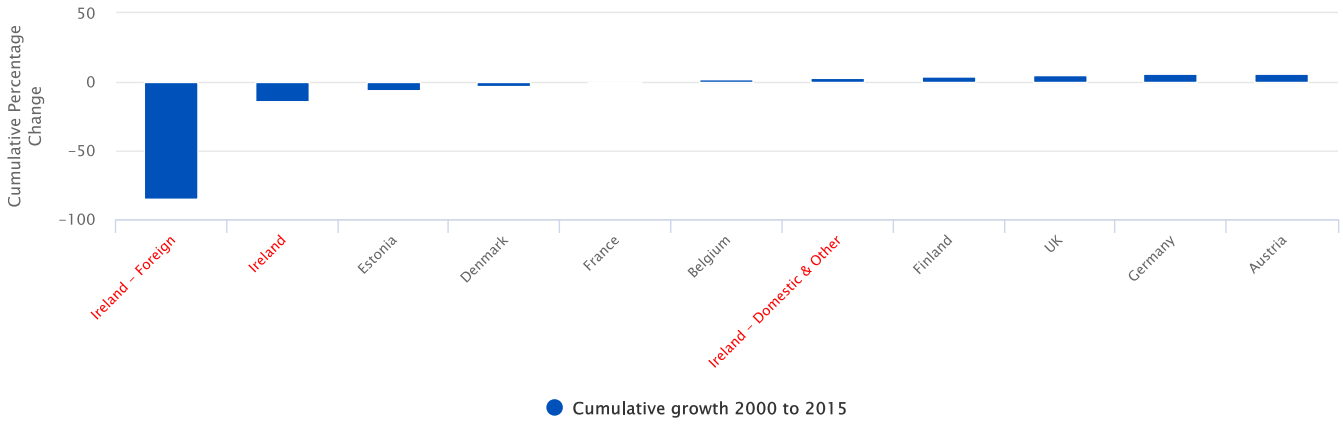


Source: CSO Ireland

Get the data: EUKLEMS data (note that this is not fully comparable with the Irish data)

The above chart shows Ireland's MFP position relative to its European partners over the period 2000 to 2014. The multi-factor productivity country comparisons follow a similar story to the previous graph. The Foreign sector in the Irish economy had a relatively strong performance when compared to its European counterparts, showing cumulative growth of four percent over the entire period behind the Czech Republic, Finland, Germany and Austria. Ireland, as a whole, shows a similar strong performance relative to the other EU countries shown. The overall economy posted cumulative growth of three percent in the period up to 2014. The Domestic and Other sector of the economy show a slightly different picture. Unlike the Irish Foreign sector, the Domestic and Other sector had positive cumulative growth of about 1 percent over the period.

Figure 5.8 Multi-factor Productivity Growth: 2000 – 2015

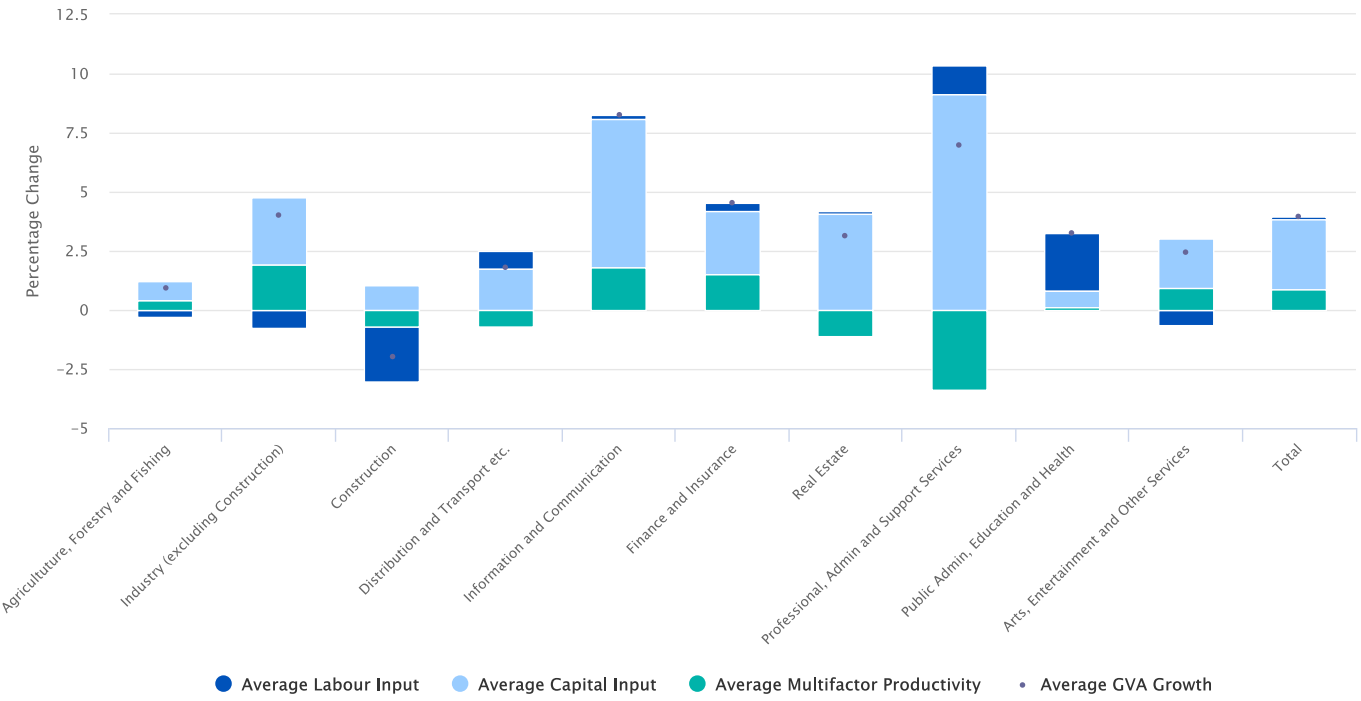


Source: CSO Ireland

Get the data: StatBank PIA02, EUKLEMS data (note that this is not fully comparable with the Irish data)

This chart shows Ireland's MFP relative position to its European partners when the period up to 2015 is considered. Unlike the previous chart showing multi-factor productivity growth up to 2014, the multi-factor productivity country comparisons up to 2015 show a different story. The Foreign sector in the Irish economy has the lowest result of the selected countries, showing cumulative growth of -80 percent over the period. Ireland as a whole achieved cumulative growth of -14 percent in the period up to 2015, resulting in a position at the bottom end of the distribution. The Domestic and Other sector in the Irish economy shows a more positive picture. Unlike the Irish Foreign sector, the Domestic and Other sector had positive cumulative growth of about three percent over the period. This positive growth raises Ireland's position to fifth in the graph, higher than Estonia, Denmark, France and Belgium.

Figure 5.9 Average Annual Productivity Growth by Sector: 2000 – 2014

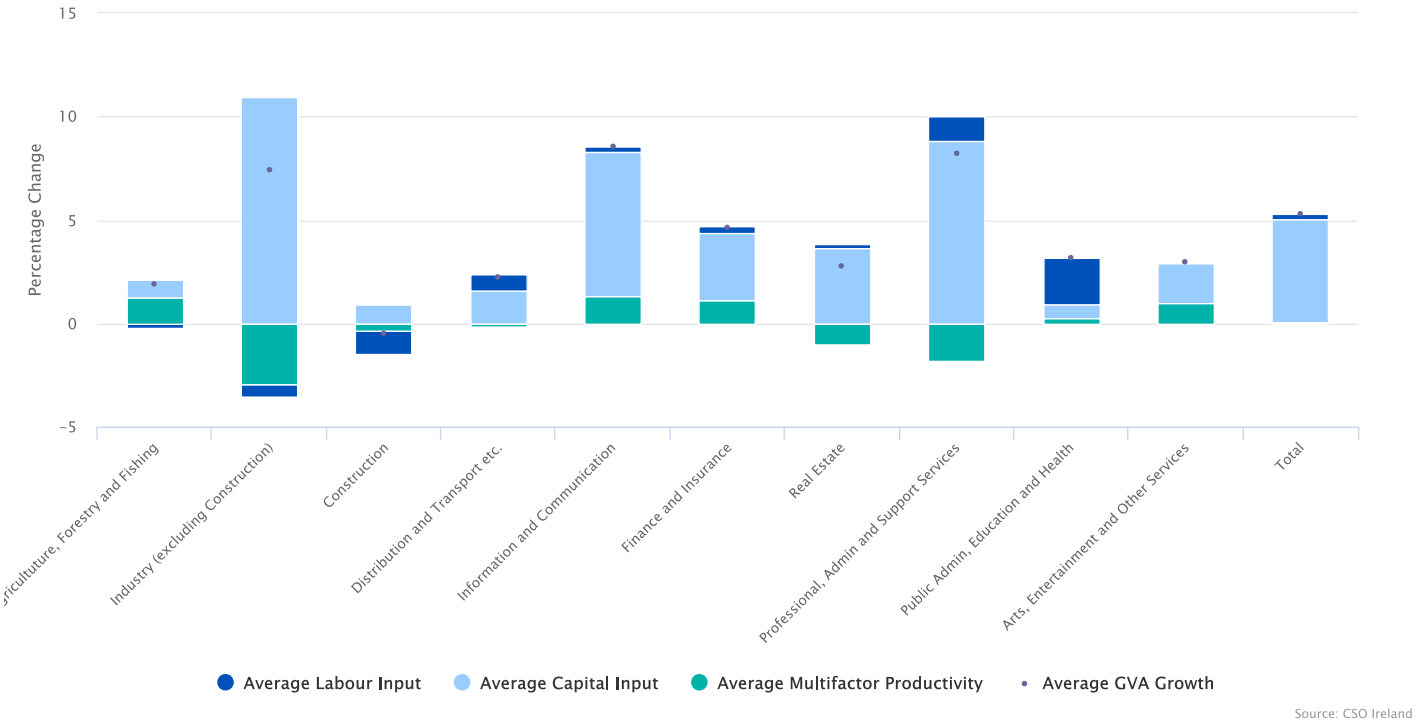


Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA03

Looking at the average annual growth over the period 2000 to 2014, Information and Communication experienced the largest average annual growth within the period, followed by Professional, Admin and Support Services. Most of the growth was again attributable to capital services. Public Admin and Defence experienced the largest growth in labour input, while sectors related to Industry and the Construction sector suffered large falls in labour input over the period up to 2014.

Figure 5.10 Average Annual Productivity Growth by Sector: 2000 – 2016

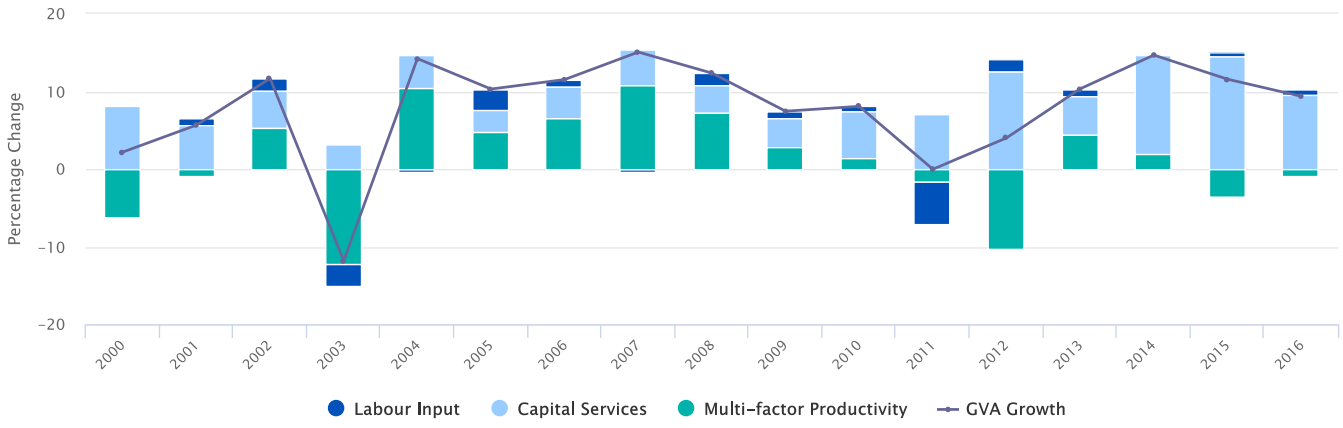


Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA03

There has been considerable variation in average GVA growth by sector over the period 2000 to 2016. Industry and Professional, Admin and Support Services experienced the largest average annual growth in GVA over the period and much of this growth was driven by capital services. In the case of Industry, labour input and MFP contributed negatively to GVA growth overall. The sector with the largest amount of MFP growth was the Information and Communication sector, followed by the Agricultural sector and the Finance and Insurance sector. Similar to the period up to 2014, Public Admin and Defence saw the largest increase in growth from labour input, while the Construction sector saw the largest fall in labour input. The latest productivity growth results indicate that GVA growth returned to pre-2015 levels in 2016 for industries such as Industry, Information and Communication and Professional, Admin and Support Services. The Industry sector had growth in GVA of 3 percent, Information and Communication growth of 9 percent and Professional services growing by 13 percent in 2016.

Figure 5.11 Information and Communications: GVA Growth by Inputs

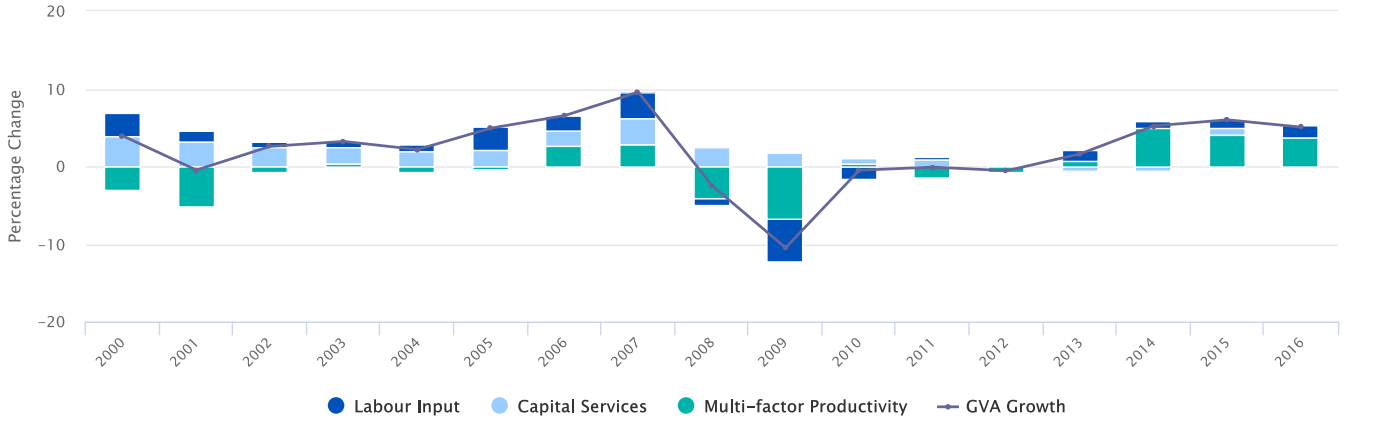


Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA03

The above chart shows the breakdown of GVA by factor inputs in the Information and Communications sector. The steady increase in growth during the period 2000 to 2002 was mainly driven by capital services. In 2003, with the onset of the dotcom bust, a significant fall was evident in MFP and labour input for the sector. Growth in GVA recovered until 2007, mainly driven by MFP and capital, with labour input only making a small contribution over the period. The onset of the international recession in 2008 led to a decline in growth until 2011. The slightly negative growth in 2011 was mainly driven by falls in labour input. The recovery in GVA growth from 2012 up to 2016 has primarily been as a result of large increases in capital services, particularly from 2014 to 2016.

Figure 5.12 Distribution, Transport, Hotels and Restaurants: GVA Growth by Inputs



Source: CSO Ireland

Get the data: StatBank N1604, StatBank PIA03

The chart above shows GVA in the Distribution, Transport, Hotels and Restaurant sector broken down by factor inputs over the period 2000 to 2016. GVA growth fell in 2001 and a fall in MFP is observed as labour input did not fall until 2002. Following the reduction in labour input in 2002 and the rise in GVA, MFP begins a fairly flat trajectory with small decreases followed by small increases until 2005. In line with increased spending in the economy, higher levels of growth in 2006 and 2007 occurred. In this sector the impact of the crisis was most keenly felt with GVA growth falling by 2.4 percent in 2008 and by 10 percent in 2009. These large declines in GVA were due to falling demand for retail services, in particular, but also back up the supply chain to falling wholesale demand. Consequently, as labour was laid off we observe falling labour input and MFP. The sector returned to growth in 2013 and there have been consistent levels of growth of about five percent from 2014 to 2016, due in particular, to increased levels of MFP.

Developments in Capital Stocks and Services

Capital services play a major part in explaining Irish economic growth and consequently, the growth in labour productivity over the period. This chapter describes the growth in Ireland's capital stocks over the period 2000 to 2016 and also explains capital services, the most appropriate measure of capital input.

Figure 6.1 Capital Intensity (Stocks & Employment)

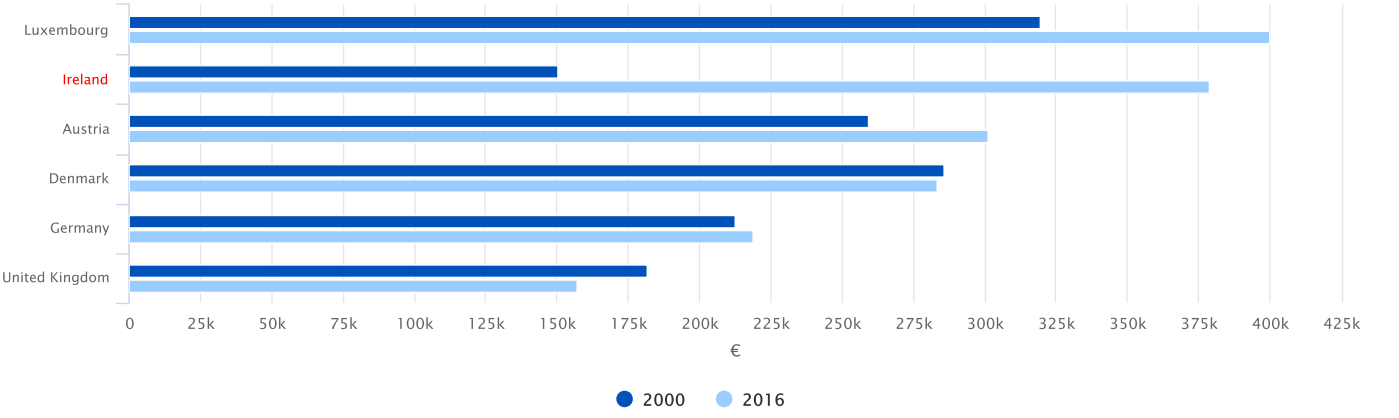
Source: CSO Ireland

Source publication: Estimates of the Capital Stock of Fixed Assets

Get the data: StatBank CSA02, StatBank PIA01

There have been substantial increases in the quantity of capital in use in the economy since 2000. One way of understanding these increases is in terms of capital stocks per employee. Ireland's capital stock per employee has increased from 150 thousand euro per employee to 378 thousand per employee between 2000 and 2016, an increase of 152 percent.

Figure 6.2 Capital Stocks per Employee



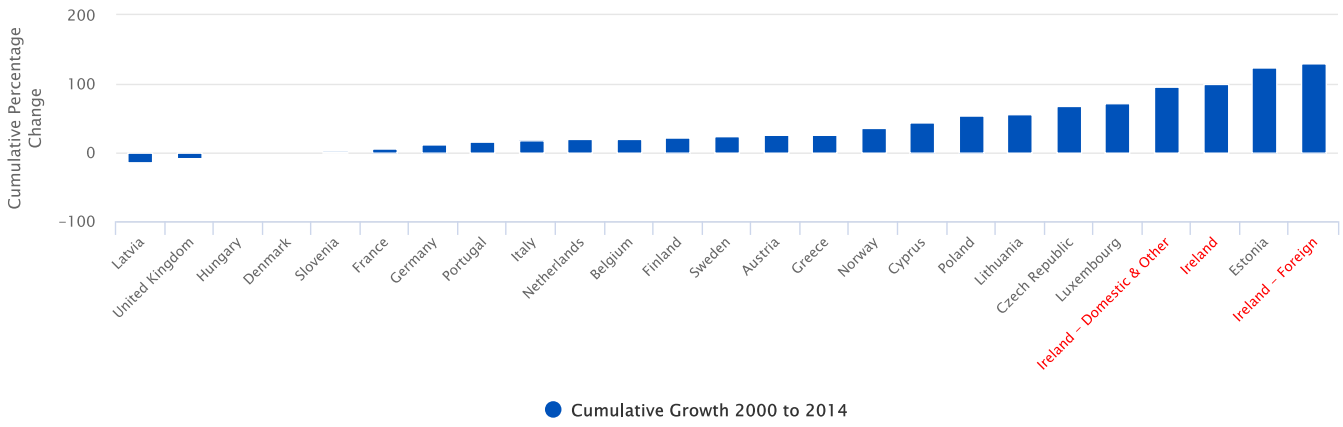
Source: CSO Ireland

Source publication: Estimates of the Capital Stock of Fixed Assets

Get the data: StatBank CSA02, StatBank PIA01, Eurostat (capital stocks), Eurostat (employment)

Ireland had a level of capital stocks per employee below many of its EU peers in 2000. However by 2016 as a result of significant capital deepening, capital intensity of labour had grown at a much faster rate than many other European countries and the value of capital stocks per employee is now one of the highest in Europe.

Figure 6.3 Cumulative Growth in Capital Stocks: 2000 – 2014



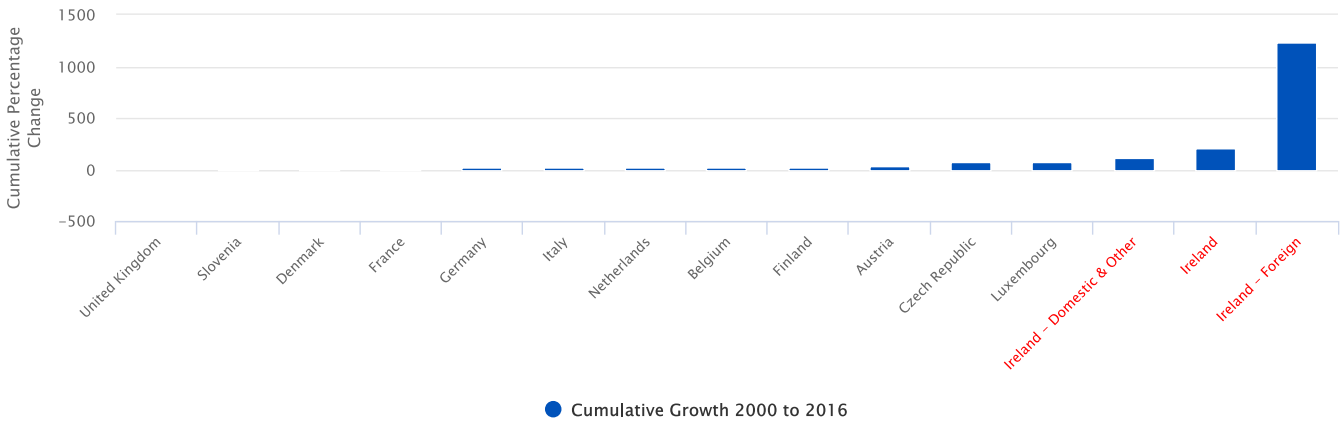
Source: CSO Ireland

Source publication: Estimates of the Capital Stock of Fixed Assets

Get the data: StatBank CSA02, Eurostat

The charts above and below compares Ireland's cumulative growth in capital stocks to other EU countries. From 2000 to 2014, the rate of increase in capital stocks in Ireland for both the Foreign sector and the Domestic and Other sector was higher than for any other country in the EU for which data are available.

Figure 6.4 Cumulative Growth in Capital Stocks: 2000 – 2016

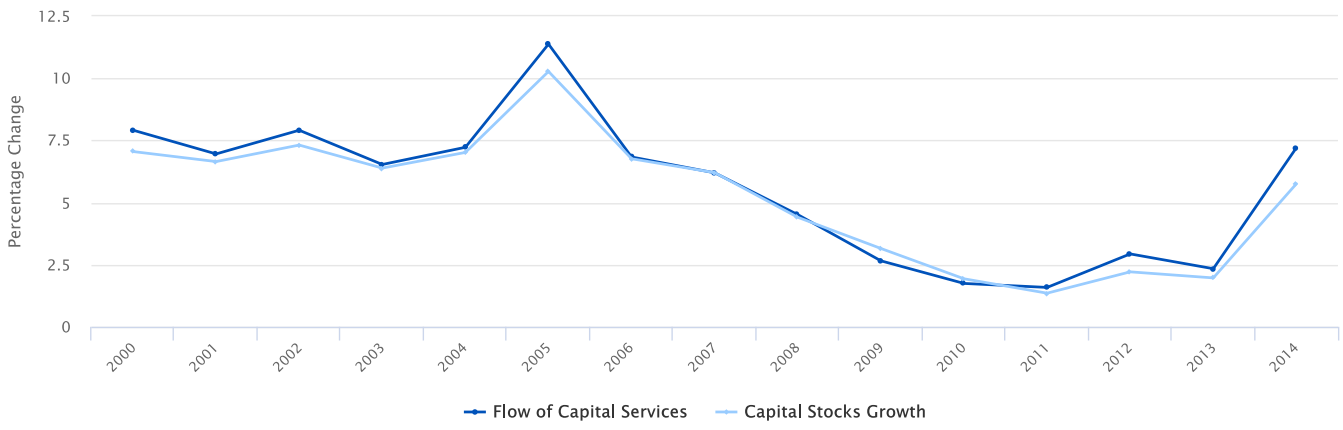


Source: CSO Ireland

Get the data: StatBank CSA02, Eurostat

The dramatic growth in Ireland's capital stock in 2015, associated with the level shift in GVA in the same year, puts overall capital stock growth significantly ahead of all other EU countries over the period 2000 to 2016, for which data are available.

Figure 6.5 Comparison of Capital Stocks and Services: 2000 – 2014



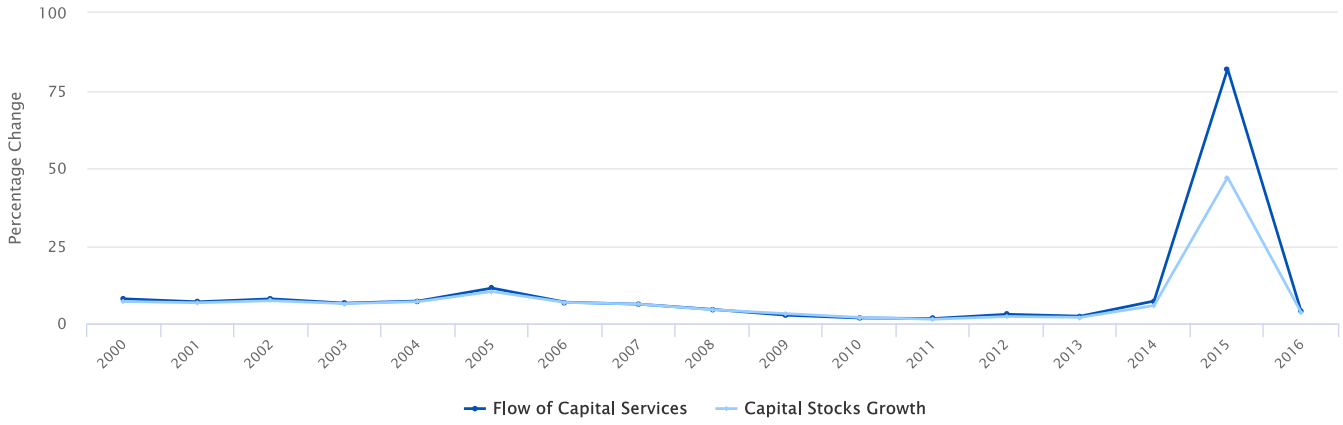
Source: CSO Ireland

Get the data: StatBank CSA02, StatBank PIA01

Capital services measure the productive use of capital. The volume index of capital services estimates the flow of capital services derived from all the capital assets in the economy. The main difference between the flow of capital services and the growth of capital stocks is the way in which different types

and ages of assets are aggregated together. Capital services tend to grow at a faster rate than capital stocks. This can be understood from the intuition that a capital asset's value will decline more quickly than its overall usefulness. Capital services are composed of the value of capital stocks weighted by the user cost for each asset. The user cost for each asset is based on the allocation of capital compensation in each asset's sector. More information on calculating capital services can be found in the appendix.

Figure 6.6 Comparison of Capital Stocks and Services: 2000 – 2016



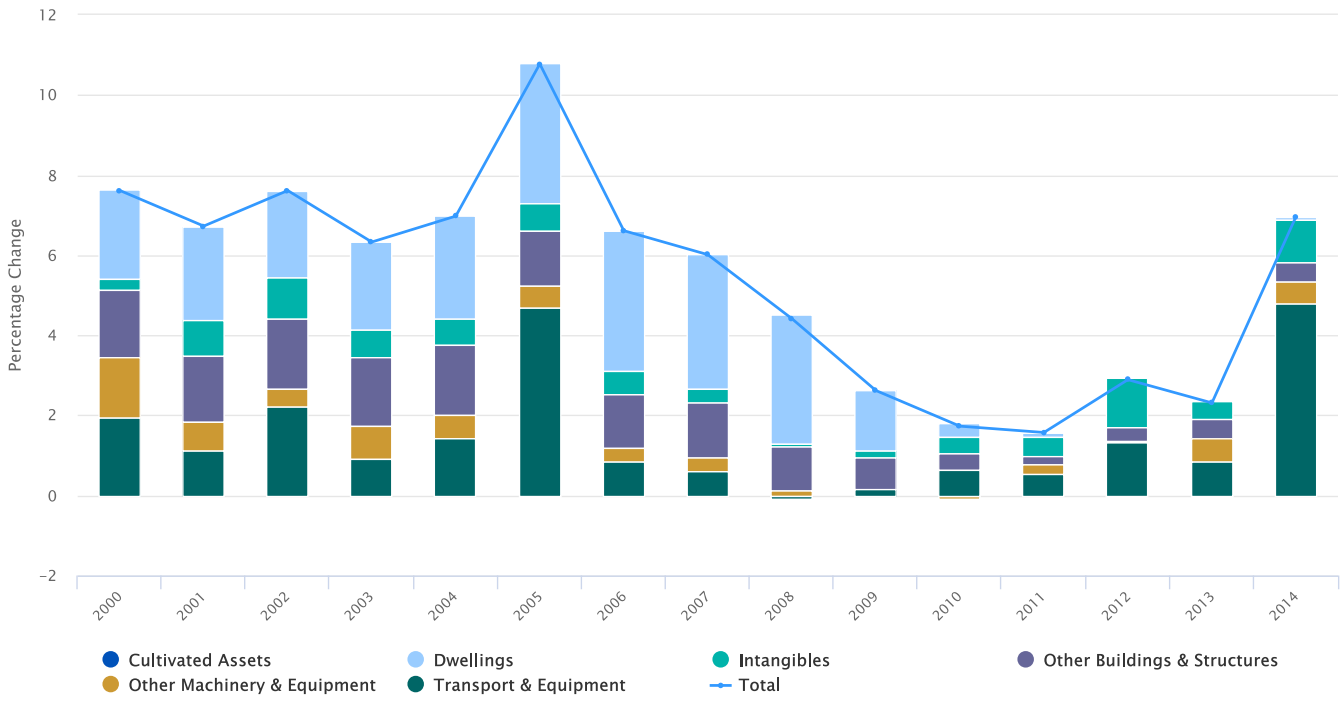
Source: CSO Ireland

Source publication: Estimates of the Capital Stock of Fixed Assets

Get the data: StatBank CSA02, StatBank PIA01

The above chart includes growth in capital stocks in 2015 and 2016. The flow of capital services in 2015 was much greater than the growth in capital stocks.

Figure 6.7 Capital Services: 2000 – 2014

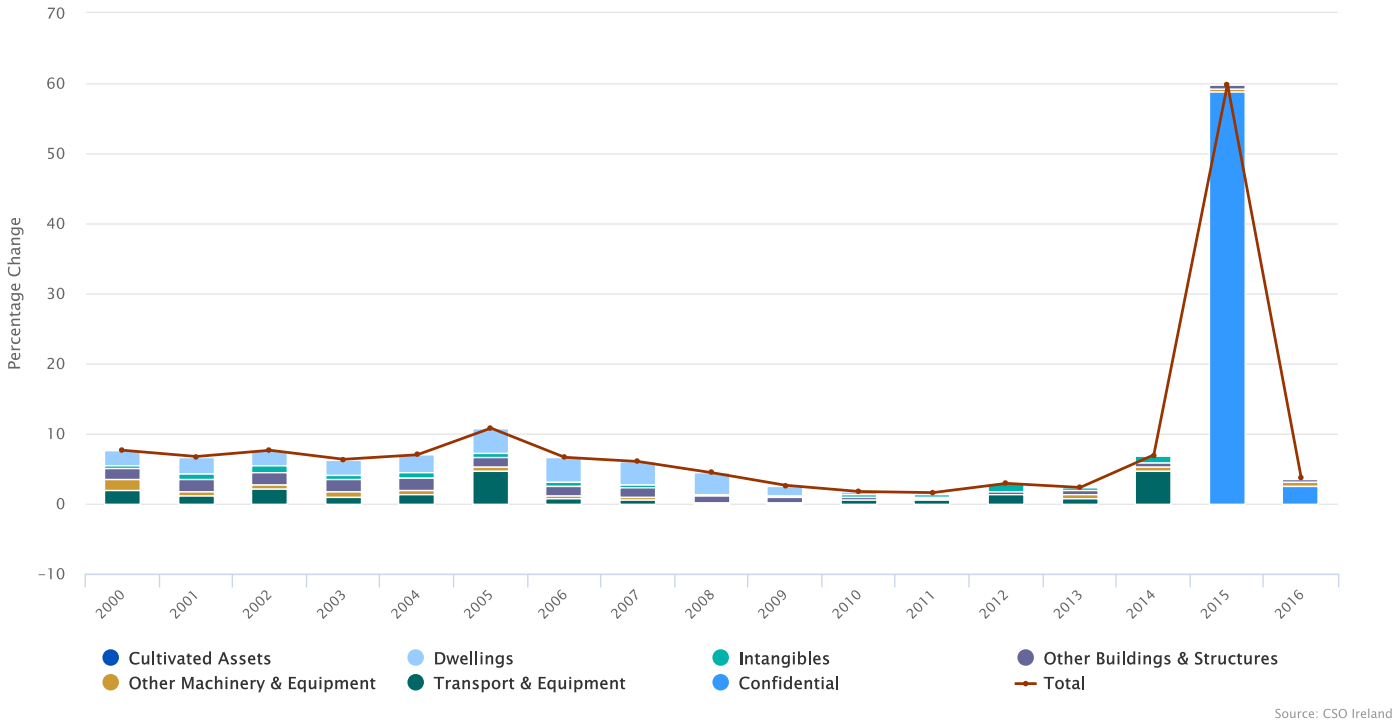


Source: CSO Ireland

Get the data: StatBank PIA01

Here we see that capital services grew at six percent or more during the years 2000 to 2007. These large increases were mainly driven by increases in the capital stock of dwellings and other buildings, during the boom period. Capital services growth was positive but lower from 2008 to 2013. Capital services growth returned to a similar growth rate in 2014 as during the 2000 to 2007 period. Nevertheless, there have been significant increases across almost all assets categories over the entire period, for example, there are additions to transport equipment in every year reflecting the increased aircraft leasing activities in Ireland.

Figure 6.8 Capital Services: 2000 – 2016



Source: CSO Ireland

Source publication: Estimates of the Capital Stock of Fixed Assets

Get the data: StatBank PIA01

Capital services growth since 2000 is dominated by the extraordinary increase in capital in 2015 associated with international corporate relocations and greatly increased contract manufacturing activities.

Summary

This publication has presented new CSO results for productivity in the Irish economy since 2000. Some key aspects of this publication are set out below.

Irish labour productivity growth averaged 4.5 percent in the period to 2016, significantly for the period ending 2014 the equivalent growth rate is 3.4 percent. This compares with an EU average of 1.8 percent for the entire period to 2016. The contribution of the Foreign sector to labour productivity growth averaged 10.9 percent over the period to 2016 and averaged 6.2 percent to 2014. For the Domestic and Other sectors, the result to 2016 was 2.5 percent to 2016 and 2.4 percent to 2014. This clearly illustrates that the impact from the globalisation events of 2015 are concentrated in the Foreign sector as there is little change in the results for the Domestic and Other sector for the two periods.

Multi-factor productivity (MFP) has played a small part in explaining Ireland's economic growth over the entire period 2000-2016. However, when the period 2000 -2014 is examined, i.e. excluding the effects of 2015, the picture for multi-factor productivity in the Irish economy improves and this is clearly illustrated in Figure 5.6 and 5.7. Growth in MFP was higher for the Foreign sector than the Domestic and Other sector up to 2014. However, the negative result for MFP in the Foreign sector in 2015 and in the overall economy over the full period is due to the impact of the globalisation events of 2015 on capital services where no corresponding change in labour input occurred. A major aspect of Ireland's growth, and therefore its productivity story over the period, is the growth in capital.

Ireland's capital stock per worker has increased from €150,000 to €378,000 per worker between 2000 and 2016, an increase of 152 percent. Capital stock per worker for the Foreign sector increased by an average annual growth rate of 6.9 percent to 2014. When the period is extended to 2016, the growth rate increases substantially to almost 32 percent. For the Domestic and Other sector, the growth in capital stock per worker is around 3.5 percent for both the periods to 2014 and for the entire period to 2016. The EU average annual growth in capital stocks per worker from 2000 to 2016 was 0.6 percent. The rate of increase in capital stocks in Ireland for both the Foreign sector and the Domestic and Other sector was higher than for any country in the EU for which data are available.

As this is the first productivity publication by CSO the results are considered experimental. There is considerable scope for extending the analysis presented in this publication to more detailed presentation by economic sector or to more detailed analysis of labour quality, i.e. gender, education, employment etc and their impacts on productivity. We look forward to a full engagement with our stakeholders to assist in setting priorities for future work in this area.

Tables

Labour Productivity: Percentage change in GVA per hour worked

Output per Unit of Capital Services: Log of GVA minus Log of Aggregate Capital Services

Multi-factor Productivity: Output per unit of labour input and capital services

Labour Input: Log of Hours multiplied by Labour Share 2 period Average

Capital Input: Log of Capital Services multiplied by Capital Share 2 period average

Gross Value Added: Growth in GVA

Capital Intensity: Growth in Capital Intensity

Table 1.1 Productivity in the Irish Economy

	Change in Productivity			Change in Inputs		Change in Output	Change in Relationship between Inputs
	Labour Productivity	Output per Unit of Capital Services	Multi-factor Productivity	Labour Input	Capital Input	Gross Value Added	Capital Intensity of Labour
2000	4.88%	1.06%	2.89%	1.91%	4.01%	9.06%	3.70%
2001	3.83%	-0.38%	1.62%	1.25%	3.55%	6.55%	4.14%
2002	6.45%	-0.81%	2.54%	0.26%	4.12%	7.04%	7.06%
2003	2.01%	-3.43%	-0.90%	0.43%	3.44%	2.95%	5.41%
2004	3.78%	-0.54%	1.50%	1.31%	3.71%	6.64%	4.25%
2005	-0.24%	-5.80%	-3.05%	2.57%	5.69%	5.10%	5.56%
2006	0.34%	-1.99%	-0.84%	2.14%	3.41%	4.73%	2.33%
2007	1.99%	-0.50%	0.74%	1.79%	3.05%	5.67%	2.48%
2008	-0.93%	-7.11%	-3.82%	-0.92%	2.14%	-2.66%	6.18%
2009	7.37%	-5.43%	1.32%	-5.19%	1.22%	-2.77%	12.54%
2010	7.06%	0.37%	3.77%	-2.41%	0.84%	2.12%	6.45%
2011	10.19%	1.92%	5.90%	-2.99%	0.81%	3.56%	7.78%
2012	0.33%	-2.84%	-1.32%	-0.13%	1.52%	0.05%	3.16%
2013	-1.77%	-0.91%	-1.31%	1.51%	1.23%	1.41%	-0.87%
2014	5.71%	0.93%	3.09%	1.07%	3.85%	8.21%	4.62%
2015	23.49%	-35.71%	-12.39%	1.21%	43.57%	27.30%	56.81%
2016	2.21%	1.11%	1.49%	0.92%	2.49%	4.98%	1.08%

Table 1.2 Productivity in the Domestic and Other Sector

	Change in Productivity			Change in Inputs		Change in Output	Change in Relationship between Inputs
	Labour Productivity	Output per Unit of Capital Services	Multi-factor Productivity	Labour Input	Capital Input	Gross Value Added	Capital Intensity of Labour
2000	2.31%	-1.61%	0.60%	2.29%	3.48%	6.49%	3.89%
2001	1.68%	-2.48%	-0.13%	1.43%	2.91%	4.25%	4.14%
2002	2.86%	-3.65%	0.01%	0.57%	3.31%	3.91%	6.47%
2003	2.22%	-2.57%	0.08%	0.93%	2.89%	3.93%	4.76%
2004	3.10%	-1.02%	1.25%	1.77%	3.27%	6.41%	4.08%
2005	0.02%	-5.84%	-2.54%	3.17%	5.19%	5.77%	5.86%
2006	0.77%	-1.18%	-0.10%	2.62%	2.97%	5.56%	1.95%
2007	1.96%	-0.16%	1.02%	2.27%	2.74%	6.15%	2.11%

2008	0.33%	-6.17%	-2.35%	-1.14%	1.91%	-1.61%	6.51%
2009	3.27%	-10.11%	-1.83%	-6.54%	0.92%	-7.41%	13.32%
2010	6.05%	-0.37%	3.49%	-2.92%	0.54%	1.01%	6.25%
2011	10.29%	2.19%	6.80%	-3.38%	0.70%	3.92%	7.61%
2012	-1.66%	-4.47%	-2.85%	-0.24%	1.04%	-2.07%	2.80%
2013	-0.40%	0.72%	0.11%	1.83%	1.00%	2.96%	-1.12%
2014	3.70%	-1.12%	1.42%	1.24%	3.38%	6.14%	4.75%
2015	4.09%	2.37%	3.26%	1.58%	2.32%	7.32%	1.64%
2016	2.54%	2.17%	2.36%	1.34%	1.54%	5.33%	0.33%

Table 1.3 Productivity in the Foreign Sector

	Change in Productivity			**Change in Inputs**		**Change in Output**	**Change in Relationship between Inputs**
	Labour Productivity	Output per Unit of Capital Services	Multi-factor Productivity	Labour Input	Capital Input	Gross Value Added	Capital Intensity of Labour
2000	9.47%	5.00%	6.19%	0.79%	5.57%	12.99%	4.05%
2001	3.38%	-1.12%	-0.05%	0.80%	6.08%	6.88%	4.44%
2002	20.31%	4.66%	8.02%	-0.74%	8.50%	16.33%	13.82%
2003	1.92%	-9.80%	-7.06%	-1.23%	4.75%	-3.84%	11.70%
2004	4.25%	-2.96%	-1.36%	-0.34%	4.44%	2.67%	7.12%
2005	8.47%	0.86%	2.58%	0.35%	6.96%	10.10%	7.28%
2006	5.28%	-0.61%	0.84%	0.12%	4.78%	5.79%	5.76%
2007	12.45%	5.66%	7.51%	-0.47%	3.18%	10.40%	6.07%
2008	-3.09%	-4.11%	-3.78%	0.10%	0.99%	-2.73%	0.97%
2009	3.26%	0.10%	0.89%	0.13%	2.75%	3.80%	3.11%
2010	9.64%	2.02%	3.77%	-0.76%	3.05%	6.12%	7.18%
2011	23.57%	10.68%	13.95%	-1.95%	1.38%	13.26%	10.48%
2012	-0.84%	-6.76%	-5.29%	0.27%	5.70%	0.38%	5.92%
2013	-2.46%	-4.83%	-4.19%	0.44%	3.29%	-0.61%	2.34%
2014	8.66%	2.17%	3.65%	0.56%	6.81%	11.32%	6.14%
2015	78.88%	-113.08%	-57.18%	0.47%	327.70%	84.00%	171.24%
2016	2.22%	0.02%	0.26%	0.29%	4.28%	4.85%	2.17%

Table 1.4 Productivity in the Information and Communications Sector

	Change in Productivity			**Change in Inputs**		**Change in Output**	**Change in Relationship between Inputs**
	Labour Productivity	Output per Unit of Capital Services	Multi-factor Productivity	Labour Input	Capital Input	Gross Value Added	Capital Intensity of Labour
2000	1.68%	-9.92%	-5.96%	0.17%	8.49%	2.20%	11.58%
2001	3.19%	-3.03%	-0.83%	0.90%	5.74%	5.82%	6.16%
2002	7.72%	4.00%	5.46%	1.63%	4.84%	12.36%	3.44%
2003	-3.94%	-16.86%	-11.54%	-2.75%	3.30%	-11.14%	12.84%
2004	16.66%	8.17%	11.08%	-0.38%	4.18%	15.28%	7.24%
2005	1.71%	6.24%	4.94%	2.72%	2.83%	10.85%	-4.54%
2006	9.47%	5.18%	6.69%	0.83%	4.31%	12.21%	3.87%
2007	17.61%	8.12%	11.47%	-0.39%	4.70%	16.25%	8.10%
2008	8.12%	7.07%	7.59%	1.48%	3.63%	13.14%	0.74%
2009	4.93%	1.98%	2.93%	0.85%	3.79%	7.73%	2.84%
2010	6.46%	-0.72%	1.46%	0.57%	6.24%	8.40%	6.97%

2011	20.71%	-10.03%	-1.64%	-5.33%	7.35%	-0.03%	28.86%
2012	-2.07%	-13.27%	-9.68%	1.70%	13.32%	4.09%	11.18%
2013	7.26%	3.56%	4.60%	0.90%	5.06%	10.88%	3.45%
2014	16.10%	-2.39%	2.02%	-0.06%	13.59%	15.81%	17.32%
2015	10.21%	-7.54%	-3.41%	0.44%	15.72%	12.26%	17.26%
2016	6.02%	-2.91%	-0.96%	0.79%	10.01%	9.82%	8.75%

Table 1.5 Productivity in the Distribution, Transport, Hotels and Restaurant Sector

	Change in Productivity			**Change in Inputs**		**Change in Output**	**Change in Relationship between Inputs**
	Labour Productivity	Output per Unit of Capital Services	Multi-factor Productivity	Labour Input	Capital Input	Gross Value Added	Capital Intensity of Labour
2000	-0.82%	-6.44%	-2.92%	2.98%	4.02%	4.00%	5.62%
2001	-2.69%	-9.35%	-4.93%	1.47%	3.17%	-0.48%	6.62%
2002	1.55%	-4.88%	-0.67%	0.68%	2.59%	2.61%	6.41%
2003	1.96%	-2.33%	0.39%	0.81%	2.04%	3.27%	4.27%
2004	0.71%	-3.22%	-0.73%	0.92%	2.00%	2.18%	3.93%
2005	0.10%	-0.94%	-0.28%	3.11%	2.16%	5.05%	1.04%
2006	3.59%	1.14%	2.67%	1.91%	2.04%	6.76%	2.39%
2007	4.21%	0.77%	2.89%	3.45%	3.38%	10.05%	3.35%
2008	-1.02%	-9.88%	-3.93%	-0.95%	2.53%	-2.44%	8.85%
2009	-2.65%	-16.13%	-6.47%	-5.32%	1.70%	-9.95%	13.44%
2010	1.77%	-2.64%	0.37%	-1.53%	0.68%	-0.50%	4.39%
2011	-0.73%	-2.64%	-1.38%	0.42%	0.88%	-0.10%	1.91%
2012	-0.75%	-0.66%	-0.72%	0.12%	0.03%	-0.56%	-0.10%
2013	-0.78%	2.86%	0.63%	1.47%	-0.48%	1.62%	-3.64%
2014	3.73%	6.75%	5.01%	0.94%	-0.61%	5.35%	-3.09%
2015	4.38%	3.92%	4.23%	1.03%	0.83%	6.18%	0.37%
2016	2.64%	5.51%	3.85%	1.48%	-0.18%	5.18%	-2.91%

Appendix

Gross Value Added

Gross Value Added (GVA) is the typical measure of goods and services produced when analysing productivity. GVA is the difference between total output and intermediate consumption in the economy. In other words, it is the difference between the value of goods and services produced and the cost of raw materials and other inputs that are used up in the production process.

GVA reported in current prices is the value for that particular year, while GVA at constant prices presents the data for each year in the value of a particular base year. GVA at constant prices are used since current prices are influenced by inflation. GVA is sourced from the National Income and Expenditure dataset, which is published annually by the CSO.

Relationship between GVA and GDP and GNI

GVA is Gross Domestic Product (GDP) excluding taxes and subsidies on products. Gross National Income is equal to GDP at market prices plus net factor income from the rest of the world plus EU subsidies less EU taxes.

Foreign and Domestic and Other sectors of the economy

This publication separates the economy into sectors that are Foreign-dominated and Domestic and Other. Foreign-owned Multinational Enterprise (MNE) dominated NACE A64 sectors occur where MNE turnover on average exceeds 85% of the sector total. These sectors are Chemicals and chemical products (NACE 20), Software and Communications sectors (NACE 58-63) and Reproduction of recorded media, Basic pharmaceutical products and Pharmaceutical preparations, Computer, electronic and optical products, Electrical equipment, Medical and dental instruments and supplies (NACE 18.2, 21, 26, 27 and 32.5). Redomiciled PLCs (also known as corporate inversions) are considered to be foreign-owned MNEs in this analysis. All other sectors are categorised as Domestic and Other sectors.

Current and Constant data

This publication uses two methods for converting data from current to constant prices. One is the previous year's prices method (PYP). This is used in calculating capital services where data aggregation is required for weighting. Chain-linked GVA is used in the rest of the publication.

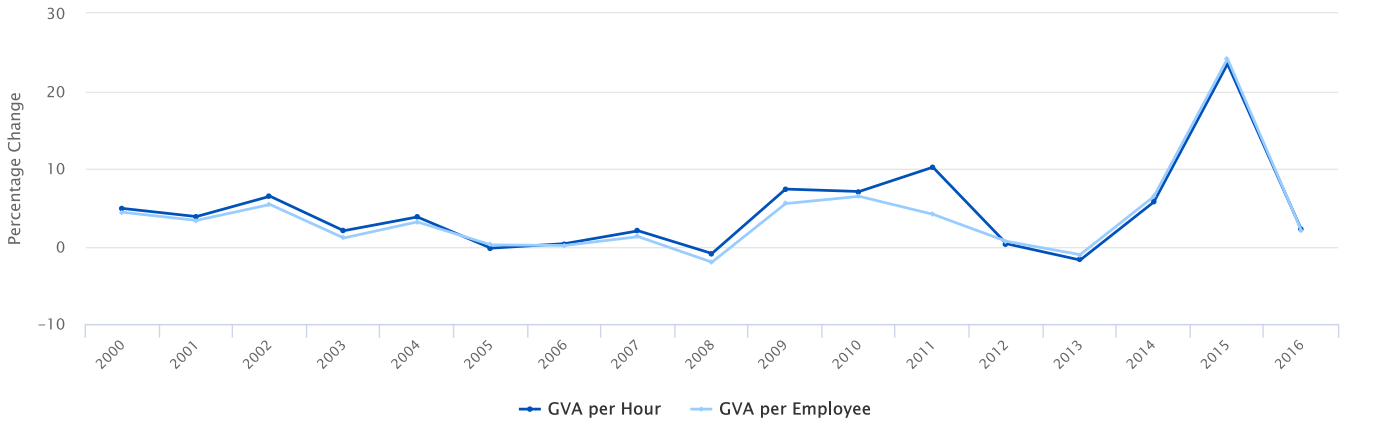
Labour Input

Labour input is the change in hours worked multiplied by the two-period average of the labour share of GVA. Hours worked is usually considered to be a more precise measure of labour than employment as it takes account of differences in hours worked in different jobs due to factors such as leave, part-time working arrangements and time unemployed during the year. The measurement of hours worked in this publication includes both employees and self-employed people. Hours worked for employees and self-employed were sourced from the Quarterly National Household Survey (QNHS) up until 2011. From 2011 onwards, hours of the self-employed continued to be sourced from the QNHS, while hours worked by employees is now sourced from the Earnings, Hours and Employment Cost Survey (EHECS), with the exception of the hours for those in Agriculture, which continues to be sourced from the QNHS. The number of people in employment includes both employees and self-employed. Employees, with the exception of Agriculture are sourced from the Earnings, with the exception of Agriculture are sourced from the Earnings, Hours and Employment cost survey. The self-employed are sourced from the Quarterly National Household Survey.

The QNHS is a large-scale, nationwide survey of households in Ireland. It is designed to produce quarterly labour force estimates that include the official measure of employment and unemployment in the state (ILO basis). The survey size is 26,000 households each quarter. EHECS is a quarterly survey designed to produce indices for the purpose of monitoring change in labour costs in Ireland and across the European Union. The survey size is 7500 enterprises each quarter. It includes all enterprises in the NACE sectors B-S with 50 or more employees and a sample of those with 3 to 49 employees are surveyed each quarter.

Illustration of Difference between Labour Productivity using Hours Worked and Employment

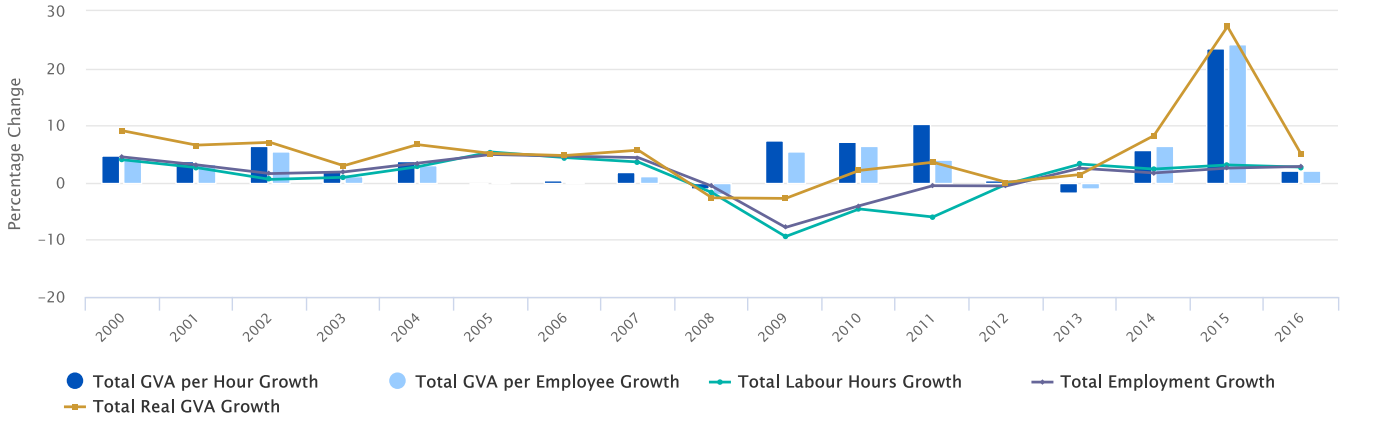
Figure 7.1 Labour Productivity: GVA per Hour and GVA per Employee



Source: CSO Ireland

The above chart compares growth of GVA per Hour and GVA per Employee. GVA per Hour and GVA per Employee are calculated as GVA divided by the total number of hours and the total employment of both the self-employed and the employees. GVA per hour is usually considered to be a more precise measure of labour productivity as it takes account of differences in hours worked in different jobs due to factors such as leave, part-time working arrangements and time unemployed during the year. Both measures mostly follow a very similar trend over the period. However, there is over a five-percentage point difference in labour productivity increase measured by GVA per hour rather than GVA per employee in 2011 and a one-percentage point difference 2009.

Figure 7.2 Labour Productivity: Breakdown by Numerator and Denominator



Source: CSO Ireland

The differences in measured labour productivity growth in 2011 and 2009 are due to larger falls in labour hours than employment. These instances are a form of labour hoarding where employers reduce the hours of employees rather than making them redundant.

Calculating Labour Productivity

Labour productivity measures output in the economy relative to labour input. It is calculated as GVA at constant prices divided by labour hours in the economy.

$$Labour\ Productivity = \frac{GVA}{Total\ Hours\ of\ the\ Employed\ and\ Self\text{-}Employed}$$

Contributions to Labour Productivity Growth

In order to look at labour productivity in more detail, it is possible to break labour productivity growth into the contribution of capital deepening and MFP.

The contribution to labour productivity growth is calculated as follows:

$$Labour\ Productivity\ Growth = \ln\left(\frac{Labour\ Productivity^{t}}{Labour\ Productivity^{t-1}}\right) = \ln\left(\frac{GVA^{t}}{GVA^{t-1}}\right) - \ln\left(\frac{Hours\ Worked^{t}}{Hours\ Worked^{t-1}}\right)$$

Capital deepening, otherwise known as the growth in capital services per hour worked, is calculated as follows:

$$Capital\ Deepening = \ln\left(\frac{Capital\ Services^{t}}{Capital\ Services^{t-1}}\right) - \ln\left(\frac{Hours\ Worked^{t}}{Hours\ Worked^{t-1}}\right)$$

The contribution of capital deepening to labour productivity growth is calculated below:

$$Capital\ Share\ two\text{-}period\ average\left(\ln\left(\frac{Capital\ Services^{t}}{Capital\ Services^{t-1}}\right) - \ln\left(\frac{Hours\ Worked^{t}}{Hours\ Worked^{t-1}}\right)\right)$$

Further information can be found here: https://www.oecd-ilibrary.org/industry-and-services/oecd-compendium-of-productivity-indicators-2016_pdtvy-2016-en

Nominal Unit Labour Costs

Nominal unit labour cost (ULC) measures employee compensation relative to real labour productivity. Growth in an economy's unit labour cost suggests that the cost of labour in the economy is rising relative to labour productivity, decreasing competitiveness. On the other hand, a decline in unit labour cost suggests that the cost of labour is declining relative to labour productivity, increasing competitiveness.

Nominal ULC (ULC) is calculated as:

$$\frac{Compensation\ of\ employees\ in\ current\ prices/Total\ employment,\ not\ including\ self\text{-}employed}{Chain\text{-}linked\ GDP\ at\ market\ prices/Total\ employment,\ including\ self\text{-}employed}$$

The sectoral breakdowns in unit labour cost between the Domestic & Other and Foreign sectors in this publication are calculated using GVA rather than GDP since taxes and subsidies, which are included in GDP, cannot be disaggregated by sector.

Capital Input

Capital input is the flow of capital services multiplied by the two-period average of the capital share of GVA. This publication terms capital input as capital services in charts for clarity. Capital services rather than capital stocks are used to measure capital deepening, capital input and calculate multi-factor productivity. The main difference between the volume index of capital services and the stock measure of capital is the way in which different types and ages of assets are aggregated together. In the volume index of capital services, each capital asset class is weighted by its user cost. The user cost is the estimated price that the user would have to pay to hire the asset for a period. In contrast, capital stock values are calculated using asset price weights for each asset type and period.

Calculating Capital Services

Capital services are the services derived from the net capital stock of produced fixed assets. Data on produced fixed assets are available in the CSO's *Estimates of the Capital Stock of Fixed Assets* release.

The aggregate capital services index is obtained using a chained superlative Törnqvist index aggregation of the capital stocks of the six asset categories using estimated user costs (also known as rental prices) for each asset type. Each user cost reflects the nominal rate of return to all assets within the industry and rates of economic depreciation and revaluation for the specific asset. The steps in calculating capital services as follows:

1. The nominal rate of return is calculated for all assets. The numerator consists of capital compensation plus the value change in the deflator for constant productive stocks minus the product of the asset price deflator, depreciation and constant price net capital stocks. The denominator consists of the asset price deflator multiplied by productive stocks, summed for all asset types. Depreciation rates are obtained for each asset category by dividing consumption of fixed capital by constant price net capital stocks (also known as productive stocks). Capital compensation is calculated as gross value added minus labour compensation. Labour compensation is calculated by adding employee and self-employed compensation.

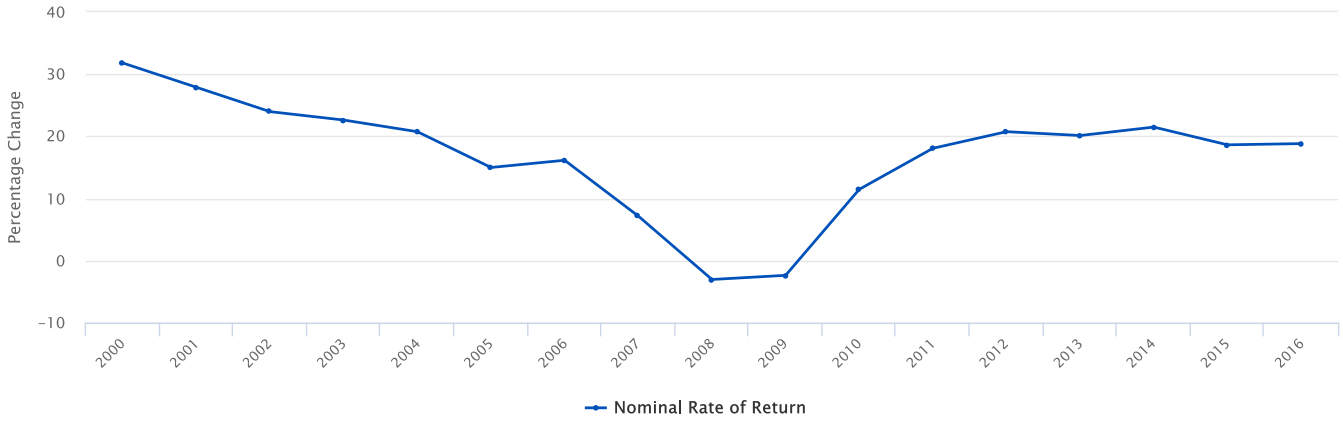
$$\text{Rate of Return} = \frac{\text{Capital compensation + numerator term 2 + numerator term 3}}{\text{Denominator}}$$

$$\text{Term 2 of Numerator} = \sum_{\text{Asset Types}} (\text{Asset Price Deflator}_t - \text{Asset Price Deflator}_{t-1}) \times \text{Constant Productive Stocks}$$

$$\text{Term 3 of Numerator} = \sum_{\text{Asset Types}} \text{Asset Price Deflator} \times \text{Depreciation} \times \text{Productive Stock}$$

$$\text{Denominator} = \sum_{\text{Asset Types}} \text{Asset Price Deflator} \times \text{Productive Stock}$$

Figure 7.3 Nominal Rate of Return

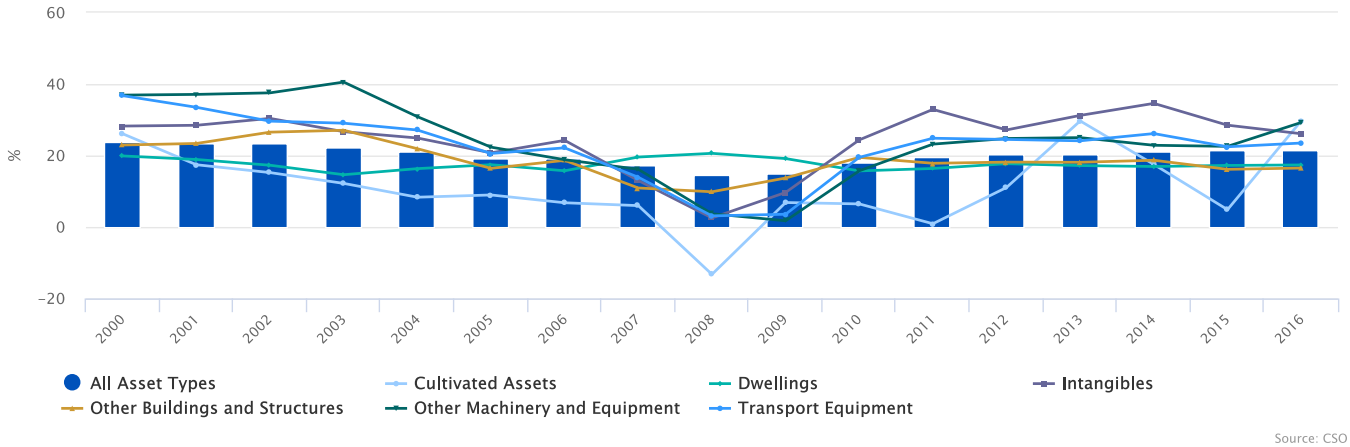


Source: CSO Ireland

2. The rate of return is then revaluated according to the depreciation rate and deflation rate for the specific asset to form user costs.

$$\text{User Cost} = (\text{Overall Rate of Return}_t \times \text{Asset Price Deflator}_{t-1}) + (\text{Depreciation Rate} \times \text{Asset Price Deflator}) - (\text{Asset Price Deflator}_t - \text{Asset Price Deflator}_{t-1})$$

Figure 7.4 User Costs

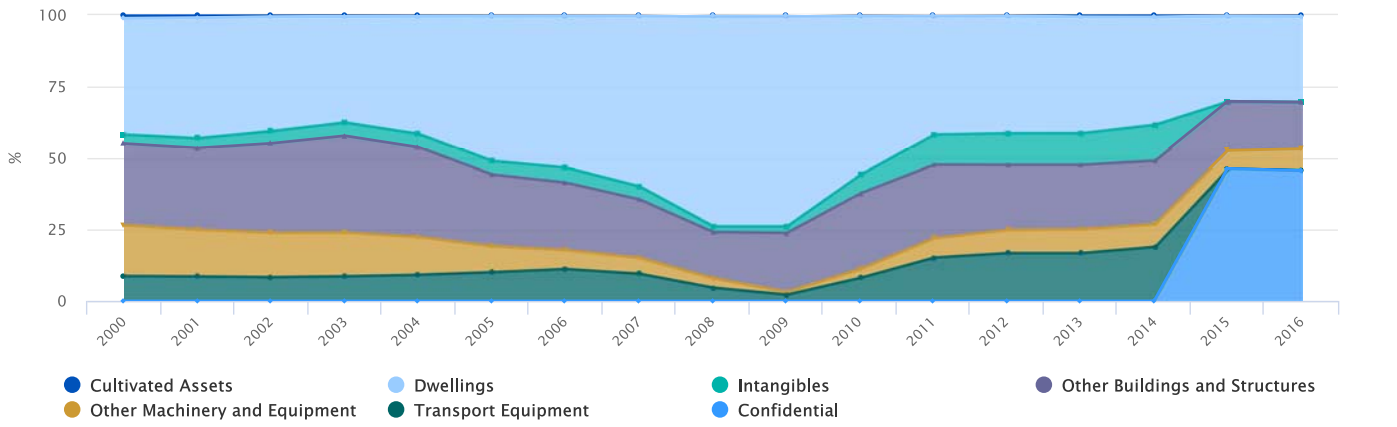


Source: CSO Ireland

3. The user costs are then weighted by industry productive stocks.

$$\text{User Cost Weight} = \left(\sum_{\text{Asset Types}} \text{User Cost} \times \text{Productive Stock}\right)^{-1} \text{User cost for all assets} \times \text{Productive stock for all assets}$$

Figure 7.5 User Cost Weights

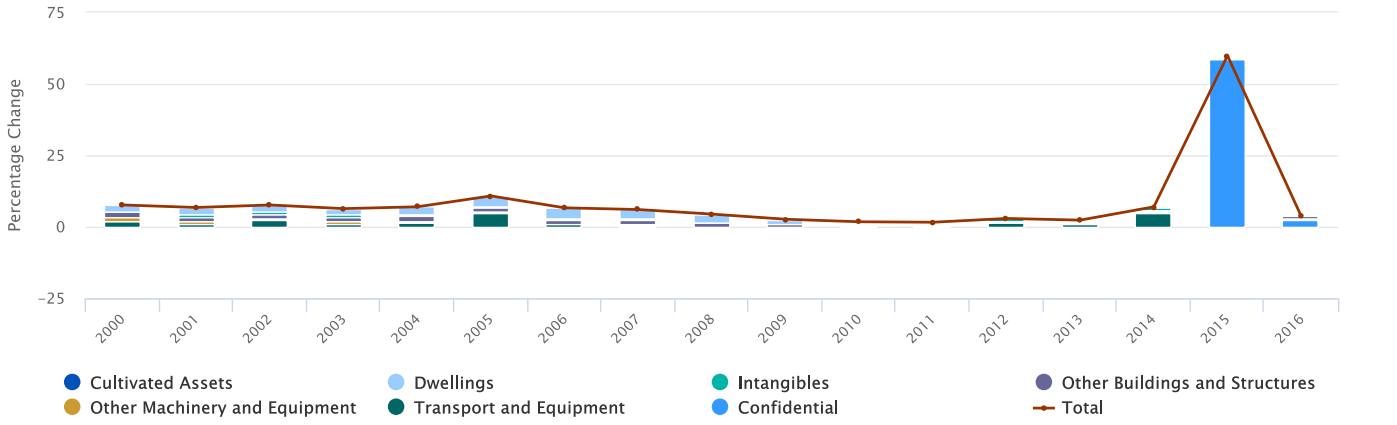


Source: CSO Ireland

4. The change in capital stocks is then weighted by the two-period average of the user cost and multiplied together to form a Törnqvist index of capital services. The log of these values can be taken to show the contributions to capital services by asset.

$$\ln(1+\textit{Capital Services}) = \sum_{\textit{Asset Type}} \textit{Two-period average of user cost weight} \times \Delta \ln(\textit{productive stock})$$

Figure 7.6 Capital Services Growth by Asset



Source: CSO Ireland

Further information on calculating capital services can be found in the following publications:

Aggregate and Industry-level Productivity Growth: OECD Manual. Organisation for Economic Co-operation and Development (2001). Available at: https://www.oecd.org/std/productivity-stats/2352458.pdf

Biatour, Bernadette, Geert Bryon, and Chantal Kegels. "Capital services and total factor productivity measurements: impact of various methodologies for Belgium." *Federal Planning Bureau, Working Paper* (2007): 3-07. Available at: http://core.ac.uk/download/pdf/6537802.pdf

Capital Stocks

This publication uses net capital stocks rather than gross capital stocks because, unlike the latter, they incorporate depreciation. Produced fixed assets are assets which result from human effort. They exclude financial assets and natural assets such as land, mineral deposits etc. Produced fixed assets comprise Dwellings and other buildings and structures (excluding the land on which they are built), Machinery and equipment (including transport equipment), Cultivated assets (e.g. Livestock for breeding such as dairy cattle) and Intangible fixed assets (Research and development, Computer software, Original works of art including musical and literary works, Mineral exploration).

Capital Intensity and Capital Deepening

Capital intensity is the ratio of capital services to hours worked in the economy (i.e. capital services per hour). The higher the capital to hours ratio, the more capital intensive the production process becomes. Capital deepening is the growth in capital services per hour worked. It is also possible to show the contribution of capital deepening to labour productivity growth by weighting capital deepening by the two period average capital share of GVA, as shown in the subsection contributions to labour productivity.

Capital intensity is calculated as follows:

$$\textit{Capital Intensity} = \frac{\textit{Capital Services}}{\textit{Hours Worked}}$$

Multi-factor Productivity

Multi-factor productivity (MFP) measures improvements in the efficiency in the utilisation of labour and capital. It is the residual output growth of an industry after calculating the contribution from capital and labour. Positive MFP results from factors such as technological change, efficiency improvements, returns to scale and reallocation of resources. Negative MFP indicates lower output from current capital and labour input relative to the output from current capital and labour input in the previous period.

Calculating Multi-factor Productivity

The following methodology shows the log approach for calculating multi-factor productivity. The first step is to create a quantity index of combined inputs:

$$\textit{Quantity Index of Combined Inputs} = \left(\frac{\textit{Labour Input}_t}{\textit{Labour Input}_{t-1}}\right)^{\textit{2 year average of the labour share of GVA}} \times (\textit{Capital Services})^{\textit{2 year average of the Capital Share of GVA}}$$

Then one creates an index of GVA divided by the previous period:

$$\textit{GVA Index} = \frac{\textit{GVA Constant Basic Prices}_t}{\textit{GVA Constant Basic Prices}_{t-1}}$$

Then one divides the GVA index by the quantity of combined index. Subtract one from this to calculate multi-factor productivity – the residual of GVA growth that is not explained by capital or labour inputs.

$$\textit{MFP} = \frac{\textit{GVA Index}}{\textit{Quantity Index of Combined Inputs}} - 1$$

Since MFP, capital and labour are multiplicatively linked, we add one to MFP, take the natural log of it and add it to similarly calculated capital and labour input growth rates to show the additive composition of GVA growth by these three factors.

$$\ln\left(\frac{\textit{GVA Constant Basic Prices}_t}{\textit{GVA Constant Basic Prices}_{t-1}}\right) = \ln\left(\frac{\textit{Labour Input}_t}{\textit{Labour Input}_{t-1}}\right)^{\textit{2 year average of the labour share of GVA}}$$

$$+\ln(\textit{Capital Services})^{\textit{2 year average of the labour share of GVA}} + \ln(1 + \textit{MFP Growth Rate})$$

This can be more simply expressed as:

$$\ln(\textit{GVA index}) = \ln(\textit{Labour input index}) + \ln(\textit{Capital input index}) + \ln(1 + \textit{MFP Growth Rate})$$

Contact Details

For further information please contact

- Michael Connolly (+353) 1 4984006
- Eóin Flaherty (+353) 1 4984234
- Yvonne Hayden (+353) 1 4984125
- Email: nat_acc@cso.ie