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THE SLOWDOWN IN FINNISH PRODUCTIVITY GROWTH

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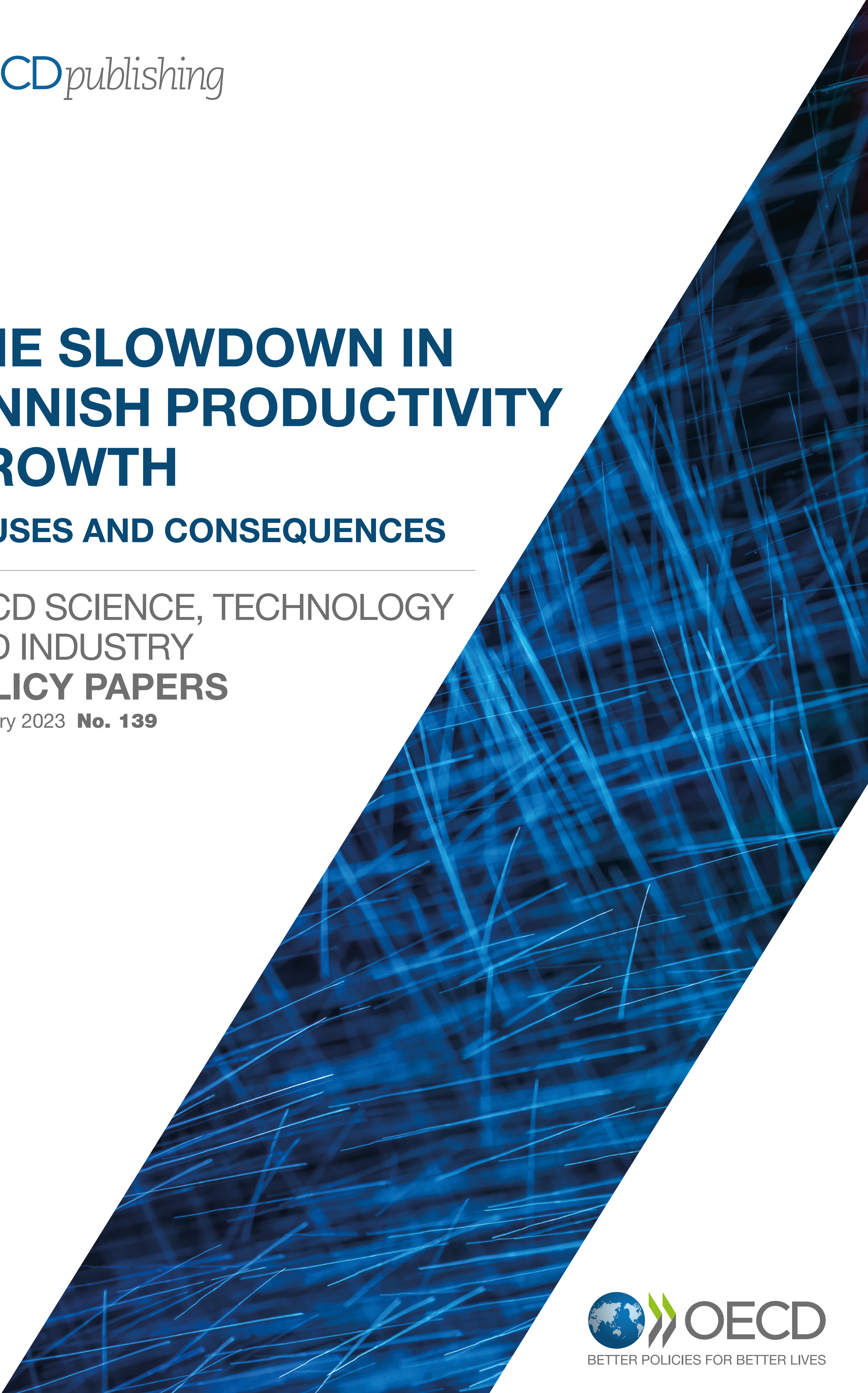

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The slowdown in Finnish productivity growth: causes and consequences

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This report analyses the trends in Finnish productivity growth over the 2000s and 2010s. It describes its key features, makes comparisons to a benchmark of OECD countries, and studies the causes of its sudden and prolonged slowdown which began at the end of the 2000s. The analysis focuses on the role of two contemporaneous demand shocks that hit the Finnish economy and propagated through value chain linkages: the Nokia crisis, the main Finnish firm active in the computer and electronics sector, and the Great Trade Collapse of 2009.

Matching detailed firm-based information on structural characteristics of productivity growth with global input-output tables and National Accounts data for 16 OECD countries, the report highlights how the prolonged drop in demand from the domestic computer and electronics sector may have induced a persistent drag on Finnish productivity growth. The Nokia crisis impacted the most productive firms of the supplier sectors, reducing productivity dispersion and lowering the allocative efficiency of resources. A sudden but short-lived shock to foreign demand, such as the one experienced during the Great Trade Collapse, may have large short-term effects on productivity, which nonetheless fade away within three years and do not affect structural features of the economy.

The report concludes with policy implications to strengthen Finnish resilience to idiosyncratic shocks to key sectors or large firms, while supporting long-term productivity growth and competitiveness.

Keywords: productivity, GVCs, Finnish economy

JEL codes: E22, E65, O47

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Executive summary

The last decades have witnessed a decline in productivity growth in most OECD countries, accompanied by an increasing diverge between the most productive firms (the "leaders") and least productive ones (the "laggards"), a decline in business dynamics and rising industry concentration and mark-ups. Cross-country analyses have traced the possible roots of these trends in the digital transformation and the rise of the knowledge-economy, among others. Yet, besides cross-country trends, productivity growth is also largely driven by idiosyncratic, country-specific events and policy choices, which require an in-depth country-level analysis, informed by cross-country benchmarks.

This report focuses on the case of Finland, where aggregate productivity growth stagnated for over a decade from 2008 to 2016, and only partially recovered before the COVID-19 shock. The report aims at characterising the structural features of productivity in the Finnish business sector and at identifying the main drivers of its prolonged slowdown, in order to inform the current policy debate.

To characterise the Finnish business sector, the analysis exploits cross-country firm-based data on productivity and business dynamics from the MultiProd and DynEmp projects, comparing Finland to an OECD "benchmark". Results show how the Finnish business sector displays a lower dispersion in productivity between leader and laggard firms, a higher degree of industry concentration, and a lower efficiency in the allocation of resources.

The report then considers various possible causes of the productivity slowdown. It discusses the limited role of the financial crisis and of industry concentration as two relevant causes of this trend: the former had a smaller impact on the Finnish economy than on other OECD countries; the latter, although high, remained quite stable over the last two decades. Thus, the analysis focuses on two other suspects: the Great Trade Collapse of 2009 (GTC), which was triggered by the financial crisis, and the crisis of Nokia, the most important Finnish company active in the computer sector whose business model entered in a deep crisis with the advent of smartphones.

Both of these two shocks are demand-side shocks to the Finnish economy and have likely transmitted through domestic and international value chains. Yet, GTC was a short-lived, international shock, while the Nokia crisis was a prolonged idiosyncratic shock to a large, highly productive, manufacturing firm, crucially linked to the rest of the Finnish economy through domestic buyer-supplier relationships. The policy-implications of these two shocks are, thus, different: GTC may point to a loss of competitiveness of the Finnish tradeable sectors, while the latter may imply a lack of diversification and domestic resilience of the Finnish economy.

To empirically test the relevance of both shocks, the study exploits a unique database that matches harmonised cross-country data on firm productivity, business dynamics, and sectoral input/output linkages.

To identify the relevance of the Nokia crisis, the analysis estimates the elasticity of aggregate productivity growth to a shock to value added in the computer sector, exploiting information on backward value chain linkages. Results show that the prolonged crisis of the computer sector may explain at least 30% of the slowdown in aggregate productivity growth experienced by the rest of the Finnish business sector during the 2009-13 period. The propagation of the Nokia crisis through value chain linkages may also have contributed to low productivity dispersion and lower allocative efficiency of resources.

To test the relevance of the 2009 Trade Collapse, the analysis exploits global input-output linkages to construct a shift-share instrument for a shock to export demand. A strong and short-lived drop in trade such as the one experienced in 2009 may have only short-term impacts on labour productivity, as the drop in value added tends to fade over three to five years.

The Nokia crisis seems, thus, to be the main explanation of the long-term slowdown in Finnish productivity growth experienced since 2009. The effect might have been strengthened by the inability of Finnish suppliers to the computer sector to shift away from the plummeting domestic market, and by the fact that - within sector - the Nokia crisis disproportionally affected the most productive firms.

To support productivity growth and the resilience of the Finnish economy to idiosyncratic shocks, it is key to support the diversification of the economy and to improve productivity-enhancing resource reallocation in the face of such shocks. Firm-level competitiveness should also be strengthened by supporting its innovative activities, and the accumulation of intangible capital and knowledge.

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1 Introduction

Over the last decades, productivity growth has been declining in most OECD countries. This trend has been accompanied by significant changes in other structural indicators. The distance between most-productive (leader) firms and less-productive (laggard) ones has been increasing (Andrews, Criscuolo and Gal, 2016[1]); firm entry and job creation rates have declined markedly (Calvino, Criscuolo and Verlhac, 2020[2]), and industry concentration and mark-ups have risen (Calligaris, Criscuolo and Marcolin, 2018[3]; Bajgar et al., 2019[4]).

Exploiting firm-based harmonised data across OECD and OECD partner economies, cross-country studies have highlighted some of the key determinants of these global trends. These include the role of the digital transformation and the rise of the knowledge-economy (Calvino and Criscuolo, 2019[5]), the evolution of GVCs over these decades (Criscuolo and Timmis, 2018[6]), and the role of the skills of workers and managers (Criscuolo et al., 2021[7]). Cross-country studies have also allowed an informed discussion on the policy implications of these trends, for instance on inequality (Criscuolo et al., 2021[8]). Recent research is also focused on identifying how the COVID-19 crisis is affecting these key aggregate trends (Criscuolo, 2021[9]).

Yet, while crucially affected by global trends, productivity growth in each country is also largely driven by idiosyncratic, country-specific events and policy choices. Moreover, global trends interact with country-specific structural and policy characteristics to generate specific challenges and opportunities. Studying in-depth country-level productivity growth and its sources and comparing the results with a cross-country "benchmark", may thus allow analysts and policy-makers to identify the country-specific bottlenecks and most effective interventions to boost productivity growth.

This report focuses on the case of Finland. During the first half of the 2000s, aggregate productivity growth was robust in Finland: from 2000 to 2007 labour productivity increased by over 15% (Figure 1). This trend reverted from 2008-09. During the Great Financial Crisis and the 2009 Global Trade Collapse aggregate value added in Finland dropped more deeply than the OECD average. Productivity failed to recover in the following years, remaining below its pre-crisis levels up to 2016. Then, after two years of robust growth, productivity declined again in 2018.

Understanding the causes of this prolonged productivity slowdown is an important topic in the Finnish policy debate. The Finnish economy is characterised by some peculiar characteristics with respect to other OECD countries over the period studied in the paper (2000-18). Productivity dispersion between leader and laggard firms is generally lower than the OECD average and industry concentration is high: consistently, allocative efficiency of resources is substantially lower than the OECD average. Yet, these indicators cannot per se explain the slowdown, as they have been very stable over the 2000s and 2010s. Worsening competition does not seem to play a role either, as the Finnish economy does not display high mark-ups while business dynamics is generally more vibrant than the OECD benchmark (with high post-entry growth and survival probability of start-ups). Finally, existing analyses argue that the impact of the financial crisis and the subsequent credit crunch on Finnish firms has been comparatively smaller than in other OECD countries, and the Finnish financial system remained generally healthy during the crisis (Bank of Finland, 2018[10]; Suni and Vihriälä, 2016[11]). The sectoral analysis presented in this report shows that the slowdown was particularly strong in the manufacturing sector and in digital services, and that it cannot be entirely explained by sectoral characteristics.

This report focuses on two possible and widely-debated causes of the slowdown: the Great Trade Collapse of 2009 (GTC), which was triggered by the financial crisis on the one hand, and the "Nokia crisis" on the other hand. Nokia is the most important Finnish firm in the computer sector. It is a large multinational that was leading the mobile phone market until 2008-09, when its business model entered into a deep crisis driven by the sudden advent of smartphones in the market.

These two shocks share some similarities: they are both demand-side shocks, and they are both are likely to be transmitted through the value chains. Yet, there are also important differences between them. The GTC was a global, though short-lived, shock to global demand. It may potentially have affected the Finnish economy more strongly than other OECD countries because of the country's position in GVCs and its sectoral distribution. The Nokia crisis was a prolonged idiosyncratic shock to a large, highly productive, manufacturing firm, crucially linked to the rest of the Finnish economy through domestic buyer-supplier relationships.

Assessing which of these shocks has been more relevant to explain the productivity slowdown has policy implications. On the one hand, it may point to a loss of competitiveness vis-à-vis global demand, while on the other it may highlight a substantial lack of resilience to granular shocks and a lack of differentiation among economic activities. Yet, empirically estimating the different role of the Nokia crisis and the GTC is difficult. Indeed, the two shocks have been largely contemporaneous and they likely had overlapping effects across sectors and firms.

This study exploits a unique database that matches harmonised cross-country data on firm productivity, business dynamics, and sectoral input/output linkages to empirically assess the impact of two demand-shocks (a shock to the domestic computer sector, akin to the Nokia crisis, and a short-term shock to global demand, akin to the GTC) on aggregate productivity growth and its structural characteristics. The analysis focuses, in particular, on the effects channelled through value chain linkages connecting countries and sectors.

For the Nokia crisis, the analysis exploits backward value chain linkages between the computer sector (where Nokia operates) and the domestic supplying sectors, and estimates the elasticity of sectoral productivity growth to a shock to value added in the computer sector. The analysis shows that this elasticity is positive and significant. According to the empirical estimate, the prolonged drop in value added in the computer sector experienced in Finland during the Nokia crisis may explain more than 30% of the slowdown in aggregate productivity growth experienced by the Finnish business sector during the 2009-13 period. This estimate only takes into consideration the effects on firm's demand through sectoral input-output linkages and should, thus, be considered a lower bound, as it does not factor-in the impact on investments, international competitiveness, and aggregate prices. Moreover, there may be some possible measurement error driven by the use of sectoral, rather than firm-level, input-output linkages, that may bias the estimate towards zero.

The analysis shows also that the propagation of the Nokia crisis through value chain linkages may also have contributed to the low productivity dispersion between leader and laggard firms and, in manufacturing, to a lower allocative efficiency of resources. Indeed, the computer sector is generally linked to the most productive firms in its upstream sectors and, thus, these are the firms that are hit the most by the shock. Because of frictions in the reallocation of inputs in these upstream sectors, the drop in value added among their most productive firms is not accompanied by a drop in the labour input of similar magnitude: as a result, the efficiency of labour allocation in the sector is reduced.

To test the relevance of the 2009 Trade Collapse, the analysis exploits global input-output linkages to construct a shift-share instrument for a shock to export demand. The analysis finds that a sudden, but short-lived, drop in trade such as the one experienced in 2009 has only short-term impacts on labour productivity. Indeed, over longer periods (three to five years) the output and value added effects tend to fade, while at the other side the labour input adjusts to the initial shock, resulting in no long-term effect on labour productivity. The GTC seems not to have had important impacts on other structural features of the

Finnish economy: its impact on productivity dispersion has been limited, and allocative efficiency – if anything –- has improved as a result of the shock, pointing again to a relatively quick adjustment of the labour input.

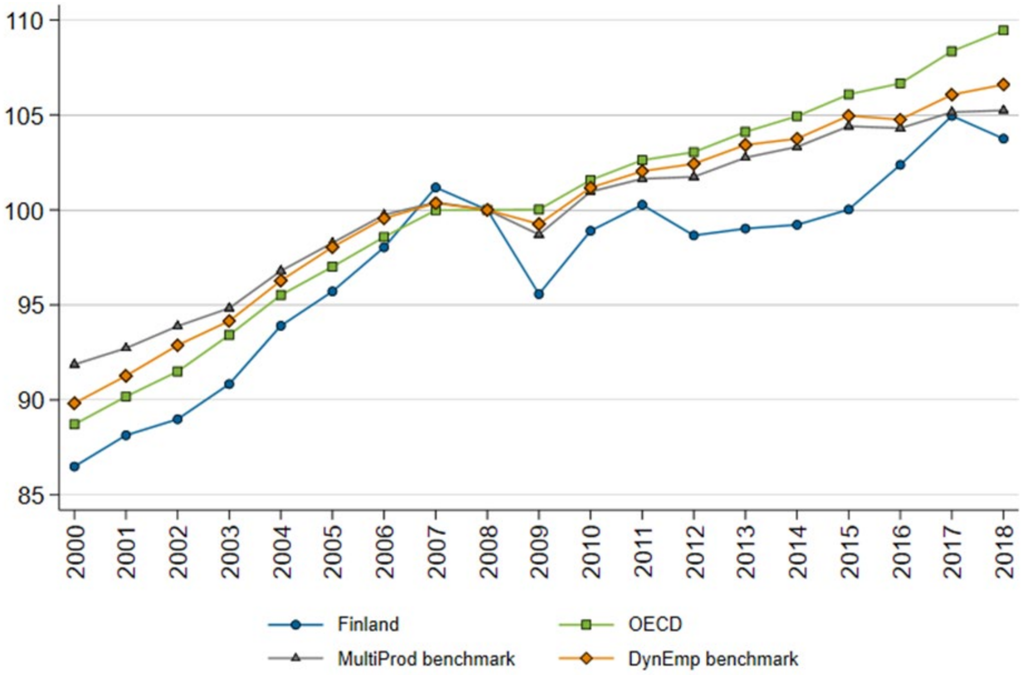
Thus, the Nokia crisis is found to be a key explanation of the long-term slowdown in Finnish productivity growth experienced since 2009. The data show that the Nokia crisis was not accompanied by a shift of domestic suppliers away from the Finnish computer sector: domestic supplying sectors remained tightly connected to the computer sector even when its value added was plummeting, and their productivity has been persistently affected. Within-sector productivity growth has been also negatively affected by the differential impact of the shock – which mostly affected more productive firms – and by the limited reallocation of the labour input across firms in response to the shock.

Conversely, the GTC is not found to have an important role in explaining long-term productivity growth in Finland. The shock was short-lived and the labour input seems to have been quicker to adjust than in the case of the Nokia shock, both in terms of aggregate quantity (supporting sector-level productivity growth) and within-sector (increasing allocative efficiency).

To improve the resilience of the Finnish economy to idiosyncratic shocks to large firms or key sectors, it is important to support the diversification of the economy and to improve productivity-enhancing labour mobility and capital reallocation in the face of such shocks. It is also key to support firm-level competitiveness by fostering its innovative activities, and the accumulation of intangible capital and knowledge. Finally, to support long-term productivity growth, the Finnish economy should tackle the structural features that are generating high levels of industry concentration, often together with a low efficiency of input allocation.

The remainder of the report is organised as follows. Section 2 discusses existing knowledge and data on productivity growth in Finland, focusing on its long-term structural trends and the analyses performed on the causes of its slowdown. Section 3 describes the data used for the analyses. Section 4 studies the impact of the Nokia crisis on the Finnish economy, discussing some descriptive evidence, the empirical strategy and the results obtained. Section 5 analyses the role of the 2009 Trade Collapse and of the financial crisis. Section 6 discusses the policy implications of the findings of the study and concludes.

Figure 1. Trends in labour productivity – Finland, OECD average, and Finnish benchmarks

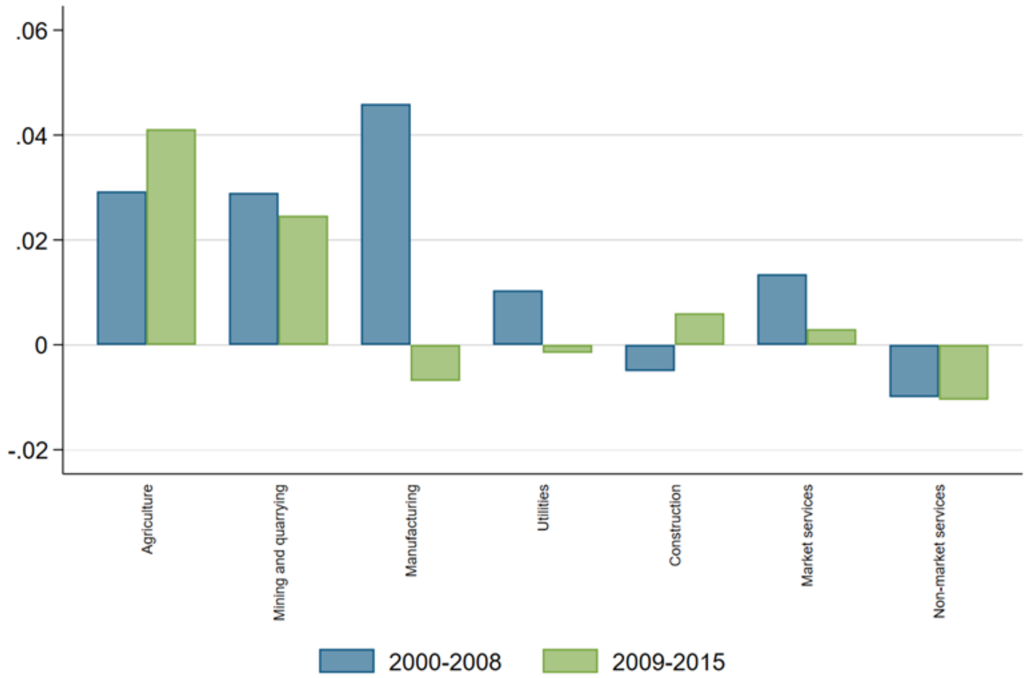


Note: This figure shows trends in labour productivity in all economy in Finland, OECD, MultiProd benchmark and DynEmp benchmark compared to the base year 2008. Labour productivity is defined as real GDP over total hours worked. MultiProd benchmark countries include Belgium, France, Italy, the Netherlands and Sweden. DynEmp benchmark countries include Austria, Belgium, France, Hungary, Italy, Norway, Portugal, Spain and Sweden.
Source: OECD Productivity Statistics.

2 Finnish productivity growth and its slowdown

Before 2009, Finnish aggregate productivity growth was largely driven by its manufacturing sectors (Figure 2). Within manufacturing, growth was particularly strong in the digital-intensive sectors (computer and electronics, Electrical equipment, and Machinery and equipment) and in Food and beverages and Pharmaceuticals. (Figure A A.1). The sudden slowdown in productivity growth was particularly strong in manufacturing, where yearly productivity growth dropped from almost 5% over the 2000-08 period to almost -1% in 2009-15. The slowdown was also sizeable in market services and utilities. Among manufacturing and service industries, the drop in productivity was particularly strong among digital-intensive sectors.

Figure 2. Average yearly labour productivity growth in A7 sectors



Note: This figure shows average yearly labour productivity growth from 2000 to 2008 and the average yearly labour productivity growth from 2009 to 2015 in the A7 level sectors. Labour productivity is defined as value added over hours worked.
Source: OECD STAN Database.

Structural features of productivity in Finland

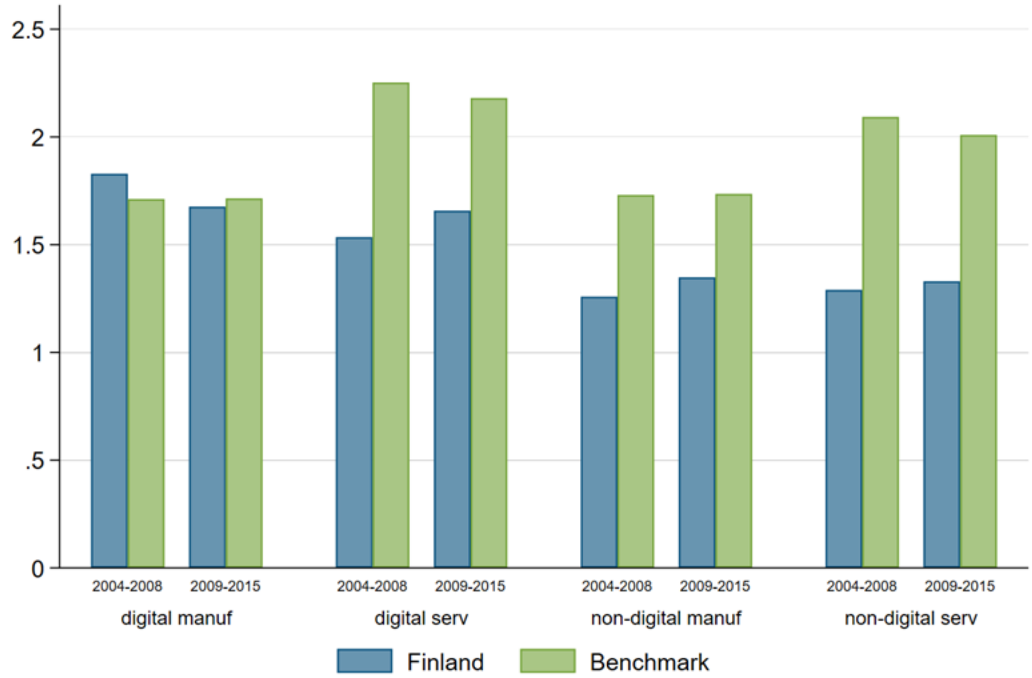
Aggregate productivity growth is the result of the performance of a large number of heterogeneous firms. Recent analyses have studied several key indicators of productivity based on firm-level data and compared them with a benchmark of OECD countries (Finnish Productivity Board, 2021[12]). The results highlight several structural features of the Finnish business sector, which are discussed below.

Lower productivity dispersion, lower efficiency of resource allocation

In Finland, productivity dispersion is generally lower than in the benchmark, with the only exception of the computer sector which drives the high levels of dispersion in digital manufacturing (Figure 3). The dynamics of dispersion has also been relatively stable over time, with only limited signs of an increase.

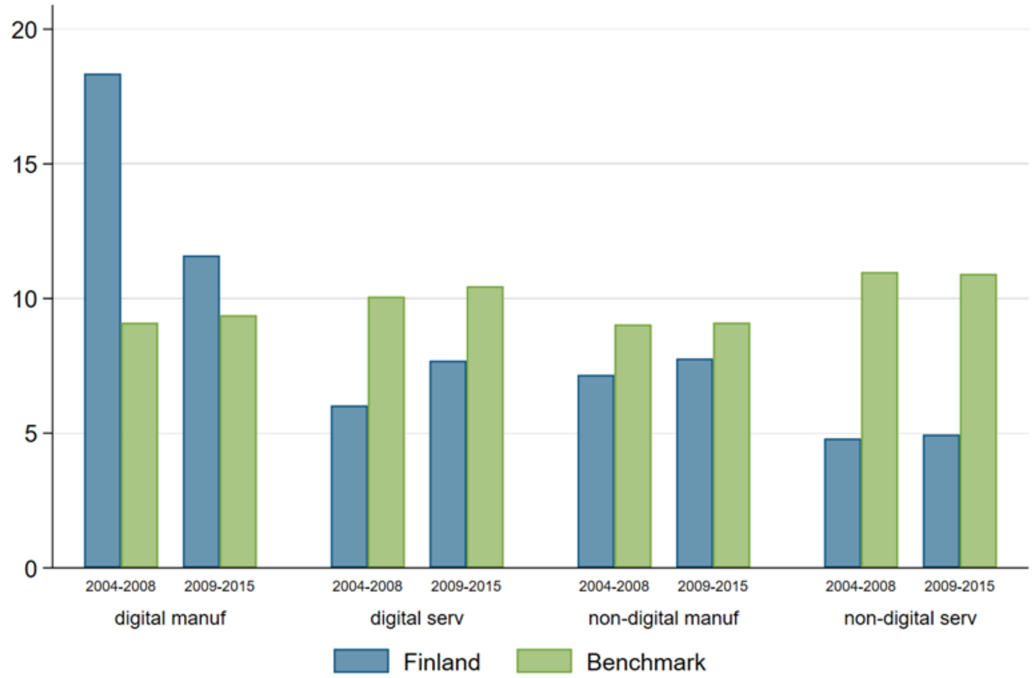
Lower productivity dispersion is accompanied by lower efficiency of resource allocation. This can be appreciated by analysing the contribution of the Olley-Pakes covariance component to aggregate productivity, which measures the extent to which productivity is driven by the positive association between firm productivity and its industry share. Figure 4 shows that the Olley and Pakes covariance provided a lower contribution to multifactor productivity in Finland relative to benchmark countries in the early 2000s, with the exception of the digital-intensive manufacturing sectors. Since 2009, allocative efficiency has improved in digital services and non-digital manufacturing, while it has significantly worsened in digital manufacturing, mostly driven by the dynamics of the computer and electronics sector.

Figure 3. 90-10 multifactor productivity ratio by digital intensity within manufacturing and non-financial market services



Note: This figure reports the 90-10 productivity ratio, on average over available years for the periods 2004-08 and 2009-215 in Finland and the benchmark group of countries according to the digital intensity of underlying SNA A38 sectors, within manufacturing and non-financial market services. The year 2013 is suppressed from the Finnish average due to a break in the time series related to Statistics Finland's business statistics renewal. The benchmark group consists of Belgium, France, Italy, Portugal and Sweden. The 90-10 ratio is defined as the ratio between the 90th and the 10th percentile of the multifactor productivity distribution. SNA A38 sector-level ratios are aggregated using sectoral weights in terms of value added. Digital intensive manufacturing sectors: 26, 28 and 29T30. Digital intensive service sectors: 61, 62T63, 69T71, 72 and 73T75. Non-digital intensive manufacturing sectors: 10T12, 13T15, 16T18, 20, 22T23, 24T25, 27 and 31T33. Non-digital intensive service sectors: 45T47, 49T53, 55T56 and 58T60.
Source: OECD MultiProd Database.

Figure 4. Share of Olley and Pakes covariance term (%) into aggregate productivity



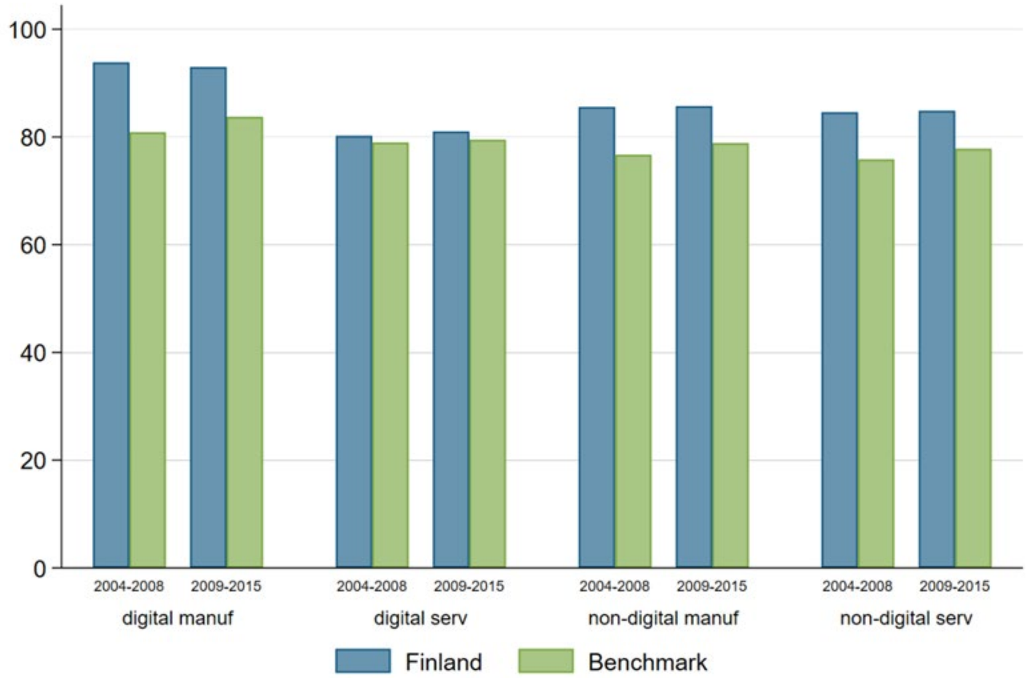
Note: This figure reports the Olley and Pakes covariance term in percentage over the log-level of productivity, on average over available years for the periods 2004-08 and 2009-15 in Finland and the benchmark group of countries according to the digital intensity of underlying SNA A38 sectors, within manufacturing and non-financial market services. The year 2013 is suppressed from the Finnish average due to a break in the time series related to Statistics Finland's business statistics renewal. The benchmark group consists of Belgium, France, Italy, the Netherlands and Sweden. The covariance term is defined as the covariance of value added and log-level MFP productivity over the average value added. This is then divided by the value-added-weighted average log multifactor productivity. SNA A38 sector-level shares are aggregated using sectoral weights in terms of value added. Digital intensive manufacturing sectors: 26, 28 and 29T30. Digital intensive service sectors: 61, 62T63, 69T71, 72 and 73T75. Non-digital intensive manufacturing sectors: 10T12, 13T15, 16T18, 20, 22T23, 24T25, 27 and 31T33. Non-digital intensive service sectors: 45T47, 49T53, 55T56 and 58T60.
Source: OECD MultiProd Database.

Industry concentration is high, but mark-ups are not

Concentration is found to be higher in Finland than in the benchmark countries both in manufacturing and non-financial market services, except for digital services where it is aligned with the benchmark (Figure 5). Concentration is generally stable over time, except in digital manufacturing, where it has slightly declined, driven by the dynamics of the computer and electronics sector.

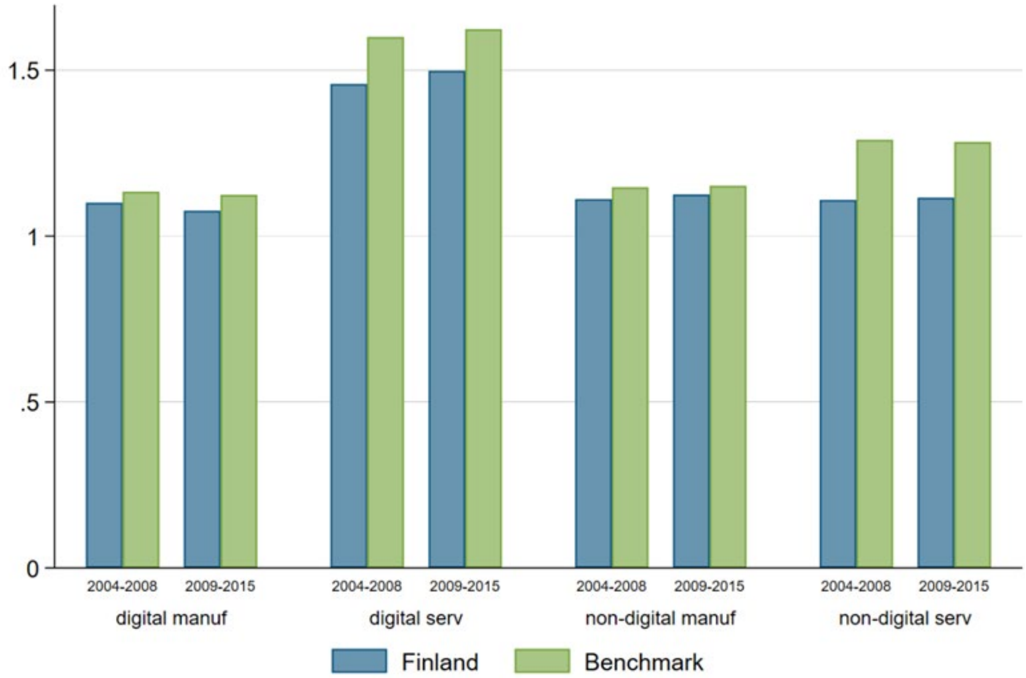
Figure 6 shows that Finnish mark-up levels are similar to the benchmark in manufacturing sectors, where international competition likely pushes mark-ups towards lower and comparable levels across countries. In Finnish non-financial market services, average mark-ups are generally lower than the average of the benchmark, particularly in non-digital sectors.

Figure 5. Gross output share (%) of top decile by digital intensity within manufacturing and non-financial market services



Note: This figure reports the share of sales of the firms in the top decile on average over available years for the periods 2004-08 and 2009-15 in Finland and the benchmark group of countries according to the digital intensity of underlying SNA A38 sectors, within manufacturing and non-financial market services. The year 2013 is suppressed from the Finnish average due to a break in the time series related to Statistics Finland's business statistics renewal. The benchmark group includes Belgium, Italy, the Netherlands, Portugal and Sweden. The share of sales in the top decile is defined as the total sales of the firms in the top decile of the sales distribution over the total sales in a two-digit industries. Sector-level weights are used when aggregating to macro sectors, and calculated separately for each year as the share of industry in terms of total sales in the macro sector. Digital intensive manufacturing sectors: 26, 28 and 29T30. Digital intensive service sectors: 61, 62T63, 69T71, 72 and 73T75. Non-digital intensive manufacturing sectors: 10T12, 13T15, 16T18, 20, 22T23, 24T25, 27 and 31T33. Non-digital intensive service sectors: 45T47, 49T53, 55T56 and 58T60.
Source: OECD MultiProd Database.

Figure 6. Mark-ups by digital intensity within manufacturing and non-financial market services



Note: This figure reports the gross output weighted average level of mark-ups on average over available years for the periods 2004-08 and 2009-15 in Finland and the benchmark group of countries according to the digital intensity of underlying SNA A38 sectors, within manufacturing and non-financial market services. The year 2013 is suppressed from the Finnish average due to a break in the time series related to Statistics Finland's business statistics renewal. The benchmark group consists of Belgium, Italy, the Netherlands and Portugal. The firm-level mark-ups are computed using De Loecker (2012[13]) methodology. Gross output is used as weight when aggregating across sectors and firms. Digital-intensive manufacturing sectors: 26, 28 and 29T30. Digital-intensive service sectors: 61, 62T63, 69T71, 72 and 73T75. Non-digital intensive manufacturing sectors: 10T12, 13T15, 16T18, 20, 22T23, 24T25, 27 and 31T33. Non-digital intensive service sectors: 45T47, 49T53, 55T56 and 58T60.
Source: OECD MultiProd Database.

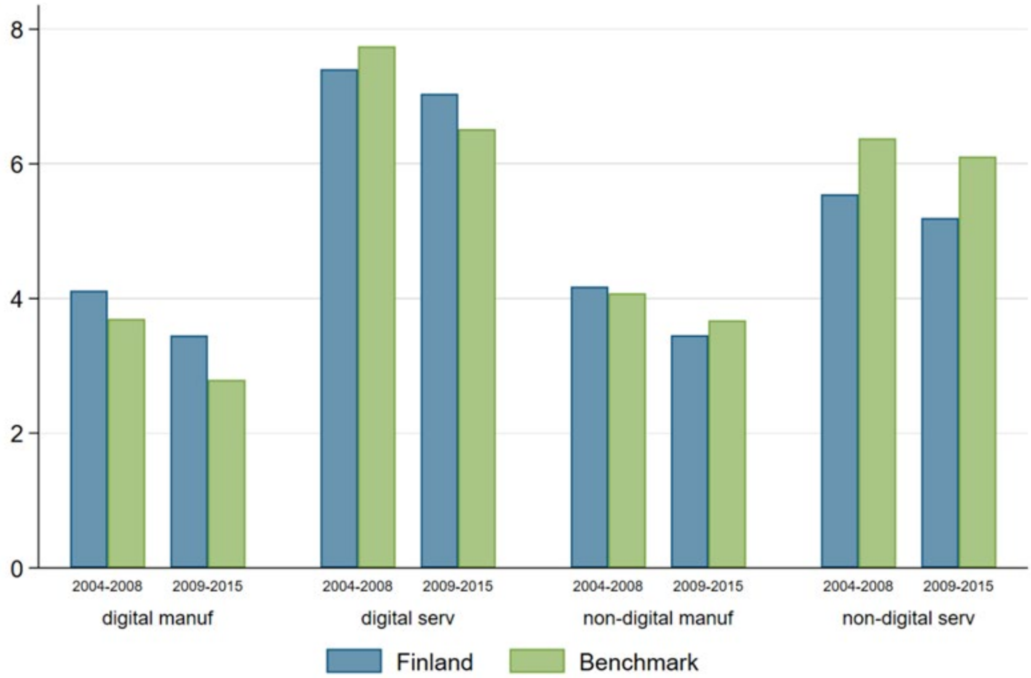
Comparable entry rates and survival of micro-entrants, higher growth of micro-entrants

Levels of entry rates in Finland appear relatively in line with other countries, although there is some degree of sectoral heterogeneity (Figure 7). Entry rates tend to be higher than in the benchmark in digital manufacturing sectors, while they appear relatively lower in non-digital service sectors. Overall, entry rates have been declining both in Finland and in the benchmark, in line with cross-country evidence from Calvino, Criscuolo and Verlhac (2020[2]).

Overall, the share of micro-entrants surviving five years is in line with the OECD benchmark (Figure 8). In manufacturing, the survival of micro-entrants appeared higher in Finland relative to the benchmark for earlier cohorts of entering firms, and have become more comparable for latest cohorts. In services, survival of micro-entrants also appears slightly higher than the average of benchmark countries.

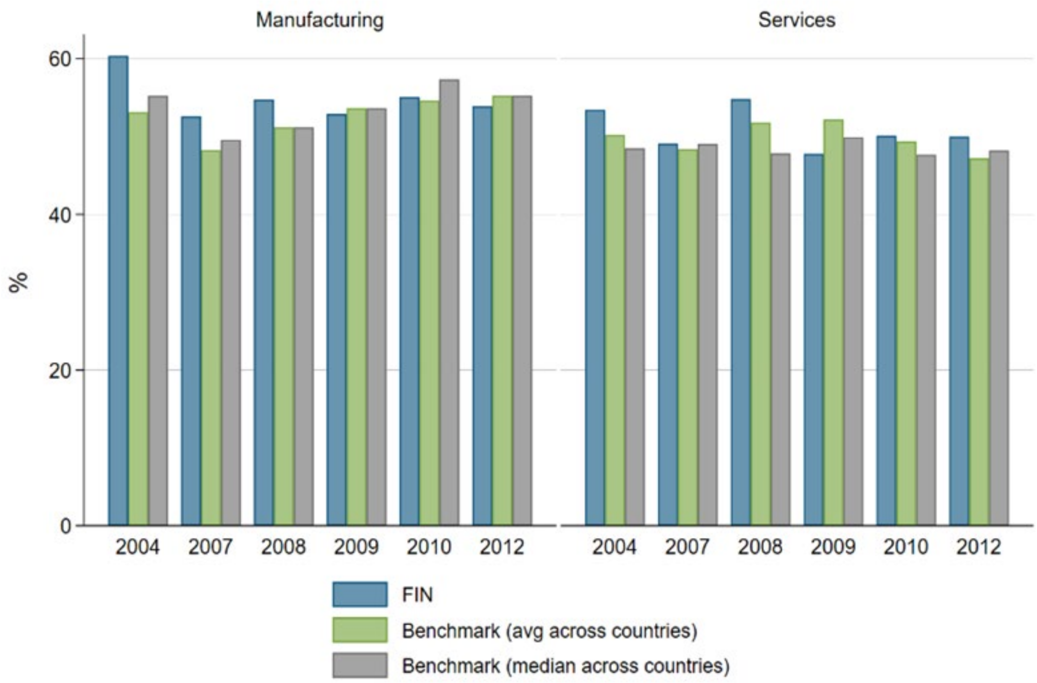
High survival probability of micro-entrants is accompanied by their stronger growth dynamics (Figure 9). The post-entry growth of micro-entrants appears particularly high, relative to the benchmark, in private services, signalling vibrant business dynamics.

Figure 7. Entry rates (%) by digital intensity within manufacturing and non-financial market services



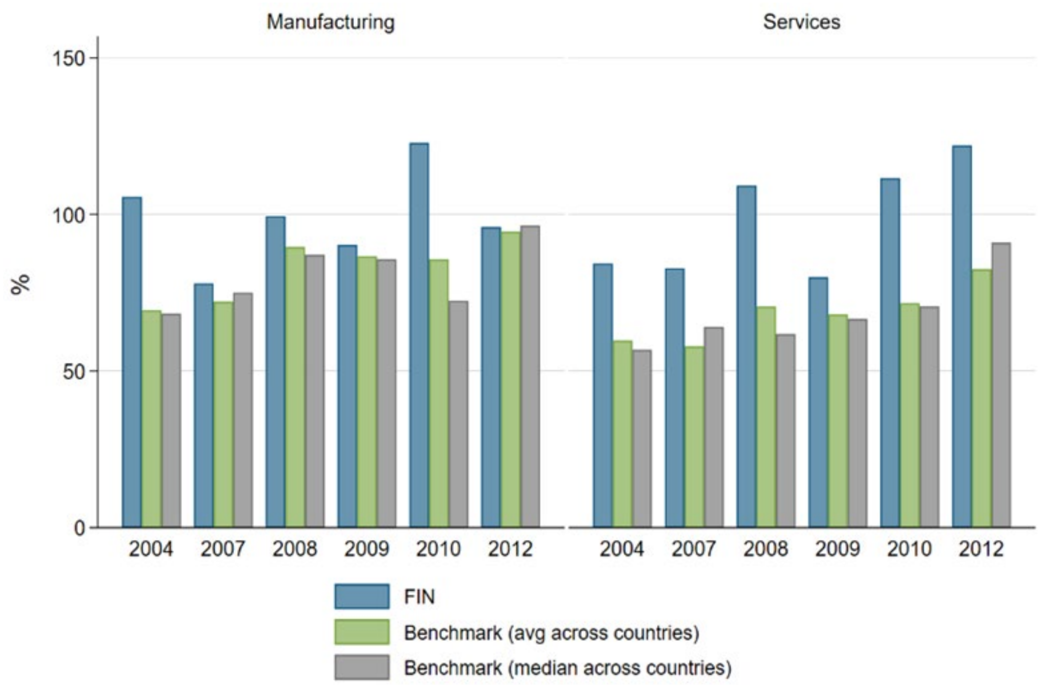
Note: This figure reports entry rates, in percentage, on average over available years for the periods 2004-08 and 2009-15 in Finland and the benchmark group of countries according to the digital intensity of underlying SNA A38 sectors, within manufacturing and non-financial market services. The year 2013 is suppressed from the Finnish average due to a break in the time series related to Statistics Finland's business statistics renewal. The benchmark group consists of Austria, Belgium, France, Hungary, Italy, Norway, Portugal, Spain and Sweden. Entry rates are defined as the number of entering units with positive employment over the number of entering and incumbent units with positive employment in a sector. SNA A38 sector-level entry rates are aggregated using sectoral weights in terms of number of units. Digital intensive manufacturing sectors: 26, 28 and 29T30. Digital intensive service sectors: 61, 62T63, 69T71, 72 and 73T75. Non-digital intensive manufacturing sectors: 10T12, 13T15, 16T18, 20, 22T23, 24T25, 27 and 31T33. Non-digital intensive service sectors: 45T47, 49T53, 55T56 and 58T60.
Source: OECD DynEmp Database.

Figure 8. Survival share of micro-entrants, after five years (%)



Note: This figure reports the average survival share of micro-entrants after five years in business by the year of establishment, in percentage, separately for manufacturing and non-financial market services in Finland and the benchmark group of countries. The benchmark group consists of Austria, Belgium, Hungary, Italy, Norway, Portugal, Spain and Sweden. The survival share of micro-entrants is defined as the number of firms still in business after five years, over the total number of firms that started at the same year, focusing on micro-entrants, defined as new firms with 2 to 9 persons engaged.
Source: OECD DynEmp Database.

Figure 9. Post-entry growth of micro-entrants, after five years (%)



Note: This figure reports the average employment growth of micro-entrants after five years in business by the year of establishment, separately for manufacturing and non-financial market services in Finland and the benchmark group of countries. The benchmark group consists of Austria, Belgium, Hungary, Italy, Norway, Portugal, Spain and Sweden. Post-entry employment growth of micro-entrants is defined as the total employment of micro-entrants still in business after five years over total initial employment of these units. Micro-entrants are defined as new firms with 2 to 9 persons engaged.
Source: OECD DynEmp Database.

Existing evidence on the causes of the Finnish productivity slowdown

Although the labour productivity of Finland fell drastically during the financial crisis, there seems to be a consensus in the literature in dismissing the financial crisis per se as a distinguishing reason for Finland's exceptionally low productivity growth since 2009. According to Suni and Vihriälä (2016[11]), who compare Finland to its northern peer countries (Sweden, Denmark, Germany, the Netherlands and the United Kingdom) during the financial crisis, Finland “has not experienced any banking problems”. They argue that “interest rates and weak credit availability can hardly have been constraining factors of growth relative to the other countries”. Moreover, they point to the fact that ECB’s survey (2021[14]) shows that Finland performs particularly well in credit availability to SMEs, relative to other Euro area countries. Similarly, Hukkinen et al. (2015[15]) argue that the access to finance has not been a key obstacle for business investments. This report takes stock of this coherent set of findings and does not study the impact of the financial shock to Finnish productivity. Yet, it emphasises that, as far as we know, a causal identification of the impact of this shock on productivity, based on matched firm-bank data and state-of-the-art methodologies, has not yet been performed for Finland (in the literature surveyed).

According to a report by the Finnish Productivity Board (2020[16]), the main candidate explanations for the sluggish productivity growth may be the Nokia crisis and poor cost-competitiveness, and the sectoral structure of the Finnish economy. Suni and Vihriälä (2016[11]) suggest that the primary cause of the Finnish productivity slowdown is the combined effects of large negative asymmetric demand shocks in combination with the poor cost competitiveness.

Reduced cost competitiveness resulted from the inability of the Finnish economy to adjust its labour costs to long-term structural changes in production technologies (Suni and Vihriälä, 2016[11]). The weakening of cost competitiveness affected negatively both exports and investments (Kaitila et al., 2018[17]). However, according to the Finnish Productivity Board (2021[12]), cost competitiveness has improved since 2012 due to a subdued wage dynamics.

Another proposed explanation for the halted labour productivity growth is a reduction in investment. According to Pohjola (2020[18]), a reduction in R&D investment and sluggish growth of ICT investment have contributed to the slowdown in productivity in Finland in the post-crisis period. In particular, the contribution to growth of ICT investments was only half of that of Sweden and the United States in the post-crisis period. Suni and Vihriälä (2016[11]) suggest that the held back in business investments could also be a consequence of both the continued weakness of export revenues that affected household income and consumption, and a reduction in corporate profitability. However, Pohjola (2020[18]) concludes that the weak development of investments cannot alone explain the sluggish productivity growth.

The analysis of this report focuses on the two main demand shocks experienced by Finland in 2009: the Nokia crisis and the GTC, and analyses whether the transmission of such shocks through value chain linkages may help explain the Finnish productivity slowdown.

3 Data

The analysis leverages a unique database that combines cross-country and cross-sector information on productivity, industry concentration, business dynamics, and global and domestic input-output linkages from different data sources.

MultiProd and DynEmp databases

The MultiProd and DynEmp databases collect several key country-sector indicators of, respectively, productivity and business dynamics. They are the result of distributed micro-data projects led by the OECD Directorate for Science, Technology and Innovation. They rely on standardised routines that collect several statistical moments of the distribution of firm characteristics (productivity, wages, age, mark-ups, employment, etc.) on the basis of confidential firm-level administrative data. The routines are centrally written by OECD staff, but locally executed by national experts. This data collection methodology puts a lower burden on national statistical agencies and limits their running costs. This way MultiProd and DynEmp databases directly use national micro-level representative databases, while at the same time achieving a high degree of harmonisation and comparability across countries, sectors, and over time (Berlingieri et al., 2020[19]; Calvino, Criscuolo and Verlhac, 2020[2]; Berlingieri, Blanchenay and Criscuolo, 2017[20]; Criscuolo, Gal and Menon, 2014[21]). [1]

Based on the MultiProd dataset, the analysis focuses on labour productivity (value added per worker), as a simpler but more widely available measure of productivity. It considers within-sector measures of productivity dispersions such as the inter-decile ratio and the distance between the 9th decile and the median, or between the median and the 1st decile. It also considers measures of industry concentration such as the share of gross output accruing to the top 10% of firms, ranked by gross output. Finally, it considers the Melitz-Polanec decomposition of aggregate productivity growth, and mainly focuses on the allocative efficiency component, measuring the change in the covariance between productivity and size of incumbents.

Inter-Country Input-Output (ICIO) tables and STructural ANalysis (STAN) database

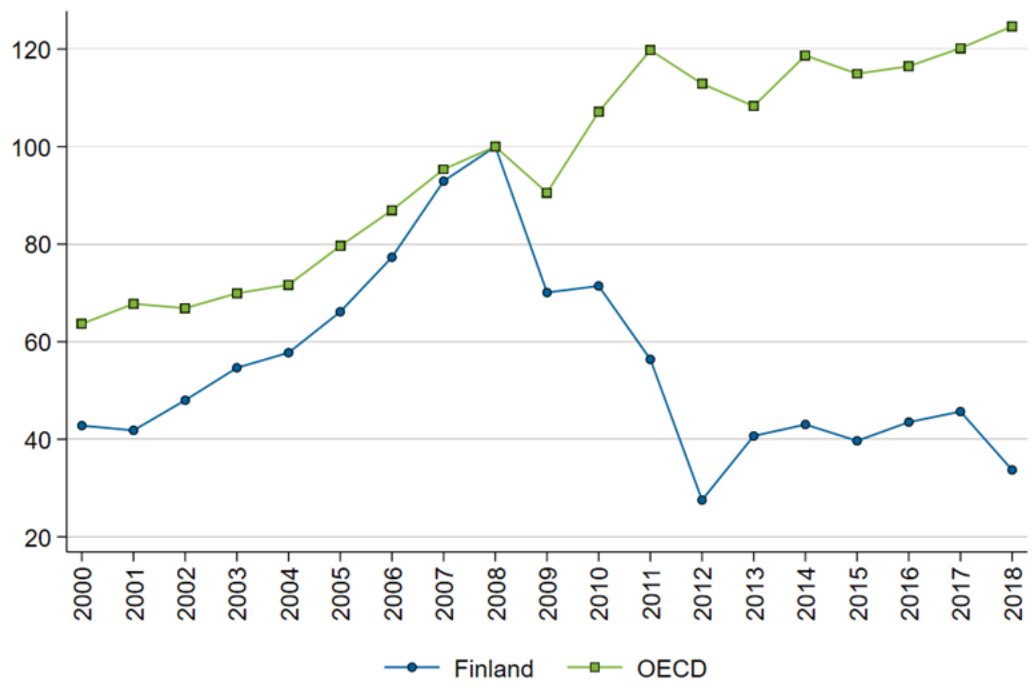
The input-output data used in this report come from the Inter-Country Input-Output (ICIO) tables (OECD, 2021[22]). The 2021 edition of ICIO covers 66 countries and 45 unique industries based on ISIC Revision 4. The centrality measures are based on Criscuolo and Timmis (2018[6]). The value-added and gross output variable used in the analysis are also from ICIO, but are deflated with the chained volume deflators from the OECD STAN database. The STAN database collects and harmonises information from annual national accounts tables of OECD countries (OECD, 2020[23]). The employment (in headcounts) and hours worked variable, used for defining labour productivity, also come from STAN.

4 The Nokia crisis

Nokia was the leading mobile phone manufacturer in the early 2000s. In 2008, the market share of Nokia's Symbian mobile smartphone operating system was half of the global market share of smartphones. However, the Symbian operating system lost the smartphone race to iOS and Android, and by 2012, the market share of Nokia in smartphones had dropped to approximately 5%. Between 2008 and 2012, the operating profit margins of Nokia also dropped from 10% to -9%. The company had an important role for the Finnish economy as whole: In the peak year 1998, the share of Nokia of the Finnish GDP was as high as 4%, but in 2011 it had fallen to 0.5%. Nokia was also a significant employer in Finland. In 2000, it accounted for 1% of the total employment in Finland, while in 2013, this share had fallen to approximately 0.4%. Before the crisis, Nokia made over 40% of the Finnish corporate R&D spending, and the share dropped to 31% in 2012 (Ali-Yrkkö et al., 2013[24]).

The fortunes of Nokia were largely reflected in those of the whole Finnish computer sector. As Figure 10 shows, the sector value-added grew at a faster pace than the OECD average until 2008, and then experienced a sharp and prolonged decline.

Figure 10. Value added of the computer and electronics sector

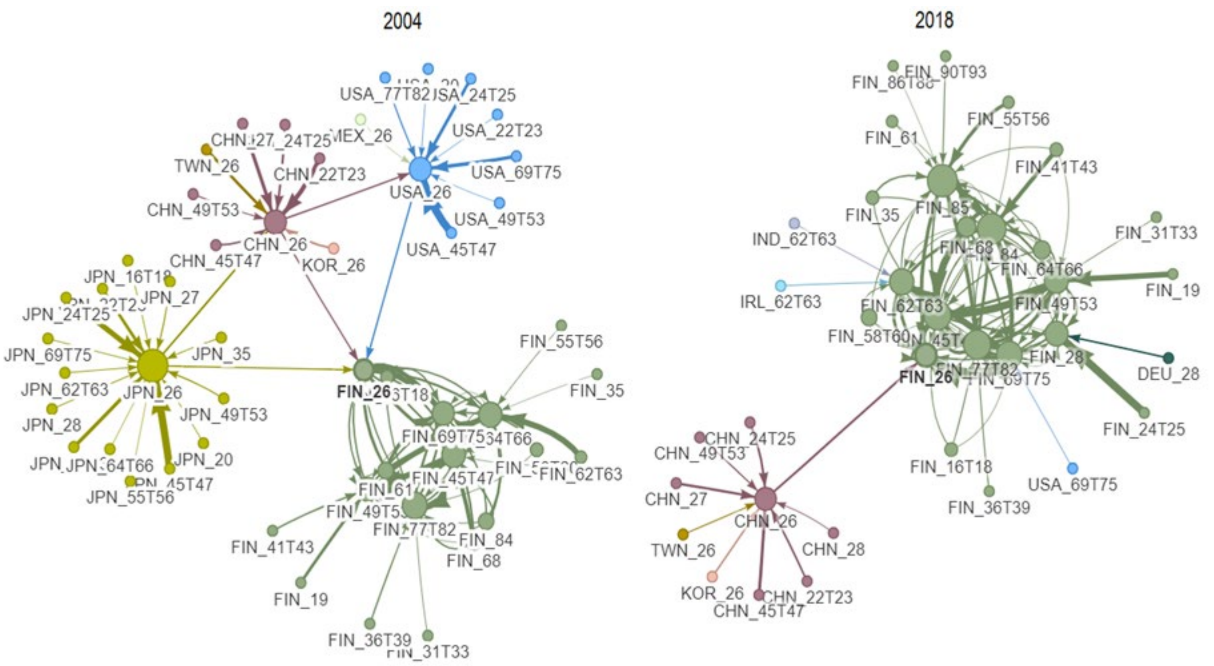


Note: This figure shows the real value added of the computer sector (ISIC Rev. 4 26) in Finland and on average in OECD indexed to year 2008 = 100.
Source: OECD STAN Database.

The crisis of Nokia had important impact on its network of suppliers and this is reflected in domestic and foreign sectoral input-output tables. Before the crisis, the Finnish computer sector had a diversified structure of foreign suppliers from Japan, United States, and the People's Republic of China (hereafter, 'China') to purchase electronics and computer manufactured goods, while sourcing services from domestic providers (left panel of Figure 11). The crisis induced a persistent change in this structure: China became much more central in the supply of electronics and computers, while domestic suppliers gained importance also for manufacturing goods such as machinery, equipment, and products of wood and cork (right panel of Figure 11).

Figure A A.2, Figure A A.3, Figure A A.4 and Figure A A.5 show similar graphs for the computer and electronics sector of Sweden, France, Germany, and the United Kingdom. In all these patterns, GVC changes have been different from those experienced by the Finnish computer and electronics sector: limited changes have been registered in France and Germany, while for Sweden and the United Kingdom, Dutch firms active in the computer and electronics sector became key suppliers. The substantial reduction in foreign suppliers, and the strengthening of the ties with the domestic economy are, thus, a peculiar feature of the Finnish computer sector since 2009.

Figure 11. Network of the Finnish computer sector in 2004 and 2018

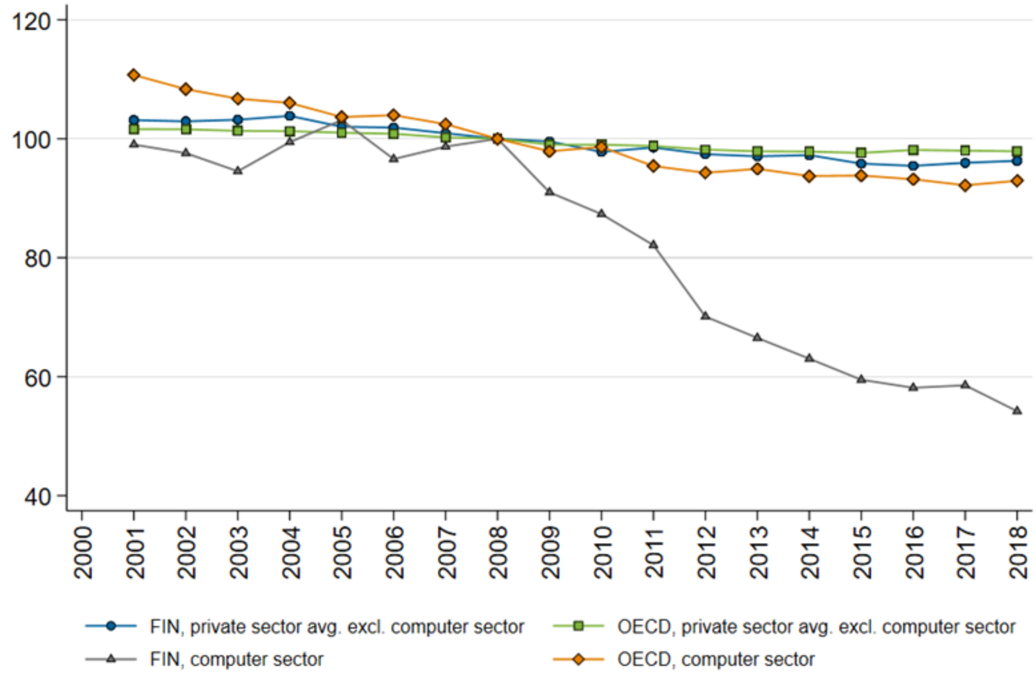


Note: This figure presents the country-industry pairs that make 2% or more of the inputs of the Finnish computer, electronic and optical products industry, and the country-industry pairs that make 2% or more of the inputs of the suppliers of the Finnish computer, electronic and optical products in the years 2004 (left panel) and 2018 (right panel).
Source: OECD ICIO Database.

By reducing the number of its foreign suppliers and relying more heavily on domestic ones, the Finnish computer sector lost its influence in the global trade network. This can be appreciated in Figure 12, which shows the evolution of the total network centrality of the Finnish computer sector (indexed to 100 in 2008) and compares it with the trends in centrality of the OECD average computer sector, and to the average Finnish private sector (net of the computer one)[2] . Recent evidence has shown how sector centrality is a key determinant of its productivity growth (Criscuolo and Timmis, 2018[6]). Importantly, the rest of the Finnish economy did not experience such a declining trend in centrality, so that the drop in productivity experienced since 2008 does not seem to be linked to a general decline in centrality of Finland across all sectors.

Rather, the increasing role of domestic sectors as suppliers of the computer sector may have ultimately strengthened the spill over of the Nokia crisis from the computer sector to the rest of the economy. To test this hypothesis, this report designs an empirical strategy to gauge the impact of shocks to the computer sector to its upstream linkages, and apply it to the Nokia case.

Figure 12. Nokia crisis and the drop in centrality



Note: This figure presents the total centrality of computer sector in Finland and on average in OECD, and the total centrality of private sector excluding computer sector in Finland and on average in OECD. Total centrality is defined as the average of forward and backward "Bonacich-Katz" centrality. Index, 2008 = 100.
Source: OECD ICIO Database.

Empirical strategy

This analysis exploits the ICIO database to identify how a sectoral shock is transmitted through local and global value chains. To show how ICIO tables can be used for this purpose, it is convenient to introduce the inverse Leontief coefficient, as a statistic that help identifying the strength of value chain linkages between two country-sector pairs. The inverse Leontief coefficient $\lambda_{c,s\rightarrow b,p,t}$ shows how much input (in dollar value) from sector s in country c is needed to produce one dollar of output in sector p of country b in year t, and it is obtained by iterating over the input-output matrix of that year. The analysis of this Section focuses, in particular, on the link between one domestic sector and the domestic computer sector, i.e., on the inverse Leontief $\lambda_{c,s\rightarrow c,computer,t}$.

The inverse Leontief in one specific year, and for each specific pairs of country-sectors, is likely to depend on specific, endogenous market forces, stemming from the short-term equilibrium between demand and supply. To gauge a more exogenous, exposure of each sector to the domestic computer industry, the analysis relies on the average across the N_c countries and *T* years. The resulting statistic measures the average domestic inverse Leontief coefficient for each sector *s*. Formally,

$$\lambda_{s\rightarrow computer} = \frac{\sum_{t=2000}^{2018} \sum_c \lambda_{c,s\rightarrow c,computer,t}}{T * N_c}$$

A country-sector level shock is then computed by interacting the average inverse Leontief coefficient $\lambda_{s\rightarrow computer}$ with the growth rate in value added in the computer sector $\Delta_h \log VA_{c,t}^{computer}$, measured over the time-horizon *h*. The change in the dependent variable of interest $\Delta_h DV_{c,s,t}$, measured over the horizon *h*, is then regressed on the shock measure, in the following linear specification:

$$\Delta_h DV_{c,s,t} = \beta_h \lambda_{s\rightarrow computer} * \Delta_h \log VA_{c,t}^{computer} + \gamma_{c,s} + \theta_t + X_h \delta + \varepsilon_{c,s,t}$$ **Equation 1**

where $\gamma_{c,s}$ are country-sector fixed effects, θ_t are time fixed effects, and X_h is a vector of h lagged controls that may change on the basis of the dependent variable of interest. Three possible time horizons are considered, i.e., h correspond to 1, 3, and 5 years. Standard errors are allowed to display two-way serial correlation at the country-sector and country-year levels.

If the number of domestic sectors would be sufficiently high, equation (1) could be estimated specifically for Finland. In practice, data are collected at the A38 level, and the focus on the business sector implies that 21 sectors are used to estimate our model. Therefore, β_h is estimated by using data from all 16 countries available in the database. However, additional results test whether the estimated coefficient is different from the one obtained for Finland only, and reveal that the effect for Finland to be not statistically nor economically different from the one estimated for the whole sample of countries.[3] Finally, the presence of asymmetric effects of positive and negative changes to the value added of the domestic computer sector are tested. The estimated effects are generally larger in absolute terms in the case of negative shocks (such as the one experienced by the Finnish economy), yet the symmetric specification in (1) is adopted to increase the precision of estimate, the estimates presented can be considered conservative.

Countries considered in this analysis include Austria, Belgium, Canada, Chile, Estonia, Finland, France, Hungary, Italy, Japan, Latvia, Lithuania, the Netherlands, Portugal, Slovenia and Sweden, reflecting data availability and quality. The observation period spans from 2000 to 2018, depending on the variables, sectors and countries considered.

Analysis focuses on manufacturing and non-financial market service sectors, and the covered A34 sectors are listed in the Table A B.1. The analysis also exploits the classification of A34 sectors into non-digital and digital industries following Calvino et al. (2018[25]). However, in the analysis manufacturing sector is not divided by digital intensity due to too few digital manufacturing sectors after excluding the computer and electronics industry.

Results

The analysis first estimates the impact of a shock to the value added of the computer sector on aggregate value added, gross output, employment and, ultimately, labour productivity growth. Table 1 shows the estimated effect of the shock over different horizons. To ease comparability across specifications, the coefficients have been standardised. A one-standard-deviation positive shock induces a positive though mild and imprecisely estimated impact on value added and gross output growth, ranging from 1.4 to 2.5 %of their standard deviations. Conversely, the impact on employment is negative over the longer-term horizon, a finding that is consistent with the stronger effect of the shock on more productive firms, discussed below. These firms are indeed characterised by lower labour intensity of production. As a result of these effects on output and input, aggregate labour productivity increases significantly, particularly over the longer term.

Table 1. The effect of a shock to the computer sector on value added, gross output, employment, and productivity of upstream industries

	Dep. Var.: Growth rate of	Value added	Gross output	Employment	Labour productivity
Horizon 1	Shock to computer sector	0.0163	0.0258*	0.00493	0.00532
		(0.0109)	(0.0136)	(0.0114)	(0.00864)
	Observations	4956	4495	4942	4338
	R-squared	0.631	0.663	0.243	0.459
Horizon 3	Shock to computer sector	0.0143	0.0184	-0.0290**	0.0370***
		(0.0104)	(0.0122)	(0.0144)	(0.0115)
	Observations	4378	3973	4364	3810
	R-squared	0.770	0.757	0.534	0.708
Horizon 5	Shock to computer sector	0.0178	0.0184	-0.0202	0.0430***
		(0.0113)	(0.0129)	(0.0167)	(0.0146)
	Observations	3798	3449	3784	3280
	R-squared	0.861	0.840	0.719	0.816

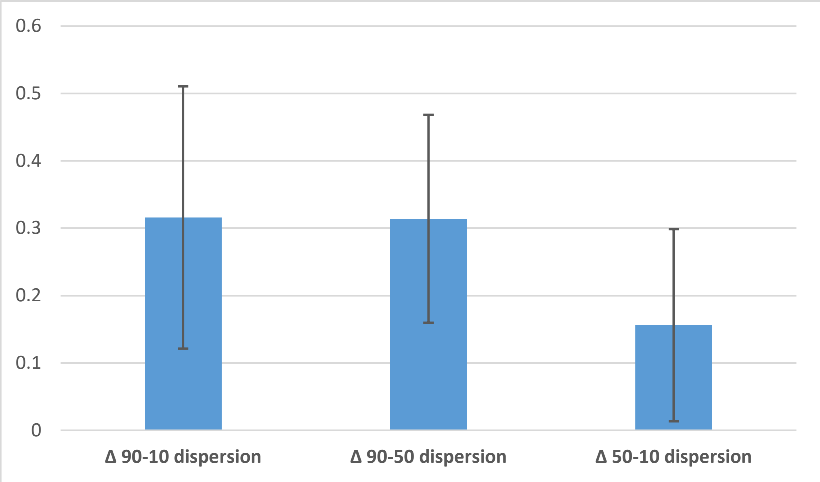
Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and STAN Databases.

These elasticities can be used to assess, with a simple counterfactual exercise, the potential aggregate impacts of a negative shock to value added growth in computer sector of the same magnitude experienced in Finland after 2008. For each sector *s*, the estimated drop in labour productivity driven by the Nokia crisis is computed by multiplying the estimated elasticity over 5-years horizon $\hat{\beta}_5$, the sector-level inverse Leontief coefficient $\lambda_{s \rightarrow computer}$, and the actual drop in value added experienced by the Finnish computer and electronics sector over the period 2009-13. Then average sector-level is estimated using 2008 Finnish sectoral employment shares as weights, and the predicted drop in aggregate productivity growth is compared to the one actually experienced by the Finnish economy over the period. According to this simple exercise, the impact of a shock to the computer sector akin to the one experienced by the Finnish economy may explain at least 30% of the drop in aggregate productivity growth experienced by the rest of the economy. This result may be considered a lower bound of the actual aggregate impact of the Nokia crisis, as the estimate does not consider other channels through which the shock may have persistent impacts, such as lower investments and innovation and general equilibrium effects.

To identify the distributional impacts of the shock within sector, model (1) is estimated using (log) changes in productivity dispersion as a dependent variable. Results provided in Figure 13 show that the shock is associated with a sizeable increase in productivity dispersion, driven mostly by the upper tail of the productivity distribution: a one standard deviation shock raises the distance between the 90^{th} and 50^{th} percentile by around 30% of a standard deviation, while the distance between the 50th and the 10th percentile increases by around 15% of a standard deviation.

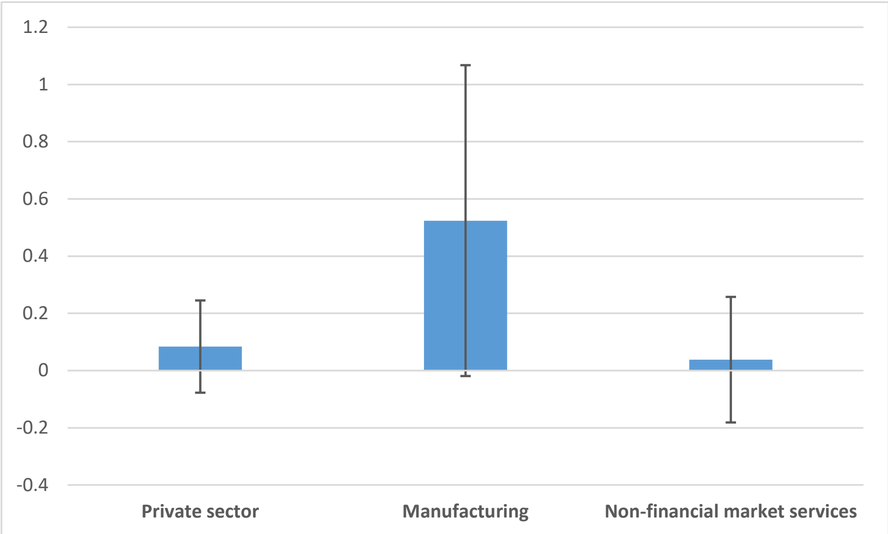
Such increase in productivity dispersion is associated to an increase in allocative efficiency in the manufacturing sector, while allocative efficiency remains largely unaffected in private services (Figure 14). This result hints to relevant sectoral heterogeneity in the effects, a topic to which is devoted the rest of this analysis.

Figure 13. The effect of a shock to the computer sector on productivity dispersion



Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors allow to display serial correlation at the country-sector and country-year levels.
Source: OECD ICIO and OECD MultiProd Databases.

Figure 14. The effect of a shock to the computer sector on covariance



Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors allow to display serial correlation at the country-sector and country-year levels.
Source: OECD ICIO and OECD MultiProd Databases.

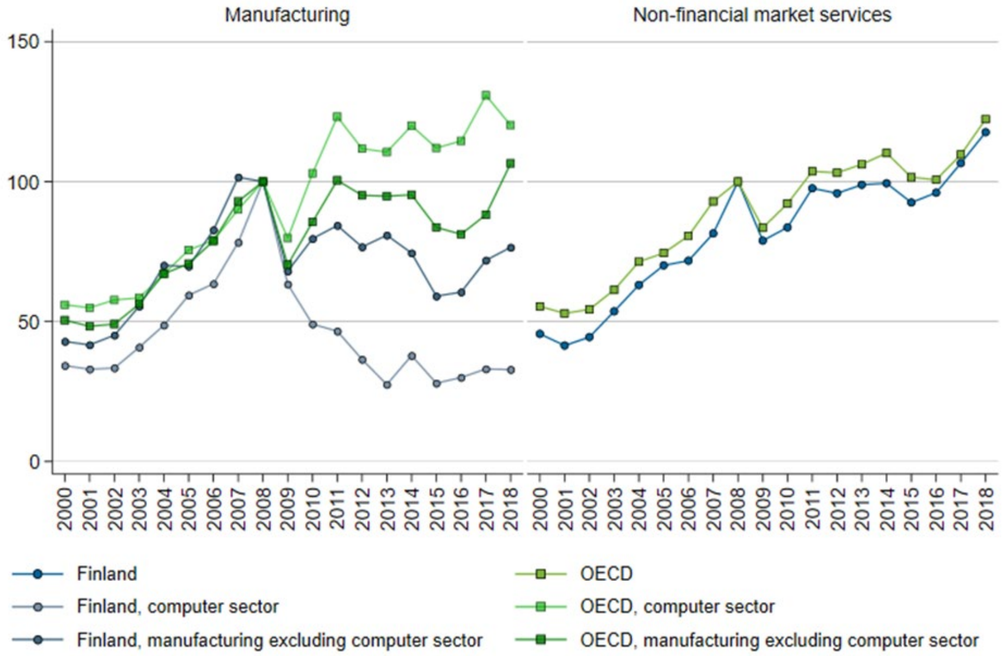
Sectoral heterogeneity

To analyse the differential impact of the shock by sector, Equation 1 is estimated differently among manufacturing and services, distinguishing among the latter between digital-intensive and non-digital services.[4] As Table A A.1, Table A A.2 and Table A A.3 show, the impact on labour productivity is only significant among manufacturing and digital service firms, for which –as Figure 11 shows – the buyer-supplier linkages with the computer sector are stronger.

Table A A.4 shows that the shock increases productivity dispersion both in manufacturing and service sectors, and the effect is larger particularly among digital services. However, Table A A.5 shows that such an increase is accompanied by rising industry concentration (as measured by the share of gross output accruing to the top decile of the gross output distribution) in manufacturing only. Such increase in concentration accompanied by larger productivity dispersion results in a more efficient allocation of resources, as measured by the covariance between size and productivity (Table A A.6). In private services, and notably in the more digital intensive ones, frictions to resource allocation seem to be more relevant, as suggested by the fact that increasing productivity dispersion is not associated with a more efficient allocation of resources.

5 The 2009 Great Trade Collapse

Figure 15. Finnish exports stayed below the OECD average in manufacturing after 2009, also without computer sector



Note: Trends in exports, real values, index 2008 = 100, by macro sector in Finland and OECD. Exports are defined as the amount of gross output that is sold from a domestic sector to all foreign country-sectors in ICIO at time t.
Source: OECD ICIO and STAN Databases.

In the wake of the financial crisis, global trade experienced a sharp, sudden and synchronised fall, referred to as the "Great Trade Collapse". From the end of 2008 to 2009, the value of global trade dropped by around 10%, and the fall was similar across all countries. Within less than one year, though, the shock started reverting and trade resumed its pre-collapse levels by 2010. Several explanations have been raised to explain the GTC. The general consensus is that it was a demand shock, triggered by the increasing uncertainty due to the financial crisis and by a downward spiral of global prices, and channelled by the tight network of GVC linkages (Baldwin, 2009[26]).

Finland was significantly hit by the GTC, and total export dropped in 2009, with differential impacts across sectors. As Figure 15 shows, exports of manufacturing sectors dropped by over 25% and – differently from the OECD average – failed to catch up to its pre-GTC levels later on. Importantly, this reduction cannot be entirely explained by the performance of the Finnish computer sector, which was affected also by the Nokia crisis. In services, instead, the drop was more limited (less than 15% for both Finland and the OECD average) and trade quickly reverted to its pre-crisis levels.

This Section tests whether such a sudden, strong, but short-lived shock to global demand can generate a persistent impact on aggregate productivity growth such as the one experienced by the Finnish economy.

Empirical strategy

This analysis exploits the ICIO database to identify how a shock to foreign demand is transmitted to the domestic economy through local and global value chains, focusing on aggregate productivity growth and its firm-level determinants.

The economic literature generally relies on shift-share instruments to identify the effect of shocks to foreign demand. The standard shift-share instrument would be composed of two elements. On the one hand, there is an aggregate or sectoral shock (the "shift"), such as the growth rate in value added in the destination country-sector $\Delta \log VA_{b,q,t}$. Notice that a one-year shock is considered, as the GTC was ultimately short-lived. On the other hand, there is a pre-determined rule to distribute this shock across the economy (the "share"). This is usually the share of global export coming from source country-sector *c,s* to destination country-sector *b,q*, measured at the beginning of the period of analysis (in this case, year 2000).

$$share_{c,s\to b,q} = \frac{X_{c,s\to b,q,2000}}{\sum_c \sum_s X_{c,s\to b,q,2000}}$$

The standard shift-share instrument (*SSS*, henceforth) is then defined as the interaction between the shift and the share components, aggregated at the destination country-sector level *c,s*. Formally,

$$SSS_{c,s,t} = \sum_b \sum_q * \; share_{c,s\to b,q} * \Delta_{h=1} \log VA_{b,q,t}$$

One shortcoming of this instrument in proxying for the impact of an export shock is that it ultimately only considers the direct input-output linkages between country-sector pairs, without considering the broader role of the GVC network.

To overcome this limitation, the *SSS* variable is augmented with a proxy of the value chain linkages. To identify the value chain linkages, it has been used the inverse Leontief coefficients $\lambda_{c,s\to b,q,t}$ computed for each pair of source country-sector *c,s,* and destination country-sector *b,q*, in each year *t.* The inverse Leontief coefficient measures the dollar value of the output of the country-sector *c,s* that is needed to produce one additional dollar value of output from *b,q*, taking into consideration the whole input-output table. For a specific year or a specific source-destination pair, this measure is likely to reflect endogenous factors that simultaneously affect the market equilibrium and the structure of the GVC network. To identify "technical" value chain linkages between sectors, we then average the inverse Leontief coefficients across countries, and years at the sector level. Formally,

$$\lambda_{s\to q} = \frac{\sum_{t=2000}^{2018} \sum_c \sum_b \lambda_{c,s\to b,q,t}}{T * N_c}$$

Subsequently, these technical inverse Leontief coefficients are added to the proxy to compute an augmented shift-share instrument (ASS):

$$ASS_{c,s,t} = \sum_b \sum_q * \lambda_{s\to q} * \; share_{c,s\to b,q} * \Delta \log VA_{b,q,t}$$

Finally, the following linear specification is estimated for various dependent variables:

$$\Delta_h DV_{c,s,t} = \beta_h ASS_{c,s,t} + \gamma_{c,s} + \theta_{c,t} + X_h \delta + \varepsilon_{c,s,t} \quad \text{Equation 2}$$

where $\gamma_{c,s}$ are country-sector fixed effects, $\theta_{c,t}$ are country-time fixed effects, and X_h is a vector of h lagged controls that may change on the basis of the dependent variable of interest. Three possible time horizons are considered for other dependent variable h: 1, 3, and 5 years. Standard errors are allowed to display two-way serial correlation at the country-sector and country-year levels.

As in the case of the analysis of the Nokia shock, model (2) is estimated on all 16 countries included in the analysis to increase the number of observations and obtain reliable estimates. Nonetheless whether the coefficients estimated for ASS are different in the case of Finland is tested in a separate set of regressions: no evidence that the elasticities computed across countries differ from those of Finland has been found. As detailed in endnote 5, results are qualitatively similar. Thus, the report resorts to elasticities obtained using all countries to provide more conservative estimate.

Results

The report estimates the impact of a short-term shock to foreign demand on aggregate growth of value added, gross output, employment, and labour productivity. Table 2 shows the estimated effect of a one-year shock over one, three- and five-year horizons. To ease comparability across specifications, the coefficients are standardised. A one-standard-deviation shock induces a positive impact on value added, employment gross output growth, ranging from 3 to 11% of their standard deviations. While the effect of the shock on value added is strongest in the first year, horizon, the effect on employment remains positive significant also over three and five years. As a result, the short-term positive effect on labour productivity fades away over longer time horizons. Thus, the GVC effects of a shock similar to the one experienced during the GTC is unlikely to explain the prolonged decline in productivity growth experienced by Finland. In the short-term, however, it may have substantially contributed to the labour productivity drop.

A simple counter-factual exercise that exploits the estimated elasticities using model (2) and considers the drop in foreign demand experienced by Finnish sectors in 2009, shows that the transmission of the GTC through global and domestic value chains may explain more than 65% of the drop in aggregate productivity in 2009.[5]

Notice that, as in the case of the Nokia shock, these estimates only identify the effect of the GTC directly channelled by value chains. There are several other channels through which a short-term demand shock may impact long-term productivity growth. For instance, by lowering investments, limit the entry of new firms (Clementi and Palazzo, 2016[27]), or generate long-term “scars” among those who entered during such a period of low demand (Moreira, 2016[28]).All these channels are not considered in this analysis and would need a specific analysis, possibly exploiting firm-level data.

In a separate set of regressions, available upon request, the impact of export shock on productivity dispersion is also estimated, industry concentration, and Melitz-Polanec components of productivity growth. The shock to mostly accrues to the top half of the productivity distribution, with limited or no effect on industry concentration, and that the growth is by and large driven by within-firm productivity growth, with limited impact on allocative efficiency both in the short and medium term.[6]

Table 2. Effect of a shock to export on value added, gross output, employment and productivity – panel A manufacturing, panel B non-financial market services

		A. Manufacturing				B. Non-financial market services			
	Dep. Var.: Growth rate of	Value added	Gross output	Employment	Labour productivity	Value added	Gross output	Employment	Labour productivity
Horizon 1	Export shock	0.0942***	0.104***	0.0666***	0.0321*	0.117***	0.113***	0.0631**	0.0676**
		(0.0230)	(0.0224)	(0.0210)	(0.0173)	(0.0256)	(0.0252)	(0.0290)	(0.0296)
	Observations	2986	2732	2973	2472	2267	2030	2262	2103
	R-squared	0.672	0.726	0.329	0.543	0.839	0.870	0.373	0.573
Horizon 3	Export shock	0.0169	0.0160	0.0609***	-0.0222	0.0158	0.0195	0.0713**	0.00362
		(0.0109)	(0.0151)	(0.0170)	(0.0140)	(0.0173)	(0.0179)	(0.0291)	(0.0281)
	Observations	2635	2409	2616	2164	2001	1794	1996	1851
	R-squared	0.778	0.765	0.601	0.781	0.904	0.914	0.659	0.793
Horizon 5	Export shock	0.00981	0.0228*	0.0436***	-0.0202*	0.0196	0.0360**	0.104***	-0.0194
		(0.00944)	(0.0118)	(0.0131)	(0.0104)	(0.0167)	(0.0181)	(0.0270)	(0.0320)
	Observations	2276	2078	2266	1854	1733	1556	1728	1597
	R-squared	0.862	0.827	0.757	0.867	0.939	0.940	0.812	0.866

Note: Results of estimating the model from Equation 2 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and STAN Databases.

6 Conclusions and policy implications

The Finnish economy has suffered from a prolonged slowdown in productivity growth over the late 2000s and 2010s. Understanding its sources is key to devise a comprehensive policy package to support a strong recovery after the pandemic and in the aftermath of Russia's war against Ukraine.

Between 2008 and 2009, Finland has been hit by three simultaneous shocks: a supply-side shock (the financial crisis) and two demand-side ones (the Great Trade collapse and the Nokia crisis). This report focused on the latter two, given the general consensus identifying limited effects of the financial crisis on the Finnish economy.

The analysis highlights how the Nokia crisis may have severely impacted long-term productivity growth through the value chain linkages connecting the domestic sectors to the computer one. Indeed, Finnish sectors that were supplying to the domestic computer sector failed to differentiate their demand and were hardly hit by the crisis of their main customer. Moreover, the shock disproportionally hit the most productive firms within these upstream sectors and this has likely contributed to reduced productivity dispersion in the Finnish economy. As the labour input failed to adjust across firms, its allocative efficiency was reduced, contributing to the slowdown in aggregate productivity.

The impact of the GTC shock through global value chains may have played a substantial part in explaining the productivity slump in 2009. Yet, the short-term reduction in foreign demand is unlikely to have impacted productivity growth over the longer-term.

These results point to the importance of strengthening the ability of the Finnish economy to adjust to idiosyncratic shocks to large firms or to key sectors. Given the long-term aggregate impacts that these shocks may have, improving resilience and boosting growth seem complementary in this case. It is, thus, important to support the diversification of the economy, to avoid excessive vulnerability to specific industries, while improving labour mobility, in order to more efficiently adapt to demand shocks. A flexible and inclusive labour market legislation, which limits labour market duality while supporting the relocation of workers across firms and sectors (with active labour policies aimed at their up-skilling and re-skilling) is crucial.

It is also key to support firm-level competitiveness by fostering firms' innovative activities, and the accumulation of intangible capital and knowledge. Fostering innovation among most productive firms is particularly important in the Finnish case, as there is evidence that the most innovative and productive firms have suffered the most from the Nokia crisis. A well-designed R&D tax credit, which benefits incremental investments, may support the global competitiveness of Finnish leader firms.

To sustain long-term growth, it is important to ensure a fast and effective diffusion of digital technologies also among less productive firms. While Finland in this aspect is among the best performers in the OECD countries, it remains key to support investments in digital skills and knowledge, as well as to support the development of a vibrant digital ecosystem to support knowledge transmission.

The good performance of Finnish start-ups, both in terms of their number and their post-entry growth, suggests that new firms may represent a key competitive advantage for the country. Yet, it is crucial to support their ability to compete with larger incumbents by maintaining a level-playing field at the market level. Regulatory barriers to competition in upstream service sectors, such as energy and transport and retail remain relatively high, limit investments in these sectors and lower allocative efficiency (OECD, 2021[29]; Arnold, Nicoletti and Scarpetta, 2008[30]).

The analysis has highlighted various issues to be addressed by policies in the Finnish economy (related to allocative efficiency, resilience, and innovation), as well as competitive advantages. A multi-pronged policy strategy to tackle the various areas that require government intervention may prove to be particularly effective, given the strong synergies that are present among these policy areas.

Endnotes

[1] See the MultiProd (http://oe.cd/multiprod) and DynEmp (http://oe.cd/dynemp) websites for more details.

[2] Total centrality is the average of backward and forward "Bonacich-Katz" centrality, which takes into account both direct and indirect linkages, computed by Criscuolo and Timmis (2018[6]). Centrality of a sector reflects its influence on other sectors in the global production network.

[3] Results available upon request.

[4] No distinction has been made between digital and non-digital manufacturing because of the small number of digital manufacturing sectors (two sectors, excluding the computer one) and the limited sample size.

[5] Results of augmenting model (2) by interacting the ASS shock with a dummy for Finnish sectors, show that the Finnish economy displays slightly larger elasticities of labour productivity to the export shock. Yet, the long-term elasticity (for horizons 3 and 5) of the Finnish sectors remains not different from zero, both statistically and economically. For 1-year horizon elasticity, the difference is more sizeable (around 30% larger): the counterfactual estimate – based on cross-country elasticities –should then be considered conservative.

[6] Results available upon request.

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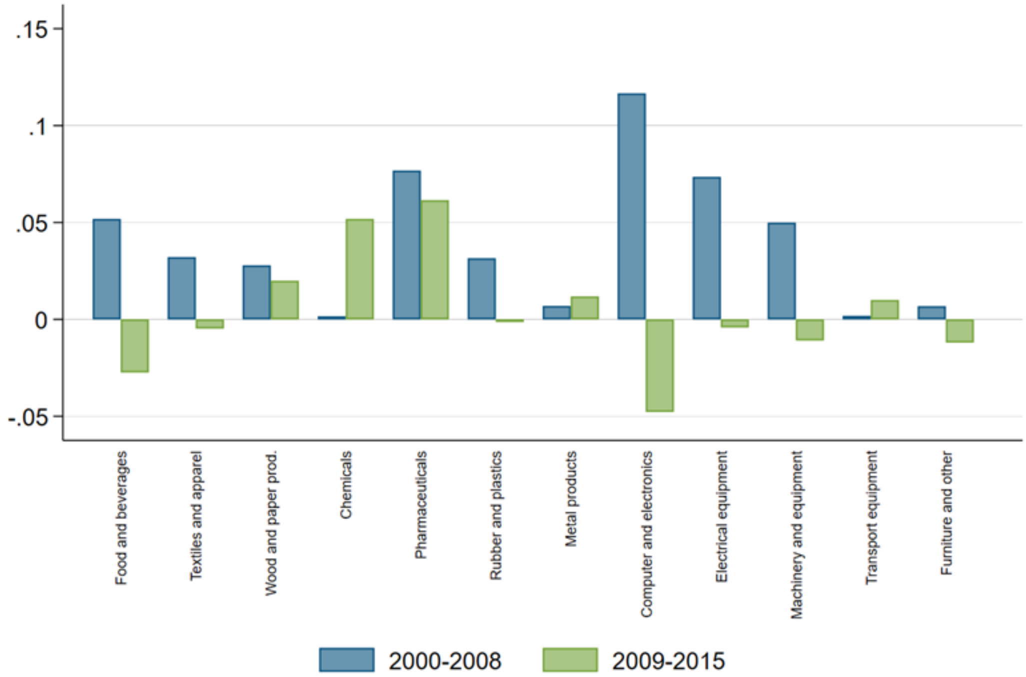
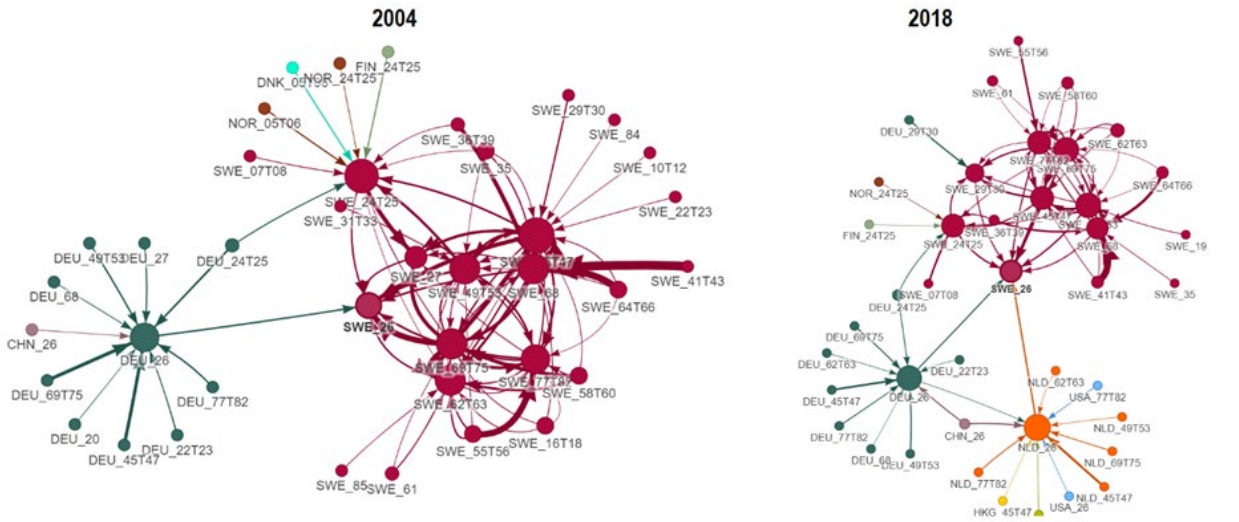
Annex A. Additional figures and tables

Figure A A.1. Average yearly labour productivity growth in manufacturing by A38 sectors



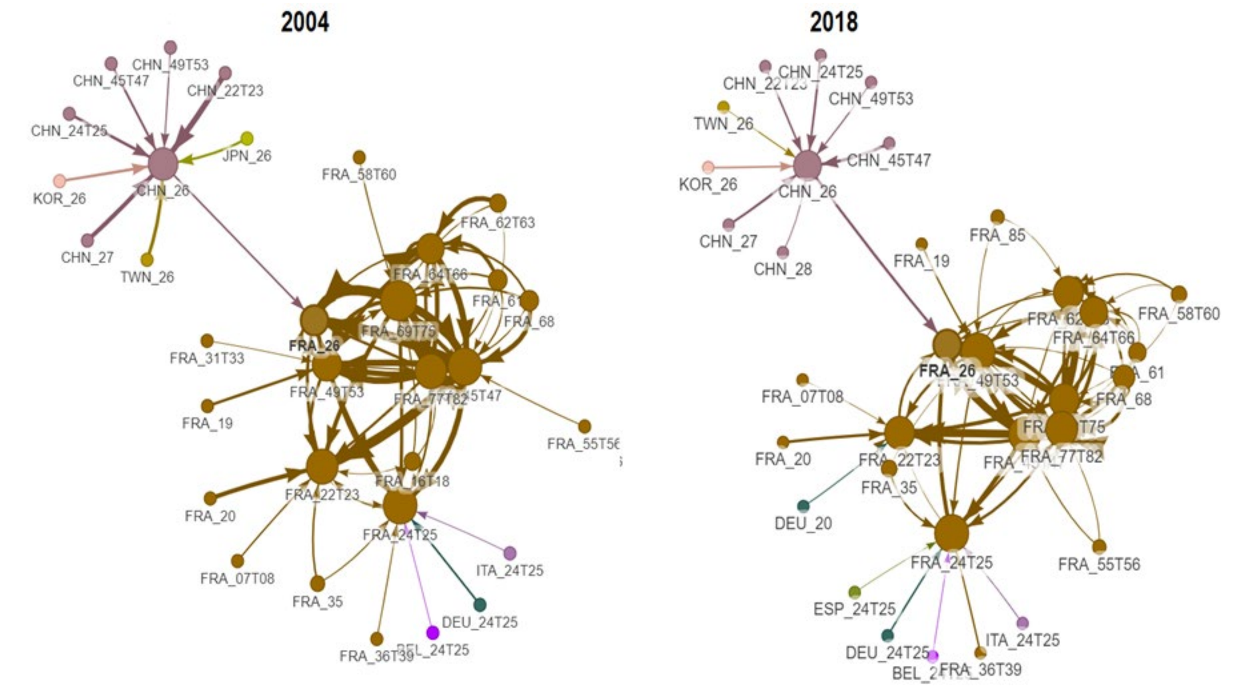
Note: This figure presents the average yearly labour productivity growth in manufacturing, by A38 sectors in the years from 2000 to 2008 and 2009 to 2015. Labour productivity is defined as value added over hours worked.
Source: OECD STAN Database.

Figure A A.2. Network of the Swedish computer sector in 2004 and 2018



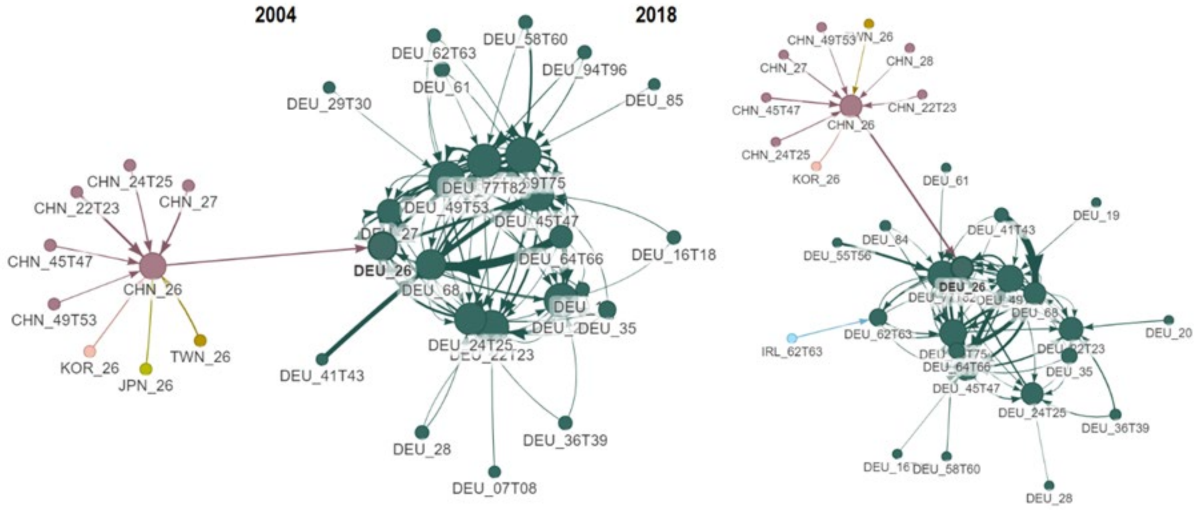
Note: This figure presents the country-industry pairs that make 2% or more of the inputs of the Swedish computer, electronic and optical products industry, and the country-industry pairs that make 2% or more of the inputs of the suppliers of the Swedish computer, electronic and optical products in the years 2004 (left panel) and 2018 (right panel).
Source: OECD ICIO Database.

Figure A A.3. Network of the French computer sector in 2004 and 2018



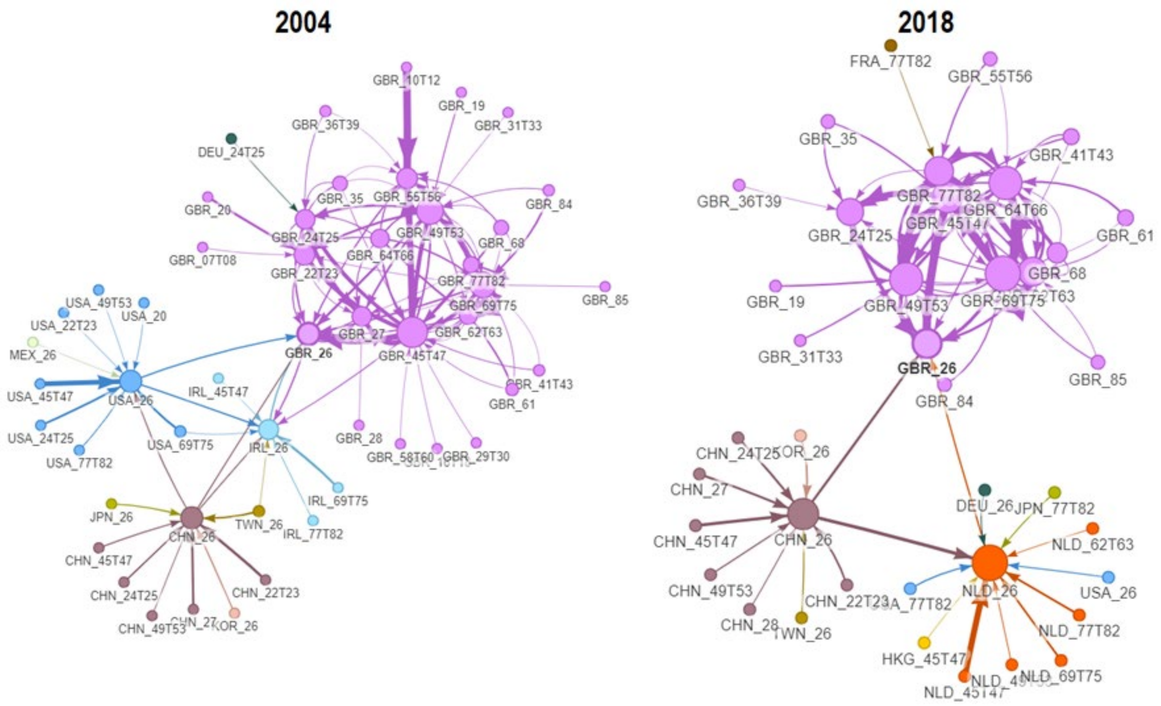
Note: This figure presents the country-industry pairs that make 2% or more of the inputs of the French computer, electronic and optical products industry, and the country-industry pairs that make 2% or more of the inputs of the suppliers of the French computer, electronic and optical products in the years 2004 (left panel) and 2018 (right panel).
Source: OECD ICIO Database.

Figure A A.4. Network of the German computer sector in 2004 and 2018



Note: This figure presents the country-industry pairs that make 2% or more of the inputs of the German computer, electronic and optical products industry, and the country-industry pairs that make 2% or more of the inputs of the suppliers of the German computer, electronic and optical products in the years 2004 (left panel) and 2018 (right panel).
Source: OECD ICIO Database.

Figure A A.5. Network of the British computer sector in 2004 and 2018



Note: This figure presents the country-industry pairs that make 2% or more of the inputs of the British computer, electronic and optical products industry, and the country-industry pairs that make 2% or more of the inputs of the suppliers of the British computer, electronic and optical products in the years 2004 (left panel) and 2018 (right panel).
Source: OECD ICIO Database.

Table A A.1. The effect of a shock to the computer sector on value added, gross output, employment and productivity of upstream industries, manufacturing (digital and non-digital together)

	Dep. Var.: Growth rate of	Value added	Gross output	Employment	Labour productivity
Horizon 1	Shock to computer sector	0.0981**	0.135**	0.0573**	0.0648**
		(0.0443)	(0.0537)	(0.0284)	(0.0316)
	Observations	2715	2479	2706	2261
	R-squared	0.608	0.650	0.248	0.477
Horizon 3	Shock to computer sector	0.0757*	0.0846	-0.0253	0.102**
		(0.0399)	(0.0512)	(0.0302)	(0.0396)
	Observations	2397	2187	2388	1979
	R-squared	0.742	0.726	0.527	0.727
Horizon 5	Shock to computer sector	0.122***	0.0995*	0.0170	0.113***
		(0.0464)	(0.0572)	(0.0379)	(0.0352)
	Observations	2077	1893	2068	1695
	R-squared	0.844	0.815	0.704	0.826

Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and OECD STAN Databases.

Table A A.2. The effect of a shock to the computer sector on value added, gross output, employment and productivity of upstream industries, non-digital services

	Dep. Var.: Growth rate of	Value added	Gross output	Employment	Labour productivity
Horizon 1	Shock to computer sector	0.0167**	0.0234*	0.00155	0.00260
		(0.00759)	(0.0136)	(0.00567)	(0.00581)
	Observations	1277	1164	1276	1175
	R-squared	0.749	0.775	0.220	0.576
Horizon 3	Shock to computer sector	0.00380	0.0106	-0.00370	6.61e-05
		(0.0113)	(0.0108)	(0.0101)	(0.0106)
	Observations	1129	1030	1128	1037
	R-squared	0.822	0.847	0.516	0.744
Horizon 5	Shock to computer sector	-0.00413	0.00366	0.00441	-0.00559
		(0.0125)	(0.0111)	(0.0119)	(0.0152)
	Observations	981	896	980	899
	R-squared	0.887	0.905	0.677	0.820

Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and OECD STAN Databases.

Table A A.3. The effect of a shock to the computer sector on value added, gross output, employment and productivity of upstream industries, digital services

	Dep. Var.: Growth rate of	Value added	Gross output	Employment	Labour productivity
Horizon 1	Shock to computer sector	0.0419***	0.0486**	0.0381	0.000470
		(0.0137)	(0.0200)	(0.0316)	(0.0265)
	Observations	964	852	960	902
	R-squared	0.739	0.748	0.273	0.391
Horizon 3	Shock to computer sector	0.0244	0.00815	-0.00274	0.0708***
		(0.0193)	(0.0274)	(0.0375)	(0.0213)
	Observations	852	756	848	794
	R-squared	0.857	0.822	0.605	0.686
Horizon 5	Shock to computer sector	0.0406*	0.0151	0.0184	0.109***
		(0.0207)	(0.0335)	(0.0406)	(0.0335)
	Observations	740	660	736	686
	R-squared	0.920	0.885	0.796	0.807

Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and OECD STAN Databases.

Table A A.4. The effect of a shock to the computer sector on dispersion, horizon 1

	Dep. Var.: Growth rate of	90-10 dispersion	90-50 dispersion	50-10 dispersion
Manufacturing	Shock to computer sector	0.375	0.355	0.198
		(0.343)	(0.292)	(0.289)
	Observations	2271	2271	2274
	R-squared	0.338	0.309	0.398
Non-digital services	Shock to computer sector	0.141*	0.196***	0.0458
		(0.0781)	(0.0700)	(0.0679)
	Observations	997	997	997
	R-squared	0.287	0.255	0.393
Digital services	Shock to computer sector	0.452**	0.328**	0.281
		(0.212)	(0.142)	(0.168)
	Observations	776	776	776
	R-squared	0.401	0.395	0.403

Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and OECD MultiProd Databases.

Table A A.5. The effect of a shock to the computer sector on concentration, horizon 1

	Dep. Var.:	Top decile GO share
Manufacturing	Shock to computer sector	0.921
		(0.726)
	Observations	1,429
	R-squared	0.283
Non-digital services	Shock to computer sector	-0.0334
		(0.107)
	Observations	591
	R-squared	0.234
Digital services	Shock to computer sector	-0.725***
		(0.121)
	Observations	550
	R-squared	0.297

Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and OECD MultiProd Databases.

Table A A.6. The effect of a shock to the computer sector on dynamic Olley and Pakes decomposition, horizon 1

	Dep. Var.:	Within	Covariance	Exit	Entry
Manufacturing	Shock to computer sector	-0.369	0.524*	0.276**	-0.308*
		(0.404)	(0.277)	(0.139)	(0.184)
	Observations	1775	1723	1753	1739
	R-squared	0.299	0.145	0.274	0.164
Non-digital services	Shock to computer sector	-0.120	0.136	0.00618	0.00301
		(0.107)	(0.142)	(0.0468)	(0.0728)
	Observations	810	809	810	809
	R-squared	0.259	0.191	0.489	0.363
Digital services	Shock to computer sector	-0.671***	-0.141	0.0165	-0.287
		(0.221)	(0.293)	(0.235)	(0.207)
	Observations	632	626	629	629
	R-squared	0.297	0.162	0.334	0.466

Note: Results of estimating the model from Equation 1 on data from the private sector of 16 OECD countries. Coefficients are standardised to ease the comparability across specifications. Robust standard errors in parentheses allow to display serial correlation at the country-sector and country-year levels. * p<0.1; ** p<0.05; *** p<0.001.
Source: OECD ICIO and OECD MultiProd Databases.

Annex B. Industry classification

Table A B.1. SNA A34 and A7 aggregations

SNA A34 aggregation based on ISIC Rev.4 classification	SNA A7 aggregation
01 to 03 Agriculture, forestry and fishing	Agriculture
05 to 09 Mining and quarrying	Manufacturing
10 to 12 Food products, beverages and tobacco	
13 to 15 Textiles, wearing apparel, leather and related products	
16 to 18 Wood and paper products, and printing	
19 Coke and refined petroleum products	*Excluded in all analyses*
20 Chemicals and chemical products	Manufacturing (continued)
21 Basic pharmaceutical products and pharmaceutical preparations	
22 to 23 Rubber and plastics products, and other non-metallic mineral products	
24 to 25 Basic metals and fabricated metal products, except machinery and equipment	
26 Computer, electronic and optical products	
27 Electrical equipment	
28 Machinery and equipment n.e.c.	
29 to 30 Transport equipment	
31 to 33 Furniture; other manufacturing; repair and installation of machinery and equipment	
35 Electricity, gas, steam and air conditioning supply	Utilities
36 to 39 Water supply; sewerage, waste management and remediation activities	
41 to 43 Construction	Construction
45 to 47 Wholesale and retail trade, repair of motor vehicles and motorcycles	Market services
49 to 53 Transportation and storage	
55 to 56 Accommodation and food service activities	
58 to 60 Publishing, audiovisual and broadcasting activities	
61 Telecommunications	
62 to 63 IT and other information services	
64 to 66 Financial and insurance activities	*Excluded in all analyses*
68 Real estate activities	Market services (continued)
69 to 75 Professional, scientific and technical activities	
77 to 82 Administrative and support service activities	
84 Public administration and defence	Non-market services
85 Education	
86 to 88 Human health and social work activities	
90 to 93 Arts, entertainment and recreation	
94 to 96 Other service activities	
97 to 98 Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	

Table A B.2. Digital and non-digital classification by SNA A7 aggregation

Manufacturing	Digital	26 Computer, electronic and optical products
		28 Machinery and equipment n.e.c.
		29 to 30 Transport equipment
	Non-digital	10 to 12 Food products, beverages and tobacco
		13 to 15 Textiles, wearing apparel, leather and related products
		16 to 18 Wood and paper products, and printing
		20 Chemicals and chemical products
		21 Basic pharmaceutical products and pharmaceutical preparations
		22 to 23 Rubber and plastics products, and other non-metallic mineral products
		24 to 25 Basic metals and fabricated metal products, except machinery and equipment
		27 Electrical equipment
		31 to 33 Furniture; other manufacturing; repair and installation of machinery and equipment
Services	Digital	61 Telecommunications
		62 to 63 IT and other information services
		69 to 75 Professional, scientific and technical activities
		77 to 82 Administrative and support service activities
	Non-digital	45 to 47 Wholesale and retail trade, repair of motor vehicles and motorcycles
		49 to 53 Transportation and storage
		55 to 56 Accommodation and food service activities
		58 to 60 Publishing, audiovisual and broadcasting activities
		68 Real estate activities

Source: Calvino et al. (2018[25]).