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Editors' Overview

The 44th issue of the *International Productivity Monitor* contains five articles: a review of the rise of pro-productivity institutions; a proposal for improved measures of output, input and productivity in the non-profit sector; a comparison of estimates of capital and total factor productivity growth across international databases; an analysis of productivity in West Asian Arab countries; and lessons from productivity research.

To address poor productivity performance, many OECD countries in recent years have established pro-productivity institutions. In particular, the EU in 2016 recommended that its members create productivity commissions to better understand productivity trends and develop policies to boost productivity growth. In the lead article of this issue, **Dirk Pilat** from The Productivity Institute and the Valencia Institute of Economic Research provides a comprehensive review of the analytical work and policy recommendations of pro-productivity institutions in 11 OECD countries.

Pilat concludes that the rise of pro-productivity institutions is consequential. This development is putting the productivity issue back on the policy agenda and adding to the global evidence base on productivity trends and policies. While there are differences regarding institutional set-up, composition, and degree of independence of the commissions, they are largely pursuing common objectives reflecting similarities in mandates and challenges, such as the global productivity slowdown, the effects of the pandemic, and digitalization. The institutions also concur on the main drivers of productivity, namely investment, human capital, R&D and innovation, digital transformation, and entrepreneurship and business dynamics.

The measurement of productivity in sectors where output is not marketed, such as the non-profit sector, has always been problematic. In the second article, **Josh Martin** from the Bank of England and the Economic Statistics Centre of Excellence and **Jon Franklin** from Pro Bono Economics develop a conceptual framework for the measurement of output, labour input and hence labour productivity in the Non-Profit Institutions Serving Households (NPISH) sector in the United Kingdom. The authors go beyond the standard national account boundaries and include volunteer workers as part of labour input.

The size of the NPISH sector in the UK has increased significantly from 3.3 to 4.4 per cent in two decades, and adjustments for volunteer labour made the sector another 1.5 percentage points larger in 2019. There has been little growth in labour productivity in the NPISH sector in the UK since 1997. But the measurement of output prices in the non-profit sector is difficult, resulting in considerable uncertainty regarding real gross value added and productivity trends.

Multifactor productivity (MFP) is a key productivity metric. Its measurement requires measures of capital stock and services and factor income shares. Yet compilers of MFP estimates use different methodologies and assumptions in constructing their MFP estimates. For example, estimates of MFP growth for Germany from 2000 to 2007 range from 0.1 to 1.1 per cent, a very large difference. In the third article, **Reitze Gouma** and **Robert Inklaar** from the University of Groningen examine estimates of MFP in the 2000-2007 period for 11 OECD countries using databases from four sources, the Penn World Tables, EUKLEMS, the OECD, and the Conference Board.

The authors attempt to explain the differences in MFP growth rates between estimates by harmonizing definitions related to capital services and asset stocks, and imposing common labour shares. Yet despite these harmonizations, substantial differences remain. The methodologies and definitions used for MFP measurement, unlike GDP, have not been standardized as part of the System of National Accounts. The authors recommend that consideration be given to doing so going forward.

Developing countries have generally experienced annual labour productivity growth of 2 per cent or more in recent decades. An exception to this trend are the West Asian Arab countries which have seen large declines in their level of labour productivity since 1982. In the fourth article, **Abdul Erumban** from the University of Groningen provides a comprehensive analysis of productivity developments in 12 West Asian Arab countries, the six countries that comprise the oil-rich Gulf Cooperation Council (GCC), namely, Saudi Arabia, Kuwait, Qatar, Bahrain, United Arab Emirates, and Oman and six non-GCC countries, Iraq, Syria, Lebanon, Yemen, Palestine and Jordan.

The sources of the poor productivity performance differ between the sets of countries. In the GCC countries, the importation of low-wage foreign labour, largely from South Asia, has resulted in many low-productivity jobs and reduced productivity through a composition effect. In the non-GCC countries, political turmoil has had a negative effect on productivity growth. The author concludes that the development of a vibrant private sector is needed to boost productivity growth in the region.

Martin Baily from the Brookings Institution has been a leading and influential productivity researcher for many decades. In the fifth and final article in the issue, he looks back over his career to highlight what he sees as the lessons learned. One key finding is the disproportionate contribution to productivity growth from a very small number of industries, in particular related to high-tech manufacturing. Baily's work with the McKinsey Global Institute on cross-country comparisons of industry productivity levels yielded many insights into the drivers of productivity growth, such as the importance of strong competitive intensity and the negative effects of regulation and trade restrictions. Drawing on the firm-level productivity studies, he notes that there has been a relationship between declining business dynamism and slower US productivity growth.

Despite advances in our understanding, much remains to be learned about the mysteries of productivity growth. Going forward, he recognizes the uncertainty about the future path of productivity growth, but nevertheless expresses a cautious optimism, in large part because of the potential for artificial intelligence to boost productivity.

The Rise of Pro-Productivity Institutions: A Review of Recent Developments

Dirk Pilat[1]

The Productivity Institute (TPI) and Valencia Institute of Economic Research (IVIE)

Abstract

This article reviews the recent analytical work and policy recommendations of eleven national productivity commissions, i.e. Australia, Belgium, Denmark, Finland, France, Germany, Ireland, the Netherlands, New Zealand, Portugal, and the United Kingdom. It finds several differences between the commissions as regards institutional set-up, composition, and degree of independence, amongst others. The commissions have much more in common in their analytical and policy work. This likely reflects common challenges, such as the slowdown in productivity and the COVID-19 crisis, as well as structural trends such as digitalization. It also reflects a shared understanding of the main drivers of productivity, notably investment, human capital, innovation, digitalization and creative destruction, and the policies affecting those drivers. The article also finds some areas that have not yet received much attention from commissions, such as the link between the environment and productivity or the relationship between productivity, wages, and inequality. The rise of productivity commissions across the OECD area provides a rich source of analysis and policy learning that should be drawn on by academics, policy makers and others interested in productivity.

The central role of productivity for economic performance has been recognised for many years. But it is only recently that many governments have decided to establish new institutions focused on providing policy advice related to the pur-

1 Research Fellow, The Productivity Institute (TPI) and Associate Researcher, Valencia Institute of Economic Research (IVIE). This article provides an overview of a large body of work by eleven productivity commissions. Out of necessity, this has required a selection among the work undertaken with only that considered most important covered in the article. In most cases, the review covers the annual productivity reports of European commissions between 2019 and 2022. For Australia and New Zealand, where no annual productivity reports are produced, the review covers key work on productivity conducted between 2017 and 2022. In some cases (e.g. Denmark, France, Germany and Portugal), the review draws partly on (official or non-official) translations of reports prepared in the national language. Comments by Bart van Ark on an early draft are highly appreciated, as are comments received from Andrew Sharpe, three anonymous referees, members of several national productivity commissions, and at seminars at The Productivity Institute, the Austrian Productivity Board, Arena Idé and the OECD. Any errors of substance or interpretation are mine. A longer version of the article with more detail is available in Pilat (2023). Email: dirk.pilat@manchester.ac.uk

2 For clarity, this article will use the term productivity commission to describe these institutions, although several of the institutions use the term productivity board or council.

suit of productivity growth, in the form of productivity commissions or boards.[2] Australia's Productivity Commission is the oldest of these pro-productivity institutions, officially created in 1998. From 2010 onwards, several other countries also established commissions, initially New Zealand (2010), Denmark (2012), Mexico (2013), Norway (2014) and Chile (2015).[3] Following a recommendation of the EU Council in September 2016, many EU countries have also established productivity commissions. Today, some 20 productivity commissions operate across the OECD and EU area.[4] Not all EU countries have established a commission, however. Among Eurozone countries, Austria only established a commission in 2022, while Estonia, Italy and Spain have not yet done so. Among non-Eurozone countries, only Denmark, Hungary and Sweden (as of April 2023) have thus far established a productivity commission.

While the work of most commissions started only recently, the work that is emerging points to many drivers and policies that are considered to affect productivity. This article reviews what the commissions have thus far explored in their work, on both the drivers of productivity and the policies that can strengthen it. It focuses on eleven countries that may provide helpful insights for the global debate on productivity, i.e. Australia, Belgium, Denmark, Finland, France, Germany, Ireland, the Netherlands, New Zealand, Portugal, and the United Kingdom (UK).

The article is organized as follows. The first section briefly frames the policy debate on productivity and the role of productivity commissions. Section 2 reviews what the various productivity commissions highlight as the main direct drivers of productivity and explores the policy issues related to those drivers. Section 3 discusses several indirect drivers and their policy implications. Section 4 summarizes and draws some conclusions.

The Role of Productivity Commissions

Broadly speaking, productivity commissions have been set up to highlight the importance of productivity for economic performance, to explore the drivers of productivity and to provide guidance to governments on policies that can strengthen productivity.[5] As noted by Banks (2015):

> "Policies that promote productivity can be difficult for governments to devise and even more difficult for them to successfully implement, given uneven political pressures and fragmented administrative structures. There is accordingly a strong case for establishing public institutions that not only help governments identify the right policies, but that can also

3 Of these five productivity commissions, those in Denmark (2012-2014), Mexico, and Norway (2014-2015) were short-lived. A new productivity commission was established in Denmark in 2019.

4 See Cavassini *et al.*(2022) and https://economy-finance.ec.europa.eu/economic-and-fiscal-governance/national-productivity-boards_en

5 Productivity-related institutions were also set up in a number of European countries in the context of the Marshall plan and were mostly aimed at providing technical advice to business on productivity. Several such institutions continue to operate in Asian countries, e.g. the Japan Productivity Centre.

counter one-sided political pressure against reform and help educate the community about what is at stake."

In practice, productivity commissions play a variety of roles, such as promoting understanding about productivity in the national policy debate; developing new evidence and analysis on productivity growth and its drivers; providing policy recommendations to government or other actors (e.g. stakeholders and parliaments); contributing to policy discussions, e.g. the COVID-19 crisis; or engaging in international discussions on productivity, e.g. at the EU or OECD level.

Their institutional set-up differs across countries, however, affecting the role they play. Recent OECD work (OECD, 2022; Cavassini*et al.* 2022) considers three elements in the work of productivity commissions, notably: a) their institutional set-up, including their resources and analytical independence; b) responsibilities and functions of the commission, including its expertise and analytical capacity; and c) outreach, including engagement with stakeholders, dissemination and influence on policy making. Moreover, the effectiveness of commissions does not only depend on these internal factors, but also on governments' commitment to support the commission, and its capacity to review and implement policy recommendations (OECD, 2022; Cavassini *et al.* 2022).

The eleven productivity commissions covered in this article differ considerably across countries (Table 1). Some commissions, like Australia and New Zealand, are well established and have a long history of work on productivity, although they both have a broader mission with productivity only part of their mandate. Both undertake relatively long and deep government-mandated productivity-related inquiries. However, Australia's five-year productivity reviews (Productivity Commission, 2017a; 2022a) or New Zealand's review of frontier firms (New Zealand Productivity Commission, 2021) are by some margin the most comprehensive reports covered in this article.

In EU countries, productivity commissions were established following the 2016 recommendation by the European Council. This set out several requirements, including an open-ended mandate; functional autonomy to prevent undue influence from government; procedures to nominate members based on experience and competence; adequate access to information; and capacity to communicate in public (European Commission (EC), 2022). These requirements are expected to be underpinned by national provisions. For example, the functional autonomy of the commissions is, in most cases, set out in domestic legislation (EC, 2022).

The recommendation includes a certain amount of flexibility, however including the type of institutional design (EC, 2022). In some EU countries, commissions were created building on long-standing economic or competitiveness councils that were given additional mandates, as in Denmark, Germany, and Ireland. In yet other EU countries, such as Belgium and France, the commissions were newly established, with a high level of independence enabling a role in both policy analysis and policy advice. And in a third group of EU countries, i.e. Finland, the Netherlands and Portugal, the commissions were closely linked to existing

Table 1: Overview of the Productivity Commissions Reviewed

Institution	Established	Type of Institution	Mission	Location
Australia Productivity Commission	1998	Standing inquiry body	Promoting productivity-enhancing reforms	Independent, reports to executive and Parliament
Belgium National Productivity Board	2019	Independent advisory body	Examine development of productivity and competitiveness	Independent structure, reports to trade unions and employer's organizations
Danish Economic Council	2017	Independent advisory body (multi-stakeholder)	To analyze productivity and competitiveness	Independent, provides advice to Danish policy makers
Finnish Productivity Board	2021	Independent expert body	Monitor productivity and competitiveness & conduct independent evaluations	Independent expert body linked to Ministry of Finance, reports to government
French National Productivity Council	2018	Independent advisory body of academic economists	Analyze productivity and competitiveness and policies that affect them	Independent, non-partisan advisory body reporting to the Prime Minister and Minister of Finance.
German Council of Economic Experts	2019	Independent academic advisory body	Analyze developments in the field of productivity and competitiveness	Independent, provides advice to German policymakers
Ireland National Competitiveness and Productivity Council	2018	Independent council established by government (multi-stakeholder)	Analyze policy and developments in the field of productivity and competitiveness	Independent council, reports to prime minister and government
Netherlands Productivity Board	2017	Independent economic research agency	Gain understanding of factors driving productivity growth	Independent agency, part of Ministry of Economic Affairs and Climate Policy
New Zealand Productivity Commission	2011	Standing inquiry body	Improved well-being, improved productivity	Independent, reports to Parliament
Portugal Productivity Council	2018	Joint temporary structure	Monitoring policies in the field of productivity and support discussion on the subject	Joint economic structure of Ministry of Finance and Ministry of Economy
UK Productivity Commission	2021	Independent body, established by NIESR and The Productivity Institute	Understand economic research related to productivity, provide policy advice, and develop policy recommendations	Body operating independently of government, working closely with policy makers

Source: National sources and Renda and Dougherty (2017), see also: https://economy-finance.ec.europa.eu/economic-and-fiscal-governance/national-productivity-boards_en for EU countries and Cavassini, et al, (2022).

government institutions and mainly provided analytical work.[6]

The UK Productivity Commission is the only commission of the eleven covered here that is not established by government and consequently works more independently from government. It is essentially a group of independent experts, mainly from academia and policy research institutions, who strive to develop ideas for a pro-productivity policy agenda while engaging in discussions with policy makers to determine policy opportunities and solutions. It is supported by a secretariat at the National Institute of Economic and Social Research (NIESR) and draws on funding provided by The Productivity Institute.

The variety in institutional arrangements shows that governments have taken different decisions on what the work of productivity commissions should entail and the advice they want to receive from these bodies. Consequently, the commissions have varying degrees of independence and links to government ministries and agencies, which may affect the nature of their work, and the advice provided. Moreover, the official reporting of the various commissions differs. Australia's and New Zealand's commissions also report to parliament, whereas most others only report to government. An interesting exception is Belgium's commission, that also reports to a council of trade unions and employer organizations.

An important difference can also be seen in the composition of the commissions. Some, as in France, Germany, and the UK, mainly consist of academics, although they may be supported by government officials, as in France. Others, as in Denmark and Ireland also include representatives from business and trade unions. And yet others are mainly composed of government officials, e.g. in the Netherlands. These differences may affect the analysis and policy advice that is emerging. For example, Ireland's analysis of specific business costs (see Section 4) may be related to the role that business plays in the commission.

The growing role of productivity commissions reflects the importance that many countries attach to productivity, and concerns about the sharp slowdown in productivity over the past decades. An extensive literature has emerged about explanations for the slowdown and the limited impact (thus far) of new technologies.[7] Several productivity commissions have undertaken their own work to identify factors that could be addressed through (national) policy action. Some of the commissions have also attempted to distinguish between structural and global factors affecting productivity and national factors. Structural and global factors might not easily be amenable by national policy action, e.g. the global slowdown in technological progress or the shift from manufacturing to services, while national factors, e.g. skills shortages, could potentially be addressed by national policies.

6 A useful overview of the work of EU commissions was recently prepared by the European Commission (EC, 2022). That article also provides further detail on the institutional arrangements of the EU national productivity commissions. Detail on several commissions in the OECD area is available in Cavassini *et al.* (2022).

7 See Goldin *et al.* (forthcoming) for a recent review of the literature.

Productivity is a complex phenomenon, driven by many factors and policies. To facilitate the discussion, this article distinguishes between two types of drivers of productivity and two areas of pro-productivity policy:

- **Direct drivers of productivity**. These correspond to the main production factors driving economic growth, i.e. a) investment and capital formation; b) human capital and skills; and c) technological progress, as driven by innovation, digitalization, and entrepreneurship. Pro-productivity policies in this area aim to influence these drivers, e.g. through investment policies, education and skills policies, innovation and digital policies, or policies related to entrepreneurship and business dynamics. Thus far, the bulk of the work of the commissions has been focused on these drivers and the related policies.
- **Indirect drivers of productivity.** These drivers and the related policies affect productivity indirectly, mainly by influencing markets and the incentives for firms to improve productivity growth e.g. through trade, competition, regulation, and industrial policies, but also as emerging from labour market pressures or resource and environmental constraints. Productivity commissions have explored a diverse range of issues in this area.

The Direct Drivers of Productivity

This section reviews what productivity commissions highlight as the direct drivers of productivity in their country and covers five drivers, i.e. investment in tangible and intangible capital; skills and human capital; R&D and innovation; digitalization; and entrepreneurship and business dynamics. It also explores the policy issues linked to those drivers.

Investment in Tangible and Intangible Capital [8]

Investment and capital formation are typically considered among the most important drivers of (labour) productivity and can also have spillover effects on multifactor productivity. Several productivity commissions have explored the slowdown in business investment in their country, including the role of macroeconomic policy. They have also examined the role of public investment, notably in infrastructure, that is often considered to have a catalytic effect on private investment and productivity.[9]

A first issue addressed by several boards is the overall decline in business investment, which is regarded as one of the main factors explaining the slowdown in productivity growth. Australia found that borrowing costs, availability of capital and profitability levels did not affect invest-

8 Intangible investment includes innovative property, computerised information, and economic competencies (Corrado *et al.* 2005). This section only discusses analysis and policy recommendations linked to aggregate investment in intangibles. The discussion linked to specific categories of intangible investment is covered in the sections on human capital and skills, innovation and R&D, and digitalization, respectively.

9 The role of foreign direct investment is explored in section 4

ment, but that the opportunity cost of capital, perceptions of risk, and market power enjoyed by firms were important (Productivity Commission, 2022a). Structural factors were considered to play a relatively limited role, although the shift from manufacturing to services might have increased the share of intangible investment. It underscored the need for deeper productivity-enhancing reforms to improve expected risk-adjusted returns.

Belgium noted that sound public finances were important, but that these should provide room for efficient public investment (National Productivity Board, 2020). It also noted the need to improve the efficiency of public spending, engage in public-private partnerships, and remain attractive to foreign direct investment.

Germany pointed to lagging investment in ICT and in complementary intangible assets such as software, data, and R&D (Sachverständigenrat, 2019). It noted the importance of a reliable business environment and a competitive tax system and suggested that fiscal policy should provide space for investment in public infrastructure and growth-promoting spending. It also called for a tax allowance for corporate equity, to help balance the privileged tax treatment for borrowed capital.

The Netherlands found that investments in intangible capital rose sharply as a share of GDP since the 1990s (CPB Netherlands Bureau for Economic Policy Analysis, 2021).

New Zealand found that its firms are typically capital-shallow (New Zealand Productivity Commission, 2021). It attributed this to the high cost of capital goods, a history of high long-term interest rates, and rapid population growth. Low returns to investment, low wages and access to low-cost immigrant labour also contributed.

Portugal found that changes in debt levels and labour market regulation had had a positive effect on aggregate investment, while uncertainty, financial constraints and the level of interest rates had a negative effect (Conselho para a Produtividade, 2021). It also found that firms still face strong financing constraints following the economic crisis, partly reflecting the small average size of firms in Portugal (Conselho para a Produtividade, 2019).

The United Kingdom noted that low levels of investment had contributed to the UK's poor productivity performance (NIESR, 2022), linking this to lack of growth finance; the overall business environment; economic uncertainty, e.g. linked to Brexit and the COVID crisis; and a labour market that may have favoured firms' increasing employment rather than engaging in new investments. It recommended a long-term infrastructure plan to catalyze private investment; reductions in the cost of capital driven by tax breaks; improvements in the tax environment; and faster growth in UK exports from new trade deals.

Despite its importance for aggregate investment, macroeconomic policy has not been a big topic for productivity commissions. Belgium noted the importance of growth and productivity for tax revenues, which in turn would allow for government spending in different areas and widen the range of political choices for government (National Productivity Board, 2019). Finland pointed to the influence of demand

and the business cycle on productivity, including changes in capacity utilization as well as demand shocks (Ministry of Finance, 2020).

Several commissions have examined the role of public investment, noting its importance for productivity and the agglomeration of activities (NIESR, 2022) and the possible catalytic effect it could have on private investment (National Productivity Board, 2020). Denmark pointed to the importance of cost-benefit analysis and noted that policy should consider all impacts of public investment (De Økonomiske Råd, 2020).

Ireland noted that austerity following the 2008 economic crisis had led to considerable infrastructure deficits (National Competitiveness Council, 2020). It recommended more spending, but also actions to improve the quality of spending (National Competitiveness and Productivity Council, 2022). It pointed to growing labour market pressures that affected the capacity to deliver on investments. It recommended more support for public bodies in evaluating, planning, and managing public investments; and suggested that regions and cities learn from best practice to maximize the efficiency of public spending. It also recommended a long-term perspective on infrastructure spending, and improvements in the planning code and the resourcing of planning authorities (National Competitiveness and Productivity Council, 2022).

Ireland also explored investment in housing, noting that affordable housing is important for competitiveness as it indirectly affects enterprises' costs, influences quality of life and the competitiveness of goods and services, and could affect the attractiveness of Ireland as a location for investment (National Competitiveness and Productivity Council, 2021).

Human Capital and Skills

Together with capital formation, human capital is typically considered among the most important drivers of productivity, not only through its direct contribution to productivity growth, but also because it is highly complementary to investment in fixed and intangible assets and to innovation and digitalization. For example, a French modelling study found that about half of the long-term slowdown in productivity growth in the country can be explained by a slowdown in the growth of human capital, noting the close links between human capital and other within-firm factors such as management, innovation, and digital technologies (Conseil National de Productivité, 2022). The slowdown was explained by slower growth of education levels as more young people completed upper secondary and tertiary education. It concluded that increasing the quality of education will now be the main lever for productivity growth. France's situation is typical of many advanced economies, with little scope for further expansion in educational achievement, and a growing focus on the quality of education, skills development and the allocation of skills across the economy.

Productivity commissions have explored a wide range of specific policy issues related to human capital, such as the role of education, including STEM education; skills formation and skills mismatch; the role of management; and the contribution of migration to productivity. Education systems and initial education levels are a first policy issue explored by productivity commissions. For secondary education, Australia recommended more diffusion of best teaching practices; better use of digital technologies and teacher's time; and greater scope for innovation (Productivity Commission, 2022a; Productivity Commission, 2022b). For tertiary education, it recommended improving incentives for providers to deliver courses adapted to changing skills needs and rebalancing funding to reflect these changing needs. It also recommended improvements in teaching quality; better adapted use of technology; continuous improvement; and actions to reduce non-completion rates. France noted that its schooling system is less successful in reducing socioeconomic inequalities than other countries (Conseil National de Productivité, 2021). Germany pointed to the need to improve equality of opportunity, noting that there is a strong correlation between children's education level and that of their parents (Sachverständigenrat, 2019). It pointed to the importance of early childhood education and greater flexibility in educational pathways. Portugal noted the great disparity in qualifications of the workforce as a factor limiting productivity growth (Conselho para a Produtividade, 2019).

Skills and life-long learning are a second key theme. Australia found that one in five Australians still have low basic skills, limiting opportunities (Productivity Commission, 2022a; 2022b). It noted that an adaptable skills system can be resilient to changing skills needs. Belgium argued for a comprehensive approach to life-long learning (National Productivity Board, 2020) and noted that the shortage of STEM, and in particular ICT-related skills, had an adverse effect on productivity (National Productivity Board, 2022).

France pointed to the mediocre level of skills compared with other European countries (Conseil National de Productivité, 2021) and noted that, until recently, there had been a lack of focus on lifelong learning and vocational training, and a lack of targeting on those who need skills the most, such as the unemployed and least qualified. It argued for a well-functioning and agile lifelong learning system, that can help meet demand for emerging skills. It also pointed to growing demand for highly cognitive skills and non-cognitive skills such as autonomy, management, and communication (Conseil National de Productivité, 2022). It recommended greater recognition of the role of soft skills in the transformation of the economy.

Ireland noted that it is doing well on ICT specialist skills and those with above basic digital skills but lags for those with basic digital skills (National Competitiveness and Productivity Council, 2021). It made recommendations related to the development of skills related to artificial intelligence (AI) and skills for the zero-carbon economy, and the delivery of a modern apprenticeship system (National Competitiveness and Productivity Council, 2022). The UK pointed to several challenges, including skills gaps; lack of high-quality training and participation in such training; gender gaps, e.g. in STEM skills; limited agility of the skills system; lack of incentives for upskilling and reskilling; and lack of good management practices

(NIESR, 2022). It also pointed to declining labour mobility between regions, which contributed to a growing skills mismatch between supply and demand.

Related to the question of skills is skills mismatch, which affects productivity by reducing within-firm productivity and affecting the efficiency of skills allocation across firms (McGowan and Andrews, 2015). Belgium found that the existing mismatch in skills risked becoming even wider because low-skilled people were hit the hardest by the COVID crisis (National Productivity Board, 2020). Moreover, it noted that the acceleration of digitalization due to the crisis was further changing skills needs. France also identified a significant mismatch between workers' skills and those required for their job (Conseil National de Productivité, 2019). Ireland pointed to key skills gaps and possible mismatch in the labour market (National Competitiveness and Productivity Council, 2022). Portugal pointed to skills mismatch as a labour market distortion of importance (Conselho para a Produtividade, 2021). It noted that the rise of telework following the COVID crisis could improve the mobility of work, expand access to talent and increase competition, but might benefit higher skilled workers most, thus potentially increasing inequality.

A relatively new issue that has gained attention in recent years is management skills, which play an important productivity enhancing role through their impact on organizational and work practices and the allocation of workforce skills within a firm (Criscuolo *et al.* 2021). Finland noted that the average quality of management in Finland is good but that the quality of management practices varies across the country (Ministry of Finance, 2020). France noted that its firms are less efficient in the human dimensions of management relative to their management strengths in production (Conseil National de Productivité, 2022).

Germany found it was doing relatively well in international rankings and noted that management skills were important for its "hidden champions", fast-growing SMEs with high market shares in specialized markets, and for firms adopting ICT (Sachverständigenrat, 2019). Ireland pointed to the challenge of management in the context of remote working, noting that managers, in particular those working in SMEs, often had not received adequate training to deal with new challenges, such as blended working arrangements of office and telework (National Competitiveness and Productivity Council, 2021). New Zealand found that many firms lack leadership skills (New Zealand Productivity Commission, 2021). It recommended a systematic approach to building and retaining talent. It also recommended the evaluation of existing programmes for building firm-level management and leadership skills. Portugal found that its schooling of managers is below the EU average, especially in small firms, affecting its adaptability to technological change and competition (Conselho para a Produtividade, 2019).

Several countries have explored the link between migration, skills, and productivity. Denmark noted that inflows of foreign labour can increase productivity by providing access to new knowledge, improving skills use, and encouraging reallocation (De Økonomiske Råd, 2022). Australia called for reforms to its skilled migration system, moving from restrictive shortage lists towards a system that would better enable employer-sponsored skills migration (Productivity Commission, 2022c). This would help it compete in global markets and help attract workers whose skills meet local demands. Denmark pointed to the need for better options for job mobility of sponsored migrants to improve matching skills to jobs. It explored policies proposed by the government to attract foreign labour and address labour shortages, including reduced thresholds for pay of foreign workers, an expanded list of persons eligible, and greater access to fast-track procedures (De Økonomiske Råd, 2022).

New Zealand noted that despite large inflows of immigrants over the past 10 years, it faces skills shortages, suggesting a skills mismatch between the supply of labour and business needs (New Zealand Productivity Commission, 2021). It recommended a government review of migration policy to assess its role and objectives. It also recommended working with industry to reduce reliance on seasonal migrant labour, and more empirical studies and evidence building to support policy making related to migration. It also argued that the relationship between productivity and immigration requires a balance of trade-offs (New Zealand Productivity Commission, 2022; Fabling *et al.* 2022). While migrants may increase the productive capacity of the economy in the long run, this may take time to bear results and require complementary investments. It recommended to improve the quality and transparency of immigration policy, instil long-term thinking in policy making and address the conflicting priorities.

Innovation, Research and Development

Innovation and technological progress are the third key driver of productivity in most economic theories of growth and in much empirical analysis. The work of productivity commissions has touched on several aspects, including the role of public and private investment in R&D and the role of public support; the role of technology and knowledge diffusion; and new forms of innovation policy.

Support policies for private R&D were examined by several countries. Belgium found that investment in R&D had increased since 2005, but that this was mainly due to a small number of large firms in a few industries (National Productivity Board, 2021). It attributed the increase in spending partly to partial tax exemptions on wages for R&D staff but noted that efficiency gains could be achieved by better aligning direct and indirect support (National Productivity Board, 2022). Denmark evaluated a proposed increase in the tax deduction for R&D and noted that more analysis would be needed (De Økonomiske Råd, 2019).

Finland found that R&D spending had been remarkably weak since 2009, mainly due to a strong decline in business spending, resulting from the collapse of the electronics industry, notably Nokia (Ministry of Finance, 2021a). It noted that direct public support through grants for cooperation may be more effective than R&D tax incentives (Ministry of Finance, 2021b). It also noted that a lack of high-productivity firms in Finland requires more attention to innovation, notably for more radical innovation projects (Ministry of Finance, 2021b).

France identified innovation as a factor that might help explain the more pronounced slowdown in productivity in France (Conseil National de Productivité, 2019). It pointed to relatively low private investment in R&D, and low efficiency of expenditure on R&D in France, including a lack of interaction between public and private research.

Germany found that business spending on innovation in is highly concentrated among large firms (Sachverständigenrat, 2020). It questioned whether the growing complexity of research and innovation might have pushed up the costs of innovation in Germany and at the global level, possibly affecting productivity growth (Sachverständigenrat, 2019). It recommended to improve incentives for SMEs to invest in innovation; expand the European Research Area; improve the diffusion of knowledge and technology; improve access to public sector data; better embed innovation criteria in public procurement; and increase the availability of private venture capital.

Ireland pointed to a decline in R&D intensity since 2012 (National Competitiveness and Productivity Council, 2021). It explored the release of a new research and innovation strategy and the establishment of an innovation funding agency (National Competitiveness and Productivity Council, 2022). New Zealand recommended that the government review the operation of the country's R&D tax incentive, identify and implement possible amendments; and consider supplementing the scheme with the use of grants (New Zealand Productivity Commission, 2021). Portugal noted that while investment in R&D has grown, much of this is concentrated in the public sector, with an insufficiently strong link to business (Conselho para a Produtividade, 2019). It found that the impacts of its system of R&D tax credits were strong and persistent and found no evidence of crowding out (Conselho para a Produtividade, 2021).

Australia focused on diffusion of knowledge across the economy rather than 'new-to-the-world' innovation (Productivity Commission, 2022d). It recommended policies to link Australian firms to foreign firms through trade and foreign direct investment; skills and migration policies, with a focus on transferable skills; and policies to improve information flows to firms. It also pointed to the importance of knowledge diffusion in non-market services but noted that innovation in these services is often slow, piecemeal, disorganized, and inconsistent across jurisdictions. Belgium noted that the transition to a knowledge-based economy has increased the barriers to diffusion and called attention to policies that can strengthen diffusion (National Productivity Board, 2022). It also called for more exploration of the topic. The UK pointed to knowledge hubs, collaboration, and open innovation for innovation performance (NIESR, 2022). It also pointed to a lack of technology diffusion from leaders to laggards, a lack of collaboration between business and universities, and a lack of absorptive capacity in many firms.

An in-depth exploration of innovation policy was undertaken by New Zealand. It noted how it is lagging other small advanced economies and argued that past attempts at focused innovation policy have lacked scale, resources, and durability to be effective (New Zealand Productivity Commission, 2021). Moreover, it noted that previous efforts have been based on government-driven processes, and not on design and governance involving multiple stakeholders. It recommended to build innovation capacities and linkages in the innovation system, review existing programmes, and develop a more focused innovation policy aimed at high potential areas to complement broader innovation policies. It recommended that government partner with stakeholders on a small number of areas to focus its efforts, conditional on matching resources from the private sector.

Digitalization

Issues related to the contribution of digitalization to productivity are an important theme in the work of several productivity commissions. This work has addressed the uptake and diffusion of digital technologies, but also relatively new topics in the productivity literature, such as the role of data as an asset and the potential contribution of telework to productivity.

Data is an intangible asset and considered to be of growing importance to firm performance, including in enabling big data analytics and artificial intelligence. Australia recommended to establish consumer rights over consumer's own data; the removal of barriers to the use of public data; adoption of a copyright law with fair use exceptions; and removal of the competition law exemption for intellectual property (Productivity Commission, 2017b). Germany found that the COVID-19 crisis had boosted demand for data-driven services (Sachverständigenrat, 2021). It pointed to several barriers to the development of a data economy, including a shortage of staff to develop digital innovations, and security concerns linked to the storage of sensitive information. It called for greater data access and sharing; more competition in the platform economy; stronger consumer protection; consideration of technological sovereignty; and more coordination linked to cyber security.

The uptake and use of advanced digital technologies for productivity was explored by many boards. Australia recognized the potential of these technologies to improve productivity (Productivity Commission, 2022e). It pointed to several barriers affecting the uptake of digital technologies, notably inadequate access to the Internet due to poor connectivity in regional and remote areas; lack of skills; limited awareness and uncertainty about benefits; as well as costs and legacy systems, that were considered a barrier for medium and large firms. It recommended new infrastructure funding arrangements to provide reliable Internet solutions for remote areas; further actions to meet skills needs, including skilled migration policies; and better coordination of digital-related policies to reduce overlap and uncertainty.

Belgium noted that it was important to take advantage of the momentum of the COVID-19 crisis to accelerate the digital transition by encouraging investment in these technologies and the necessary complementary investment in skills (such as digital and management skills), organizational innovation and management capacities, fast, secure and reliable broadband, a new digital culture, further progress on e-government, and regulation aligned with the digital economy (National Productivity Board, 2020). France noted that its lag in ICT adoption might help explain the slowdown in productivity in France (Conseil National de Productivité, 2019). It noted that this might be linked to management and organizational practices, rigidities in the labour market, and regulatory barriers in the product market. Germany noted that its delayed adoption of ICT and low levels of investment might explain the low productivity impacts of ICT in Germany thus far. It recommended greater investment in digital infrastructure, by addressing barriers such as long approval procedures; more teaching of digital skills and improvements in lifelong learning; and reforms to competition rules (Sachverständigenrat, 2019). Ireland pointed to a relatively low use of advanced digital technologies by business and argued for more certainty on the roll-out of the National Broadband Plan (National Competitiveness and Productivity Council, 2022).

The impact of remote working or telework on productivity was also explored by some commissions. France found that firms that increased telework in 2019 were on average more productive and had also been more resilient during the crisis. It concluded that teleworking is likely to have a varied impact on the attractiveness of jobs, working conditions, and the split between full and part-time work, with uncertain impacts on aggregate productivity (Conseil National de Productivité, 2022). Ireland noted that it might take time before the impacts of telework on productivity become apparent (National Competitiveness and Productivity Council, 2021). To help maximize the gains of teleworking for productivity, while minimizing the risks for workers, it recommended improvements in digital infrastructure, and in digital and managerial skills; new legislation on the right to request telework, as well as simpler rules to claim expenses linked to working from home. The UK also noted the potential for increased productivity from working from home (NIESR, 2022).

Entrepreneurship, Business Dynamics and Resource Allocation

While entrepreneurship and business dynamics have long been considered important drivers of productivity, work on this topic has only recently become part of the analytical toolbox of productivity commissions, thanks to greater access and availability of microdata. Key issues that have been considered are the contribution of entry, exit and firm growth to productivity; productivity convergence and divergence, and the contribution of resource allocation to aggregate productivity growth; and business dynamics following the COVID-19 crisis.

Entry, exit and firm growth are the first set of issues that have been explored by productivity commissions. Belgium pointed to a low rate of resource allocation, low rates of new firm creation, and the lowest rate of firm exit among EU countries as factors affecting productivity (National Productivity Board, 2019). It also found that many innovative start-ups struggle to reach a sufficient scale (National Productivity Board, 2021). Policy-wise, it noted the importance of favourable conditions for young innovative start-ups, including in helping them scale. It also recommended to remove exit barriers for unviable businesses (National Productivity Board, 2021).

Finland noted that lack of competition and business dynamics is not the cause of poor productivity growth in Finland (Ministry of Finance, 2022). It noted also that access to funding does not seem to be the main problem for SMEs and business dynamics (Ministry of Finance, 2021a), but that lack of skilled personnel and competent management are important factors. Moreover, while general funding was not a constraint, access to funding for R&D by young innovative firms was considered a factor. It pointed to several policies that can strengthen creative destruction, including innovation policies; competition policies to support the reallocation of resources; education and training policies to improve knowledge creation; and housing, regional and labour market policies to facilitate labour mobility (Ministry of Finance, 2020).

Germany found that slow population growth may be among the factors explaining its low start-up rate (Sachverständigenrat, 2019). It also pointed to growing market concentration. It pointed to regulation in the labour market and market access barriers in services sectors as areas where improvements might be possible. The Netherlands found that the churn of firms – the sum of entry and exit – had declined, mainly due to a declining entry rate from 2006 onwards (CPB Netherlands Bureau for Economic Policy Analysis, 2021). It also noted that the entry of new firms contributed positively to productivity growth in services, but that incumbents drove productivity growth in manufacturing.

On productivity divergence and resource allocation, Belgium found a growing divergence in productivity growth between leaders and laggards (National Productivity Board, 2019). It also found that the country did have several global productivity leaders. Finland found a high diversity of productivity among firms and found that it lacks high-productivity firms (Ministry of Finance, 2021b). It also noted that resource allocation is poor, with the most productive firms operating on too small a scale. Moreover, it found that resource allocation has worsened, with labour moving away from the most productive firms to the less productive ones. It also noted that firms had invested more in capital than could be expected and hired less workers than expected, noting that misallocation was a significant factor lowering productivity (Ministry of Finance, 2022). France found that the overall slowdown in productivity is more pronounced for firms at the frontier (Conseil National de Productivité, 2022). This could point to a slowdown in the overall rate of technological progress and affect the scope for technology diffusion (OECD, 2015). It also noted that the renewal of firms at the frontier has slowed down, which may point to reduced competitive pressures. The Netherlands found no evidence of productivity divergence between frontier and lagging firms (CPB Netherlands Bureau for Economic Policy Analysis, 2021). The UK noted that the UK's productivity problem is concentrated among the leading firms, rather than the laggards (NIESR, 2022). On resource allocation, it noted it was doing well compared to other OECD countries, with most resources going to the most productive firms.

While several commissions discussed the role of frontier firms for productivity, policies related to frontier firms were the focus of work in New Zealand, which found that productivity levels in frontier firms were considerably below those in other small advanced economies (New Zealand Productivity Commission, 2021). It also found that the gap between frontier and non-frontier firms did not change significantly between 2003 and 2016, in contrast with many European countries. This could indicate that technology diffusion has been relatively effective but could also reflect the relatively low productivity levels of frontier firms and low growth rates, making it easier for non-frontier firms to keep up. It noted that non-frontier firms in European countries benefited from productivity growth in frontier firms in other countries, unlike in New Zealand. This likely reflects its distant location, which acts as a barrier to the diffusion of tacit and non-codified technologies.

A third issue addressed by several commissions is business dynamics following the COVID-19 crisis. Denmark noted that the economic support packages that the government had introduced to address the COVID crisis risked entrenching the prevailing business structure by protecting unprofitable businesses that might have exited the market in the absence of COVID (De Økonomiske Råd, 2021) For future economic crisis situations, it recommended using more targeted schemes rather than general support schemes, as general schemes might weaken structural adjustment (De Økonomiske Råd, 2022). France pointed to a significant drop in bankruptcies as emergency measures ensured the survival of many firms (Conseil National de Productivité, 2021). It pointed to two key risks; a) bankruptcies of productive firms once these measures are lifted with possible knock-on effects; b) overprotection of unviable, "zombie" firms with possible impacts on resource reallocation. It called for better information to help target support, prepare the unwinding of emergency measures, and identify necessary debt reductions.

Germany found that the number of job losses and business closures during the COVID-19 crisis was lower than in previous recessions (Sachverständigenrat, 2021). It attributed this to support measures for firms, a short-term working scheme, and the suspension of the obligation to file for insolvency. It recommended to improve the efficiency of allocation mechanisms following the crisis by a range of reforms. Portugal noted the growing productivity divergence between sectors and firms linked to the COVID-19 crisis as the most productive firms and those investing most in intangible assets were better able to use new digital technologies (Conselho para a Produtividade, 2021). It noted that this could point to distortions related to the diffusion of knowledge and technologies. It also pointed to the experience of previous international crises as regards the emergence of so-called "zombie" firms (Conselho para a Produtividade, 2021).

Only a few commissions have paid specific attention to the productivity issues related to SMEs. Ireland pointed to opportunities for closer links between the multinational enterprise sector and domestic SMEs, for example through trade links, labour mobility, innovation cooperation and closer links with research institutions (National Competitiveness and Productivity Council, 2021).

Summary on Direct Drivers of Productivity

With a few gaps and some differences in emphasis, the eleven productivity commissions reviewed in this article have generally all analysed the role of investment, human capital, R&D and innovation, digital transformation, and entrepreneurship and business dynamics for productivity (Table 2). Drawing on that work, they have also explored a wide range of policy issues over the period covered by this review. Some of the issues reflect common challenges linked to international developments, e.g. the slowdown in productivity growth, or rapid digitalization spurred by the COVID crisis. Others reflect national contexts and specific domestic challenges. Many common elements can also be observed in the policy responses advocated by the commissions. A few points stand out in the work thus far:

- Considering its importance, productivity commissions have devoted relatively little attention to policies to address the slowdown in aggregate investment, possibly since they consider it a structural factor, not easily influenced by national policy. Moreover, only a few commissions have explored the role of macroeconomic policies and financial markets for investment. This may be linked to the mandate of commissions and institutional arrangements within countries. Only a few commissions have explored the broad policy settings related to intangible investment, e.g. linked to its financing, although many have examined specific areas of intangible investment, such as skills, R&D and data.
- Human capital and skills are the most widely explored drivers of productivity, including new issues such as management. Research by France's commission suggests that the role of human capital for productivity growth is much larger than suggested by growth accounting, possibly linked to the strong complementarities with investment. Several commissions point to lack of skills and skills mismatch as constraints on productivity growth.
- Innovation and technology are also explored by many commissions, with relatively standard policy advice emerging related to business support policies, innovation systems and advanced technology use. There has been relatively little attention thus far to new or emerging issues, such as the role of data and artificial intelligence for productivity, or, except for New Zealand, the role of more targeted (or mission-oriented) innovation policies. Most surprisingly given its prominence in the debate on productivity, only a few commissions, notably Australia and Belgium, have explored policies linked to technology diffusion.
- Although a relatively new issue, most commissions have explored several dimensions of business dynamics and

Table 2: Key Themes in the Work by Productivity Commissions on Direct Drivers of Productivity

	Investment	Human Capital and Skills	R&D and Innovation	Digitalization	Entrepreneurship & Business Dynamics
Australia	Macro Drivers of Business Investment, Structural Factors, Social Benefits	Foundational and Specific Skills, Lifelong Learning, School Productivity	New to the World Innovation versus Diffusion, Non-Market Services	Uptake Advanced Technologies Data Economy, Non-Market Property, Infrastucture	
Belgium	High-Quality Infrastructure, Digital & Green Transition and R&D, Public Budget, FDI	Skills Mismatch, Retaining Talent, Lifelong Learning, STEM Skills	R&D Concentration, Tax Credits, Innovation System, Diffusion	Digitalization and COVID, Complementary Investment, Just Transition	Firm Dynamics & COVID, Zombie Firms, Scaling, Productivity Divergence
Denmark	Public Infrastructure, Cost-Benefit Analysis, Targeted Support for SMEs	Relocation of Education & Training, Foreign Labour	R&D Tax Credits		COVID and Firm Dynamics, Support Schemes
Finland	Capital Intensity, Role Demand and Business Cycle	Structure Labour Force Management Skills	Incentives for Private R&D, Productivity of R&D, Radical Innovation		Creative Destruction, Growth SMEs, Resource Allocation, High-Productivity Firms
France		Quality of Education, Soft Skills, Management and Diversity, Inequalities, Skills Mismatch	Investment in R&D, Structural Factors, Efficiency of R&D, Public-Private Links	Telework and Productivity, Co-Investment in Digital Technology, ICT Diffusion	Business Dynamics & COVID, Unwinding Support, Productivity Divergence, Frontier Firms
Germany	Infrastructure, Intangibles, Fiscal Policy, Equity Finance	Lifelong Learning, Equality of Opportunity, Management Skills	Innovation System Concentration, Costs and Complexity of Innovation	Impact COVID, Data economy, Platforms, Cloud, Sovereignty, Digital Infrastructure	Firm Dynamics & COVID, Allocation, Support Policies, Market Access, Demography
Ireland	Digital, Transport & Energy Infrastructure, Housing, Planning	Digital and AI Skills, Green Skills, Management Skills, Skills Gaps & Mismatch	R&D Intensity, Innovation Strategy, Research and Innovation Funding Agency	Broadband Plan and Advanced Technology Use Telework and COVID	Domestic SMEs, links to MNEs and Research Institutions
Netherlands	Intangibles Digital Technologies			Digital Technologies	Business Dynamics Productivity Divergence
New Zealand	Capital Intensity, Macro Drivers of Investment	Talent, Management and Leadership, Immigration, Skills Mismatch	R&D Tax Credits, Procurement, Focused Innovation Policy		Frontier Firms, Productivity divergence, Technology Diffusion
Portugal	Investment Dynamics, Financial Constraints of Firms	Disparity in Qualifications Skills Mismatch, Entrepreneurial Skills	Collaboration, R&D Tax Credit Scheme, Innovation System, R&D Concentration	Digitalization and COVID, Technology Diffusion	Productivity divergence Zombie Firms, Resource allocation, Diffusion
United Kingdom	Investment Policies, Tax Breaks, Infrastructure Plan	Skills, Training Management, Skills Mismatch	Innovation, Diffusion, Collaboration, Centres of Excellence	Homeworking	Reallocation, Frontier firms, Labour Mobility

Source: Section 3 and reports of national productivity commissions. See Pilat (2023) and references for further detail.

acknowledge its importance for productivity. The link between business dynamics, competition and productivity has not yet been much explored. Except for New Zealand, most commissions have paid more attention to policies related to laggards than to policies that might boost productivity in frontier firms.

Indirect Drivers of Productivity

This section provides a brief overview of work on several key indirect drivers of productivity, i.e. trade and foreign direct investment; the business environment, competition, and regulation; structural features and industrial policy; regions and productivity; the role of energy and environmental factors; and the role of labour markets. As noted above, these drivers and the related policies affect productivity indirectly, by influencing the functioning of product, labour and financial markets and the resulting allocation of resources; by providing access to international markets, and by affecting firms' incentives to improve productivity.

Trade, FDI and Global Value Chains

Trade and foreign direct investment (FDI) are important drivers of productivity linked to foreign competition, specialization, technology diffusion, and economies of scale, amongst others.

Trade policy issues have not been discussed much by EU commissions, likely reflecting the EU's role in policy making in this area. Belgium and Germany advocated actions to strengthen Europe's position in global value chains, increase coordination at the European level and strengthen multilateralism (National Productivity Board, 2020; Sachverständigenrat, 2019). Germany's latest report recommended to reduce dependencies and increase resilience of global value chains by greater diversification (Sachverständigenrat, 2022). While it considered this mainly a responsibility for the private sector, it noted that government could provide targeted support for diversification, help develop strategic alliances and partnerships, and provide loan and investment guarantees. Australia argued for the removal of remaining tariffs to reduce costs for importing firms and advocated policies to draw greater benefits from trade in services (Productivity Commission, 2022a). The UK noted the constrained demand for UK exports (NIESR, 2022), pointing to the high costs of exports, with Brexit having increased the frictional costs of trade and supply side gaps.

On FDI, Australia argued for adjustments to its screening regime, in ensuring that these appropriately account for security concerns, but avoid disincentivizing investment (Productivity Commission, 2022a). France found that high labour costs, production and corporate taxes have held back the location of production sites, while the R&D tax credit system had a positive effect (Conseil National de Productivité, 2022). It suggested continuing to develop its tax system so that it weighs less on the factors of production than in other countries. New Zealand recommended a more proactive approach to attracting FDI by incorporating FDI policies within a focused innovation policy and by upgrading its innovation system (New Zealand Productivity Commission, 2021).

Business Environment, Competition and Regulation

The business environment is important for productivity with empirical research showing that sound competition is a positive factor for productivity growth, whereas too much or inappropriate regulation can hold back productivity growth.

Several commissions explored issues related to competition. Australia pointed to an increase in overall concentration in the economy; a decline in firm entry and exit; as well as an increase in mark-ups (Productivity Commission, 2022a). It noted that competition laws need to remain fit for purpose (Productivity Commission, 2022a; 2022f).

Denmark found that markups increased from 5 per cent above costs in 2000 to 18 percent in 2018, suggesting that competition had become weaker (De Økonomiske Råd, 2022). It found that firms increased their productivity and market share when they were given more opportunities to import semi-finished products or goods for resale. It also suggested that increased demand for exports may have increased firms' productivity and mark-ups, e.g. due to knowledge spillovers associated with trade. It found no evidence that firms benefiting most from new technologies had increased their market power, e.g. in benefiting from economies of scale in software development, or that regulation had become more anti-competitive.

Finland suggested that less effective competition policies may have contributed to a weakening of business dynamics (Ministry of Finance, 2021a). Germany argued for a strengthening of European competition policy with a focus on standardized regulation and lower barriers to entry (Sachverständigenrat, 2019). It also recommended not to promote or create national or European champions. Ireland explored high business costs in several services sectors and noted that enhancing domestic competition is essential to reduce costs and boost productivity (National Competitiveness and Productivity Council, 2021; 2022). The Netherlands found no evidence that average mark-ups had grown (CPB Netherlands Bureau of Economic Policy Analysis, 2021).

On regulations, New Zealand noted that these often do not keep pace with innovation, creating costly barriers to innovation and productivity (New Zealand Productivity Commission, 2021). It recommended prioritizing keeping regulations up to date with technological and other changes, notably in areas related to innovation, and that the design and operation of regulations should allow for flexibility in achieving the desired regulatory outcomes. Portugal noted that firms still face high administrative barriers, including complex licensing systems and slow judicial system (Conselho para a Produtividade, 2019). Moreover, despite progress, some professional services continued to face high barriers to entry, such as legal, accounting, architecture, and engineering services.

Structural Features and Industrial Policies

The structural dimension of productivity is a well-known theme in productivity analysis that has been explored by several productivity commissions, including the impact of the shift from manufacturing to services on productivity, and the role of industrial policies.

Several countries addressed issues related to their economic structure. Belgium found that production sources are shifting towards the least dynamic activities in terms of productivity (National Productivity Board, 2022). France noted that intra-sectoral dynamics are the main source of productivity, and that employment is shifting to sectors with higher productivity levels, but lower productivity growth (Conseil National de Productivité, 2022). The UK found that its productivity problems were mainly located in finance and manufacturing, although it noted that industrial structure was not the main challenge, but rather performance within sectors (NIESR, 2022).

Industrial policies were another focus. France suggested that policies to foster new activities, e.g. green innovation, could help develop high-growth sectors (Conseil National de Productivité, 2022). Germany noted that growing dependencies on supplies of energy and raw materials pose new challenges to its economic model (Sachverständigenrat, 2022). It recommended to increase European production capacities in strategically important areas, such as renewable energy and the domestic extraction of critical raw materials. It also recommended to strengthen strategic autonomy, including by stockpiling of strategic raw materials, and by supporting the EU concept of "open strategic autonomy". The UK noted that industrial policy had been affected by a short-term approach and argued for more effective institutional frameworks (NIESR, 2022).

Regional Dimensions of Productivity

Several productivity commissions have explored the regional dimensions of productivity, e.g. the role of cities and the contribution of different regions to aggregate productivity. Both Australia and Denmark focused on the role of cities. Australia noted that 80 per cent of its GDP is produced in cities and that Australia's eight capital cities represent over two-thirds of total employment. It made recommendations to strengthen the role of cities for productivity, e.g. governance arrangements for public infrastructure; reforms to improve road provision; the application of competition principles to land use policies; the implementation of best practice in development assessments; and the removal of stamp duties and the transition to a land tax (Productivity Commission, 2017a). Denmark also explored the impact of cities on productivity (De Økonomiske Råd, 2021), including the role of planning regulations and municipal taxes. It found that planning regulations that reduce space for businesses have implications for productivity in large cities and that the use of property is distorted by municipal taxes for infrastructure.

Some countries have explored the role of regions for productivity. Belgium undertook a regional diagnostic of productivity (National Productivity Board, 2022). France noted that it is the EU country with the highest concentration of productivity, with only one region (Île-de-France) having had productivity growth over 1 per cent annually (Conseil National de Productivité, 2022). The UK found that it is the most inter-regionally unequal major high-income country in the OECD (NIESR, 2022). It pointed to a wide range of complex and diverse factors explaining this inequality, including the allocation of human capital and investment across the economy, and outlined several possible policy priorities.

Energy, Green Transition, and Productivity

In recent years, some productivity commissions have also started exploring issues linked to energy, environment, climate change and the green transition and their link to productivity. Australia noted that climate change will have large impacts on productivity and that policies to contain climate change will entail costs. It recommended least-cost mitigation and adaptation policies to minimise risks (Productivity Commission, 2022a).

Belgium noted that the impacts of the transition to a low-carbon economy on labour productivity were somewhat ambiguous, but that climate change itself is a serious threat to productivity (National Productivity Board, 2022). It pointed to the energy crisis as another urgent reason to accelerate the transition and noted the importance of price signals and innovation.

Denmark explored policies to reduce greenhouse gas emissions by 70 per cenr by 2030 (De Økonomiske Råd, 2022). It noted that most of the policies are expected to be costly, as they are based on subsidies and other measures, rather than a uniform greenhouse tax. Germany noted its dependencies on energy and critical raw materials and set out policies to increase diversification and develop greater strategic autonomy (Sachverständigenrat, 2022). Ireland noted that well-designed environmental policies do not have large negative effects on the economy, but that the climate transition will generate winners and losers (National Competitiveness and Productivity Council, 2022). It noted that it is therefore vital that adequate supports are in place to assist enterprises and displaced workers adjust to the changes.

New Zealand argued for a strong and long-term commitment to the transition and transparency about policies (New Zealand Productivity Commission, 2018a). It recommended the use of emissions pricing to send the right signals for investment, innovation, and mitigation. It also recommended to devote more resources to low-emissions research, and to the deployment of low-emissions innovations, combined with other supportive regulations and policies.

Labour Markets and Productivity

Besides human capital, several commissions have explored the link between labour markets and productivity, including labour force participation and mobility and labour market regulation.[10] Australia noted that a well-functioning labour market is critical to productivity by matching jobs to people with appropriate skills (Productivity Com-

10 Issues related to migration policies, skills and productivity were already addressed in section 2.

mission, 2022c).

A first issue addressed by several commissions is labour force participation, even though this has uncertain impacts on productivity. Germany pointed to actions to leverage untapped labour market potential to increase the trend growth rate (Sachverständigenrat, 2019). This includes bringing more people into the labour market, notably women and older workers, reducing long-term unemployment, encouraging the immigration of skilled workers, reform of the tax system to increase incentives for those not currently in employment, and a more flexible retirement age. Ireland pointed to tighter labour market conditions that were leading to skill shortages and made several recommendations to increase labour market participation among under-represented groups, such as women, older workers and the disabled, as well as further actions to bring “returnees” back into the labour market (National Competitiveness and Productivity Council, 2022).

Australia and Portugal both looked at industrial relations and labour market regulation. Australia pointed to the relevance of its workplace relation system to productivity, noting that employers and employees should – in principle - have strongly aligned interests in improving productivity to increase both profits and wages (Productivity Commission, 2022c). It recommended further simplification of its award system to improve the flexibility of employment conditions, better meet employer and employee needs, and reduce compliance costs in starting new businesses (Productivity Commission, 2022c). It also argued for reforms to the enterprise bargaining system, which it considered unnecessarily complex, noting this could improve resource allocation and innovation. Portugal noted that the Portuguese labour market has a very high level of segmentation, with groups of workers covered by very different levels of employment protection (Conselho para a Produtividade, 2019). This is likely to affect mobility and incentives for training, and ultimately wages and productivity.

Labour market mobility is another theme addressed by some commissions. Finland argued that improvements in the mobility of the labour force, including the immigration of skilled employees, can promote better resource allocation (Ministry of Finance, 2021b). It noted that regulations affecting the labour market should be considered with this perspective in mind. The UK pointed to lack of labour mobility as a factor affecting productivity (NIESR, 2022).

Governance, Health and Productivity Measurement

Beyond the themes discussed above, that reflect mainstream issues in the debate on productivity and its drivers, productivity commissions have explored some additional issues, including the role of government, health and measurement.

Australia noted the need for more effective governments in the context of productivity-enhancing reforms and made extensive recommendations (Productivity Commission, 2017a). New Zealand argued that state sector productivity is a key contribution from government to overall productivity and well-being (New Zealand Productivity Commission, 2018b). The UK explored the role of governance, noting this not only concerns the respective roles of national and local governments, but also the level of "policy churn" (NIESR, 2022).

Australia also explored the performance of the health sector, noting that people in poor health are less likely to be employed, tend to be less productive and work shorter hours. The UK also stressed the role of health, notably mental health, for productivity (NIESR, 2022).

Several productivity commissions explored measurement issues linked to productivity. Belgium discussed benchmark revisions in the national accounts (National Productivity Board, 2020). Denmark included new measures of productivity in the primary and lower secondary school sector (De Økonomiske Råd, 2019). Ireland recognised the importance of better evidence for productivity-related policies and recommended further research (National Competitiveness and Productivity Council, 2021). The UK also discussed measurement issues (NIESR, 2022).

Summary on Indirect Drivers of Productivity

The overview of work on indirect drivers shows that productivity commissions are tackling a wide range of issues in their work. Compared with the analysis of direct drivers of productivity discussed in the second section, there is greater variety in the work of the productivity commissions on indirect drivers, however. Some themes, such as trade and investment and the business environment, including competition and regulation have been explored by several commissions (Table 3). Others, such as structural factors and industrial policy, and the regional dimensions of productivity have been explored by far fewer.

Differences in mandates and institutional arrangements at the national level may affect this variety, for example the extent to which commissions are expected to examine the regional dimensions of productivity or only national drivers and policies, or the role of productivity commissions relative to other national authorities, e.g. competition commissions. Recent work by some commissions on complex and emerging issues such as climate change, value chain resilience and strategic dependencies suggests that several commissions do not take a narrow view of their mandate and are willing and able to tackle a wide variety of factors that may affect productivity.

Main Findings and Conclusions

The rapid rise in the number of productivity commissions across the OECD area – from five in 2014 to 21 today – is helping to put productivity (back) on the policy agenda and is adding to the global evidence base on productivity and pro-productivity policies. While there is considerable variation in institutional arrangements, composition and focus on analysis or policy advice, the commissions broadly appear to pursue a common agenda. This likely reflects similarities in mandates (Table 1); common challenges, such as the global slowdown in productivity and the recent COVID-19 crisis; broader underlying trends affecting productivity such as digitalization and structural change; as well as a shared understanding of the main drivers of productivity.

Most of the analytical work undertaken

Table 3: Key Themes in the Work by Productivity Commissions on Indirect Drivers of Productivity

	Trade, FDI, value chains	Business environment	Structural issues	Regional dimensions	Energy, green transition	Labour markets	Other issues
Australia	Trade in Services, FDI Screening, Tariffs	Concentration, Competition and Consumer Laws		Cities, Planning, Infrastructure, Governance, Tax	Carbon Pricing, Tradeable Permits, Impacts Productivity	Reform Migration, Mobility, Workplace Bargaining System	Health Sector; Effective Government
Belgium	GVCs, Growth Markets		Sectoral Shifts	Regional Diagnostic	Climate Change & Productivity, Energy		Measurement of Productivity
Denmark		Competition, Mark-ups, Regulation	Review Support Policies, Targeting	Cities, Planning Rules, Tax Policies	Carbon Taxes, Tax Reform, Other GHGs	Foreign Labour	Measurement of Productivity
Finland		Competition, Regulatory Policies				Mobility, Regulations, Immigration	
France	Attractiveness FDI, Location Factors, Tax Policies		Sectoral Shifts, Industrial Policies	Regional Concentration of Productivity			
Germany	GVC Resilience, Dependencies, Trade Distortions	European Competition Policy	Open Strategic Autonomy, EU Production		Renewable Energy and Critical Raw Materials	Labour Market Participation, Immigration	
Ireland		Cost Factors and Domestic Competition			Interaction Climate & Competitiveness, Support Policies	Labour Market Participation, Role of Returnees, Migration	Evidence for Productivity Analysis
Netherlands		Mark-ups					
New Zealand	Market Size, Distance, FDI Attractiveness	Innovation-Enabling Regulation, Data Rights			Emissions Pricing, Innovation and Regulatory Policies	Review Immigration Policies	Public Sector Productivity
Portugal		Regulation, Costs, Competition, Barriers to Entry				Labour Market Segmentation, Incentives Training	
United Kingdom	Trade, FDI, & Ownership, Export Demand		Structure & Sectors, Firm Size, Industrial Policies	Inter-Regional Gaps, Levelling Up, Governance		Reallocation & Labour Mobility	Governance, Health, Measurement

Source: Section 4 and reports from national productivity commissions, see Pilat (2023) and references for further detail.

by the productivity commissions follows relatively standard methodologies, such as trend and industry analysis, growth accounting and economic modelling (Pilat, 2023). However, most commissions have now moved beyond aggregate and sectoral-level data to micro data and are also examining the role of firm dynamics and reallocation, and the productivity divergence between leaders and laggards. Stronger cooperation between the productivity commissions in this analytical work, e.g. in the context of the EU or the OECD, or in bilateral or multilateral arrangements, would be valuable.

While most commissions have only limited resources for research, some interesting findings are emerging, e.g. research from France on the role of human capital in explaining the productivity slowdown, or from New Zealand on the role of frontier firms. Some central questions in the productivity debate have received relatively little attention in the analytical work, however, such as the slowdown in aggregate investment or in technology diffusion.

Most commissions address all five of the direct drivers of productivity in their work, i.e. investment, human capital, innovation, digitalization, and business dynamics, although with differences in their precise focus. The similarities in this aspect of their work are not surprising, as these five drivers largely determine the contributions of fixed and intangible capital, human capital, and multifactor productivity to aggregate growth performance. Consequently, many commissions also cover the main policy issues related to these drivers in their work. There are interesting differences in the work on these drivers as well, however. For example, some countries (e.g. Germany) have explored several specific issues linked to digitalization, such as the role of data, whereas others have only engaged in a general exploration of the topic. And while many countries have explored policies related to lagging firms, others, such as New Zealand have also explored the role of frontier firms for productivity.

There is much greater variation in the work of the commissions on the indirect drivers of productivity and the related policy issues. While some issues, such as trade and FDI policies; business, competition, and regulation policies; and labour market policies have been addressed by several commissions, far fewer have explored industrial and regional policies, for example. Differences in (perceived) mandates may play a role here, for example the extent to which commissions are expected to examine the regional dimensions of productivity or only national drivers and policies. Institutional arrangements at the national level may play a role too, e.g. the role of productivity commissions relative to other national authorities, e.g. competition commissions or monetary and financial markets authorities. Moreover, most productivity commissions from EU countries have only explored some dimensions of trade, presumably since the main responsibility for trade policies rests with the European Union, not with national EU governments.

Some commissions also respond to national crisis situations as part of their work. Following the start of the COVID-19 crisis, many commissions have undertaken work to examine its impact on productivity through channels such as telework and firm dynamics, and some (e.g. Belgium, Denmark, France, and Germany) have also played a role in examining COVID support schemes or recovery packages.

Many of the policy recommendations emerging from the commissions reflect the results of long-standing work on productivity and structural reform. At the same time, and as shown by Tables 2 and 3, there is considerable variety in the analysis and policy advice of the commissions, suggesting that national policies for productivity are not "one-size-fits-all".

New policy questions linked to productivity, such as the rationale for a more focused or targeted innovation policy (New Zealand); resilience and strategic dependencies (Germany); or policies linked to data and artificial intelligence (Australia, Germany, Ireland) are now starting to be tackled by some commissions. This shows that many commissions have gone considerably beyond the "Washington consensus" (Williamson, 2004), and do see a clear role for government in strengthening productivity.

The wide range of issues covered also suggests that many commissions do not take a narrow view of their mandate and are willing and able to tackle a wide variety of factors that may affect productivity. In taking on such a wide range of issues, questions of policy coordination across different parts of government emerge, however. Except for the UK, this is not an issue that has been addressed in much detail by productivity commissions in their productivity reports.

While the commissions have already tackled many issues, there are also several important issues that have not yet received much attention in their work, notably:

- *The impacts of climate change on productivity*, and more generally the link between productivity and sustainability. The bulk of the work thus far has focused on exploring the productivity of labour and capital and their joint (multifactor) productivity rather than on other relevant productivity measures, such as resource productivity, or measures of productivity adjusted for environmental impact (Rodríguez *et al.* 2018). Some commissions, such as Belgium and Ireland, have started to reflect on these issues in their latest reports. Given the large impact that climate change is likely to have on productivity, this is an important gap in the work of several productivity commissions.
- *The role of intermediate inputs for productivity.* Apart from some work by France in their latest report (Conseil National de Productivité, 2022), few commissions have taken a so-called KLEMS perspective on productivity, accounting not only for capital (K) and labour (L), but also for the role of intermediate inputs, i.e. energy (E), materials (M) and services (S). Growing concerns about supply chains and the availability of intermediate inputs (energy and critical raw materials in particular) is starting to lead to some work on this topic, notably in Germany's latest report (Sachverständigenrat, 2022), which explored the country's dependencies on energy and raw materials.
- *Wages, inequality, well-being, and productivity.* Most productivity commissions have focused on the con-

tribution of productivity to growth and have not yet examined how the benefits of productivity are diffused to workers and across the economy, and how productivity growth relates to inequality and inclusive growth (see e.g. Berlingieri *et al.* 2017; OECD, 2021). Only a few commissions, such as New Zealand and Chile have gone beyond GDP in considering well-being or broader indicators of economic and social performance. Some of the recently established commissions, such as Austria, are starting to go beyond GDP in their work, however. As with climate change, this is an important gap in the work of several commissions, given the growing focus on well-being and more inclusive growth in the international policy debate.

- *Productivity of the public sector and its impact on aggregate productivity.* While this topic has been addressed in Australia and New Zealand, and is noted by the UK, productivity commissions in the EU have not yet focused much of their work on this issue.

Despite the many similarities, it is not always clear how the commissions set their agenda. In Australia and New Zealand, the topics for inquiries related to productivity are largely set by the government, although both commissions also engage in their own research. However, in European countries, the commissions are – in principle – functionally autonomous from government and can set their own agenda within their mandate. In some EU countries, like Finland, France, and Portugal, the first reports produced in 2019 or 2020 established an empirical underpinning for further analysis and subsequent reports deepened the analysis and policy reflections. Political considerations do influence agenda setting, however, as commissions are expected to respond to emerging policy issues and political realities. For example, Belgium's Central Economic Council provides suggestions for future topics that could be addressed by Belgium's National Productivity Board (National Productivity Board, 2022). Moreover, the composition of the commissions – academic, government or multi-stakeholder – may also play a role in the topics that are being explored.

A question that cannot be easily answered through this review of national productivity reports is the impact that the commissions have on the national productivity debate, on policy development and implementation, and ultimately on productivity growth. Some commissions, such as the Australian Productivity Commission, reflect on the impact of their work in their annual report (Productivity Commission, 2022g). This report noted that the direct impact of its work on policy development is complicated to assess, as it is only one contribution to a policy outcome. However, Banks (2015) notes that the Australian government have accepted and implemented many of the recommendations by the Australian Productivity Commission in the past, notably in the areas of industry assistance and economic policy, with a more mixed record on social and environmental policy. Banks also notes the high economic benefits of the resulting reforms, e.g. in terms of higher productivity and lower prices. New Zealand's commission notes that "the influence of our work may only emerge over long timeframes, and it may be challenging to directly identify and attribute it to our work" (New Zealand Productivity Commission, 2023).

The commissions in Europe do not appear to assess their impact in a formal and public way, although several note their role in stimulating public debate on productivity, with Germany's commission noting its "significant influence on the political decision-making process" (Sachverständigenrat, 2023). In Ireland, however, the government publishes a formal response to the recommendations by the national commission in its annual report (Government of Ireland, 2022). More generally in the EU, according to the European Commission, commissions "with higher visibility are those based on an existing institution that during the years has managed to build up a good reputation among policymakers and the public at large" (EC, 2022). Moreover, according to Cavassini *et al.* (2022), "focusing on long-term challenges can enhance the institutions' influence and credibility".

Not all commissions provide specific policy advice, however, making the impact of their work on policy particularly difficult to assess. Outside the commissions examined in this article, Chile's productivity commission provides an interesting example, as it regularly measures the implementation of its recommendations on national policy in its annual productivity report (Comisión Nacional de Productividad, 2019; 2020). Further analysis on the impact of the commissions on policy development would be valuable.

Policies for productivity are not only complex, but also wide-ranging, which means there remains much work ahead for commissions to further disentangle the drivers of productivity and the policy levers that can be used to strengthen productivity and diffuse its benefits. The current experimentation by more than 20 commissions across the OECD – in a variety of institutional arrangements – with analysis and policy advice on productivity is a new and important source of policy learning that should be drawn on in full by academic research and policy analysis. Cooperation between the commissions in various international settings and engagement with the academic community and stakeholders can play an important role.

This article suggests that productivity commissions are playing an important role in putting productivity back on the policy agenda and providing new evidence and policy advice. Countries that have not yet established their own commission may therefore wish to set one up to benefit from this new source of policy learning on productivity. Moreover, such countries may wish to draw on lessons learned in establishing such institutions, e.g. in ensuring their analytical independence and in providing access to all the necessary data to inform proposed policies and interventions with sound evidence (Banks, 2015; Cavassini, et.al., 2022).

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Fuller Measures of Output, Input and Productivity in the Non-Profit Sector: A Proof of Concept for the United Kingdom

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Abstract

We explore the appropriate conceptual framework for thinking about the output and productivity of the non-profit sector, and sketch a roadmap for measuring the productivity of this sector. Doing so requires us to go beyond the National Accounts, since some inputs to the non-profit sector (such as volunteer time) are outside the GDP boundary. Using a range of publicly available data we estimate new input and output measures for the Non-Profit Institutions Serving Households (NPISH) sector in the UK, and from these estimate labour productivity levels and growth. We find that the NPISH sector in the UK has grown rapidly over the past 20 years, with hours worked and nominal GVA growing faster than for the economy as a whole. Our fuller measures suggest NPISH accounts for about 4.4 percent of GDP in 2019, up from 3.3 percent two decades before, and compared with 2.9 per cent in 2019 before conceptual adjustments. The NPISH sector is less productive than the UK average, although similar to other labour-intensive industries like retail. We estimate little growth in labour productivity between 1997 and 2019, although price measurement in the relevant industries is difficult, so there is considerable uncertainty around our estimates of real GVA and productivity growth.

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Whether it is through interventions to support the homeless, providing mental health care for children, or funding research into life-threatening diseases, the non-profit sector (also often described as the "third sector" or "social sector") plays an important role in tackling some of the most complex problems that our society faces. And yet, we know relatively little about it compared to many other parts of our society. In the UK, and many other countries, we do not know the scale of its economic contribution, how efficiently it uses the resources provided to it by funders or, importantly, whether it is getting more effective at tackling these problems over time.

In other parts of the economy we use measures of productivity to understand improvements in the efficiency of sectors and industries over time. However, such measures are challenging both conceptually and practically for the non-profit sector. Understanding both the level and the growth of productivity of the non-profit sector, relative to other sectors of the economy, would allow better assessment of the needs for, and effectiveness of, additional investment in the sector.

At present, we cannot readily answer questions about the size, growth or productivity of the non-profit sector in the UK, since reliable measures of the output and inputs of the sector do not exist. This is for many reasons, including definitional and conceptual challenges, data deficiency, and inattention in statistical circles. We aim to address some of these issues in this article, by presenting a new framework for thinking about the output of the non-profit sector in National Accounting terms, assembling publicly-available data for the UK into this framework, and presenting initial results.

The activity of many non-profit bodies falls within the Non-Profit Institutions Serving Households (NPISH) sector of the National Accounts. In the UK, NPISH comprises most higher education establishments (including universities), charities, and a range of other non-profit bodies. As measured, it accounts for about 3 per cent of UK Gross Value Added (GVA) in 2019, although as we demonstrate, this is an underestimate of its true value.

Like the government sector, the output of the NPISH sector cannot be measured by market transactions, since there are not economically significant prices.[2] Thus, productivity cannot easily be measured either. This has been partially overcome for the public sector based on recommendations in the 'Atkinson Review' (Atkinson, 2005), but little attention has been paid to similar challenges measuring the output of the NPISH sector. As such, the measure of the NPISH sector in the National Accounts is, we believe, an incomplete measure of the sector.

2 Non-market producers provide all or most of their output to others free of charge or at prices that are not economically significant. Economically significant prices are prices which have a substantial influence on the amounts of products producers are willing to supply and on the amounts of products that purchasers wish to acquire. It is the criterion that is used to classify output and producers as market or non-market, thus deciding whether an institutional unit in which government has a controlling interest is to be designated as a non-market producer and so classified in the general government sector, or as a market producer and so classified as a public corporation (ESA 2010, 20.19).

Work by the Johns Hopkins Center for Civil Society Studies as part of their Comparative Nonprofit Sector Project helped to develop the conceptual and practical underpinnings for better measurement of the non-profit sector in some countries. Their work, alongside researchers from several countries, led to the development of a UN Handbook on Non-Profit Institutions. The latest version, published in 2018, is entitled the *Handbook of National Accounting: Satellite Account on Non-profit and Related Institutions and Volunteer Work* (United Nations, 2018). Countries as diverse as the United States, New Zealand, and Mozambique have produced satellite accounts following this Handbook, although few countries publish updates routinely. Valuation of unpaid household service work, including informal volunteering, is under discussion as part of the update of the System of National Accounts currently under international discussion, although this explicitly excludes discussion of formal volunteering.[3]

The UK has not, as of 2023, produced such a satellite account, but UK Government has committed that "DCMS [Department for Culture, Media and Sport] will work with the Office for National Statistics (ONS) to bring together economic data on the value of the social economy – a civil society 'satellite account'" (DCMS, 2022). DCMS commissioned a study into the feasibility of a satellite account for "civil society" in late 2022. Sector advocates ThinkNPC conducted research into the use cases for a civil society satellite account for the UK, including interviews with sector participants (French and Davies, 2023). Stakeholders argued that the mere existence of such data would put the sector on equal footing with the rest of the economy, strengthen their bargaining position for resources, inform analysis of the sector, and enable monitoring of the health of the sector. Kenley (2021) makes similar arguments.

This article makes an initial stride towards such a satellite account, but with a focus on productivity. We use a narrower definition of the non-profit sector, using data only for the NPISH sector for practical reasons. We do not attempt to construct a full satellite account, instead limiting our focus to the measurement of GVA (in nominal and real terms) and hours worked in order to describe trends in the level and growth of labour productivity of the sector. We make amendments and additions to standard measures, such that our estimates go 'Beyond GDP' and are inconsistent with current National Accounting rules. Our adjustments also go beyond the recommendations of the aforementioned UN Handbook in a conceptual sense, which we believe better reflects the true value of the non-profit sector. All data and estimates in this article are for the UK, using a range of official data sources, principally from the UK Office for National Statistics (ONS).

The article proceeds as follows: section 1 defines the non-profit sector for the purposes of this article, and sets out the conceptual framework; section 2 describes the

3 Known as "Towards the 2025 SNA". Discussion on unpaid household service work, including informal volunteering, is discussed in guidance note WS.3, part of the Well-being and sustainability theme. More information from: https://unstats.un.org/unsd/nationalaccount/towards2025.asp

data and methods used; section 3 presents the results of a proof of concept set of estimates for inputs, output and labour productivity of the non-profit sector; and section 4 concludes.

Conceptual Framework

In this section we first address definitional issues, then set out the conceptual framework for inputs and output, before providing a summary and describing some unresolved issues.

How Do We Define the Non-profit Sector?

The data, methods and approach in this article are rooted in the National Accounts, which are the internationally recognised way to compile statistics of the economy. While this has its limitations, including many that impinge on the accurate measurement of the non-profit sector, it is nonetheless a useful starting point for this article given its central position in most economic statistics. We will have to go 'beyond the National Accounts' in a number of places through this article.

The National Accounts define five main institutional sectors, which reflect differences in ownership and funding.[4] One of these is the Non-Profit Institutions Serving Households (NPISH) sector, which is for economics units that are non-market operators (earn less than 50 per cent of their revenue from sales of goods and services; or do not charge economically significant prices), but not state-owned. The other sectors are: non-financial corporations (both publicly and privately owned); financial corporations; government (both central and local); and households (reflecting households as consumers, and unincorporated businesses).

While the NPISH sector is the obvious home for non-profit organisations, they can exist in other institutional sectors, especially the Private Non-Financial Corporations (PNFC) sector. A business that is not-for-profit but does still operate in the market (charges economically significant prices, or earns more than 50 per cent of its revenue from sales) would be classified in the PNFCs sector, but might be of relevance to analysis of the productivity of the non-profit sector. Additionally, non-profit institutions that do not "serve households" will not be allocated to NPISH; for instance, non-profit institutions that "serve businesses", such as industry trade bodies, will usually be allocated to the PNFC sector.

It is difficult to quantify the size of the non-profit sector outside of the NPISH sector, but we suspect it would be large and an important target for future research. However, identifying non-profit organizations outside the NPISH sector is impossible from published aggregate data, and would only be possible from microdata analysis, which is beyond the scope of this article. We revisit this topic briefly in section 4.

For this article, we focus on the NPISH

4 Most of these sectors also have more detailed subdivisions, which are not pertinent to this article. Throughout, we use "sector" in the National Accounting sense, referring to the description given in the text here. The way in which many people use "sector" – to describe the type of output, e.g. manufacturing or services – are referred to as "industries" in the National Accounting context, which is again the term we use throughout.

sector. This encompasses much of what we are interested in when considering the non-profit sector, and is the only sector in the National Accounts which is clearly related.

The education industry accounts for around 70-80 per cent of the NPISH sector in the UK as measured. This primarily reflects universities, all of which are classified in the NPISH sector in the UK. Our interest is principally in the non-profit sector, for which we use NPISH as a tractable proxy. However, we are relatively less interested in universities, which are quite unlike the rest of the non-profit sector. Universities also receive considerable attention already from other organisations in the UK such as the Higher Education Statistics Agency. As such, we will present results for the NPISH sector including and excluding education, with the measure excluding education our preferred measure of the non-profit sector.

Conceptualizing and Measuring Inputs in the Non-Profit Sector

Like the rest of the economy, inputs in the non-profit sector can be thought to include labour, capital assets, and intermediate goods and services. However, unlike most of the rest of the economy, not all of those factors of production are paid for in the non-profit sector, notably the labour.

We conceptualize the production function of the non-profit sector as:

$$Y = Af(L_p, L_v, K, I)$$

Where Y is output, equal to a function of paid labour L_p, volunteer labour L_v, capital K, and intermediate inputs I, with a productivity term A. Define $L = L_p + L_v$.

The specific functional form is not important to the subsequent sections, but it is necessary to state that L_p and L_v are positive and non-overlapping: that is, each hour of labour input is either paid or given voluntarily, such that measuring only L_p would underestimate inputs by L_v.[5]

While L_p can be measured through standard household and labour market surveys, as for the rest of the economy, L_v usually cannot. L_v is a relatively large input in the non-profit sector, but a relatively small input outside the non-profit sector. As such, its measurement does not attract much attention when measuring the economy as a whole, or most other sectors. Measuring L_v is thus mostly a challenge unique to the non-profit sector.

Measuring only L_p would clearly lead the estimated level of total labour input (and total inputs) to be too low; that is $L > L_p$. However, also relevant for productivity analysis, the rate of change of L_p might not be a good proxy for the rate of change of L, since there is no reason to assume that $\partial L_p = \partial L_v$. Put another way, if the balance of paid to unpaid labour input changes over time, which it might well, then measuring only paid labour input would be to mis-measure the growth of total labour input. It is therefore crucial to account for volunteer labour input (L_v) as well as paid labour input (L_p).

The preferred measure of labour input

5 L_p and L_v may be seen as either complements or substitutes in production. We see them as mostly substitutes, although they will display some complementarities in some settings.

for productivity statistics is hours actually worked (as opposed to hours paid, or contracted, for instance), although numbers of jobs or workers are also sometimes used. Data on hours worked is usually found in household surveys, such as the Labour Force Survey (LFS).

However, the institutional sector classification of organizations in the National Accounts has no bearing on voluntary activity, so it is quite possible that people volunteer for organizations outside the NPISH sector, and even outside the broader non-profit sector. Thus, if including volunteering time in the measure of inputs in the NPISH sector, in order to maintain alignment between inputs and output, we must ensure that our measure covers only volunteering done for NPISH units. This is difficult, since volunteers will not typically know the institutional sector of the organization they are volunteering for, and could not report it even if asked, which in the UK they are not. We can make an estimate of the fraction of formal volunteering done for NPISH units by aligning the reported 'fields' of volunteering with the industries of NPISH units, and making some informed estimates, which we describe in section 3 and Appendix A.

The alternative is to expand our measures to cover all non-profit organizations, regardless of institutional sector. In some ways this is easier, but in others harder – it avoids additional modelling of volunteering input, but necessitates the identification of non-profit units outside the NPISH sector, which is challenging. We believe this is preferable, and would be more useful to industry and policymakers, but is beyond the scope of the present article.

Conceptualizing and Measuring Output in the Non-Profit Sector

In order to ensure additivity across the economy, the typical numerator in the productivity equation is "gross value added" (GVA). GVA is calculated by deducting "intermediate consumption" (IC) from total output (TO). Total output is equal to the value of all output of the unit, including market output (i.e. sales, or turnover), non-market output (output produced and provided for free or at prices that are not economically significant), and output for own final use (output produced by a unit and retained for its own use, such as the in-house development of software).

Intermediate consumption is the cost of purchased intermediate goods and services produced by other units, which is the output of other units in the economy. It covers all current expenditures, such as raw materials, business services, utilities, rent, and overheads. Expenditures on capital assets are not deducted. Deducting intermediate consumption from total output avoids double counting when adding across the economy.

In the market sector of the economy, total output can be readily measured based on turnover (with adjustments for output for own final use and changes in inventories), and so GVA can be calculated by subtracting intermediate consumption from total output. GVA can equivalently be expressed as the sum of:

- Compensation of employees *(CoE)* – all payments to workers, i.e. wages and salaries, bonus and overtime payments, and non-wage labour remuneration such as employer's pension and

National Insurance contributions.

- Gross operating surplus *(GOS)* – covering both depreciation (consumption of fixed capital) and a return on capital (net operating surplus).
- Taxes less subsidies on production *(T-S)* – taxes and subsidies relating specifically to production, and not to products, hence excluding Value Added Taxes (VAT), fuel duties, and so forth.[6]

Algebraically:

$$TO = CoE + IC + GOS + (T - S)$$

$$GVA = TO - IC = CoE + GOS + (T - S)$$

Gross Operating Surplus *(GOS)* can be decomposed into the costs of using capital through depreciation (consumption of fixed capital, CFC) and a return on capital which is broadly equivalent to profit (net operating surplus, NOS). Algebraically:

$$GOS = CFC + NOS$$

$$GVA = CoE + CFC + NOS + (T - S)$$

However, this basic model for market sectors does not work for the non-profit sector. Like the public sector, output of the non-profit sector is largely not paid for at the point of use and there are no market prices, and thus cannot be reported as turnover in standard business surveys. While its value can be approximated as the sum of costs of production, this relies on full and accurate estimates of the economic costs of production, which are challenging.

We address the two main components of GVA – compensation of employees, and gross operating surplus – in the next sections, highlighting how National Accounts measures could be adapted to better reflect economic reality of the non-profit sector. In doing so, we go ‘Beyond GDP’, making adjustments that are inconsistent with current National Accounting rules, but better reflect the economic reality of the non-profit sector.

Gross Operating Surplus in the Non-profit Sector

By its definition, the non-profit sector is unlikely to be aiming to maximize profits, although some third-sector organizations do make profit which is reinvested or distributed. Instead it is more likely to be maximizing its output, delivering as much of its output as it can without making a loss.[7] This means that the amount of Net Operating Surplus (NOS) earned in the sector is likely to be far lower than for a profit-maximizing firm, although we argue that NOS should not be zero in this sector.

The components of Gross Operating Surplus can be hard to measure accurately across the whole economy. Estimates of consumption of fixed capital depend on assumptions and models about depreciation rates. GOS as a whole, and NOS within that, are often calculated by residual in the National Accounts. In the case of

6 Henceforth we ignore this component, since it is small relative to the other components, and would not materially affect the results to factor it in.

7 This is akin to Ramsey-Boiteux pricing (Ramsey, 1927; Boiteux, 1956) – public monopolies (often natural monopolies) which aim to maximize social welfare by maximizing output, may have to price above marginal cost to avoid making a loss and having to rely on subsidies. We are grateful to Hux Dixon for this insight.

the non-profit sector, these components are even harder to measure – conceptually, and practically. The National Accounts, following international guidance, currently measure GOS of the NPISH sector as follows:

- An estimate is made for Consumption of Fixed Capital using models for the capital stock of the sector, based on surveys and administrative data about capital investment, and assumptions about depreciation rates;
- Net Operating Surplus is assumed to be zero for entities in the NPISH sector.

Whilst NOS is likely to be far less important in the non-profit sector than in other sectors, we feel a low "normal" rate of profit is still appropriate conceptually.[8] This follows the Hall and Jorgenson (1967) conceptualization of the user cost of capital as reflecting both economic depreciation and a rate of return on capital, reflective of the opportunity cost of holding the investment in that asset rather than in a financial product or another investment. Such a return on capital can also be motivated by financing costs, for instance the interest rate on a loan, or the social time preference rate. By excluding even a low return on capital, we feel the National Accounts underestimates the true Gross Operating Surplus (and thus the value of the capital input) of the non-profit sector.

That is not to say we want to attribute profits to the non-profit sector. Rather, this is a method to reflect the true value of the capital services used in production in order to value output. This is not necessary in the market sector, since there are economically significant prices. For the non-profit sector, where we cannot rely on prices and have to instead value output by the sum of costs, it is important to reflect the true economic value of those costs. Valuing capital services more fully, by incorporating the opportunity cost component as well as consumption of fixed capital, does that.

Thus, we adapt National Accounts measures by first re-defining GOS:

$$GOS = CFC + \text{`normal'}NOS + \text{`supernormal'}NOS$$

Setting only 'supernormal' NOS = 0 for the non-profit sector (rather than both NOS components as in the National Accounts) gives adjusted GOS of the non-profit sector as:

$$GOS^* = CFC + \text{`normal'}NOS$$

Compensation of Employees in the Non-Profit Sector

Economic theory says that, under certain conditions, the "value" of labour to production (the marginal product of labour) is equal to the total cost of employment. On this basis the total labour cost should be a helpful way of measuring the value of labour where outputs of a sector are not directly observable. However, there are two challenges in the non-profit

8 This argument applies equivalently to the government sector, which also has NOS set to zero in SNA 2008. As for NPISH, we believe this undervalues the contribution of capital in the government sector in the National Accounts. This argument is also made in the OECD Measuring Capital Manual (OECD, 2009, sections 8.3.2 and 16.3).

sectors.

First, many non-profit organizations will use unpaid volunteers to help deliver their outputs. Given volunteers are unpaid by definition, their cost to the organization is zero. However, this does not mean their value is zero. As noted earlier, we are estimating the value of output in the non-profit sector by the true economic costs of the inputs, in the absence of market prices. Volunteer time has an economic cost: the opportunity cost of the time of the volunteer, who could be doing other paid work, or enjoying leisure, instead of volunteering. Valuation of volunteer time could thus depend on the valuation of the opportunity cost, which could reasonably be argued as the legal minimum wage, the volunteer's own market wage (if they are employed), or a market equivalent wage of the work being carried out. In aggregate these are unlikely to be very different, although may be quite different for individuals with high-paying employments.

We use an estimate of the market wage of occupations doing similar work to the volunteers, consistent with ONS Household satellite account (see ONS, 2013). This is also the recommended approach in all the international guidance, including in the UN Handbook of National Accounting: Satellite Account on Non-profit and Related Institutions and Volunteer Work (United Nations, 2018, p.58). The System of National Accounts (SNA) 2008 (United Nations et al., 2009, paragraph 23.34) recommends valuation of volunteer labour in a Non-Profit Institutions satellite account be based on "remuneration rates of employees undertaking similar work". The International Labour Organisation (ILO) Manual on Measuring Volunteer Labour (International Labour Organisation, 2011, pp.36-39) also suggests an approach based on average market wages in the industry and/or occupation of the volunteer.

Recall that valuation of volunteer time is only necessary in order to fully value the output of the non-profit sector. Thus, our objective is to value the labour input of the volunteer to the associated production activities, rather than an estimate of the social value (to the individual or society). Thus, an imputed wage rate that best reflects the type of labour input they are providing (proxied by the wage rate on similar paid labour) seems most appropriate.

Specifically, we use the wage of employees in the private sector in occupations that relate to the type of volunteering being carried out.[9] The validity of the shadow wage will depend on the similarity of the voluntary activity with that done by the wage donor. These shadow wages should be adjusted to represent "total employment costs", paralleling compensation of employees for employees.

Second, the labour costs component is further compromised if the total labour cost does not truly represent the marginal product (value) of labour services. There is evidence that the paid (and unpaid) work-

9 The weighted average of occupational wages used by ONS (2013) to value volunteering, and as adopted in this article, turns out to be around twice the level of the National Minimum Wage in the UK. The difference is falling over time as the National Minimum Wage increases, especially following the introduction of the National Living Wage in 2016. In 2019, the volunteering shadow wage we use is 75 per cent larger than the main National Living Wage.

force in the non-profit sector is motivated by non-pecuniary factors, such as the social value of the work (see e.g. Kamerāde and McKay, 2015). This means they may accept wages below the wage for an equivalently skilled job in the market sector, since they receive a form of non-monetary compensation for their labour, despite the fact that their marginal productivity should be almost identical. How much higher will depend on the value that the workers place on the non-pecuniary benefits. DCMS (2020) and Croner (2017) find that workers in the non-profit sector earn 20-30 per cent less than workers in other sectors. O'Halloran (2022) controls for a range of individual-level factors such as education and experience, and suggests that the differences in wages may be smaller than this but still significant. Thus, the true value of the labour services is likely to be higher than that paid by the non-profit sector.

We do not seek to include the value the non-pecuniary benefit per se. Indeed, many well-paid workers in the market sector might receive non-pecuniary benefits in their jobs too. Rather, we wish to accurately value the labour services provided by the workers in the non-profit sector, in order to more accurately value the output of the sector. The disconnect between pay and the value of the labour services is only a challenge for the non-profit sector as, unlike in the market sector, the value of labour services is used to value the output of the sector. The presence of non-pecuniary benefits is simply the reason that the pecuniary value of labour services would undervalue the output of the sector.

Thus, we adapt National Accounts measures by first expanding the compensation of employees to include the value of volunteer time:

$$CoE^{*} = W_p L_p + W_p L_v$$

Where W_p is the going hourly labour compensation (including non-wage labour costs, etc.) of paid workers in the market, L_p is hours of paid labour, and L_v is hours of volunteer labour.

We assume that workers in the non-profit sector accept a below-market wage due to non-pecuniary benefits, such that:

$$(1+\alpha)W_p^{NPS} = W_p$$

Where α is a factor reflecting the degree of discount accepted by workers in the non-profit sector due to non-pecuniary benefits. If $\alpha = 0$, then there is no discounting, and wages in the non-profit sector are market wages. If $\alpha > 0$, as we believe, then there is discounting, and wages in the non-profit sector are below market wages, and thus understate the true value of the labour services.

Then our adjusted measure of compensation of employees in the non-profit sector can be written as:

$$CoE^{*} = (1+\alpha)W_p^{NPS} L_p + W_p L_v = W_p L_p + W_p L_v$$

Appropriate Deflators (Price Indices) and Volume Output Measurement

Measurement of productivity growth requires output be measured in volume terms, that is as an estimate of the volume of output rather than its cost. This is usually achieved by applying suitable price indices, or "deflators", to estimates of the cost of the output. Price indices should account for changes in observed and unobserved price, including changes in quality. If products improve in quality, but observed price stays the same, effective prices have fallen – this can be thought of as getting 'more' (a higher quality good) for the same price, and thus the effective price falling. Prices of high-tech products like laptops and mobile phones are explicitly adjusted for quality change in the inflation statistics using a variety of techniques, but most services are not adjusted for quality change explicitly (ONS, 2019).

In measurement of public service productivity, the UK ONS makes explicit adjustments for changes in service quality, and applies these to the change in the 'quantity' of output, in their 'public service productivity' statistics (ONS, 2022), but not to output measures in the UK National Accounts. For instance, in estimating the true growth in the volume of public service education services, quality measures of exam attainment are incorporated alongside quantity measures of the number of students. This relies on high-quality and relevant data to proxy for quality changes, which are attributable to the service being provided. Where this can be done, the estimates are likely to be of high quality, and ONS is a world-leader in the measurement of public service output – however, this has high data demands and requires significant research effort.

Ideally, future work would explore direct volume output measures for the non-profit sector, similar to those used for public sector output. For instance, the volume of output of non-profits working to help people back into employment could be measured directly by the number of people supported or the number of coaching sessions delivered. Crucially, these would need to be adjusted for changes in quality, such as the increase in the number of people obtaining sustained employment who would not otherwise have done. This would require significant investment in data collection and methodology.

For the proof of concept in this article, we will use price indices covering relevant activities to deflate the estimates of the cost of GVA in the non-profit sector. This will give estimates of the growth in "real GVA" (GVA in constant prices). However, this is crucially dependent on the relevance and quality of the deflators used.

Summary and Conceptual Framework

To summarize, we make the following modifications to current National Accounts measurement to produce conceptually superior estimates of the level of productivity of the non-profit sector:

- Adjust labour inputs to also capture volunteer time, by estimating the fraction of volunteering time that relates to NPISH units in the National Accounts;
- Adjust the value of GVA to capture:
  - the cost of volunteer time (covering shadow wages and salaries and shadow non-wage labour costs)
  - the non-pecuniary value workers in the non-profit sector receive from working in that sector, so as to put the valuation onto market equivalent rates
  - a 'normal' rate of return on cap-

ital, as well as consumption of fixed capital

For estimates of productivity growth, we use price indices of relevant activities to deflate the (adjusted) GVA of the non-profit sector.

Our adjusted GVA measure can thus be written as:

$$GVA^{*} = W_p^{NPS} L_p + \alpha W_p^{NPS} L_p + W_p L_v + CFC + \text{`normal'} NOS$$

Data and Methods

Accurate productivity measures require consistency between the input and output measures used – namely that they correspond to the same activity, and cover the same time period. Measures of the input and output of the non-profit sector suffer issues that make good productivity measures challenging.

To make "proof of concept" estimates of our expanded GVA concept for the non-profit sector, and accordingly productivity measures, we use a range of publicly available data and some creative methods and assumptions. The publicly-available data are limited, and the results in this article are accordingly fairly uncertain. With further work, including with microdata sources, we believe considerable improvements would be possible.

The data sources used in this article are set out below. Links to the data used are provided in the Data Appendix.[10]

Current Price GVA of the NPISH Sector (before adjustment)

Data from UK National Accounts publications from ONS give us compensation of employees and gross operating surplus (which is just equal to consumption of the fixed capital in the absence of any net operating surplus) for the NPISH sector, which added together gives GVA (ignoring net taxes on production).

We are grateful to the ONS for publishing the proportion of GVA in each industry that comes from the NPISH sector, annually between 1997 and 2019 (see Data appendix for link, and Appendix B for summary table).[11] We combine these with ONS estimates of GVA in each industry (from the "GDP low-level aggregates" dataset) to estimate NPISH GVA in each industry, and then aggregate for a sector-whole figure, which approximately matches the estimate from aggregate CFC and CoE above.[12]

By doing so, we can explore the industrial make-up of the NPISH sector in the National Accounts for the first time (see Appendix B for a summary).[13] As measured, around three-quarters of the NPISH sector comes from the education industry – primarily reflecting universities, as well as other education institutions that meet

10 See the online appendix at the following link: http://www.csls.ca/ipm/44/IPM_44_MartinFranklinArticle_OnlineAppendix_.pdf

11 See the online appendix at the link provided in footnote 10

12 Not exactly, due to rounding and the omission of net taxes on production.

13 See the online appendix at the link provided in footnote 10

the NPISH inclusion criteria (such as nurseries and private schools). Since universities are not what most people are interested in when considering the non-profit sector, we present estimates with and without the education industry included.[14]

It is worth noting we are not using estimates of NPISH final consumption expenditure (FCE), a component of the expenditure measure of GDP. By convention, the NPISH sector is assumed to consume its own non-market output, in the same was as for the government sector consuming its non-market output (government final consumption expenditure). The UK ONS measures real NPISH FCE by deflating estimates of current price output of the sector, comprised of compensation of employees, intermediate consumption, consumption of fixed capital, and net taxes on production. Deflators are chosen or constructed to accord with the relevant concepts. This is the same method as for estimates of much government output, although some government output is also measured 'directly' using cost-weighted activity indices.

Value of Volunteering

The UK Household satellite account (produced by ONS) provides estimates of the value of formal volunteering, annually from 2005 to 2016 in the latest release (ONS, 2018). These are based on the estimated hours of regular, formal volunteering, sourced from various surveys including most recently the Community Life Survey (run by research agency Kantar Public on behalf of DCMS). These hours are then multiplied by estimated hourly wage rates for appropriate occupations, sourced from the Annual Survey of Hours and Earnings (ASHE). For more details on the ONS methods, see ONS (2013). The valuation is independent of the allocation of volunteering to industries.

We extend these estimates in two ways: over time and accounting for non-wage labour costs. We then establish what fraction of this volunteering should be included in NPISH, and allocate it to industries.

Extension in Time

We extend estimates back to 1997 and forward to 2019, based on a model that approximates as closely as possible the methodology in the ONS Household satellite account, using only publicly available data. Given the scope of this article and without access to microdata, this necessarily requires additional assumptions and modelling.

Specifically, we build a model based on:

- The rate of participation in regular, formal volunteering, by age group, sourced from the Community Life Survey and earlier Citizenship Survey. Since data for earlier periods are not for every year, and the survey mode changes over time, we interpolate, splice between sources, and extrapolate as necessary.

14 See for example the definitions used for the NCVO Almanac: https://www.fc.production.ncvocloud.net/ncvo-publications/uk-civil-society-almanac-2021/about/definitions/general-charities

- The size of the UK adult population by age group, sourced from *nomis*, based on mid-year population estimates from ONS.[15]
- The average hours of volunteering by age group, based on information in ONS (2013), ONS (2017b) and published by DCMS in 2022 (see Data Appendix) with additional modelling and adjustments.[16]
- The average wages of relevant occupations, sourced from ASHE, following the information in ONS (2013).

This model gives a close match for the value of volunteering reported in the household satellite account, and we use this to extrapolate official estimates. Chart 1 shows our modelled estimates come close to the official figures in both magnitude and trend, and we use our model to extend the official estimates.

The first three factors in our model (participation, population, and average hours) provide an equivalent means to extrapolate hours of volunteering, necessary to add to labour inputs. Our estimate of hours worked is a reasonable match for the data in ONS (2013) and ONS (2017b) in most years with available comparisons (Chart 2). New data published by DCMS in 2022 (see Data Appendix) is also similar up to 2015, after which it suffers from a mode effect and is not comparable.[17]

Accounting for Non-Wage Labour Costs

The ONS Household satellite account values volunteering only by a shadow wage (sourced from ASHE), which does not account for the value of non-wage labour costs that an employer would incur if the labour were paid.[18] While these non-wage labour costs are not actually incurred, they are a necessary addition to make the shadow wage for the volunteer input conceptually equivalent to that of paid employees in the sector. We use National Accounts data to calculate the ratio between "wages and salaries" and "compensation of employees" of the NPISH sector between 1997 and 2019, and use this to scale up the (extended) volunteering estimates from the household satellite account, which are based on the value of (shadow) wages only. Chart 3 shows this uplift ratio for the NPISH sector, as well as for non-financial corporations, government and the whole economy. The series for NPISH is mostly between that for the whole economy (lower) and government (higher).[19]

Allocation of Volunteering Time and Value to Industries

To incorporate volunteering into the output and inputs of the non-profit sector, we

15 To access *nomis* look at the following link: https://www.nomisweb.co.uk/

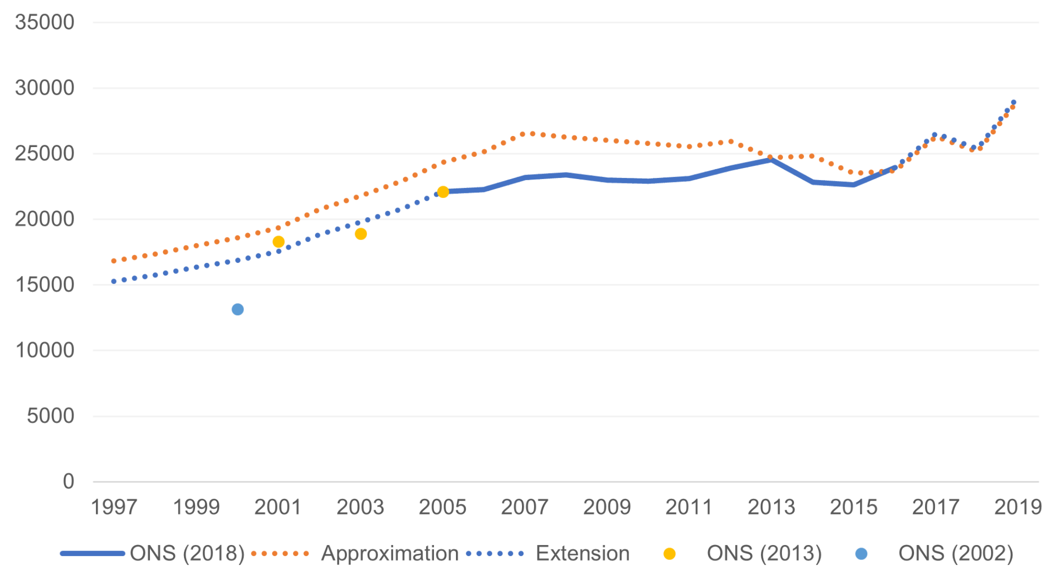
16 See the online appendix at the following link: http://www.csls.ca/ipm/44/IPM_44_MartinFranklinArticle_OnlineAppendix_.pdf

17 See the online appendix at the link provided in footnote 16.

18 This is our reading of ONS (2013) and ONS (2018).

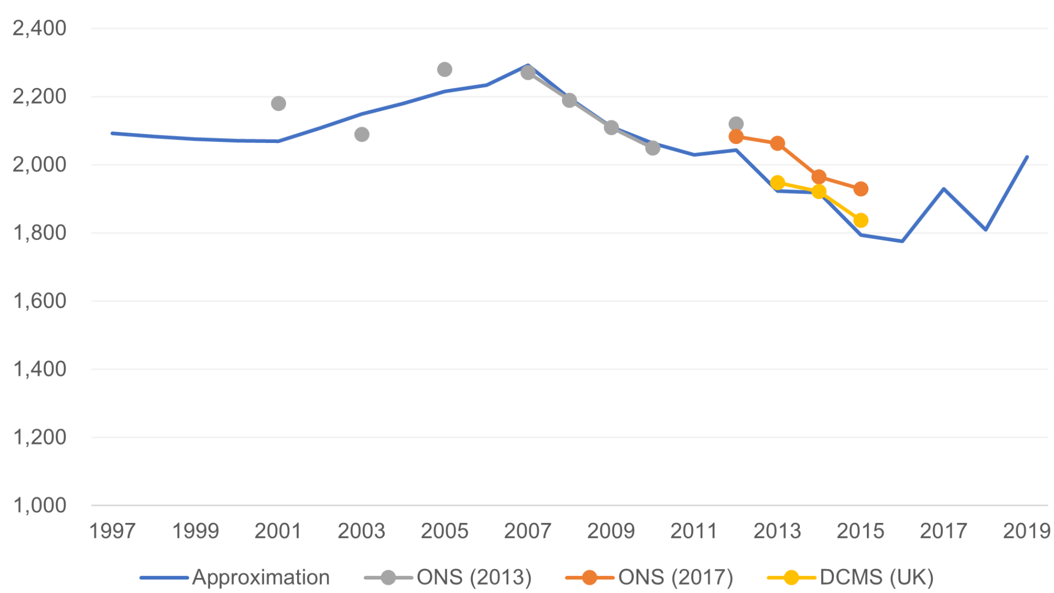
19 There is a spike in the NPISH series in 2018, due to the one-off recording of an increase in lecturers' pension contributions. We are grateful to an anonymous referee for this information.

Chart 1: Value of Volunteering in the United Kingdom, Existing Estimates and Extension, 1997 to 2019, £ million



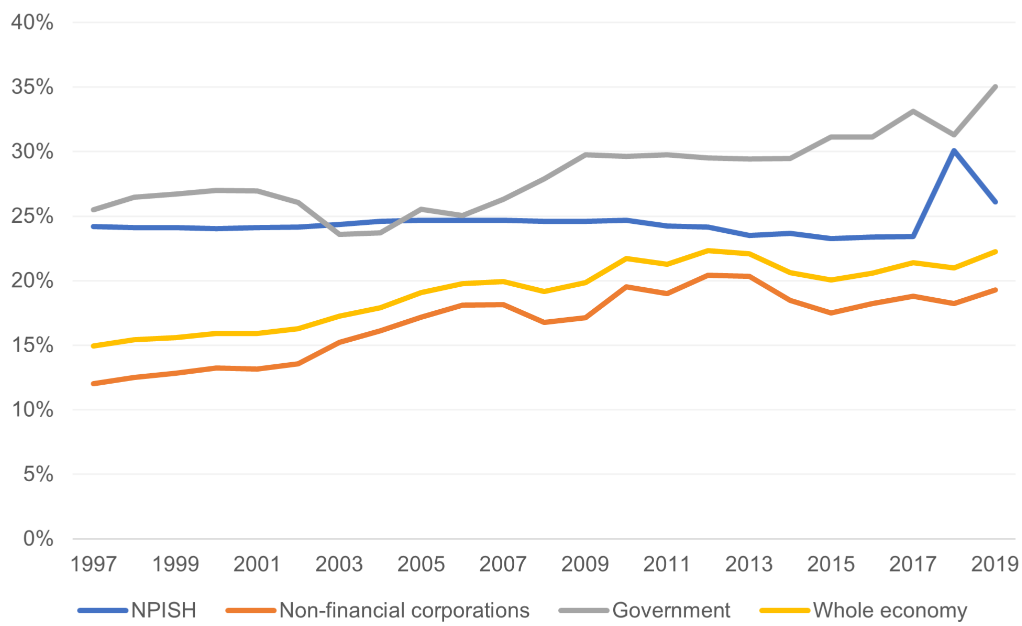
Source: ONS – Household satellite account (various iterations, see Data Appendix); authors' calculations using various sources (see text).

Chart 2: Millions of Hours of Volunteering Per Year, Existing Estimates and Extension, 1997 to 2019



Source: ONS (2013), ONS (2017), DCMS (2022), authors' calculations.

Chart 3: Uplift from Wages and Salaries to Compensation of Employees, Various UK Institutional Sectors, 1997 to 2019



Source: ONS – various Blue Book 2021 data, see data appendix; authors' calculations.

Notes: The NPISH series is much flatter than for other sectors, likely reflecting the use of assumptions or fixed proportions in the calculation by ONS. The spike in the NPISH series in 2018 is due to the one-off recording of an increase in lecturers' pension contributions.

need to ensure that it relates to the same activity as the rest of the input and output measures. For this article, that means that it should relate to activity in the NPISH sector. Not all volunteering will relate to activity in the NPISH sector – for instance, some volunteering could be in government-funded schools or hospitals, which would relate to activity in the government sector. Some volunteering (such as informal community groups) might not relate to any activity in the National Accounts boundary, which is clearly not relevant to the NPISH sector either. We aim to incorporate only the volunteering which relates to the NPISH sector in our estimates.

The source of data on volunteering is not related to the National Accounts or business statistics, which makes strict alignment with industries and sectors difficult. An indication is given by respondents, who report the 'field' of volunteering they participate in, on the Community Life Survey. We make assumptions about the proportion of volunteering which is relevant to the NPISH sector based on the 'field' of volunteering', as shown in Table A2 in the appendix.[20] We also assign 'fields' to industries based on the given descriptions of the fields.

We are grateful to DCMS for publishing a bespoke breakdown of the volunteering data, covering five years from 2016/17 to 2020/21. Given the various issues of in-

20 See the online appendix at the following link: http://www.csls.ca/ipm/44/IPM_44_MartinFranklinArticle_OnlineAppendix_.pdf

terpreting the data for our purposes, and to reduce the effects of sampling error, we take a simple average across years rather than reflecting year-to-year changes. Since respondents can volunteer in more than one 'field', we rescale the proportions to 100 per cent. Where volunteering could plausibly relate to multiple industries, we divide the time equally amongst the possible industries.

Multiplying the proportions of volunteering in each 'field' from the published data, by our assumptions of relevance as detailed in Table A2, yields an estimate of the relevant proportion of total volunteering; this is 58 per cent of volunteering relating to NPISH, or 54 per cent if excluding Education. As such, most of the volunteering we identify is in the non-Education NPISH sector.

Uplift for the Value of the Non-Pecuniary Benefit of Working for Non-Profits

As argued in the previous section, it is conceptually appropriate to inflate the labour payments in the NPISH sector to put them on a "market equivalent" basis, since workers in the non-profit sector likely accept lower wages due to non-pecuniary benefits they receive from working in the sector. DCMS (2020) and Croner (2017) find that workers in the non-profit sector earn 20-30 per cent less than workers in other sectors. O'Halloran (2022) controls for individual level factors such as education and experience, and suggests that the true gap is closer to 5 per cent, but this is based on a narrower concept of the non-profit sector than NPISH. We apply a 10 per cent increase, constant over time. This could be refined with microdata work that would enable analysis that controls for education and experience, amongst other factors, and allow this to vary over time.

Uplift for Gross Operating Surplus

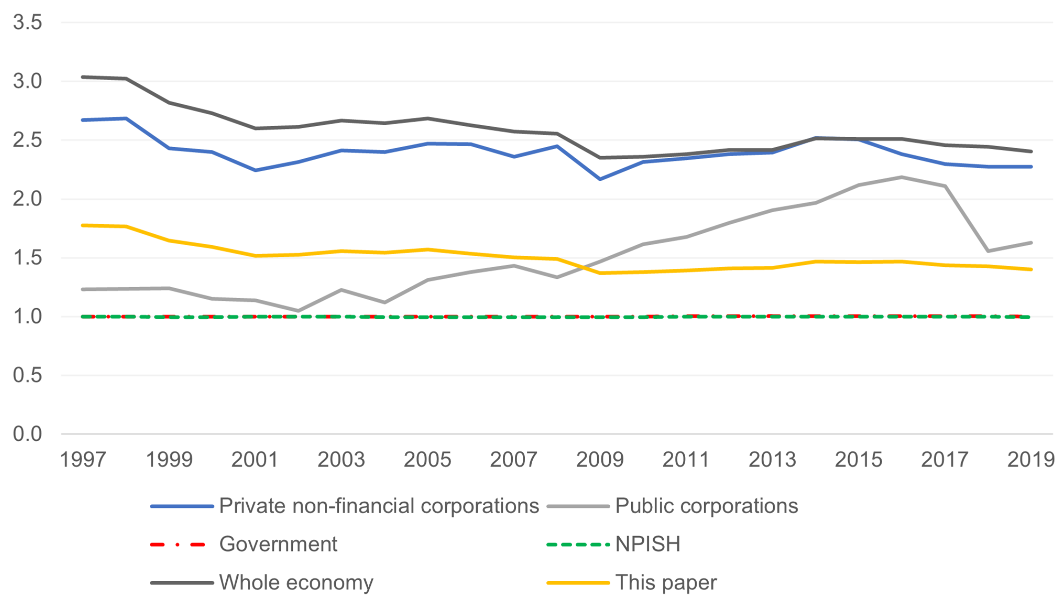
Using data from the National Accounts, we estimate the ratio between consumption of fixed capital and gross operating surplus by institutional sector (Chart 4). For NPISH and government, this ratio is 1, since gross operating surplus is only consumption of fixed capital. For the private sector, and the economy as a whole, the ratio varies between about 3 and 2.5, declining non-uniformly over time.

For the NPISH sector, we use an average uplift of 1.5, which is close to the average for the public non-financial corporations sector. Public corporations share some similarities to NPISH, in that they have a somewhat unusual mix of market and non-market characteristics and objectives. The public corporations sector is dominated by a small number of large bodies, which makes the data somewhat volatile. For our uplift ratio for the NPISH sector, we fit the trend of the ratio for the whole economy to the level from the public corporations sector. Multiplying this ratio by the known total for consumption of fixed capital gives a good first approximation to account for 'normal' NOS for the NPISH sector.

Deflators and Real GVA

In order to explore the growth of the volume of output, and hence of productiv-

Chart 4: Ratio of Gross Operating Surplus (GOS) to Consumption of Fixed Capital (CFC) for Selected UK Institutional Sectors, Used in this Article



Source: ONS – various Blue Book 2021 data, see data appendix; authors' calculations.

Notes: NPISH and government ratios can vary very slightly from 1 due to rounding differences across ONS publications.

ity, we must adjust for inflation over time using price indices, also known as "deflators". The appropriate deflators for NPISH GVA are those that reflect the activities of NPISH, and are conceptually well matched to the implied industry GVA deflators of the relevant industries.

We construct implied industry GVA deflators from the ONS industry GVA data (the "GDP low-level aggregates" dataset), by dividing current price GVA by the chained volume measure of GVA. This gives a GVA deflator for each industry which makes up NPISH GVA. We assume that the price growth of the aggregate industry is a good match for price growth of the NPISH component of that industry. This will be a better assumption when NPISH accounts for a large fraction of the industry.

We then construct a composite deflator for NPISH GVA using the relevant industry deflators in the right combination. Specifically, we construct a chained Paasche price index, using the industry shares of total NPISH GVA as weights.[21] The industry shares of NPISH GVA come from the industry GVA data described earlier (see Appendix B for a summary of these shares).[22] We do this with and without the education industry, adjusting weights accordingly, since we exclude education in various

21 A Paasche index uses weights in the current period, as opposed to a Laspeyres index which uses weights from the base period. A chained index means the weights are updated, in our case each year. It is typical to use Paasche indices for prices, and Laspeyres indices for volumes.

22 See the online appendix at the following link: http://www.csls.ca/ipm/44/IPM_44_MartinFranklinArticle_OnlineAppendix_.pdf

results in section 4. Applying these composite deflators to the NPISH current price GVA estimates gives real GVA estimates.

The industry GVA CVM data in the GDP low-level aggregates dataset are double-deflated estimates, meaning that different deflators have been applied to each output by product, and intermediate consumption by product. Double deflation calculates volume estimates of output and intermediate consumption separately, and then deducts the real estimates of intermediate consumption from the real estimates of total output.[23] As such, the deflators implied by the CVM data reflect the balance of output and intermediate consumption.

In our framework, we increase the estimate of output by adding the value of volunteering, increasing paid compensation of employees, and adding 'normal' net operating surplus. However, we do not change the estimate of intermediate consumption, which means that the balance of output and intermediate consumption in GVA changes.[24] As such, the implied deflators from the unadjusted GVA data might not be appropriate for the new output estimates, but will continue to be appropriate for the unadjusted GVA component of our new total.

To construct a suitable output deflator, we use the ONS "experimental industry output deflators", which are a mix of industry output and product deflators, reflecting the mix of products produced by each industry. We create a chained Paasche price index from these industry output deflators, using the sum of the GVA adjustment components by industry (volunteering value, non-pecuniary wage uplift, and 'normal' net operating surplus) as weights. Chart 5 shows our constructed deflators, alongside the unadjusted versions.

The quality of the composite deflators, and thus the real GVA estimates, is clearly dependent on the quality of the underlying industry output deflators. Table A3 in the appendix shows details of the make-up and quality of these industry output deflators, using information published in ONS' GDP(O) sources catalogue.[25] Table A3 includes the proportion of total adjusted GVA that each industry accounts for (with and without the education industry), the data source/method for the deflator, the associated quality rating given in the Eurostat Prices and Volumes handbook, and the average annual growth rate in the deflator between 1997 and 2019.[26]

Many deflators are sub-optimal, with only 16 per cent of the total receiving an A rating. Large fractions are "derived"

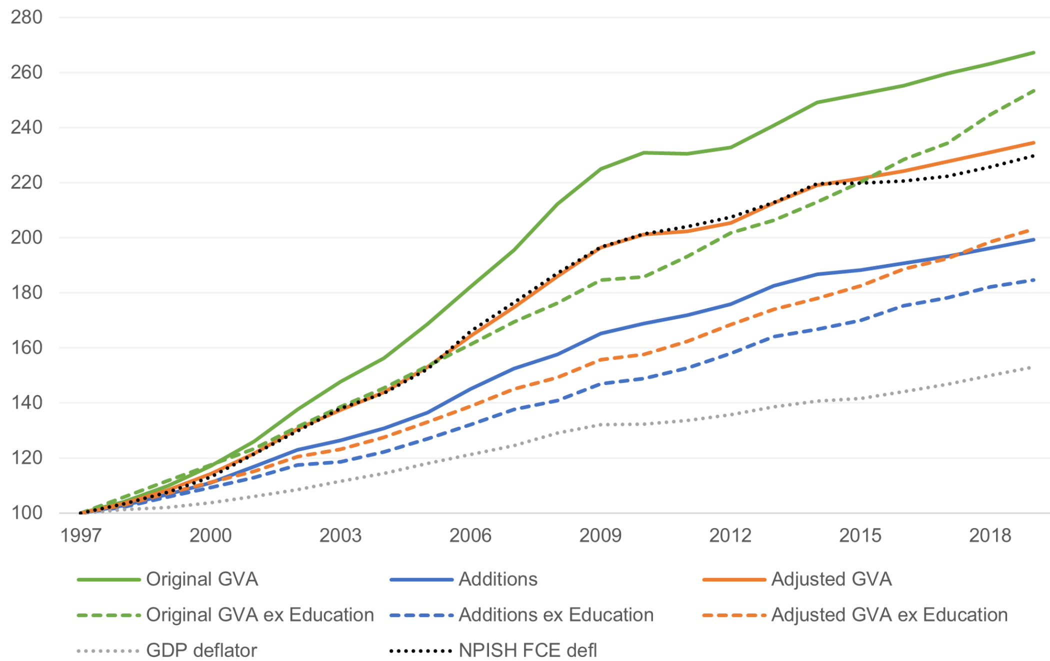
23 See more on double deflation in ONS (2017a).

24 For example, imagine that unadjusted total output was £20m, and intermediate consumption was £10m, such that unadjusted GVA was £10m. Our additions add £5m to output, making adjusted total output £25m and adjusted GVA £15m. But the industry GVA deflators are on the basis of output being £20m and intermediate consumption being £10m, so they might not be appropriate for the additional £5m of output – there is now more output relative to intermediate consumption than there was before.

25 See the online appendix at the following link: http://www.csls.ca/ipm/44/IPM_44_MartinFranklinArticle_OnlineAppendix_.pdf

26 The quality ratings are given in the ONS GDP(O) sources catalogue (ONS, 2021); we have not checked this information with the Eurostat Prices and Volumes handbook.

Chart 5: Various Deflators for the NPISH Sector and GDP, Index 1997 = 100



Source: ONS – various; authors' calculations

Notes: FCE = Final consumption expenditure; GVA = Gross Value Added. Solid lines are for total NPISH (including Education industry); dashed lines are for NPISH excluding Education. "Original GVA" series use implied GVA deflators; "Additions" series use industry output deflators; "Adjusted GVA" series are the aggregate of "Original GVA" and "Additions". Summaries of growth rates can be found in Table B4 of Appendix B.

deflators, meaning the deflator is not directly estimated, but derived from independent volume and current price output estimates. This is common when measuring public sector output since most such output does not have an associated price. For instance, the implied deflator for Education output is partly the difference between the growth rate in the cost of delivering education (current price output), and the growth rate in the cost-weighted number of students receiving education (volume output). While direct volume output estimates are often high quality, without adjustment for changes in quality, these derived deflators will tend to overstate price changes (though quality will not always be increasing).[27] Indeed, the average annual growth rate of the deflators in Table A3 tends to be higher than that of the implied GDP deflator, and especially so for those that are partly or fully "derived" deflators. This faster rate of growth in the deflator will depress the growth in real output, and may thus lead us to understate growth in real (adjusted) NPISH GVA and productivity.

The GDP deflator grows far slower than the various other deflators in Chart 5, since

27 Adjustment of non-market output for changes in quality is prohibited under the European System of Accounts 2010, currently followed by the UK ONS, although is permitted under the System of National Accounts 2008, which is followed by other countries.

its composition is quite different. In covering the whole economy, the GDP deflator will reflect trends in the prices of manufactured goods and technology products, as well labour-intensive services. The manufacturing industry has seen faster productivity growth than the rest of the economy over the past two decades, and thus slower price inflation. The prices of technology products have largely fallen over this period, once accounting for quality change. These make up part of the GDP deflator, thus reducing the measure of aggregate price changes. The relevant deflators for the NPISH sector consist principally of labour-intensive services, and so do not reflect such trends.

Labour Inputs

ONS does not publish estimates of workers, jobs or hours worked by institutional sector, making estimates of even the paid hours of work in the NPISH sector difficult. We use the GVA proportions, and apply them to industry-level hours worked estimates from the ONS productivity data. This implicitly assumes that the level of labour productivity per paid hour worked (i.e. ignoring the contribution of volunteering, and before making the other adjustments described in earlier sections) in an industry is the same in the NPISH sector and non-NPISH sector for that industry, since the same proportion of GVA and labour inputs would be allocated to NPISH from the industry. While this is less than optimal, it seems the only viable option for now.

Results

The results in this section reflect considerable uncertainty in the data and assumptions, described in section 3. While we believe these are useful first estimates, they would benefit from further work, and should be interpreted accordingly. As such, we present a range of estimates in places, reflecting our uncertainty particularly relating to deflators.

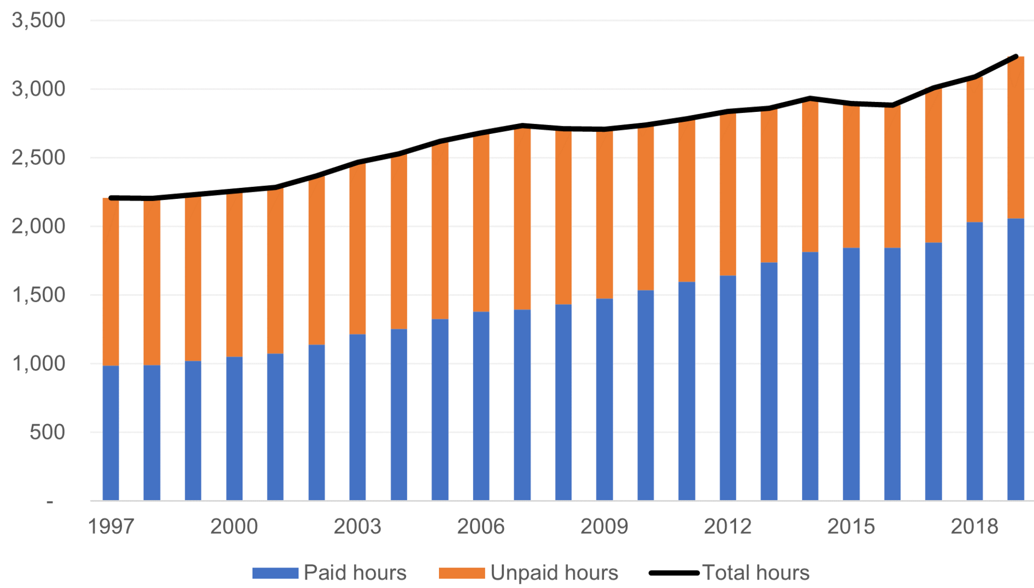
Recall that the education industry makes up a very large share of currently-measured NPISH GVA (around 70-80per cent), which primarily represents universities, which are not what most people are interested in when thinking about the non-profit sector. The output deflator for this activity (which relates to the whole education industry, including government-owned schools) is also unusual: it is derived from measures of spending, and volume output measures of cost-weighted activity indicators (number of pupils in schools, etc.), not adjusted for quality change. As such, we present estimates of NPISH including and excluding education, with our preferred measure being the variants without education.

Labour Inputs

Labour inputs are measured by hours worked, which are the sum of paid hours worked and volunteering hours worked.

For NPISH including education (Chart 6), paid hours worked represent about two-thirds of the total in recent years, up from about half in early years. These shares (the ratio of volunteer to paid labour) are fairly consistent with past work from the Johns Hopkins Centre for Civil Society Studies

Chart 6: Hours Worked, NPISH Sector Including Education, 1997 to 2019, Millions of Hours per year



Source: ONS, DCMS, authors' calculations.

(e.g. Johns Hopkins Centre for Civil Society Studies, 2017). Total hours worked increases quickly over time, at 1.8 per cent per year on average between 1997 and 2019, compared with average annual growth of 0.8 per cent in the economy as a whole. Volunteering hours increase slowly between 1997 and 2007, before falling, and finish in 2019 down slightly on 1997 levels, consistent with Chart 2.

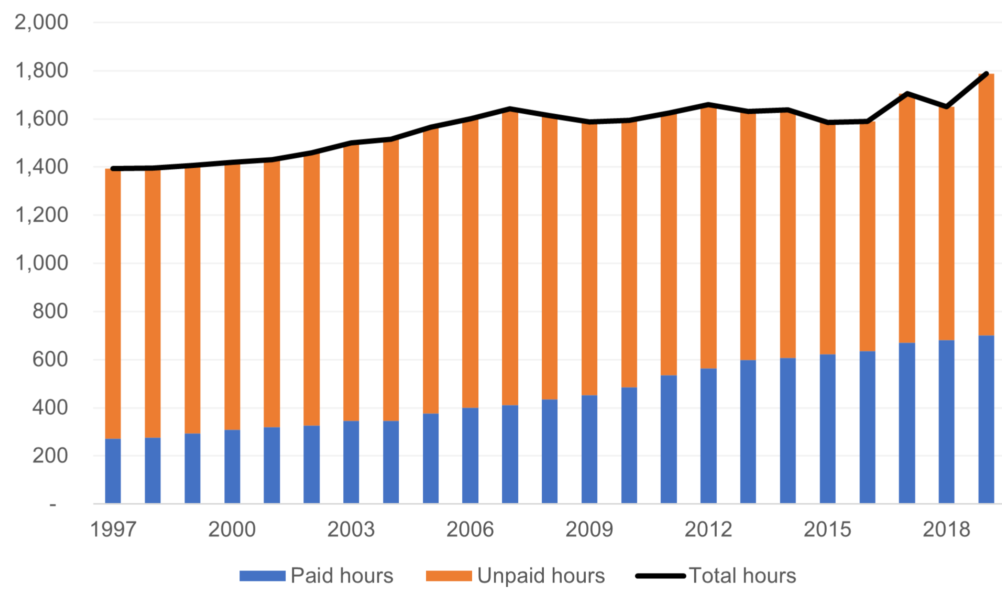
For NPISH excluding education (Chart 7), volunteering hours represent a much larger share of the total – about 80 per cent in the early years, falling to about 60 per cent in more recent years, as paid hours worked have grown more quickly. Total hours worked grow at an average annual rate of 1.1 per cent between 1997 and 2019, faster than for the economy as a whole, despite the large slow-growing volunteering component.

Current Price GVA

Current price GVA comprises the components in the National Accounts of compensation of employees and consumption of fixed capital, and our additions of the value of volunteering (including a shadow non-wage labour cost, not included in ONS household satellite account estimates), a 'normal' return on capital, and an uplift for the non-pecuniary benefit received by employees in the sector (to convert wages to true economic costs of labour inputs).

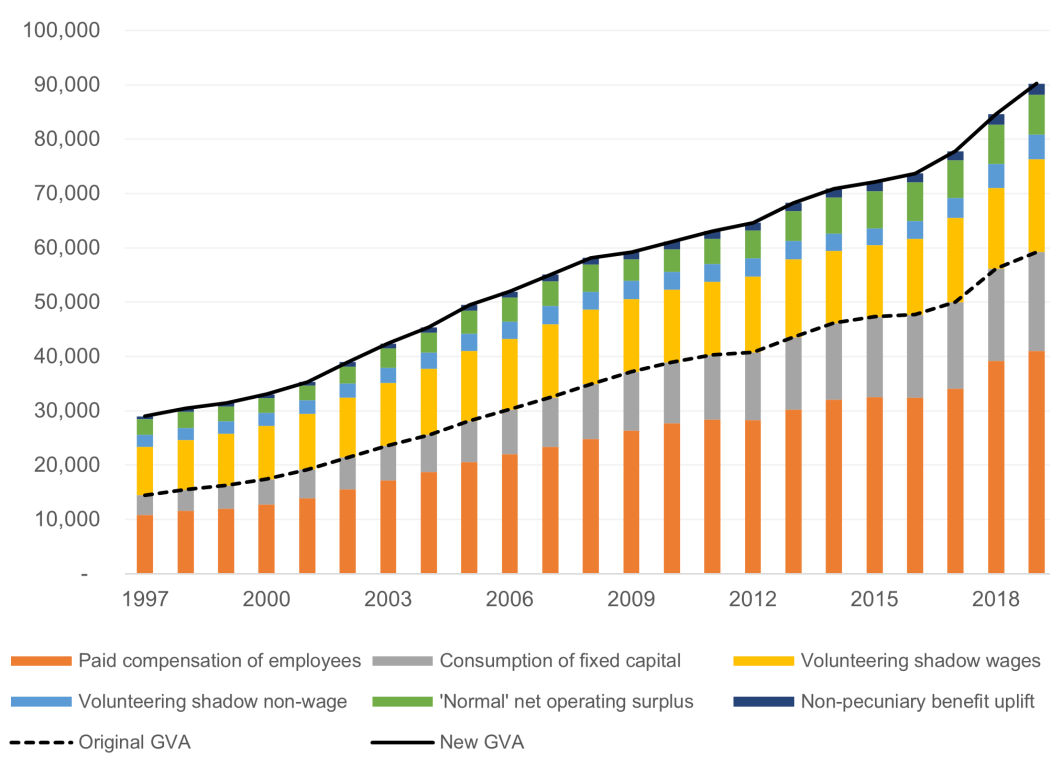
For NPISH including education (Chart 8), these adjustments account for about 35-50 per cent of the total in most years, with their relative contribution falling over time due to more rapid growth of the national accounts components. NPISH GVA goes from accounting for about 2.9 per cent of total GVA in 2019 before adjustments, to

Chart 7: Hours Worked, NPISH Sector Excluding Education, 1997 to 2019, Millions of Hours per year



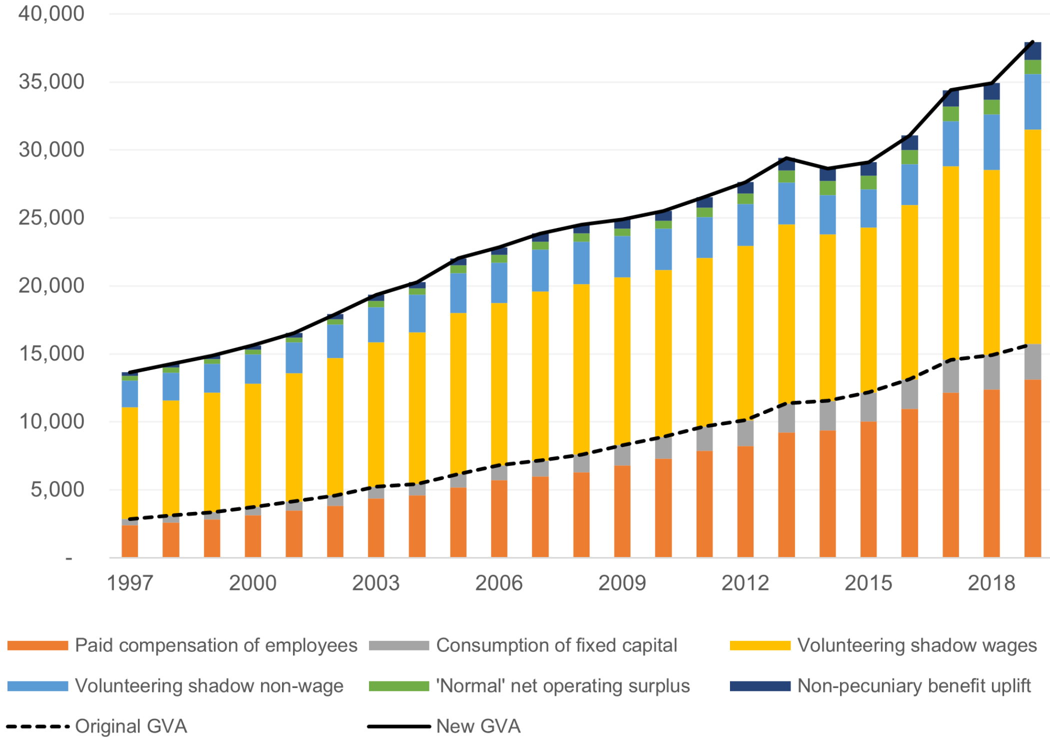
Source: ONS, DCMS, authors' calculations.

Chart 8: Components of Current Price GVA, NPISH Sector Including Education, 1997 to 2019, £ million



Source: Authors' calculations from various sources (see text).

Chart 9: Components of Current Price GVA, NPISH Sector Excluding Education, 1997 to 2019, £ million



Source: Authors' calculations from various sources (see text).

4.4 per cent after adjustments.[28]

For NPISH excluding education (Chart 9), the adjustments make a far larger difference, contributing about 60-80 per cent of the total. Volunteering is the primary contribution, although this is a relatively slow-growing component. This subset of NPISH accounts for about 0.8 per cent of GDP in 2019 before adjustments, rising to 1.9 per cent after. Table 1 summarizes the contribution of each component of GVA, for NPISH including and excluding Education, in 1997 and 2019.

Real GVA

Our central estimates of real GVA (inflation-adjusted GVA) uses a composite GVA deflator (from the implied industry GVA deflators) for the national accounts components of GVA, and a composite output deflator for the additional components of GVA. However, there are considerable uncertainties around both components, so in this section we present three sensitivities using different deflators. The full list of series are summarised in Table 2. See section 3 for description of methods and terms.

For NPISH including education (Chart 10), our central estimate [orange solid line] grows at an average annual rate of 1.3 per cent between 1997 and 2019, with much faster growth coming between 2017 and 2019. This is slower than the growth in real

28 Since we are increasing NPISH GVA with these conceptual adjustments, we have also increased whole economy GVA by an equivalent amount when calculating the share that NPISH accounts for in the economy.

Table 1: Components of Current Price GVA, NPISH Including and Excluding Education, 1997 and 2019, £ billion

Component	NPISH including Education		NPISH excluding Education	
	1997	2019	1997	2019
Paid compensation of employees	10.8	41.0	2.4	13.1
Consumption of fixed capital	3.7	18.2	0.5	2.6
Sub-total: Original GVA	*14.5*	*59.2*	*2.9*	*15.7*
Volunteering shadow wages	8.9	17.1	8.2	15.8
Volunteering shadow non-wage labour costs	2.2	4.5	2.0	4.1
'Normal' net operating surplus	2.9	7.3	0.4	1.0
Non-pecuniary benefit uplift	0.5	2.1	0.2	1.3
Total: New GVA	*29*	*90.2*	*13.6*	*38*

Source: ONS, authors' calculations.
Notes: Components may not sum to sub-total and total due to rounding.

Table 2: Variants of Real GVA Used in the Article

Variant	Deflator for unadjusted GVA component	Deflator for adjustments to GVA (additional output)
1 – Adjusted (Central case)	NPISH GVA deflator	NPISH Output deflator
2 – Adjusted (All GVA deflator)	NPISH GVA deflator	NPISH GVA deflator
3 – Adjusted (All Output deflator)	NPISH Output deflator	NPISH Output deflator
4 – Adjusted (GDP deflator)	GDP deflator	GDP deflator
5 – Unadjusted	NPISH GVA deflator	-

GDP [black dotted line], which grew at an average annual rate of 2.0 per cent between 1997 and 2019. Before adjustments [blue solid line], our estimate of NPISH GVA volume growth was higher, at 2.0 per cent on average per year.

However, using different deflators gives quite different results, as shown in Chart 10. Variant 2 [yellow dashed line], which uses the implied GVA deflators for both the existing and additional components of our GVA measure (Table 2) yields slower growth, and Variant 3 [grey dashed line], which uses our constructed output deflator for all components yields faster growth. Variant 4 [light blue dashed line], which uses the GDP deflator, results in yet faster growth, in line with the far slower price inflation seen in Chart 5.

For NPISH excluding education (Chart 11), our central estimate [orange solid line] grows at an average annual rate of 1.4 per cent between 1997 and 2019, which is again slower than for the economy as a whole. The unadjusted series [blue solid line] grows much faster, at an average rate of 2.6 per cent per year between 1997 and 2019. The adjusted series grows much slower due to the addition of the slow-growing volunteering component.

Using different deflators again gives quite varied results, as shown in Chart 11. Variant 2 [yellow dashed line], which uses the implied GVA deflators for both the existing and additional components of our GVA measure, again yields slower growth. Variant 3 [grey dashed line], which uses our constructed output deflator for the total measure, and Variant 4 [light blue dashed line], which uses the GDP deflator, both yield markedly faster growth.

Labour Productivity

Labour productivity is calculated as GVA divided by hours worked. Levels of productivity are based on current price GVA, and growth rates of productivity are based on real GVA.

The level of labour productivity in the NPISH sector is lower than the UK average before and after adjustments (Chart 12). While the adjustments increase the level of current price GVA substantially, it also increases hours worked by a larger margin, such that the level of labour productivity falls a little.

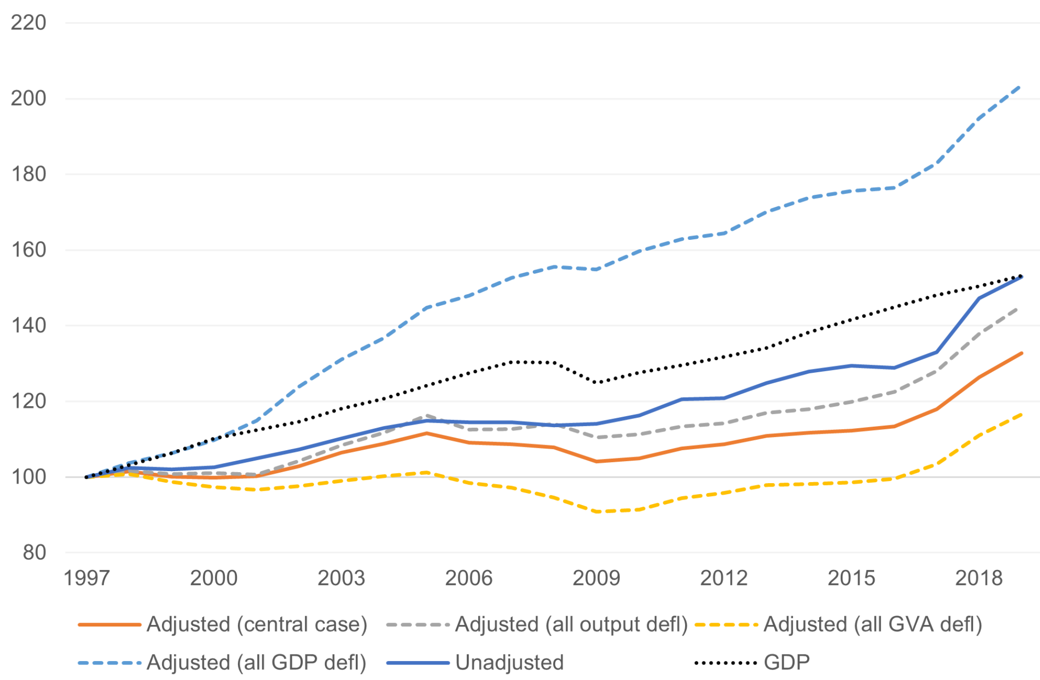
NPISH including education is consistently more productive in levels terms than NPISH excluding education. The former includes universities which are reasonably productive as measured. Both variants are similar to the level of productivity in other labour-intensive industries like retail, and accommodation and food services. The UK average level includes highly productive, often capital-intensive industries such as mining and quarrying, and real estate.

In our central measures, real labour productivity in the NPISH sector including Education falls between 1997 and 2019, both before and after our adjustments (Chart 13). The adjustments reduce the extent of the fall in productivity substantially. Between 1997 and 2019, output per hour worked falls at an average annual rate of 0.5 per cent, compared with 1.1 per cent growth for the economy as a whole. The variants using alternative deflators, as per Chart 10, give commensurately faster productivity growth. This is especially true when using the GDP deflator, which follow the trends in real GVA (Chart 10) and deflators (Chart 5).

However, a large fraction of this measure is education, for which the volume of output is measured without adjusting for quality changes, and grows slowly. ONS public service productivity (PSP) statistics, following the framework in the Atkinson Review, includes explicit quality adjustments on the volume of output for some service areas, including education. While this relates to government-provided education, these quality adjustments might nonetheless give a truer measure of the volume growth of the rest of the industry, including universities. We can apply the ONS PSP education quality adjustment growth rate to the education component of the NPISH sector, to produce an alternative measure of real GVA and thus productivity. This measure (green dashed line) grows faster than our central measure, since the measured quality of public education services is generally improving over the time series (reflecting more output being produced, for the same inputs), and this leaves productivity marginally higher in 2019 than in 1997.

For NPISH excluding education (Chart 14), our central measure sees labour productivity rising by an average of 0.3 per cent per year between 1997 and 2019, faster than the unadjusted measure. Once again, the results are quite sensitive to the choice of deflator (and hence real GVA mea-

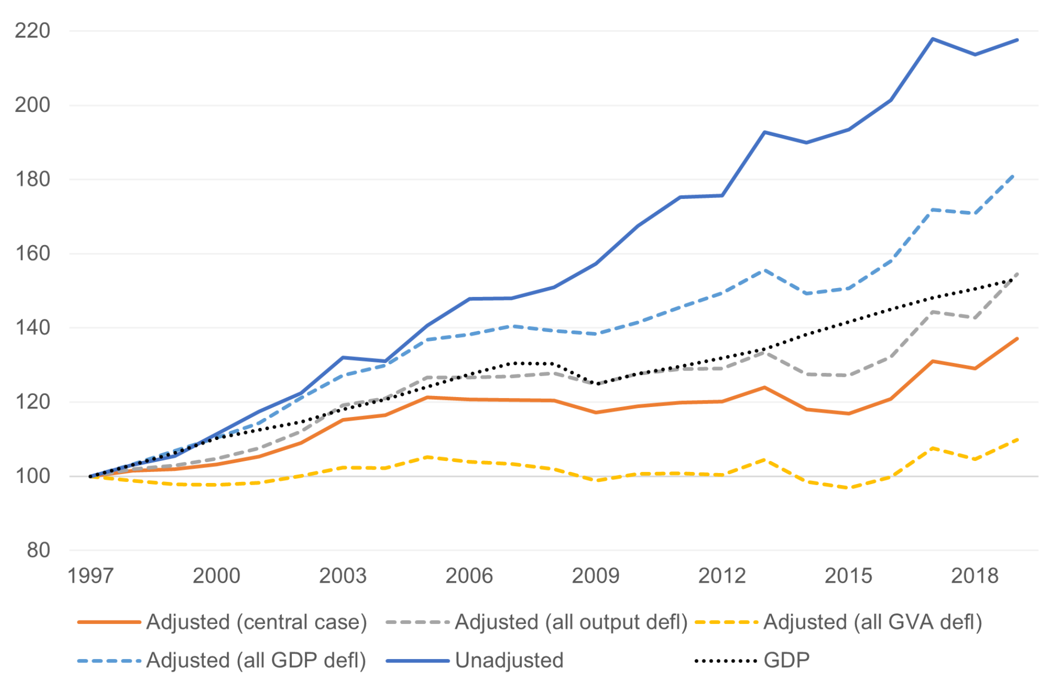
Chart 10: Real GVA, NPISH Sector Including Education, Multiple Variants, 1997 to 2019, Chained Volume Measures(CVM), Index 1997 = 100



Source: ONS; authors' calculations from various sources (see text).

Notes: See Table 4 for description of deflators used in each series.

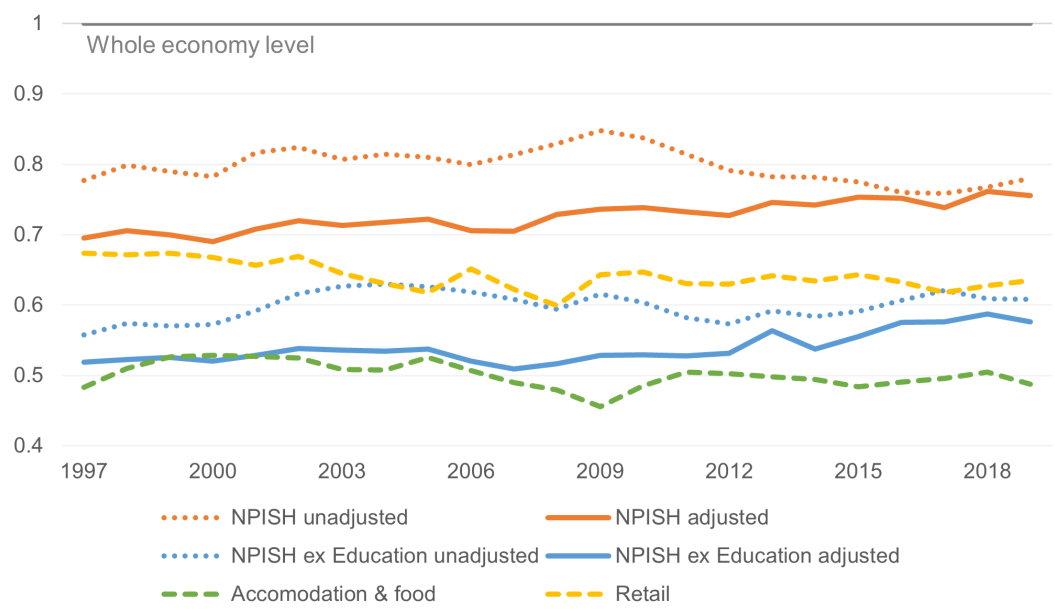
Chart 11: Real GVA, NPISH Sector Excluding Education, Multiple Variants, 1997 to 2019, Chained Volume Measures(CVM), Index 1997 = 100



Source: ONS; authors' calculations from various sources (see text).

Notes: See Table 4 for description of deflators used in each series.

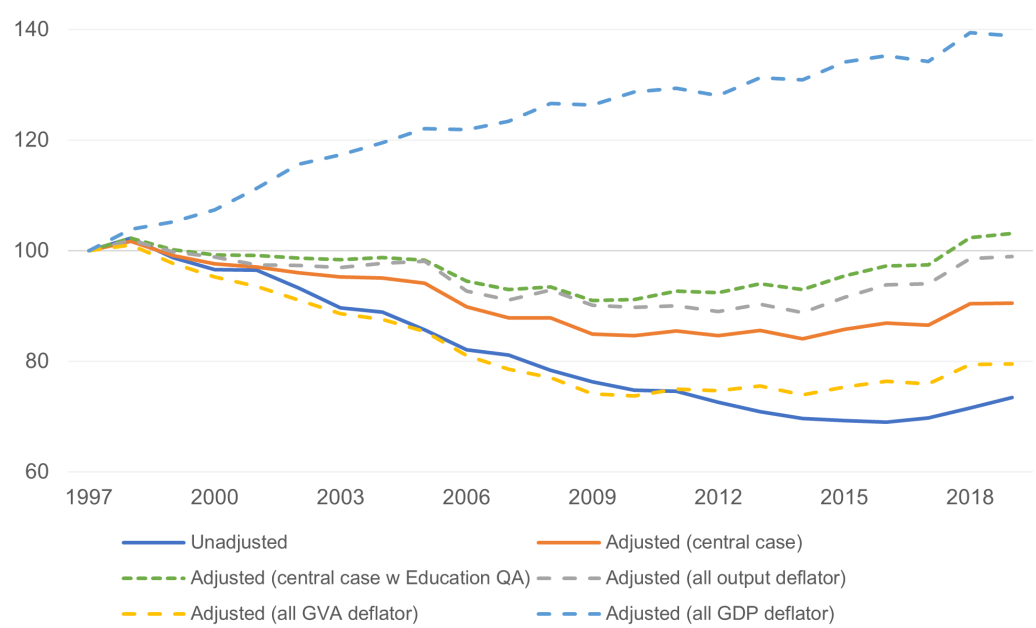
Chart 12: Level of Labour Productivity (Nominal GVA per hour Worked), NPISH Sector Including and Excluding Education, 1997 to 2019, Relative to the UK Average



Source: ONS – output per hour worked; authors' calculations from various sources (see text).

Notes: All series expressed relative to the UK average (UK whole economy) = 1.

Chart 13: Labour Productivity (Real GVA per hour Worked), NPISH Sector Including Education, Multiple Variants, 1997 to 2019, Index 1997 = 100



Source: Authors' calculations from various sources (see text).

Notes: See Table 4 for description of deflators used in each series.

sure, as in Chart 11). The variants using the GDP deflator, or the output deflator across all components, see faster productivity growth than our central case.

Labour productivity in other labour-intensive industries, like accommodation and food services and retail, have been close to flat between 1997 and 2019 (Table 3), so our central case is quite in-keeping with these similarly labour-intensive sectors. Unlike much of the rest of the economy, there is no evidence of a slowdown in productivity growth in the non-profit sector after the 2008 economic downturn – a phenomenon known as the "productivity puzzle".

Discussion

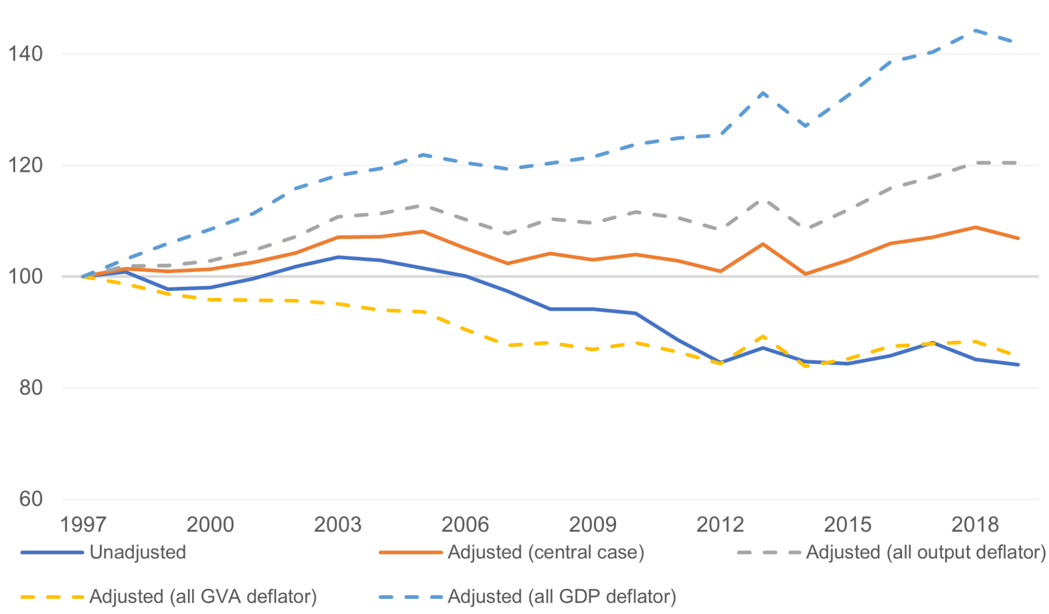
The article introduces conceptual adjustments to National Accounts data to, we believe, better reflect the value and growth of the output, input and productivity of the non-profit sector. For now, this is limited to the coverage of the National Accounts NPISH sector, although we hope that future work will expand to cover non-profit bodies regardless of their institutional sector in the National Accounts.

While the data and estimates in this article are tractable, and move in the right direction, they come with considerable uncertainties. In many areas, assumptions have been necessitated by lack of data or the scope of this article. This article has relied only on publicly available sources (and data made publicly available from ONS and DCMS, for which we are grateful) and use of microdata sources would enable refinement of the estimates and assumptions.

The results are particularly sensitive to the choice of price deflators, as showcased in Charts 13 and 14. Deflators for relevant industries tend to grow faster than for the economy as a whole, and in some cases very fast indeed. This (by identity) supresses the growth of real (inflation-adjusted) output, and thus the growth of productivity. The quality of the deflators is typically low, as seen from Table A2, which might explain the rapid increase in measured prices. The low quality and fast price growth are likely due to the use of deflators based mostly on costs, without adjustment for changes in service quality over time. Factoring in changes in quality, as in ONS public service productivity statistics, would tend to yield slower growth of the deflators, and commensurately faster growth of real output and productivity, since quality is generally measured to be increasing over time (though that need not be true in all cases).

Indeed, we believe the best approach for productivity measurement of the non-profit sector would mirror that of public services, following the Atkinson Review (Atkinson, 2005). This involves the identification of direct measures of the volume of output, and adjustment for changes in service quality over time. For instance, in the case of public education, output is measured based on the number of pupils in schools adjusted for attendance (a direct quantity measure, employed in the National Accounts), adjusted for changes in education quality which are proxied by changes in exam attainment, post-school outcomes, and student well-being (a quality measure, used only in ONS public service productivity statistics). An equivalent approach for the non-profit sector, while methodologically and practically difficult, would be op-

Chart 14: Labour Productivity (Real GVA per hour Worked), NPISH Sector Excluding Education, Multiple Variants, 1997 to 2019, Index 1997 = 100



Source: Authors' calculations from various sources (see text).

Notes: See Table 4 for description of deflators used in each series.

Table 3: Average Annual Growth Rates of Labour Productivity (Real GVA per hour Worked), 1997 to 2019 and Sub-Periods, Various Variants and Comparators

	1997-2007	2007-2019	1997-2019
NPISH including Education			
1 – Adjusted (Central case)	-1.3	0.2	-0.5
1a – Adjusted (Central case with Education quality adjustment)	-0.7	0.9	0.1
2 – Adjusted (All GVA deflator)	-2.4	0.1	-1.0
3 – Adjusted (All Output deflator)	-0.9	0.7	0.0
4 – Adjusted (All GDP deflator)	2.1	1.0	1.5
5 – Unadjusted	-2.1	-0.8	-1.4
NPISH excluding Education			
1 – Adjusted (Central case)	0.2	0.4	0.3
2 – Adjusted (All GVA deflator)	-1.3	-0.2	-0.7
3 – Adjusted (All Output deflator)	0.8	0.9	0.9
4 – Adjusted (All GDP deflator)	1.8	1.5	1.6
5 – Unadjusted	-0.3	-1.2	-0.8
Memo items			
Whole economy	2.0	0.4	1.1
Non-financial services*	1.5	0.8	1.1
Retail trades, except of motor vehicles	0.6	0.2	0.3
Accommodation and food services	-0.4	-0.7	-0.5
Government services*	-0.5	0.0	-0.2

Source: ONS – output per hour worked; authors' calculations from various sources (see text).

Notes: See Table 4 for description of deflators used in each series. "Non-financial services" excludes imputed rental from the real estate industry;"government services" is SIC 2007 sections O, P and Q, comprising Public administration and defence, Education, and Health and social care, these measures are consistent with the National Accounts and not adjusted for quality change. See Appendix B for equivalent figures of nominal GVA, hours worked, and deflators.

timal.

This article only partially addresses the important issue of "value" vs "cost". When output is not sold, as for the non-profit sector, the value of the output is very difficult to determine. We produce fuller estimates of the true economic cost of production, reflecting the full labour and capital costs, but this relates only precariously to the true social value of the output. As the old maxim says:"something is only worth what someone is willing to pay for it", except in this case, no one is paying (or at least, not paying what it is truly worth, given the purpose of the sector). However, the value of the output is still more appropriately thought of from the perspective of the recipient, than the funder or donor.

One way to put this is that many non-profits generate positive externalities – benefits that fall to those other than the individual deciding to "pay" for the services delivered by non-profits. There are at least two reasons to believe this would be the case.

First, while the person buying a good or service in a market sector is normally the person consuming that good or service, in the non-profit sector it can often be a donor that effectively "buys" the service for an entirely different group of beneficiaries. There is no reason to believe that the value the donor places on the output will be the same as the value that the direct beneficiaries or all other potential donors will place on the non-profit's output.

Second, non-profit interventions can often affect the consumption of publicly provided goods and services or the productive capacity of the wider economy. There are many studies that highlight the relatively high social benefit-cost ratios of charitable interventions, suggesting there are significant positive externalities to their work.[29]

To robustly estimate and incorporate the value of these benefits would require significant additional data to be gathered about the outputs and outcomes delivered by the non-profit sector. It would also require us to go 'Beyond GDP', since externalities (positive or negative) are not included in the National Accounts.

This article is a proof of concept of the measurement of the non-profit sector, and a first step in the right direction, leaving many avenues for further work. First, there would be considerable benefit for understanding the sector as a whole from extending the current approach to non-profit organizations outside the NPISH sector. These organizations are an important part of the "third sector", and the delineation based on institutional sector classification will be meaningless to most operating in this area. However, the non-profits operating outside the NPISH sector will be much harder to capture, and cannot be identified from aggregate data. It will therefore be necessary to use microdata analysis and data linkage to identify the relevant organizations and estimate their value added. One option would be to link the Charities Register (maintained by the Charity Commission for England and Wales) to the Inter-Departmental Business Register (IDBR) to identify registered charities

29 See for example, Pro Bono Economics (2020, 2021).

across all institutional sectors. However, some third-sector organizations will also not be registered charities. Analysis using the Annual Business Survey might allow identification of non-profit organizations by "revealed activity" – that is, the making of little to no profit for many years without exiting the market. Microdata analysis of the Community Life Survey would also likely improve the volunteering estimates, which are important.

Second, the UK government's announcement that it will work to develop a full non-profit satellite account (DCMS, 2022) should provide a sharper, more regular focus on the data limitations in the sector (and several of the potential building blocks for such a satellite account are contained within this article).

Finally, to generate more robust estimates of real output and productivity will require exploration of sources for direct output volume estimates and quality adjustments, in the spirit of the Atkinson Review. Given the heterogeneity of activity in the non-profit sector, this will likely entail research into a diverse range of domains, such as social care, museums and galleries, and R&D. The data may not yet exist, or be collected and consistent – some harmonization and collection will likely be necessary before it would be suitable for use in output measurement. Such an endeavour would be a substantial undertaking and is well beyond the scope of the present article. Measuring public service output and productivity in this way was only made possible by many years of investment by the ONS in the mid-2000s, and work continues to this day to develop the methods further (Foxton, Grice, Heys and Lewis, 2019). However, an equivalent investment in measuring and understanding outputs for the non-profit sector would provide a foundation for improved understanding of the value the sector provides to the wider UK economy.

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Capital Measurement and Productivity Growth Across International Databases

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Abstract

A country's multifactor productivity (MFP) growth, the growth of GDP that is not accounted for by growth of factor inputs, is of great interest as an indicator of living standards and technological progress. Yet different well-established databases show markedly different MFP growth rates for the same country and period. In this article, we show that differences in the measurement of capital input can account for one-third of the range of MFP growth rates across databases. Harmonizing a series of methodological choices for capital measurement substantially reduces variation across databases, but sizeable differences remain. This work highlights the continued relevance of these choices and can inform users who try to understand differences between databases and assess the robustness of differences in MFP growth across countries to measurement choices.

Productivity is a topic of enduring interest measuring growth of output, accounting for growth in inputs. Especially for a long-run perspective, we want to focus on productivity as a more enduring foundation for living standards than output, since additional inputs require giving up either leisure (due to more time spent at work) or current consumption (saving to finance investment).[2] Against this backdrop, we focus our analysis on multifactor productivity (MFP), accounting not just for growth of hours worked but also for changes in the composition of the workforce and the accumulation of capital. Under certain conditions, MFP growth is also an indicator of technological progress. Under certain conditions, MFP growth is also an indicator of technological progress. As international data on MFP growth have become increasingly widespread in recent decades, we aim to contrast results from different

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2 See e.g. Basu *et al.* (2022) for a more explicit formulation of the link between welfare and multifactor productivity along these lines.

databases and provide guidance to users on the sources of some of the differences between the databases.

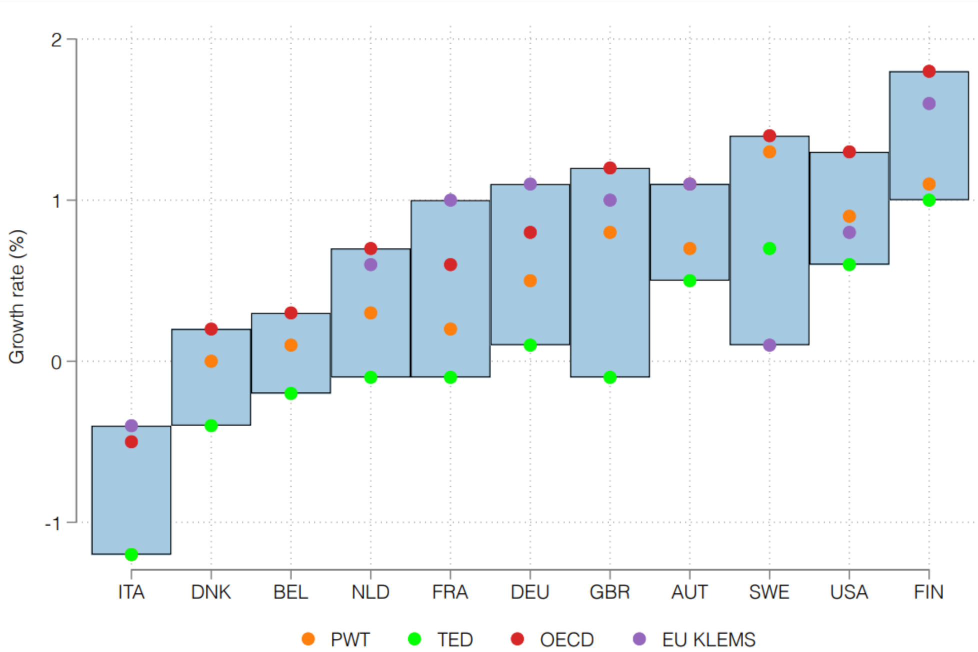
There are currently four main databases that provide data on economy-wide MFP growth for advanced economies, using detailed statistics on inputs of capital and labour. These databases are the Penn World Table (PWT), The Conference Board Total Economy Database (TED), the EU KLEMS database, and the OECD Productivity Statistics.[3] Providing data on MFP growth requires not only data on growth of gross domestic product (GDP) but also data on the input of labour (accounting for changes in the composition of the workforce) and the input of produced capital, such as buildings and machinery. The conceptual framework for growth accounting, on how to measure and aggregate data on inputs, is well-established (e.g. OECD, 2001) and many individual pieces of data are readily available for advanced economies. Yet the four databases we compare here show notably different MFP growth rates for the same country and period.

We illustrate this point in Chart 1, where we show MFP growth across the four databases for the period 2000–2007, highlighting the range across databases; Appendix Table 1 provides the growth rates for each database. We chose this period because it is recent enough to be covered by all databases yet distant enough that the precise vintage of National Accounts data used in the construction of the data will not have a substantial impact on the results. As the Chart shows, average annual MFP growth in (for example) Germany over this period could be as low as 0.1 per cent (TED) or as high as 1.1 per cent (EU KLEMS), with growth rates of 0.5 per cent for PWT and 0.8 per cent for OECD. This full percentage point difference between the fastest and slowest MFP growth rates is not atypical for the eleven countries we compare in this article. On average, the range in growth rates between the database with the fastest and slowest reported growth is 0.9 percentage points. To put this cross-database range in perspective, note that MFP growth rate over this period averaged only 0.5 per cent (across countries and databases). For countries such as France, Germany, or the UK, you would conclude that MFP growth stagnates or that it grows at a respectable 1 per cent per year depending on the choice for a particular database.

For a non-expert user of productivity data, there currently is no clear explanation for why a country for a particular period can have such widely divergent estimates of MFP growth across these databases. The aim of this article is to better understand the reasons for these differences, by comparing the different variables that go into the productivity growth

3 We use PWT version 10.01, see www.ggdc.net/pwt for details. We use the April 2022 version of TED https://conference-board.org/data/economydatabase/. We use the 2021 version of EU KLEMS, released by LUISS Lab of European Economics, https://euklems-intanprod-llee.luiss.it/. We use the OECD productivity statistics downloaded in May, 2022, available at http://www.oecd.org/sdd/productivity-stats/. The database by Bergeaud, Cette and Lecat at http://www.longtermproductivity.com/ could also have been included in the comparison, however it differs from the other productivity databases in that in distinguishes only two capital asset types. See Bergeaud *et al.* (2016).

Chart 1: Range of Average Annual MFP Growth Across Databases, 2000-2007



Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.
Notes: the chart shows for each country a bar ranging from the smallest to the highest average annual growth rate for the 2000–2007 period across the four databases, PWT, TED, EU KLEMS and OECD. Countries are ordered by the average growth rate across the four databases. Also included are the growth rates in each database; note that in some cases two databases show the same average growth rate. Spain has been omitted from this comparison, due to problems in the OECD capital stocks data, resulting in unreliable capital stock estimations with extreme growth rates for methods 3 and 4 in the analysis. See Appendix Table 1 for the full data.

comparison, without making value judgments on the choices made by each of the databases.

We find that the MFP growth discrepancies are not driven by differences in the growth of GDP (for instance due to data vintage differences) or the growth of hours worked between the databases but are primarily driven by differences in the measured growth of capital services. Differences in the contribution from labour composition changes also lead to differences in MFP growth, but the size of those differences is generally smaller than for capital. Furthermore, there are substantial differences in methodological choices across the databases, which motivates our empirical exercise of gradually harmonizing capital measures.

In the remainder of this article, we discuss the general growth accounting methodology of all four databases (Section 1), provide a comparison of results and methods (Section 2), illustrate how much harmonization of different methods reduces differences (Section 3) and conclude (Section 4).

Growth Accounting Framework

For the estimation of MFP, each of the four databases follows the basic growth accounting methodology, based on the work by Solow (1957), Jorgenson (1963) and Jorgenson and Griliches (1967). In this framework the growth of MFP is defined as the growth of output not accounted for by the contribution from growth of labour and capital inputs used in production:

$$\partial MFP = \partial Y - (1-\alpha)(\partial H + \partial LC) \\ -\alpha \sum_i w_i \partial K_i \quad (1)$$

Where $\partial MFP \equiv \log(MFP_t/MFP_{t-1})$ denotes the log growth of MFP, and likewise ∂Y, ∂H, and ∂LC denote the log growth of GDP, hours worked, and the composition of labour input; all expressed in quantity/volume terms. α denotes the output elasticity of capital, and we assume a constant returns to scale production function, so $(1-\alpha)$ is the output elasticity of labour. Assuming cost minimization by producers and perfect competition in factor and output markets, the marginal product of an asset will equal its marginal cost. In that case, we can measure the output elasticities using the share of each input's income in total GDP. One of the main contributions of Jorgenson and Griliches (1967) was to clarify how to account for heterogeneity in labour and capital. The basic logic is the same, the marginal product of each type of labour or capital should equal marginal costs.

In equation (1), we explicitly distinguish different types of capital input, so that $\sum_i w_i \partial K_i$ reflects the weighted aggregate growth rate of the capital stocks, ∂K for i assets, where w_i are capital cost shares. We will refer to this weighted aggregate growth of capital stocks as capital services growth throughout the remainder of this article. Note also that α and w_i will vary over time; all four databases account for this using a Törnqvist index, where the output elasticity is measured as a two-period average cost share, which implies replacing, e.g. α by $\overline{\alpha}_t = \frac{1}{2}(\alpha_t + \alpha_{t-1})$.

While capital stocks by asset type are available from official statistics, productivity databases typically employ some type of harmonization procedure to estimate capital stocks that are consistent across countries and reflect capital assets relevant for production. We discuss the choices that are made by each of the databases in the next section. The most commonly employed method in capital stock measurement is the Perpetual Inventory Method (PIM), which starts from a starting capital stock for a particular asset i, and builds up the capital stock for succeeding years as follows:

$$K_{i,t} = (1-\delta_i)K_{i,t-1} + I_{i,t} \quad (2)$$

Where $K_{i,t}$ denotes the estimated stock in year t for asset type i, $K_{i,t-1}$ the capital stock in the previous year, δ_i the time invariant geometric depreciation rate of asset type i, and $I_{i,t}$ the investment in asset type i at time t.

The share in capital costs of capital type w_i also needs to be estimated in order to calculate capital services from the capital stocks. Within the growth accounting framework, the user cost of capital is derived by multiplying a rental price, $p^K_{i,t}$ by the asset's capital stock $K_{i,t}$. This rental price reflects the price at which the investor is indifferent between buying the asset and selling it at the end of the period or rent-ing the capital good for a one-year lease in the rental market (e.g. OECD, 2009). The cost-of-capital equation shows this relationship as a function of investment prices, depreciation, and the rate of return, in the absence of taxes:

$$p^K_{i,t} = p^I_{i,t-1} \cdot r_t + p^I_{i,t} \cdot \delta_i - p^I_{i,t-1} \cdot (p^I_{i,t} - p^I_{i,t-1}) \quad (3)$$

Where $p^I_{i,t}$ denotes the investment price of asset type i at time t, δ_i the geometric depreciation rate of asset type i, and r_t the (nominal) rate of return at time t. As discussed in the next section, the rate of return can be the (ex-post) rate of return that exhausts the part of GDP not accruing to labour (the internal rate of return) or an (ex-ante) assumed rate of return. A more complete expression of the rental price should also consider the tax treatment of investment, depreciation, and capital income (Hall and Jorgenson, 1967). However, none of the four databases under consideration incorporate these tax factors in their calculations, so we omit these in our further discussion.

The contribution of capital services growth in equation (1) is equal to $\alpha \sum_i w_i \partial K_i$, but for our comparison of databases, we rely on a modified decomposition that (partially) accounts for the endogeneity of capital accumulation:

$$\partial Y - \partial H = \frac{\alpha}{1-\alpha}\left(\sum_i w_i \partial K_i - \partial Y\right) + \partial LC + \frac{\partial MFP}{1-\alpha} \quad (4)$$

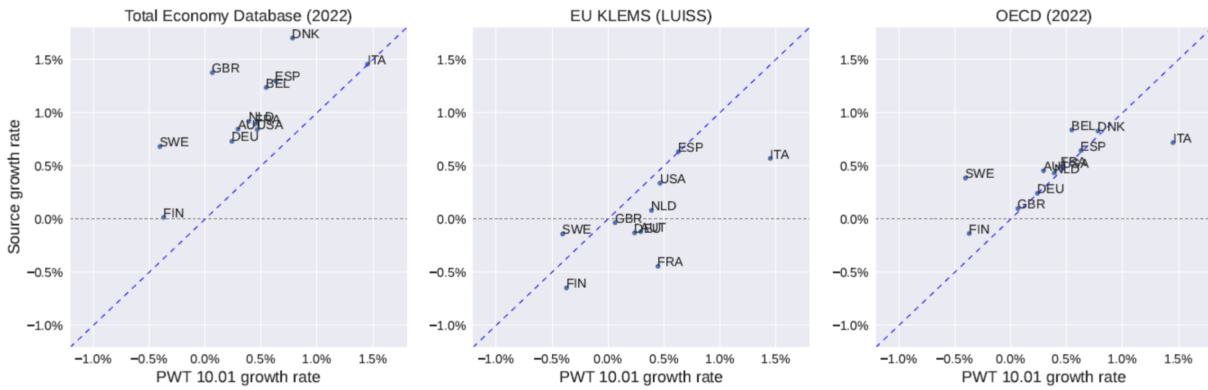
As discussed in Fernald and Inklaar (2020), this expression is useful because in many models the capital-output ratio is stationary in steady state (though possibly with a trend if there are trends in the relative price of investment goods). Slower growth in technology and labour naturally lead to a lower path for both capital and output, but, in neoclassical models, will not show up as a decline in the capital-output ratio. Thus, the capital-output ratio can help diagnose whether there are special influences that reduced capital relative to output.

All four databases in our analysis apply a growth accounting methodology that is well-described using equations (1) – (4) and we can calculate the contribution of capital services growth to labour productivity growth, $\alpha/(1-\alpha)(\sum_i w_i \partial K_i - \partial Y)$, from equation (4); henceforth, the capital contribution. Yet implementing these equations requires a series of methodological choices that have a substantial impact on the results.

Comparing Results and Methods

In Chart 2 we show that the capital contribution varies substantially across the four databases. In this article we dig deeper into these differences and investigate the potential causes. We focus on a set of ten Western European countries and the United States, since the underlying data for these countries adheres to the same SNA definitions, with a high level of statistical quality. Furthermore, we compare the results averaged for the period 2000-2007, a relatively recent period, which

Chart 2: Contributions of Capital Services per unit of Output to Labour Productivity Growth, Compared Against PWT 10.01



Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.
Notes: the figure shows the average annual contribution of capital services to labour productivity growth for the period 2000–2007, based on equation (4). The blue dashed line is the 45-degree line.

means differences in the statistical source material are minimized.[4] The period is chosen to end before the Global Financial Crisis. This choice is to avoid a situation where differences in the vintage of National Accounts data need careful attention. We find that differences in capital measurement methods can account for one-third of differences in MFP growth across databases. Differences in choices on basic data, such as whether to use official estimates of capital stocks directly or estimate capital stocks using a harmonized method from official data on investment, as well as differences in labour composition change, lead to a continued wedge between the databases. Furthermore, accounting for part of the differences in MFP growth rates does not imply we can more narrowly pinpoint 'true' MFP growth, but rather that we better understand the sources of the differences.

Given that we compare four databases, there are six unique pairwise comparisons we can make. Since our main empirical exercise is to show how the harmonization of capital measurement affects cross-database differences, a full set of pairwise comparisons becomes even more complex. For that reason, we select PWT as our point of reference for most of this article. This is not to argue that its methodological choices are superior to those of other databases as methodological harmonization could also have been done towards other databases. Having a single point of reference can be hazardous since two databases that both differ markedly from PWT, may be very similar to each other. We will thus also include pairwise comparisons in our detailed discussion of results in Section 3.

Each of the databases has published documentation regarding the data sources, as well as the methodology used to calculate the productivity statistics. In this article we focus on the key areas in which dif-

4 An analysis for the more recent 2008–2019 period shows very similar patterns of differences between databases.

ferent methodological choices can and are being made by each database, specifically about the estimation of capital stocks and services. These choices, while motivated by economic theory and purpose of the analysis, are to some extent arbitrary and depend on subjective views on how MFP can best be measured. The current document can also be viewed as a sensitivity analysis with respect to these differences in methodological choices and differences in the sources and use of the data.[5]

Since the data source for output and labour in the current set of countries is the National Accounts (NA), the data for these variables is very similar across each of the databases, as can be seen from Chart 3, which compares average annual labour productivity growth across the databases. This confirms our expectation that this is a period for which differences due to, for example, NA revisions are of secondary importance. Given this result in Chart 3, we focus on the data for the capital stocks and investment in the main text. In Appendix Table 3 we also provide a comparison of differences in labour composition change. For most countries, the differences are smaller than for capital services though there are some remarkable results that would benefit from closer scrutiny.

The National Statistical Institutes (NSIs) for the countries in our comparison publish capital stocks by asset type in current and constant prices, which can lead to cross-country differences because the methods that NSIs use may differ. This could be a benefit, for example, if the service lives of assets would differ by countries and the NSIs would incorporate this country-specific information in their data. However, there may be too little country-specific data to motivate appropriate choices and, instead it could be that each NSI simply makes the set of measurement choices that they find most appropriate.

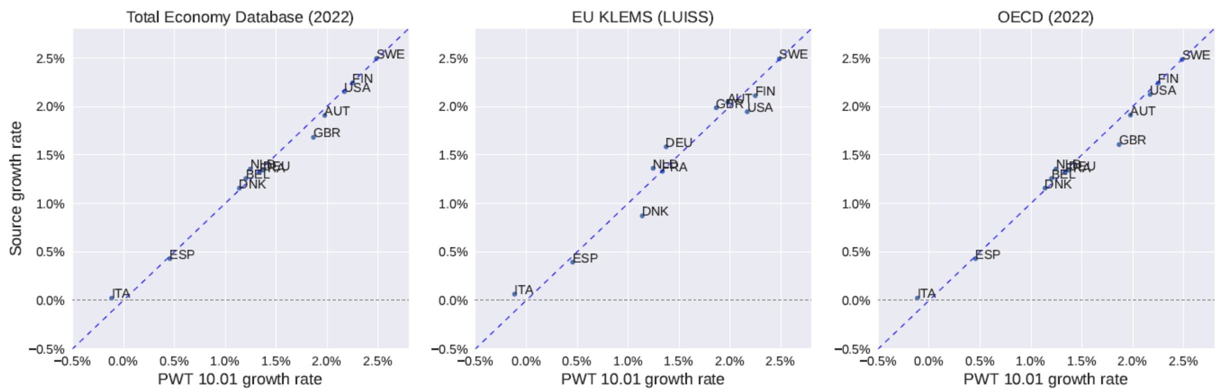
Of course, even those databases that do harmonize capital stock calculation methods will still need to rely on official statistics on investment and (typically) investment prices, so harmonization can only be taken so far. Furthermore, the official capital stock series reflect wealth capital stocks, but when doing productivity analysis, we are interested in the productive capacity of the capital stock.[6] So even when relying on official statistics for wealth stocks, as EU KLEMS does, methodological choices regarding user costs of capital will need to be made. In other words, the difference between databases is not one of 'harmonize or not' but the degree to which harmonization takes place.[7]

5 For a description of the methods of the four databases, see PWT, OECD, TED, EU KLEMS [accessed: May 2023]

6 For an overview of the difference between productive and wealth capital stocks, see OECD (2009). In brief, equation (2) provides estimates of wealth stocks, while accounting for differences in the user cost of capital using equation (3) is needed to measure productive stocks.

7 The analytical module of the EU KLEMS database does provide growth accounting estimations based on a harmonized measure of the capital stocks, but it also includes additional intangible asset types that are not part of the national accounts, which complicates a comparison with the other databases. A growing number of countries provide official statistics on MFP growth, but coverage is still much less extensive than in the databases covered here.

Chart 3: Average Annual Labour Productivity Growth, 2000-2007



Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

For the estimation of harmonized wealth stocks, the OECD, PWT and TCB databases typically start out from an initial capital stock and build up the time series using investment series from the national accounts. The key elements in constructing productive capital stock estimates are:

- Choice or estimation of the initial capital stock,
- The combined retirement/age-efficiency profile of assets, reflected in the depreciation rate,
- Information on investment and asset prices.

Table 1 below presents a stylized overview of the methods used by each of the productivity databases under consideration for their capital stock estimations. The first three sets of choices ('initial stocks', 'build up capital stock' and 'deflators') all affect the capital contribution primarily through the estimation of capital stocks by asset, i.e. equation (2). The final choice, on rental prices, affects the capital contribution through equation (3), through different w_i, and (4), through different α.

As can be observed from Table 1, PWT, TED and OECD employ a version of the Perpetual Inventory Method (PIM) for constructing capital stocks. Table 2 gives an overview of the assets covered by each database, along with the (implied) geometric depreciation rates used. Note that OECD does not include residential structures or cultivated assets in productivity estimations. This leads to an inconsistency between the growth of output, which does include value-added growth in the residential real estate industry, and the growth of inputs, which omits the key input in the residential real estate industry.[8]

EU KLEMS relies on capital stocks from official statistics, so they do not construct a PIM-based capital stock. But for computing the user cost of capital, the depreciation is an important input. As discussed in Pionnier, Belén and Baret (2023), depreciation rates applied in official statistics vary considerably across countries, which can account for some of the cross-country

8 Additionally, none of the databases include land or inventories, which creates the same inconsistency.

Table 1: Capital Stock Estimation, Methodology Overview

	PWT	TED	OECD*	EU KLEMS
Initial capital stock	1950 capital/ output ratio with long run PIM approach*	Harberger steady-state assumption	Long run PIM approach, based on (confidential) historical GFCF data**	
Build up capital stock	Geometric depreciation rates, see Table 2	Geometric depreciation rates, see Table 2***	Hyperbolic age-efficiency profile; retirement profile normal distribution; average service life, see Table 2.****	EU KLEMS takes the investment and capital stock series, including implicit deflators, directly from EUROSTAT, for the derivation of the rental price, geometric depreciation is used, see Table 2
Deflators	Investment prices, hedonic adjustments for ICT	Investment prices, special hedonic adjustments for ICT*****	Investment prices, hedonic ICT deflators******	
Rental price	Ex-post (internal rate of return)	Ex-post (internal rate of return)	Ex-ante (4 per cent real rate plus inflation)	Ex-post (internal rate of return)

Source: compilation by authors based on database documentation; see footnote X for further details. [NB: see specific comments 11 for the new footnote with links to documentation]

Note: * Inklaar, Woltjer and Gallardo Albarrán (2019).

** This information was received from bilateral exchanges with the OECD Productivity Statistics team.

*** In PWT, assets are assumed to be used in production during the year in which the investment is made. To reflect this, half of current year's investment is depreciated, so equation (2) is implemented as:
$K_{i,t} = (1 - \delta_i)K_{i,t-1} + I_{i,t} - \frac{1}{2}\delta I_{i,t}$

**** OECD (2021).

***** Byrne and Corrado (2019).

****** Schreyer (2002); Colecchia and Schreyer (2002).

Table 2: Geometric Depreciation Rates

Asset Code				Rate (%)			
OECD	**EU KLEMS**	**TED**	**PWT**	**OECD***	**EU KLEMS**	**TED**	**PWT***
N111321	IT	hard	IT	31.2	31.5	31.5	31.5
N111322	CT	com	CT	11	11.5	11.5	11.5
N1122	Soft	soft	SOFT	33.3	31.5	31.5	31.5
N1113O	OMach	nonITmach	OMach	11.4	13.1	12.6	12.6
N11131	TraEq	tra	TraEq	11	18.9	18.9	18.9
N1111	RStruc	str	RStruc	n.a.**	1.1	2.5	1.1
N1112	OCon	str	OCon	2.5	3.2	2.5	3.1
N1114	Cult	Not available	CULT	n.a.**	20		12.6
N1124	RD	Not available	RD	10	20		15
N112X	OIPP	Not available	OIPP	14.3	13.1		15

IT: information technology; CT: communication technology; SOFT: software; OMach: other machinery; TraEq: transportation equipment; RStruc: residential structures; OCon: other construction; CULT: cultivated assets; RD: research and development; OIPP: other intellectual property products.

Source: compilation by authors based on database documentations; see footnote X for further details. [NB: see specific comments 11 for the new footnote with links to documentation]

* OECD reports the following average service lives in years: IT 7; CT, OMach 15; OCon 40; Soft 3; RD 10; OIPP 7.

For the purposes of this article, service lives are converted to geometric rates using the Declining Balance Rates (DBR) from Fraumeni (1997). No DBR are available for Soft, RD and OIPP, so they are assumed to be 1.

DBR's used: IT 2.1832; CT and TraEq 1.65; OMach 1.715; OCon 0.8892.

** Not available in the OECD productivity database.

*** PWT uses detailed assets in this table for its calculations. Data for the following four groups of assets are published: structures, machinery and equipment, transport equipment, and other assets.

differences in capital growth. Furthermore, EU KLEMS introduces an inconsistency by (implicitly) using one set of depreciation rates for their capital stocks and another one for the user cost of capital.

Investment at current prices and investment deflators are available from National Accounts statistics, but for information and communication technology (ICT) assets, the use of harmonized deflators based on better quality-adjusted price data for the United States is often used.

The PWT, TED, and EU KLEMS databases calculate r_t from equation (3) by estimating an internal rate of return, i.e. the rate of return that exhausts the part of GDP not accruing to labour. We refer to this as the ex post method since the return is determined based on realized capital income. By contrast, the OECD employs an ex-ante approach where the real rate of return is fixed at 4 per cent and this is converted to a nominal rate of return by adding the 5-year centered moving average of changes in the national Consumer Price Index (OECD, 2021). Using the ex-post version of equation (3) ensures that factor costs sum to total output. Using the ex-ante method, capital costs can be notably lower than GDP minus labour compensation, leaving 'factorless income' (Karabarbounis and Neiman, 2019) or 'pure profits' (Hall, 1990; Barkai, 2020). If factorless income/pure profit is positive, the capital contribution will typically be lower under the ex-ante method than the ex-post method because the assumed output elasticity of capital, α, is lower.[9]

The Impact of Harmonizing Capital Measurement

As discussed in the introduction, we have chosen to take the 2000-2007 average of the growth accounting results for each of the databases, for a set of ten western European countries and the United States. To assess the importance of different methodological choices, we recalculate the results for each of the databases, using four levels of methodological harmonization:

M1. **No harmonization:** Calculating capital services contributions per unit of output based on the reported capital services index and labour share $(1-\alpha)$ in total factor costs from the database, using equation (4).

M2. **Recalculate capital services:** Recomputing capital services contributions based on reported capital stocks by asset and a harmonized ex-post capital services method, using equations (3) and (4).

M3. **Recalculate asset stocks:** Reestimating capital stocks using a harmonized PIM method, based on reported investment series by asset, using equation (2) and using the reported 1995 stocks as the starting stocks. From these series we calculate capital services contributions, as in M2.

9 A smaller effect is that assets with a high depreciation rate will have a relatively higher share, w_i, in total capital because the ex-ante rate of return is lower than the ex-post rate of return. The overall difference in capital contribution depends on the difference in growth between high-depreciation assets and low-depreciation assets.

M4. **Impose common labour shares:** Recomputing capital services contributions based on reported investment series by asset, using harmonized PIM stocks as in M3, harmonized ex-post capital services method as in M2, and using the PWT labour share $1 - \alpha$.

These four methods are best seen as cumulative harmonization steps. Our starting point, M1, is the capital contribution from each database, with M2 we harmonize the user cost equation, with M3 we also harmonize the calculation of capital stocks and with M4 we also impose common labour shares. We would thus expect that under M4, differences across databases are at their smallest as all harmonization steps are implemented at the same time.

Harmonization means that one database's methodological choice is applied to all others, which could be seen as expressing a conceptual preference for that database's choice. That is not the intention of our exercise, the intention is rather to assess the quantitative importance of each choice for cross-database differences. We use PWT's measurement choices as our point of reference for the capital services method (step 2), the PIM method and depreciation rates (step 3) and the labour shares (step 4) but could have done the same exercise using another database's choices. In summarizing our results, below, we will not only show the differences of each database vis-à-vis PWT (as the point of reference, see Table 3) but also vis-à-vis each other (Table 6).

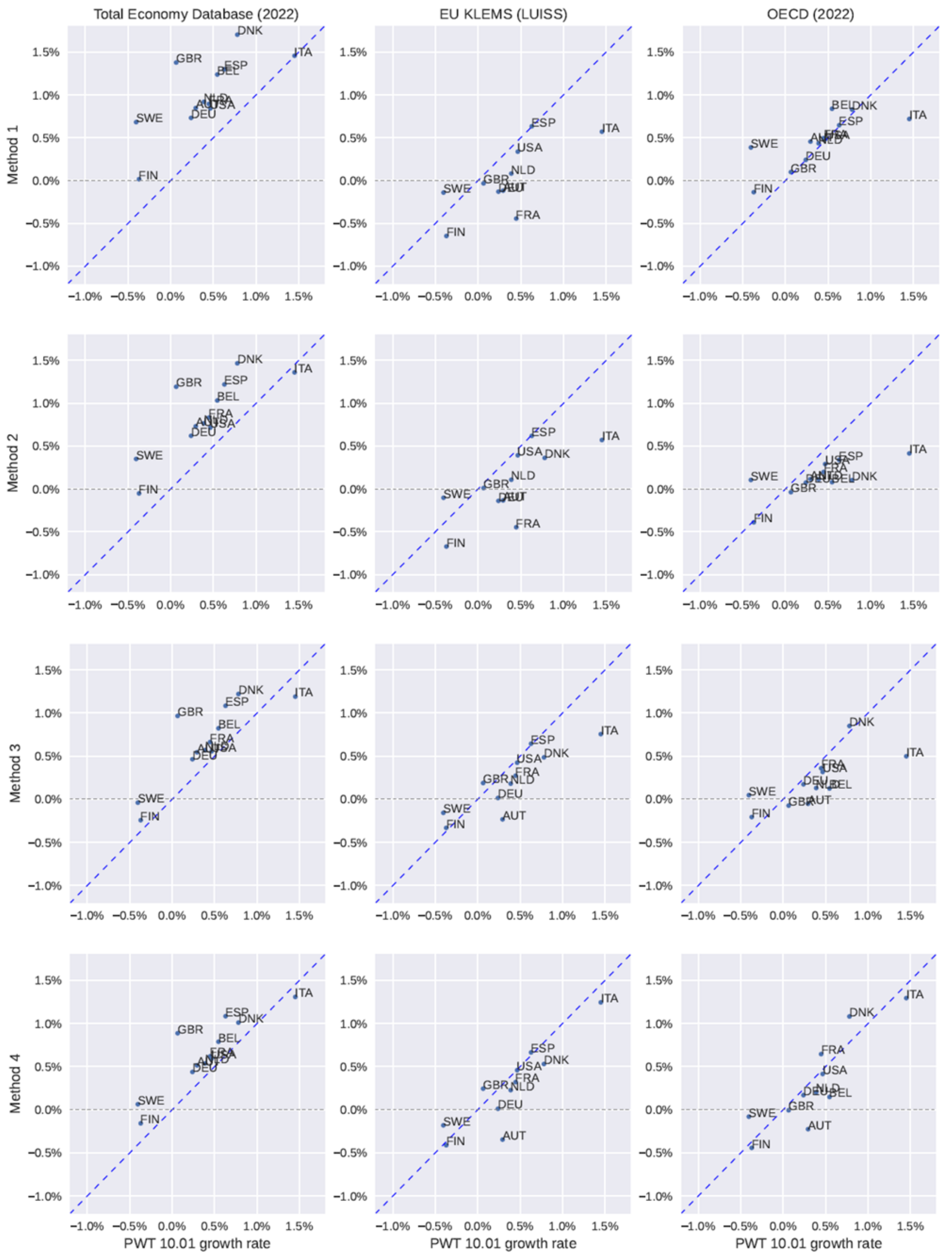
We expect that each step of further harmonization will reduce the differences between the databases. To illustrate the differences, we show in Chart 4 scatter plots with comparisons of the other three databases to PWT for each of the four harmonization steps, in Table 3 we provide summary statistics associated with each scatter plot, namely the average difference and the square root of mean squared differences.

It should be noted that OECD Productivity Data Base (PDB) does not publish the productive stocks on which their capital services estimates are based. However, investment series used in this database are available from Table 8A in the OECD National Accounts (NA) database. Therefore, we use the wealth capital stocks by asset as reported in Table 9A of the OECD NA database, for harmonization method 2. For methods 3. and 4. we take the 1995 stock values as the initial stock. These stocks include values for residential structures and cultivated assets, which are not included in OECD. Additionally, the labour share $1 - \alpha$ is not reported directly in OECD PDB. Therefore, they have been calculated from the reported growth contributions such that the M1 calculations result in MPF growth rates that are fully consistent with those reported in the database.

Method 1: No Harmonization

The first row of Chart 4 replicates Chart 2, comparing the growth contribution of capital services per unit of output to labour productivity growth across databases. These values have been derived directly from the reported growth of output, hours worked, labour and capital services, as well as the derived or reported shares of labour compensation in value added. We refer to this as the first

Chart 4: Capital Services Contributions at 4 Levels of Harmonization



Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

Notes: See main text for details of the harmonization methods.

Table 3: Capital Contribution Differences Relative to PWT (in percentage points)

Comparison database:	TED		EU KLEMS		OECD	
Summary statistic:	Average difference	(Mean sq. differences)0.5	Average difference	(Mean sq. differences)0.5	Average difference	(Mean sq. differences)0.5
Method 1	-0.62	0.71	0.34	0.44	-0.09	0.35
Method 2	-0.47	0.55	0.34	0.46	0.26	0.45
Method 3	-0.26	0.37	0.18	0.31	0.16	0.38
Method 4	-0.25	0.33	0.13	0.25	0.06	0.26

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.
Note: Average difference: contribution from PWT 10.01 minus contribution from the comparison database
(Mean sq. differences)$^{0.5}$: square root of mean squared differences

method of recalculation (M1).

The estimated capital contributions in TED are systematically higher than that of PWT, but also higher than the other two databases. Most striking are the growth contributions for the UK, Denmark and Sweden where the difference in contribution exceeds 1 percentage point and changes sign for Sweden.[10] EU KLEMS reports capital contribution that are lower than those of PWT, apart from Sweden. Italy and France are the countries for which the largest differences can be observed, as seen by the vertical distance to the 45-degree reference line. Results for OECD are more in line with what PWT is reporting, although Sweden is again an outlier, changing sign from a negative contribution in PWT to a positive contribution in the OECD results. Similar to EU KLEMS, OECD also shows an almost full percentage point lower capital contribution for Italy than PWT. The results of three additional methods of recalculation are shown in the other rows of Chart 4, which are discussed in the next sections. Table 3 reports the average growth difference and the square root of mean squared differences for each method by database pairing, giving us measures of deviation from the PWT growth rates for each database.

Method 2: Recalculation of Capital Services with Reported Stocks

In the second step we harmonize the calculation of capital services growth starting from the reported capital stocks by asset type from each of the databases. For the calculation of capital compensation by asset type, we use the PWT geometric depreciation rates mapped to the assets of the other databases, shown in Table 2. The rates reported to have been used by the other databases are reported as a reference, and they are generally quite similar. Additionally, we use investment deflators in the calculations, even though for EU KLEMS implicit stock deflators are available.

The row for Method 2 in Chart 4 and Table 3 shows that the recalculation of capital services has not brought the results of TED and PWT much closer, but the average difference did decrease somewhat. The

10 There have been considerable revisions in the latest version of the ONS data, which can be found here: https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/datasets/multifactorproductivityexperimentalestimatesreferencetables

difference in capital services contributions for EU KLEMS and PWT have stayed the same compared to Method 1, indicating EU KLEMS and PWT methodology for calculating capital services contributions are virtually identical.

The recalculation based on reported stocks has resulted in more divergence of the OECD and PWT contributions. Clearly taking the wealth capital stocks from OECD National Accounts database produces results quite different from using OECD's unpublished productive capital stocks. As noted above, OECD does not include residential structures in its measure of capital services. Therefore, part of the divergence from Method 1 to Method 2 can be attributed to the inclusion of residential structures in the capital services measure. Finally, as mentioned in section 2, OECD uses an ex-ante exogenous rate of return to calculate capital services. These results imply that PWT, TED and EU KLEMS use a similar approach to calculating capital services, which also follows from the documentation.

Method 3: Recalculation of Capital Services Using PIM Stocks

Going one step further in the harmonization of the calculation methods, we recalculate the capital stocks based on the investment by asset from the reported 1995 capital stocks, applying the Perpetual Inventory Method (PIM) in the same way across data sources. We apply the PWT method where half of the current years' investment is depreciated and use the PWT geometric depreciation rates as reported in Table 2.

The row for Method 3 in Chart 4 and Table 3 shows that the harmonized recalculation of capital services as well as the capital stock has brought the results of the databases closer together relative to Methods 1 and 2 for TED and EU KLEMS, and relative to Method 2 for OECD. For the TED the average difference in the capital growth contribution has been reduced by 0.21 percentage points compared to Method 2, but this is not immediately clear from the chart, which suggests that this convergence is spread over all countries. For EU KLEMS the results are also moving closer to PWT, as is visible from the plot, where the countries are moving closer to the 45-degree reference line. For the OECD the results are moving closer to the Method 1 results, with Italy still being an outlier.

Thus, harmonizing the calculation of the capital stocks across databases brings the results of each database closer to PWT. For EU KLEMS this could be expected given that they use official capital stocks, directly from the NSIs, without any harmonization. For OECD this method suggests that the harmonized PIM stocks come closer to OECD's own unpublished measures of productive capital stocks. For TED the increased convergence to PWT contributions is somewhat puzzling, given that the methods as presented in Table 1, as well as the depreciation rates in Table 2, for TED and PWT are quite similar.

Method 4: Recalculation of Capital Services Using PIM Stocks and PWT Labour Shares

In a final attempt to bring the results closer together and harmonize the methods of calculation one step further, we ap-

Table 4: **Average Share of Labour Compensation in Total Factor Costs (in %), 2000-2007**

	PWT	TED	EU KLEMS	OECD
AUT	57.5	54.9	66.0	72.0
BEL	61.5	59.7		75.6
DEU	62.3	59.9	67.1	71.4
DNK	63.6	56.3	65.9	72.1
FIN	56.7	52.1	63.2	74.8
FRA	61.7	58.7	67.1	76.1
GBR	59.6	56.0	64.5	78.7
ITA	50.5	53.2	62.8	72.7
NLD	60.9	57.5	67.3	74.6
SWE	53.0	49.1	54.7	69.1
USA	62.0	65.8	65.0	77.0
Average	59.0	56.6	64.4	74.0

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.
Notes: The table shows the share of labour compensation in total costs. For PWT, TED and EU KLEMS, labour plus capital costs are assumed to be equal to GDP, for the OECD the use of an exogenous rate of return means that labour plus capital costs may be less (or more) than GDP.

ply the PWT labour shares, instead of the reported shares. The application of PWT labour shares has only a small impact on the comparative results of TED and EU KLEMS, although the capital services contribution for Italy has moved much closer to the PWT result for EU KLEMS.

For OECD, using the PWT labour share, reduces the square root of mean squared differences to 0.26 per cent, the lowest value across the four methods. This is mainly due to the effect this adjustment has on the outliers in the previous three methods. Italy has moved up to the PWT level of capital services contribution and has been completely removed as an outlier. To a lesser extent the same can be said for Sweden, comparing Method 1 and 4. Conversely, results for Austria and Denmark now diverge a bit more from PWT, as compared to Method 1, but since their results were more comparable to PWT to begin with, this has less effect on the square root of mean squared differences.

This suggests there are considerable differences in the calculations of the labour share across these databases. Table 4 shows the average share of labour compensation in value added for the 2000-2007 period, and indeed confirms this finding. As shown in the bottom row, OECD reports a labour share that is on average 15 per cent higher than PWT, for this set of countries. TED reports labour shares that are roughly similar to PWT, and EU KLEMS is in the middle between PWT and OECD.

As discussed in the previous sections, the higher OECD labour share can be explained, by the presence of factorless income in an ex-ante framework, which leads to a lower estimate of capital compensation, and conversely a higher labour share in total factor costs. EU KLEMS calculates the labour share by assuming the self-employed, on average, earn the same hourly wages as employees. For certain sectors such as agriculture, this method tends to overstate labour costs, which leads to higher labour shares. PWT uses mixed-income as a proxy for the income of the self-employed. Lastly, TED uses the same approach as PWT, but calculates the labour share as a percentage of GDP at market prices which includes net taxes on

Table 5: Average Growth of Aggregate Investment Prices (in %), 2000-2007

	PWT	TED	EU KLEMS	OECD
AUT	0.8	0.7	1.5	1.5
BEL	1.0	0.4		1.7
DEU	0.0	0.0	0.3	0.3
DNK	1.3	0.1	2.1	2.1
FIN	1.9	2.1	2.3	2.3
FRA	1.8	1.5	2.3	2.3
GBR	1.9	-0.7	2.2	2.7
ITA	2.0	1.1	2.5	2.5
NLD	1.7	0.6	2.2	2.2
SWE	0.8	-0.6	1.4	1.5
USA	2.1	1.5	2.1	2.1
Average	1.4	0.6	1.9	1.9

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

products, yielding labour shares that are slightly lower than in PWT.

The TED capital contributions are generally higher than for the other databases. This can be traced to the application of alternative hedonic ICT investment deflators, which results in a significantly lower aggregate price inflation of investment as can be seen from Table 5. This in turn leads to higher capital stock growth and therefore higher capital services growth.

Comparing the results in Chart 4 and Table 3 for Methods 1 and 4, shows that increasing the harmonization of calculations reduces cross-database differences in the contribution of capital to growth. The average difference is smaller, in particular for EU KLEMS and TED, and the root mean squared difference is considerably smaller for all three comparisons. The first harmonization step, which harmonizes the capital services calculation from given stocks (Method 2 versus Method 1) has an ambiguous effect on cross-database differences, increasing the root mean squared difference for the comparison of PWT to OECD and EU KLEMS and reducing it for the comparison to TED.

The second harmonization step, which recalculates capital stocks reduces differences for all three comparisons and is the most substantial step for the comparison of PWT to EU KLEMS and TED. For those two comparisons, the third harmonization step, which imposes the same labour shares, leads to a more modest reduction in cross-database differences. This third step is very important for the OECD-PWT comparison. This is unsurprising as the OECD's labour share estimates in Table 5 differ substantially from the other two.

A downside of looking at these separate harmonization steps is that, taken in isolation, they may introduce inconsistencies. For example, the OECD uses an ex-ante rate of return to calculate capital costs and the labour share is equal to labour compensation divided by labour compensation plus capital costs. The other databases rely on an internal rate of return, which is set so that total capital cost adds up to GDP minus labour compensation. The difference in Table 4 is best understood as showing that capital costs are notably lower than GDP minus labour compensation, leaving substantial 'factorless income' (Karabarbounis and Neiman, 2019) or 'pure profits' (Hall,

Table 6: Root Mean Squared Differences of Capital Contributions for Different Reference Databases

Reference:	Comparison: TED	EU KLEMS	OECD
Method 1			
PWT	0.71	0.44	0.35
TED		0.87	0.61
EU KLEMS			0.43
Method 4			
PWT	0.33	0.25	0.26
TED		0.42	0.43
EU KLEMS			0.22
Difference: Method 4 – Method 1			
PWT	-0.38	-0.19	-0.09
TED		-0.45	-0.18
EU KLEMS			-0.21

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.
Notes: The table shows root mean squared differences of the contribution of capital services growth to labour productivity between databases. The first column shows the reference database, across the rows the comparison databases are shown. The Methods refer to the harmonization steps, from no harmonization, Method 1, to the fullest harmonization (in this article), Method 4; see the main text for the full description.

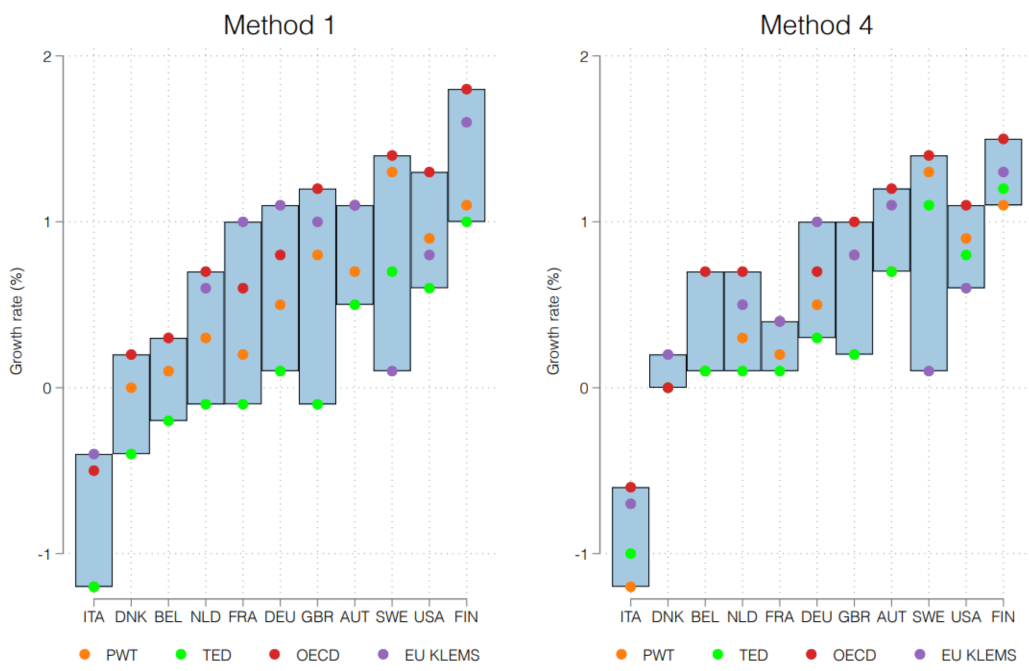
1990; Barkai, 2020). In Method 2 only the capital services calculation is changed while that change also impacts the factor shares, so both should be adjusted for a harmonized comparison between the databases.

Table 4 has PWT as the point of reference for both the harmonization steps and the comparison. In Table 6 we show how the root mean squared differences vary with different reference databases for the comparison. The first row under Method 1 shows the root mean squared differences from Table 3, comparing each database to PWT. In the second row, the comparison is made with TED contribution, in the third EU KLEMS is the point of reference. We show only the original contributions (Method 1), the final step in our harmonization (Method 4) and the difference (Method 4 – Method 1).

These results show that comparisons with TED have the largest differences to other databases, under Method 1 (0.71 points, 0.87 points and 0.61 points) and Method 4 (0.33 points, 0.42 points and 0.43 points). The large root mean squared difference that remains after our harmonization steps (i.e. Method 4) is most likely due to the large difference in investment deflators (Table 5). It is not immediately clear why the harmonization steps also have the largest impact on TED (–0.38 points, –0.45 points and –0.21 points). Excluding TED comparisons shows the smaller root mean squared differences, already in Method 1 (0.44 points, 0.35 points and 0.43 points) and they are small and comparable in Method 4 (0.25 points, 0.26 points and 0.22 points).

In closing, we return to our motivating Chart 1, which showed the range of MFP growth estimates from the different databases, i.e. Method 1. We now have more harmonized capital contribution, based on Method 4, and can compute MFP growth based on these contributions. The result is shown in Chart 5, with the ranges of MFP growth from Chart 1 on the left and the ranges based on Method 4 on the right. The range of MFP growth rates

Chart 5: Range of MFP Growth Rates Across Databases, Method 1 versus Method 4.



Notes: The chart shows for each country a bar ranging from the smallest to the highest average annual growth rate for the 2000–2007 period across the four databases, PWT, TED, EU KLEMS and OECD. Also included are the growth rates in each database; note that in some cases two databases show the same average growth rate. Countries are ordered by the average growth rate across the four databases. The panel on the left, labelled 'Method 1' is based on the data from Appendix Table 1, and 'Method 4' is based on Appendix Table 2.
Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

based on Method 4 is notably smaller, on average 0.6 versus the 0.9 based on Method 1. Ranges are smaller for all countries, except Belgium (where the range was small to begin with) and Sweden, where the difference is driven by the large labour composition change shown in EU KLEMS (see Appendix Table 3). Note that these smaller ranges do not imply that we can more precisely pinpoint MFP growth. Rather, we can conclude that the capital measurement choices we focus on, can account for one-third of the differences in MFP growth rates between databases. The remainder of the differences are due to differences in capital measurement we did not harmonize (e.g. investment deflators) and differences in labour composition change.

Conclusion

As is noted by frequent users, there are considerable differences between MFP growth rates from different productivity databases. The reasons for these discrepancies are methodological, statistical, as well as country-specific in nature. The previous section has shown that differences are smaller when applying a harmonized methodology in calculating capital growth contributions to labour productivity growth. However, differences partially remain. In particular, the TED data show higher growth rates, which have been traced back to the use of alternative deflators for ICT assets.

As was mentioned in the introduction, Appendix Table 1 shows that the rankings of countries based on their average MFP growth rates is quite similar for this set of countries, despite the sizable differences in average MFP growth. Appendix Table 2 shows the same information based on the recalculated MFP growth rates using Method 4. It can be seen that after harmonization, the order of countries based on their average productivity growth rates is also quite similar across these databases.

Judging by these rankings, the user will arrive at more or less the same comparative economic performance from PWT, OECD, and TED, even though TED reports notably lower MFP growth, due to a higher capital contribution. EU KLEMS seems to be the odd one out with a few striking anomalies. The most notable example is Sweden, which PWT, OECD and TED rank as one of the fastest-growing countries while in EU KLEMS, Sweden ranks near the bottom. Appendix Table 3 shows that the contribution of labour composition for Sweden in EU KLEMS is 1.9 percentage points higher than the contribution in PWT, which explains the low MFP growth value. The difference for Germany (third place in EU KLEMS, sixth of the other databases), would also lead to very different conclusions regarding comparative economic performance.

These differences in MFP growth rates are a cause for concern, especially because it is hard for a non-expert user to trace some of the differences, let alone make a reasoned choice between databases. Each database developer has arguments and reasons for the measurement choices they make, and it is not our aim to suggest that some of those choices are better than others. Instead, our aim with this article has been to highlight some of these differences and illustrate how harmonizing some of these choices can help reduce the differences, thereby demonstrating the importance of particular measurement choices.

Of the different methodological choices, methods for estimating capital stocks and estimating the rental prices of capital seem to lead to the largest differences. We also note that the choice on ex-ante vs. ex-post user costs impacts not only rental prices but also the capital share, so taken together, this choice is quite impactful. We do not claim to be exhaustive in this analysis, as there are more detailed levels at which harmonization of capital calculations could be attempted. Furthermore, choices regarding data and methodology for labour input and labour composition also contribute to differences in measured MFP growth and we have done no more than highlight those differences. This work assesses the robustness of differences in MFP growth across countries to measurement choices, thus highlighting the continued relevance of these choices and can inform as well as caution users who try to understand differences between databases.

Yet urging caution from non-expert users seems to us an undesirable state of affairs. As indicated, in these methodological choices there is no absolute preferred option and efforts to harmonize approaches, such as through the original EU KLEMS project, have had only partial success. The overall conceptual framework for growth accounting and capital measurement has been well-established for years, so the situation where alternative, equally plausible approaches can be chosen, is likely to prevail. We would argue that the only way forward on this is through coordination between National Statistical Institutes for the next revision of the System of National Accounts. Putting this on the agenda after the current round of revisions completes in 2025 holds out hope for more coordination on capital measurement and better international comparability of MFP growth as a result.

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Appendix

Appendix Table 1: Average Annual MFP Growth and Country Ranking 2000–2007, Method 1

	PWT10.01		**Total Economy Database (2022)**		**EU KLEMS (LUISS)**		**OECD (2022)**	
	rank	average growth (%)	rank	average growth (%)	rank	average growth (%)	rank	average growth (%)
SWE	1	1.3	2	0.7	8	0.1	2	1.4
FIN	2	1.1	1	1	1	1.6	1	1.8
USA	3	0.9	3	0.6	6	0.8	3	1.3
GBR	4	0.8	8	-0.1	4	1.0	4	1.2
AUT	5	0.7	4	0.5	3	1.1	5	1.1
DEU	6	0.5	5	0.1	2	1.1	6	0.8
NLD	7	0.3	6	-0.1	7	0.6	7	0.7
FRA	8	0.2	7	-0.1	5	1.0	8	0.6
BEL	9	0.1	9	-0.2			9	0.3
DNK	10	0	10	-0.4			10	0.2
ITA	11	-1.2	11	-1.2	9	-0.4	11	-0.5

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

Appendix Table 2: Average Annual MFP Growth and Country Ranking 2000–2007, Method 4

	PWT10.01		**Total Economy Database (2022)**		**EU KLEMS (LUISS)**		**OECD (2022)**	
	rank	average growth (%)	rank	average growth (%)	rank	average growth (%)	rank	average growth (%)
SWE	1	1.3	2	1.1	9	0.1	2	1.4
FIN	2	1.1	1	1.2	1	1.3	1	1.5
USA	3	0.9	3	0.8	5	0.6	4	1.1
GBR	4	0.8	6	0.2	4	0.8	5	1.0
AUT	5	0.7	4	0.7	2	1.1	3	1.2
DEU	6	0.5	5	0.3	3	1.0	6	0.7
NLD	7	0.3	7	0.1	6	0.5	7	0.7
FRA	8	0.2	9	0.1	7	0.4	9	0.4
BEL	9	0.1	8	0.1			8	0.7
DNK	10	0.0	10	0.0	8	0.2	10	0.0
ITA	11	-1.2	11	-1.0	10	-0.7	11	-0.6

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

Appendix Table 3: Growth Contribution Differences of Labour Composition (in %)

	Total Economy Database (2022)	EU KLEMS (LUISS)
AUT	0.41	0.06
BEL	0.15	
DEU	-0.15	0.24
DNK	0.30	0.41
FIN	0.28	0.36
FRA	-0.04	0.24
GBR	0.02	0.13
ITA	0.04	0.57
NLD	-0.19	0.07
SWE	0.1	-1.90
USA	-0.04	-0.14
Average difference	0.08	0.00
(Mean sq. differences)$^{0.5}$	0.20	0.66
Excluding Sweden:		
Average difference	0.04	0.09
(Mean sq. differences)$^{0.5}$	0.21	0.29

Sources: PWT version 10.01, TED version April 2022, EU KLEMS version 2021 and OECD version May 2022; see footnote 3 for further details.

Average difference: contribution from PWT 10.01 minus contribution from the comparison database. (Mean sq. differences)$^{0.5}$: square root of mean squared differences.

OECD PDB does not provide estimations of labour composition change.

The Falling Productivity in West Asian Arab Countries Since the 1980s: Causes, Consequences, and Cures

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Abstract

This article analyzes the macro trends in real per capita GDP and productivity in 12 West Asian Arab countries, distinguishing between the oil-rich GCC economies and the non-GCC West Asian Arab economies. We use a panel data econometric analysis to understand the trade-off between productivity and job creation in the region. Further, we examine the sources of aggregate labour productivity growth in terms of a) structural change and within-industry productivity improvements and b) capital deepening and total factor productivity growth. Although the nature of productivity problems in the two groups of countries - the GCC and non-GCC West Asian Arab economies - differ, the challenges in addressing those are substantial for both. Developing a vibrant private sector that can foster productivity growth is a common challenge for both groups of countries. The inability to embrace innovation and technology and to translate investment in capital to productivity are important impediments to boosting productivity growth. Focusing on technology and innovation, continuing the efforts to diversify away from oil, and upskilling the local workforce are essential to creating more productive jobs for the native population.

The literature widely agrees on the importance of productivity for long-run economic growth (Krugman, 1994). In the neoclassical supply side perspective, global change to labour productivity growth is considered a source of sustained long-term economic growth, achieved with exogenous technological change (Solow, 1957). The demand-side explanations of the relationship between labour productivity and

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GDP growth, such as Kaldor (1966) and Verdoorn (1949, 2002), focus on the increasing rate of return, especially in the manufacturing sector. Manufacturing output growth enhances productivity both in the manufacturing as well as in the non-manufacturing sector.

Empirically, at the aggregate level, the correlation of labour productivity trends with GDP growth and per capita GDP growth is strong although not perfect.[2] Moreover, despite the multi-dimensional characteristics of economic well-being, which makes the relationship between productivity and well-being less straightforward, empirical studies establish a strong relationship between the two, suggesting productivity is a valuable indicator of welfare.[3] Attaining productivity growth at the aggregate economy level, through improved productivity in firms and industries, and also through moving resources to more efficient activities, is therefore crucial for sustaining long-run growth and welfare.

This article aims to delve into the productivity dynamics in West Asian Arab countries in terms of the trade-off between productivity and job creation, and the roles of structural change and overall efficiency gains in driving aggregate labour productivity. The Arab economies, consisting of oil-resource-rich economies with very high levels of per capita GDP, and impoverished non-oil economies, are generally classified as emerging and developing economies (IMF, 2022). While the oil-rich economies suffer from institutional weakness and resource dependency, the non-oil Arab countries share the usual challenges that many developing economies face, such as poverty, corruption, weak infrastructure, and lack of physical and social capital, alongside institutional weakness. In spite of the importance of productivity and structural change for economic growth these aspects are seldom considered in understanding the growth dynamics of the Arab countries.

In this article, we first provide an overview of the growth in per capita GDP and labour productivity in West Asian Arab countries since 1950. This helps us demonstrate the productivity problem that the region faces and place it in the larger global context, exposing how severe and unique the problem is in the region. Subsequently, we analyze the region's productivity problem on three different dimensions:

- The trade-off between labour productivity and employment creation in generating economic growth in the region compared to the global, emerging, and advanced economies are examined. This exercise aims to understand whether the region has been compromising on productivity

2 The term per capita GDP throughout this article refers to 'real per capita GDP' unless mentioned otherwise. The two terms - per capita GDP and real per capita GDP, may be used synonymously in the article.

3 See Oulton (2022) for a recent study. Note that while the welfare effects of productivity gains may be more apparent in productivity levels - higher productivity levels are associated with higher levels of well-being. Productivity growth, which helps countries eventually attain higher productivity levels, is considered the most important long-term source of sustainable improvement in living standards (Sharpe and Fard, 2022). Basu *et al.* (2022) further shows that when TFP is measured using prices and quantities as perceived by consumers, the welfare gaps between countries are due to TFP gaps rather than gaps in human or physical capital stocks.

by overly relying on job creation.

- The role of structural change, i.e. the relative importance of the within industry productivity growth and worker reallocation across industries, in driving aggregate labour productivity growth is analyzed., and
- The proximate sources of labour productivity, i.e. total factor productivity and capital accumulation, in the region, are examined from a comparative perspective.

The study covers 12 West Asian Arab economies: six Gulf Cooperation Council (GCC) economies, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates (UAE), and six other West Asian Arab economies, which we call 'non-GCC economies", Iraq, Jordan, Lebanon, Syria, Yemen, and the Occupied Palestinian Territory (PSE, hereafter Palestine).[4] Throughout the article, the reference to "West Asian Arab economies" or simply "Arab economies" corresponds to the aggregate of the six GCC and six non-GCC economies mentioned earlier. Note that this study does not cover any of the North African countries, which are often considered while comparing economic dynamics in the Arab world (e.g. Rauch and Kostyshak, 2009; Saleh, 2021).

The distinction between GCC and non-GCC economies is of high importance, as the productivity and growth dynamics in the two groups of countries are quite distinct. Therefore, we provide a comparative picture of the two stories whenever possible. The period of the analysis is 1950-2019, wherever the data is available.[5] Most data used in the study are from The Conference Board Total Economy database (TED), World Bank World Development Indicators (WDI), ILOSTAT, and the United Nations National Accounts Statistics (UNNAS). Since the TED does not contain Palestine, we have extended the TED data using additional data from other sources, including the Palestinian Central Bureau of Statistics (PCBS).[6]

The article is organized into six main sections. Section 1 provides an overview of the trends in GDP, per capita GDP, and labour productivity growth in the West Asian Arab economies. In section 2, the article examines the trade-offs between productivity and employment to see whether the region's employment-driven growth have negative effect on productivity. Section 3 examines the within-industry and between-industry productivity effects on aggregate labour productivity growth. Section 4 examines the role of capital deepening and total factor productivity in driving aggregate labour productivity growth. Section 5

4 In a recent study on the historical growth dynamics in the Middle East and North African economies, Saleh (2021) treats the six GCC and Yemen as the Arabian Peninsula and the other five economies (together with Israel) as the Levant. However, given the economic similarities of Yemen with the countries in the Levant group, rather than the ones in the GCC, we combine Yemen with this group and call them non-GCC economies. Saleh's study also covers Egypt, Iran, Turkey, and the North African economies (Algeria, Libya, Morocco, and Tunisia).

5 All data on per capita income and labour productivity are available for the entire period of 1950-2019 for countries other than Palestine, for which the data is available only since 1970.

6 See Data Appendix for more details.

highlights some critical challenges and opportunities for the region to achieve productivity growth. The last section concludes.

GDP, Per Capita GDP and Labour Productivity Growth in the West Asian Arab Economies

Table 1 provides the growth rates of GDP, per capita GDP, labour productivity, and employment in the GCC and non-GCC Arab countries, in comparison with advanced economies, emerging economies, and the global economy. The results are provided for six sub-periods during the last 70 years, which are 1950-1960, 1960-1970, 1970-1982, 1982-1992, 1992-2009, 2009-2019. This periodization is based on five break points identified using the Bai and Perron (1998, 2003) structural break tests in the region's GDP, per capita GDP and labour productivity (GDP per worker). Despite its limitations, Bai and Perron's approach was the most feasible approach to identify a periodization that can be used across a heterogeneous group of countries in our sample.[7] It is hard to justify using a periodization derived based on events in any of the individual countries in our sample for all countries and the region as a whole. An alternative is to use an arbitrary periodization, such as growth rates by decades. Therefore, we opted for a widely used approach to identify structural breaks in the data and use it as the basis for our periodization.

We discern several facts from the table. First, taking 12 Arab countries (six GCC and six non-GCC economies) in the region together, the period of high GDP, per capita GDP, and labour productivity growth during the seven decades since 1950 was the first two decades following the oil discovery. The region's growth acceleration during this period, which was even faster than the global growth rates, was driven by the GCC (Table 1). The oil fortune seems to have supported these countries in tapping their catch-up potential during this period. Previous studies also documented the impressive growth in the region during this period (e.g. Girgis, 1973).[8] The continued economic spin-offs from oil discovery resulting in substantial public investments in infrastructure, health, education, and public sector enterprises (Yousef, 2004), resulted in high growth in per capita GDP and labour productivity in the GCC oil-rich economies. The non-GCC Arab

7 Bai and Perron's (1998, 2003) method allows us to identify the phases of growth solely derived from the data, minimizing the residual sum of squares of the regression of the natural log of the relevant variable on the time trend over several years of the data. It should be noted that the breaks in this analysis are identified using the aggregated data for the entire region, which includes the oil-rich GCC economies and other Arab economies. Therefore, the breaks may not necessarily be aligned with country-specific events, and also, the impact of global events such as oil price rises may be lessened by the fact that we have countries with and without oil resources in the sample. However, some of these events may also have a common impact on all the countries in the region, which is more likely reflected in the breakpoints identified.

8 Girgis (1973) suggests that during 1958-1967 the Arab region grew faster than developed economies at the time and even faster than the growth rates of advanced economies during the industrial revolution. This fast growth, however, is not surprising as the region had significant potential for technological catch-up. The countries Girgis (1973) considered consisted of some countries which are not on our list (Algeria, Libya, Morocco, Sudan, Tunisia, and Egypt) and some which are on our list (Iraq, Jordan, Kuwait, Lebanon, Saudi Arabia, Syria, and Yemen).

Table 1: GDP, Per Capita GDP and Labour Productivity, Average Annual Percent Change, 1950-2019

	1950-1960	1960-1970	1970-1982	1982-1992	1992-2009	2009-2019
GDP						
World	4.9	5.4	3.4	2.8	3.3	3.1
Advanced economies	4.8	5.2	3.0	3.0	2.3	2.0
Emerging & developing economies	5.1	5.7	4.1	2.4	4.5	4.2
Emerging Asia	4.6	4.5	5.0	5.7	6.6	5.6
West Asian Arab Economies	6.9	8.5	5.9	0.5	3.8	2.9
GCC	7.3	10.4	6.4	1.9	3.4	3.4
non-GCC	6.5	5.3	6.4	-3.1	5.5	1.3
Per capita GDP						
World	3.2	3.8	2.1	1.6	2.3	2.3
Advanced Economies	3.5	4.1	2.2	2.3	1.6	1.5
Emerging & developing economies	2.7	3.4	1.7	0.6	3.2	3.1
Emerging Asia	2.5	2.1	2.8	3.8	5.4	4.8
West Asian Arab Economies	3.6	4.1	0.4	-3.4	0.1	0.4
GCC	3.6	5.1	0.1	-2.3	-0.7	1.0
non-GCC	3.8	2.1	3.2	-6.0	2.9	-1.3
Labour productivity						
World	3.4	3.9	1.7	1.3	2.1	2.1
Advanced Economies	3.6	4.0	2.0	2.0	1.5	1.0
Emerging & developing economies	2.9	3.6	1.2	0.3	2.8	3.1
Emerging Asia	2.3	2.7	1.7	3.2	5.2	5.0
West Asian Arab Economies	3.8	4.3	1.2	-3.7	-0.5	-1.0
GCC	3.5	5.1	1.1	-2.7	-1.3	-0.8
non-GCC	4.5	2.7	3.6	-6.2	2.3	-1.5
Employment						
World	1.5	1.5	1.7	1.5	1.2	1.0
Advanced Economies	1.2	1.1	1.0	1.0	0.8	1.0
Emerging & developing economies	2.1	2.1	2.9	2.1	1.7	1.2
Emerging Asia	2.3	1.8	3.3	2.5	1.4	0.5
West Asian Arab Economies	3.1	4.2	4.7	4.3	4.3	3.9
GCC	3.9	5.3	5.4	4.6	4.7	4.3
non-GCC	2.1	2.5	2.8	3.1	3.2	2.8

Note: Labour productivity is measured as GDP per worker. Growth rates are calculated as log changes. The sum of employment and labour productivity growth adds up to GDP growth. West Asian Arab Economies consist of six GCC economies (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) and six non-GCC economies (Iraq, Jordan, Lebanon, Syria, Yemen, and the Occupied Palestinian Territory). For the list of countries in the global, advanced, and emerging groups, see Appendix Table 1. Regional growth rates are a weighted average of individual country growth rates, using nominal value-added weights. All growth rates are calculated as log changes.
Source: Author calculation using The Conference Board Total Economy Database, April 2021.

economies also seem to have benefitted from exporting labour to the GCC in the early phases of oil discovery. Emigration to GCC's oil economies, which national governments of these countries have generally supported, has been a gainful opportunity to create jobs for citizens and gain remittance incomes in these countries (Kapiszewski, 2015), helping their domestic income, production, and consumption growth.

Second, with the rise in oil prices in the 1970s, growth in income, output, and productivity has weakened globally. Although it produced an initial positive effect on oil-exporting GCC economies, the effect was not sustained longer. The GCC economies witnessed a slowing growth during the 1970-1982 decade, as they seemed to have intensified their resource reliance. More importantly, the per capita GDP growth was barely positive, showing stagnation in the standard of living that they achieved during the fast phase of post-oil discovery growth. The non-GCC economies, however, did see some improvement; their productivity and per capita GDP growth improved by about one percentage point from the previous decade.

Third, labour productivity growth was quite close to per capita GDP growth in all the regions in the first two periods. That seems to have changed in the 1970s when the Arab economies in general, and the GCC in particular, showed an enormous disconnect between the two. In the rest of the world, per capita GDP grew much faster than productivity, while that did not happen in the Arab world. This implies that jobs have become increasingly less productive in the region. Although the disconnect in the region eased in the 1980s, that was accompanied by contractions in both indicators. The link, however, appears to be improving in the post-global financial crisis era.

Fourth, 1982-1992 was a decade of economic losses for the West Asian Arab countries in general, and for the non-GCC economies, in particular. The region lost much of its previously made per capita GDP and labour productivity gains. The fall in global oil demand and the subsequent decline in oil prices in the early 1980s lowered economic growth in all the GCC economies. Furthermore, with the Iraq war, the region's challenges during this period were quite high, and the Iraq economy shrunk substantially. No single country in the non-GCC economy group improved economic growth, leading to substantial deterioration in people's economic well-being.

Fifth, the long-term GDP growth improved in the Arab countries during the 15 years prior to the global financial crisis.[9] A similar rising trend is observed in the emerging markets in general during the 1992-2009 period from the previous decade. However, the improvement in the Arab world's GDP growth was not enough to offset the rise in the region's population. The GCC witnessed continued erosion in per capita GDP and labour productivity.[10] The non-GCC economies witnessed an improvement from the contraction of productivity and per capita GDP in the previous period, yet the growth rate remained lower than in the 1970s.

Sixth, in the most recent period, 2009-2019, the per capita GDP and labour productivity continued to suffer in the West Asian Arab economies, with mini-

9 The average growth rate for 1992-2009, which includes the crisis years 2008 and 2009, is lower by 0.1 percentage point, compared to the 1992-2007 (when the crisis years are excluded) growth rate for the region as a whole, with the GCC growth lower by 0.2 percentage points, and the non-GCC group showing no difference between the two periods. At the same time, the financial crisis has lowered global GDP growth by nearly half a percentage point – the average global growth for 1993-2007 (excluding the crisis years) was 3.6 percent, compared to 3.1 percent reported in Table 1. In an earlier study, Erumban and van Ark (2018) documented a more than one percentage point loss in global GDP growth due to the global financial crisis, from 4.2 per cent in 2000-2007 to 2.7 per cent in 2008-2015. Comparing the decade after the global financial crisis, 2009-2019, with 1992-2007 (excluding the crisis years 2008 and 2009), we note that the impact has been substantial even on long-term growth.

10 It may be noted that the financial crisis has further lowered the average real per capita GDP growth in the Arab region by nearly half a percentage point which was solely driven by productivity losses in the GCC. The per capita GDP growth in the West Asian Arab region (GCC) for 1992-2009 was 0.1 (-0.7) per cent compared to 0.5 (-0.1) per cent for 1992-2007. Inclusion of crisis years in the calculation of average growth rates did not change the per capita income growth rates in the non-GCC economy group. In comparison, the global economy's per capita GDP growth was lower by 0.3 percentage points at 2.3 per cent during 1992-2009 compared to 2.6 per cent growth during 1992-2007. A similar pattern exists in the case of labour productivity as well, suggesting a somewhat larger productivity-reducing impact of the crisis on the GCC compared to non-GCC Arab economies group and the global economy.

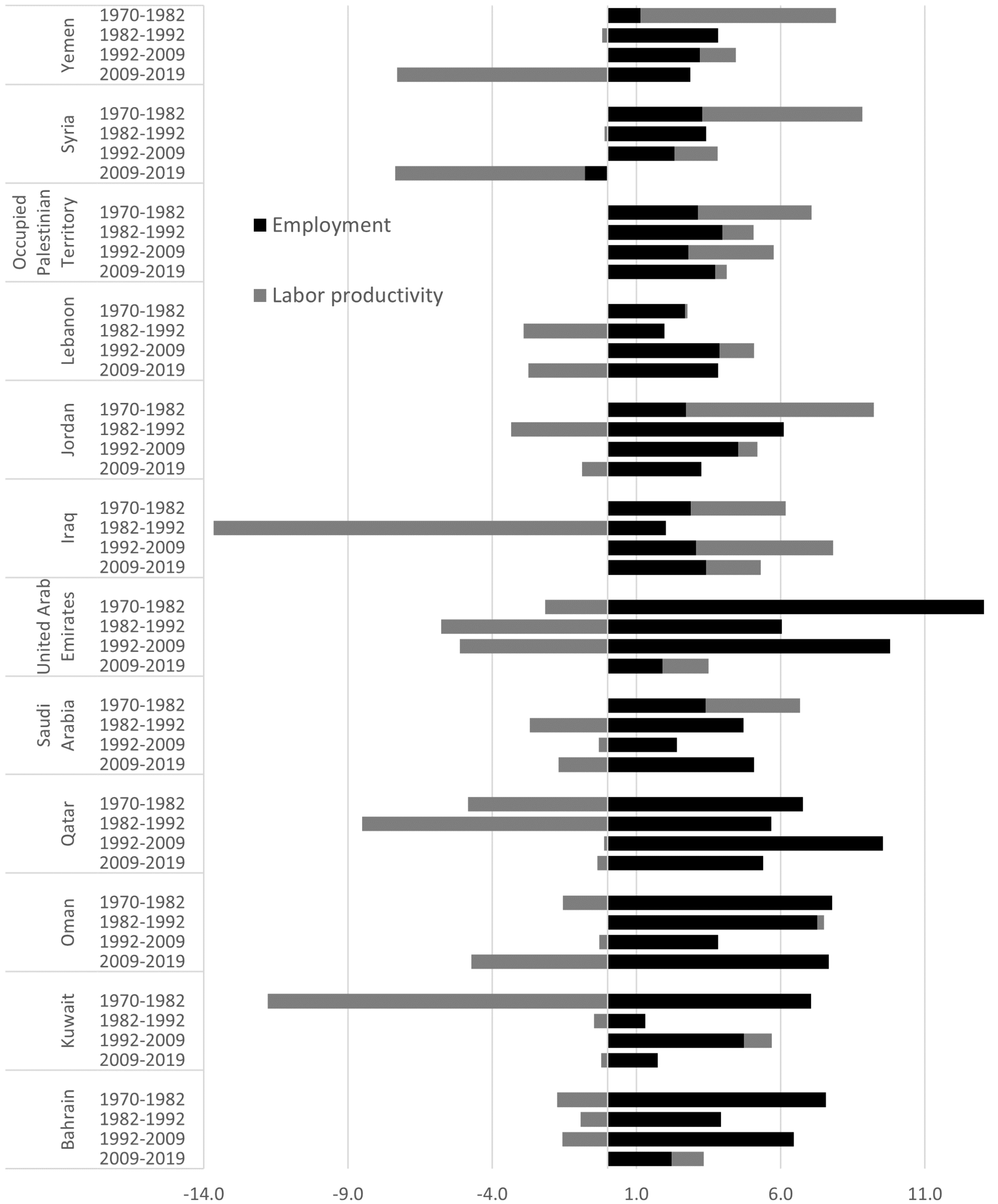
mal growth in per capita GDP and continued erosion in productivity. GDP growth rate remained at 0.2 percentage points lower than the 1992-2009 period globally, whereas it declined by almost one full percentage point in the Arab economies group. Interestingly, the decline in Arab GDP growth during this period solely came from the non-GCC economies. The GCC as a region sustained its growth in the previous period. It may be noted that some of the geopolitical situations and domestic instability in the non-GCC economies contributed to the significant volatility in the region's growth. Five of the six countries in this group witnessed significant political turmoil in recent years.

Finally, productivity did not contribute positively to growth in the West Asian Arab economies for nearly four decades except for some beneficial effects from globalization and catch-up growth in the non-GCC group in the 1990s. Comparing growth rates of labour productivity and employment – two components that add up to the GDP growth – there is a significant difference between the rest of the world and the West Asian Arab economies. GDP growth has been largely driven by improving productivity in both emerging and advanced economies in the last seven decades. The Arab economies do not follow that model. Almost all of the GDP growth in these economies since the 1970s, on average, was driven by adding more workers to the labour force, with no improvement in productivity in any of the three time periods we consider since 1980s. This was primarily driven by the poor performance of the GCC, where labour productivity growth was positive only during the 1950s and 1960s. In the non-GCC economies, productivity growth contributed positively except during 1982-1992, and during the most recent period, 2009-2019.

Thus, the weakening productivity elasticity of GDP (the share of GDP growth accounted for by labour productivity) further endorses the disconnect between productivity and GDP growth in the West Asian Arab region in general, particularly in the GCC. While one-half to two-thirds of GDP growth in advanced economies and emerging Asia came from labour productivity, the productivity elasticity fell to less than 20 per cent in the GCC in the 1970s before it further fell to negative terrain in the subsequent periods.

We learn from these trends the weakness of the Arab economies, particularly the oil-rich GCC economies, in translating their fortunes into productive jobs, ensuring the sustainability of their growth path. The productivity weakness of the GCC is a phenomenon across the board (Chart 1). A few exceptions are the UAE and Bahrain in the most recent period, Saudi Arabia in the 1970s, Kuwait during 1992-2009, which included its post-war reconstruction period, and Oman during the 1980s. In the non-GCC economies group, the crisis in Yemen and Syria has caused erosion in productivity growth in recent periods. Also, the crisis in Syria seems to have impacted the economic dynamics in Lebanon and Jordan, where productivity growth has decelerated lately. Historically, most non-GCC Arab economies have shown positive productivity growth in the other periods, although at varying rates, except for major declines in the 1983-1992 period in Iraq, Jordan, and Lebanon. This period included the years of

Chart 1: Contribution of Employment Growth and Labor Productivity Growth to GDP Growth, 1970-2019



Note: The sum of employment and labour productivity adds to GDP growth. For other notes and sources: see Table 1.

Table 2: Real Per Capita GDP Growth Rates in GCC Countries using GDP and Consumer Price Deflators, 1982-2009 and 2009-2019

	GDP deflator		CPI deflator	
	1982-2009	2009-2019	1982-2009	2009-2019
Bahrain	0.1	0.8	1.4	0.7
Kuwait	2.0	-0.2	1.0	-1.6
Oman	1.0	0.9	3.4	1.0
Qatar	-1.9	0.8	-1.9	1.4
Saudi Arabia	-1.1	0.9	0.1	1.4
United Arab Emirates	-1.2	1.6	-3.0	1.7

Notes: For Oman, the growth rates for the first period are only for 1991-2009, and for the UAE, it is for 1995-2009
Sources: Author's calculation using data from TED, WDI, and United Nations.

the Iraq war, resulting in severe economic destruction in that country and substantial instability in the region.

Sensitivity of Real Income Trend to Choice of Deflator

Indeed, since our per capita income and labour productivity comparisons are based on GDP deflators, it undermines the potential terms of trade gains on real incomes in the GCC economies from the rises in oil prices. Since much of the revenue generated in the oil-exporting GCC economies relies on their export of oil, the price rises in oil are likely to benefit the consumers, enhancing welfare gains. Kohli (2022) shows that one can obtain trading gains by using the ratio of GDP and gross domestic expenditure prices. This article does not examine in detail the measurement of trading gains. However, following Kohli (2005, 2022)'s arguments, we made a rough comparison of growth rates of per capita GDP deflated by GDP deflators with per capita GDP deflated by consumer price deflators.

The results do not suggest a uniform pattern in terms of the welfare impact of terms of trade across countries in the GCC (Table 2). Three of the six GCC economies show a higher real per capita GDP growth during the 1982-2007 period when CPI deflators were used instead of GDP deflators, albeit by differing magnitudes. While the difference was quite negligible for Qatar, it was in the range of 1 to 2.5 per cent for Oman, Bahrain, and Saudi Arabia. However, while the growth rate turned from -1.1 per cent to only a tiny positive growth of 0.1 per cent for Saudi Arabia when CPI is used, it worsened the growth contraction in the UAE. The CPI-based real per capita GDP growth was lower by more than 1.5 percentage points for the UAE and by one full percentage point in Kuwait.

For the post-2009 period, Saudi Arabia and Qatar had CPI-based growth rates higher by more than half a percentage point, whereas in other countries, it was either lower (e.g. Kuwait) or similar (Bahrain, Oman, and UAE). Clearly, using CPI improves income growth in the GCC economies in general. Yet, it did not make any noticeable impact in creating positive and welfare-enhancing expansions in large economies in the region like Saudi Arabia, the UAE, Qatar, and Kuwait. Hence, there is only limited evidence to argue that the gains from the export of oil have substantially compensated for the negative impact of the productivity slowdown.[11]

Overall, enhancing productivity growth remained a considerable challenge for the West Asian Arab economies since the 1980s. This was partly because of the limited potential for technological change and productivity in the GCC's highly capital-intensive oil sector, which creates only a very small portion of the total employment. Moreover, these nations have not been able to tap the potential in the non-oil sectors to boost productivity growth, and their failure to foster a solid and competitive private sector and an attractive investment climate conducive to private sector investment seem to have adversely affected their productivity performance. Although many economies pursued liberal reforms after the oil crisis in the early 1970s, they were less successful in becoming a competitive, market-oriented economies (see Saleh, 2021).

A segmented labour market with cheap expatriate workers also has facilitated employment-driven growth with less priority for productivity. The native population engaged in highly paid government jobs (Baldwin-Edwards 2011; Al-Mejren and Erumban, 2021), and the private sector economic activity relied primarily on expatriate workers. Therefore, the sluggish growth in the aggregate per capita income we observed in Table 1 does not necessarily imply a decline in the well-being of the region's native population. Rather it is likely affecting the migrant workers, who are paid relatively lesser wages.[12] In the next section, we econometrically examine whether this extreme focus on employment, often exploiting the availability of cheap foreign workers, has made these countries compromise productivity.

The Trade-off Between Jobs and Labour Productivity

The relationship between GDP and per capita GDP with labour productivity depends upon how the changes in employment, labour force participation, and total population interact with each other (see Marattin and Salotti, 2011). Given that per capita GDP is the ratio of total GDP to the total population, growth in per capita GDP is the sum of the changes in the proportion of working population (or the changes in employment rate) and changes in output per worker (or labour productivity). According to the TED, the employment rate, measured as employment to population ratio, has increased in most West Asian Arab economies over the last

11 It may, however, be noted that the GCC's macro productivity growth is reasonably positively correlated with oil price growth. The simple correlation between the growth rates of global oil prices and GCC's labour productivity growth is 0.5 for 1970-2018. Although the correlation is positive for total factor productivity growth also, it is lower at 0.36. A general positive association exists between the physical productivity measures and oil price growth in the GCC, although the intensity of the association differs across years.

12 Historically, the wage gap between native and foreign workers is vast in the GCC economies, with a more equitable wage distribution among natives and larger wage inequality among foreign workers (Al-Quadsi, 1985), and it remains so even today. For instance, as of 2019, the average wage of the natives is nearly two times higher than the average wage of the migrant workers across all sectors of the Saudi Arabia economy (General Organization for Social Insurance, 2019). Typically, migrant workers from poorer Asian countries, who constitute a major portion of the expatriate workers in the GCC, gain much lower wages than their richer Western counterparts.

seven decades, with faster increases in the last 25 years.

A number of factors, including the rising female participation, increases in the youth population, and the inflow of migrant workers, contributed to the surge in participation and employment rates.[13] In the strict neoclassical sense, rising participation and employment can lower capital intensity and labour productivity due to decreasing returns to labour (Choudhry and van Ark, 2010). Increased labour supply can also discourage firms from adopting new technologies to foster productivity, a likely possibility in the Arab countries, especially in the GCC, given the availability of cheap expatriate workers. However, if the rise in participation is driven by the demand for workers, reflecting rising opportunities in the economy, it is unlikely to harm productivity. Therefore, an important question is whether the rise in participation rates is accompanied by growth in productivity or whether it happens at the cost of productivity. In other words, given that much of the growth in the region is driven by employment creation rather than productivity, whether the region's rising participation further leads to a trade-off between productivity growth and employment growth, and how the region fare compared with other major regions of the world.

We examine the trade-off between labour productivity growth and employment rate, using a modified version of the methodology suggested by Choudhry and van Ark (2010). We estimate the following panel data regression equation using the random effect model:

$$\begin{aligned}\Delta \ln y_{i,t} =& \alpha_0 + \beta \cdot \Delta \ln ep_{i,t} \\ &+ \sum_{j=1}^{3} \gamma_j \cdot D_i + \sum_{j=1}^{3} \theta_j \cdot ep_{i,t} \cdot D_i \\ &+ \epsilon_i + e_{i,t}\end{aligned} \quad (1)$$

where y is labour productivity, *ep* is employment to total population ratio, D is the regional dummies for advanced economies, GCC, and other Arab economies (so that the reference group is all other emerging market economies).[14] ϵ is the random error term for each country, e is the model error term, and the subscripts i and t indicate respectively country and year. The model is estimated for the entire time period 1970-2019, and further for four subperiods, 1970-1982, 1982-1992, 1992-2009, and 2009-2019. The regression models for all the five time periods are estimated using random effects, as the Hausman test failed to reject the presence of random effects in most models. There were two cases, 1982-1992 and 1992-2009, in which the Hausman

13 In general, migrant workers have high participation rates compared to native workers. For instance, Erumban and Al-Mejren (2022) report a nearly 85 per cent participation rate for migrants compared to less than 45 per cent for natives in the GCC. Hence, the inflow of migrant workers to the region greatly increased the aggregate participation rate.

14 Note that the employment rate we use in this calculation is not the standard measure of the labor force participation rate, which includes both employed and unemployed populations in the numerator and only the working-age population in the denominator. The employment rate consists of only the employed people in the numerator and the total population in the denominator.

test rejected the existence of random effects. In these cases, we also estimated the fixed effect model. Since the results did not differ from the random effect model, we do not report the fixed effects results. The interaction terms in the above equation help us understand the differing impact of employment rates on productivity growth in different regions. The regression results are provided in Table 3.

The results show a negative and significant coefficient for the employment rate, suggesting a trade-off between productivity and employment in the reference group. However, there is substantial heterogeneity across regions, as we discern from the interaction coefficients. For the advanced countries, the interaction term has a positive coefficient which is larger than the coefficient of the employment rate in general, except during the 1970-1982 period and 2009-2019. There is no evidence of a strong negative trade-off between labour productivity growth and employment rate in the advanced economies during the two sub-periods between 1982 and 2009, which also includes the period of advancement in ICT and associated productivity gain in these economies in the 1990s. However, the trade-off has reversed after the global financial crisis.

In the case of the GCC, the coefficient of the interaction term is negative except for 1970-1982, during which it was positive but substantially smaller than the absolute value of the negative coefficient of the employment rate.[15] Thus, taking the main effect of employment rate and the interaction effects together, the productivity-employment trade-off was negative throughout the entire period. What is even more important to note is that it has worsened in the most recent period, even worse than the rest of the emerging markets group. The trade-off remains negative in the non-GCC economies group but is less pronounced than the GCC and worse than the advanced economies. It is also relatively lower than the reference group except for the 1970-1982 period.

It appears that the Arab economies' excessive reliance on job-led growth results in significantly lower productivity growth in the region. This has been particularly more pronounced in the oil-rich GCC economies, while the non-GCC group also tend to trade jobs with productivity at a lesser pace. A better understanding of this trade-off might be obtained if the quality aspects of labour, for instance, the differences in the skill levels of workers, are taken into account. Such an attempt requires data on the skill distribution of workers and is not considered in the present analysis. In section 4, where we examine the growth accounting contributions, we consider labour quality and its contribution to labour productivity growth.

15 Note that the statistical insignificance of some interaction effects does not mean these regions have the same effect as the benchmark region. Since the main effects of both the employment rate and region dummy variables are significant, the sign and magnitude of the interaction are critical in determining the extent of the main effect. We also estimated clustered OLS regressions with region dummies and separate region-specific fixed and random effects regressions. The results convey the same conclusion.

Table 3: Panel Data Regression Results Explaining Labour Productivity Growth

	1970-2019	1970-1982	1982-1992	1992-2009	2009-2019
$\Delta \ln ep$	-0.549***	-0.692***	-0.493***	-0.519***	-0.824***
	(0.03)	(0.10)	(0.05)	(0.03)	(0.10)
Regional dummies (D)					
Advanced	0.497*	1.48***	1.777***	-0.154	-0.824*
	(0.276)	(0.470)	(0.505)	(0.379)	(0.480)
GCC	-2.462***	-3.346***	-2.14*	-2.522***	-1.584
	(0.612)	(1.033)	(1.124)	(0.844)	(1.07)
non-GCC	-0.584	2.397**	-3.043**	0.116	-4.509***
	(0.607)	(1.08)	(1.183)	(0.836)	(1.035)
Interaction terms ($D * \Delta \ln ep$)					
Advanced	0.561***	0.549***	0.669***	0.564***	0.594***
	(0.073)	(0.209)	(0.144)	(0.099)	(0.207)
GCC	-0.075	0.086	-0.13	-0.032	-0.073
	(0.074)	(0.159)	(0.164)	(0.104)	(0.218)
non-GCC	-0.088	-1.788**	0.696	-0.004	0.235
	(0.132)	(0.91)	(0.758)	(0.142)	(0.263)
Constant	1.389***	0.987***	-0.25	2.25***	2.216***
	(0.16)	(0.273)	(0.294)	(0.22)	(0.274)
Observations	6517	1596	1330	2261	1330
$\mathbf{R}^2$					
Within	0.073	0.049	0.075	0.116	0.061
Between	0.219	0.292	0.208	0.125	0.257
Overall	0.082	0.098	0.10	0.117	0.098
Wald Chi2	536.8***	127.3***	132.3***	297.1***	120.7***

Note: The dependent variable is growth rate of labour productivity (see equation 1). All models are estimated using random effects. Since the models include regional dummies for advanced economies, and GCC and non-GCC West Asian Arab economies, the reference group is all other emerging market economies. Therefore, the coefficient of $\Delta ln \cdot ep$ is the coefficient of changes in employment-population ratio on productivity in emerging markets excluding the Arab states. *Standard errors are in parentheses.* *** p<.01, ** p<.05, * p<.1

Structural Change and Aggregate Labour Productivity in West Asian Arab Economies

Changes in the Structure of West Asian Arab Economies

The productivity trends discussed in the previous sections were at the aggregate level, which conceals sectoral differences. Structural change, or the relocation of workers from low productivity sectors to high productivity sectors of the economy, is perceived to be an essential feature of the process of economic development (Lewis, 1954; Kuznets, 1966; Chenery Syrquin, 1975; Denison, 1967). The nature and speed of structural transformation are very important in enhancing and sustaining ag-

16 Despite its importance for aggregate productivity growth, our understanding of structural transformation in the Arab economies is limited, largely due to the lack of adequate sectoral data. Even in cross-country studies that consider African and Middle East economies, Arab economies are often excluded due to a lack of data (McMillan and Rodrik, 2014). In their paper on structural change and productivity, McMillan and Rodrik (2014) include a number of African countries, but Turkey is the only Middle Eastern economy in their sample. One recent study that extends the productivity analysis to include a structural change in the Arab economies is van Ark *et al.* (2019), which is confined to the GCC only.

gregate economic growth and productivity (Lin, 2011; McMillan and Rodrik, 2011).[16] We examine the structural change bonus to aggregate productivity growth in the West Asian Arab economies during 1992-2019 period by combining industry-level GDP data from the UNNAS with ILOSTAT's modeled employment estimates for seven broad sectors of the Arab economies.

Table 4 and Table 5 respectively show the distribution of value-added and employment across broad sectors of the economy in the 12 West Asian Arab economies, averaged over two periods, 1992-2007 and 2009-2019. We document three important trends across countries. The first is a falling share of agriculture in terms of output and employment, consistent with the traditional structural transformation hypothesis. However, the sector remains an important job provider in the non-GCC group, especially Iraq, Yemen, Lebanon, and Syria, and has seen an uptick in its output share in Jordan and Yemen.

Second, the manufacturing output share has increased in most economies except for two GCC economies, Kuwait and the UAE, and two other Arab economies, Palestine and Syria. However, it remains relatively low compared to emerging economies like China, Indonesia, Malaysia, Myanmar, Philippines, and Vietnam.[17] On the contrary, manufacturing share in total employment declined or stagnated in all countries except Yemen, where it slighted improved (Table 5). Whereas four of the six countries in the non-GCC economies group had 10 per cent or more of their jobs in manufacturing, only two countries, Bahrain and the UAE, could achieve such a mark among the GCC economies. In general, the manufacturing job shares in the West Asian Arab economies are relatively low compared to emerging economies like China or advanced economies like the United States in their fast-growing phases.[18]

Finally, there has been a general increase in the output share of the services sector in the non-GCC economies, albeit to varying degrees, except for Jordan. In contrast, the output share of the services sector declined in three GCC economies, Bahrain, Kuwait, and Oman, while the remaining three had improved service presence.

The divide between GCC and non-GCC West Asian Arab economies becomes more apparent when comparing employment shares in the services. The services share fell across the GCC economies, with the fall being most intense in Oman and Qatar. In contrast, the service jobs increased considerably in the non-GCC group, except for Jordan.

Thus, the pattern we observe here is similar to the premature de-industrialization phase observed in the literature in the con-

17 According to the Economic Transformation Database, manufacturing constituted about one third of Chinese output in the 1990s and 2000s, and is still about 30 per cent, whereas in other emerging Asian economies, it is about one fifth (see de Vries *et al.* 2021).

18 In the 1950s, nearly one quarter of total employment in the United States was in the manufacturing sector (see Rodrik, 2016). Similarly, according to the Economic Transformation Database, in the 1990s and 2000s, about one fifth of total employment in China came from the manufacturing sector. The manufacturing job share increased from less than 10 per cent to close to 20 per cent in Vietnam and 11 to 14 per cent in Indonesia from 1992 to 2018 (see de Vries *et al.* 2021).

Table 4: Average Industry Share in Nominal Value Added and Employment, West Asian Arab Economies, 1992-2009 and 2009-2019

	Agriculture		Manufacturing		Other industries*		Services	
	1992-2009	2009-2019	1992-2009	2009-2019	1992-2009	2009-2019	1992-2009	2009-2019
Arab Economies*	**5.3**	**3.1**	**8.9**	**9.4**	**40.9**	**40.6**	**44.9**	**46.9**
GCC**	3.3	1.6	9.5	10.2	43.4	43.4	43.8	44.8
Bahrain	0.6	0.3	12.8	16.3	26.1	28.1	60.5	55.2
Kuwait	0.3	0.4	8.2	5.6	45.8	50.9	45.7	43.1
Oman	2.2	1.6	7.0	9.8	47.8	47.1	42.9	41.5
Qatar	0.5	0.1	8.8	9.1	53.6	53.3	37.1	37.5
Saudi Arabia	4.6	2.4	9.8	11.5	43.8	42.0	41.7	44.2
UAE	1.5	0.7	9.6	8.3	40.2	41.4	48.7	49.6
Other Arab Economies**	12.6	7.9	6.9	6.9	32.0	31.5	48.6	53.7
Iraq	8.3	4.1	1.3	2.3	66.4	51.3	24.0	42.3
Jordan	4.3	4.5	18.8	20.8	8.3	7.7	68.6	67.0
Lebanon	4.7	4.0	8.2	8.4	17.3	8.0	69.9	79.6
Palestine	11.7	9.2	13.5	13.0	11.9	8.3	62.9	69.4
Syria	24.9	20.7	5.1	4.7	22.3	25.3	47.6	49.3
Yemen	13.6	16.1	7.2	9.5	27.6	19.9	51.5	54.4

Note: * Other industries consist of mining and utilities and construction. The mining sector in the GCC consists of a large oil sector. ** Aggregates are based on the PPP converted nominal value added in each region.

Source: UNNAS.

Table 5: Average Industry Share in Employment, West Asian Arab Economies, 1992-2009 and 2009-2019

	Agriculture		Manufacturing		Other industries*		Services	
	1992-2009	2009-2019	1992-2009	2009-2019	1992-2009	2009-2019	1992-2009	2009-2019
Arab Economies*	**18.6**	**10.5**	**9.6**	**9.1**	**13.4**	**17.0**	**58.4**	**63.3**
GCC**	5.5	3.3	8.1	8.1	16.7	21.8	69.8	66.8
Bahrain	1.7	1.1	15.0	12.1	14.8	23.1	68.5	63.7
Kuwait	2.4	2.1	4.9	4.3	17.2	18.8	75.4	74.8
Oman	7.7	4.8	5.1	4.9	9.1	28.8	78.1	61.5
Qatar	3.0	1.3	9.6	7.5	29.7	46.7	57.7	44.4
Saudi Arabia	5.7	4.2	7.5	7.5	14.3	15.8	72.5	72.6
UAE	6.7	2.4	11.0	10.9	23.1	24.0	59.2	62.7
Other Arab Economies**	27.5	17.9	10.6	10.0	11.2	12.2	50.8	59.9
Iraq	28.2	20.9	9.9	9.3	9.7	13.4	52.2	56.4
Jordan	4.2	3.0	13.5	12.2	9.5	13.0	72.8	71.8
Lebanon	18.3	13.1	13.7	12.1	11.2	13.3	56.8	61.5
Palestine	14.7	9.4	13.4	11.8	16.8	16.2	55.2	62.5
Syria	26.3	12.6	13.9	13.8	14.0	12.0	45.8	61.6
Yemen	40.1	27.5	5.1	5.6	9.4	8.4	45.4	58.5

Note: Please see Table 4 for notes and source.

text of emerging markets (Rodrik, 2016). Although the improvement in manufacturing productivity in some countries seems to have helped expand the sector's output share, this has been accompanied by a lack of job creation in the sector. As predicted by the traditional structural transformation theories (Lewis, 1954), the reliance on primary sector jobs has been falling everywhere. But that has not been shifting towards the manufacturing sector. Like many emerging market economies, which witness premature deindustrialization, jobs in countries in the non-GCC Arab group are directly moving towards services during the missing manufacturing phase. In the GCC countries, however, that does not seem to be true, where other industries, including the mining sector, capture jobs.

Impact of Structural Change on Productivity Growth

What do these changes in the employment and production structure mean for aggregate productivity? If resources are moved to sectors where productivity levels are relatively high or to sectors where productivity is growing faster, it will increase aggregate economy productivity growth. This gain in aggregate productivity is often considered a structural change bonus. In this section, we examine the impact of changing employment structure in the West Asian Arab economies on aggregate productivity, considering seven broad sectors of the economy. These are agriculture; manufacturing; other industries (including mining); trade, hotels and restaurants; transport, storage and communication; and other activities.

We use the standard shift-share decomposition method based on Fabricant (1942) to distinguish the contributions of sectoral productivity growth from the contribution of employment shifts across sectors to aggregate labour productivity growth. Assuming additivity in real output across sectors, we obtain aggregate labour productivity (y) as the ratio of the sum of sectoral value added and the sum of sectoral employment (see Erumban and Das, 2019). Then, following de Vries *et al.* (2015), we decompose the change in aggregate labour productivity levels (Δy) into within-sector productivity change and a between-sector worker reallocation effect using the following decomposition:

$$\Delta y_t = \sum_j \Delta y_{j,t} \cdot s_{j,t-1} + \sum_j \Delta s_{j,t} \cdot y_{j,t-1} + \sum_j \Delta s_{j,t} \cdot \Delta y_{j,t} \qquad (2)$$

where s_j is the share of sector j in total economy employment. The symbol Δ indicates a change over the previous year. The first term on the right-hand side of equation (2) called the *within sector productivity effect*, is the product of the relative employment size of a sector and the change in its productivity. It reflects the productivity contribution of that sector to the aggregate economy. The second term, which is the product of the change in sectoral employment share over the two-time points and the level of labour productivity in the sector in the previous year, captures the expansion of employment in sectors with various productivity levels. When positive, it indicates an expansion of employment in sectors with relatively high productivity levels. This term is a measure of static worker reallocation or structural change effect. The third term is the product of the change in employment share and change in productivity, thus capturing the expansion of jobs in sectors with different rates of productivity change. If positive, it implies an expansion of employment in sectors with faster productivity growth, thus a dynamic worker reallocation. The final results discussed in the subsequent parts of this section are presented in growth rate forms, which are obtained by dividing both sides of the equation by aggregate productivity

Chart 2: Within Sector and Structural Change Contributions to Aggregate Labour Productivity Growth in West Asia Arab Economies, 1992-2009 and 2009-2019

Notes: The GCC is a weighted average for Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, and the non-GCC for Iraq, Jordan, Lebanon, Syria, Yemen, and the Occupied Palestinian Territory. The West Asian Arab economies are a weighted average of the GCC and non-GCC countries. The weights used are the nominal value-added shares of each country in the respective aggregate. The aggregate labour productivity growth rates presented in this chart may differ slightly from the log changes in Table 1 and Chart 1 because the results presented here are based on first differences in productivity and not log changes (see equation 2).

Source: Author calculation using data from UNNAS and ILOSTAT

levels in the previous period.

We calculate the structural change effect for the period 1992-2019 divided into two sub-periods – 1992-2009 and 2009-2019 – for all the 12 Arab economies, aggregated into GCC and other Arab economies.

The results are quite interesting and suggestive of the weakness of the region in thriving a growth-enhancing economic diversification (Chart 2). During the 1992-2009 period, when the aggregate productivity growth in the Arab economies was just below zero, the average static gains (the shift of jobs from low productivity to high productivity sectors) were positive. However, the absence of any within-industry productivity growth and dynamic (the shift of jobs from low growing to fast-growing sectors) productivity losses in the region contributed to an overall labour productivity contraction. Moreover, the positive static gains observed for the region as a whole were solely due to the non-GCC countries. In contrast, productivity growth has eroded within industries in the GCC, where the static and dynamic effects were also negative. This suggests that the GCC's worker reallocations were not growth-enhancing but rather growth-reducing.

In the non-GCC group, in contrast, there has been much happening during this period. Both within-sector and static reallocations were positive and large in magnitude, indicating the productivity advancement in individual industries and the shifting of jobs to more productive sectors. The dynamic effects, however, were negative.

However, in the post-2009 period, both the GCC and the non-GCC regions suffered from major declines in within-industry productivity growth. The dynamic effect continued to be negative everywhere, whereas the static effect was positive, albeit lower in magnitude in the non-GCC than in earlier periods. Indeed, there has been some positive momentum in the region because more jobs are shifted to sectors with relatively high productivity levels, but the dynamic effects and within-industry productivity were not improved.

Van Ark *et al.* (2019) have shown a similar positive static effect and negative dynamic in the GCC during the 2009-2017 period. However, when they removed the oil sector from the analysis and examined the worker movements across sectors within the non-oil economy, the results suggested productivity advances in some non-oil sectors. That, however, seems to have been offset by the productivity declines in the oil sector, thus cancelling its impact on aggregate productivity. The results, however, did not suggest any growth-enhancing inter-sectoral worker movements within the non-oil economy. Our results tend to reiterate that the weakness of structural change in delivering growth is present in the GCC and is a feature of the region in general. These results signify the need for continued efforts to diversify the domestic economies of the Arab countries. This requires promoting a competitive labour market rather than a segregated one, stimulating private investments, and initiating reforms that facilitate an investment climate for businesses to move resources to the most productive sectors.

Proximate Sources of Labour Productivity Growth: Total Factor Productivity vs. Capital Accumulation

This section examines the role of capital accumulation and total factor productivity in driving aggregate labour productivity growth in the West Asian Arab economies. In order to understand the relative roles of capital deepening (the growth of capital per worker) and total factor productivity growth in driving labour productivity growth in the West Asian Arab states, we use the standard growth accounting framework, which decomposes labour productivity growth into the contribution of capital per worker, labour quality and total factor productivity, i.e.

$$\begin{aligned}\Delta \ln y_t = &\nu_{K,t}\Delta \ln K_t \\ &+ \nu_{L,t}\Delta \ln LQ_t + \Delta \ln TFP_t\end{aligned} \tag{3}$$

where K is capital input, measured as capital services,[19] LQ is a measure of labour quality, approximated by accounting for differences in educational composition of total employment, and TFP is the total

19 Aggregate capital service growth rates are obtained as user cost weighted sum of individual asset specific capital stock growth rate.

20 See de Vries and Erumban (2020), for more details regarding the measurement of each variable used in the growth accounting.

Table 6: Sources of Labour Productivity Growth, by Region, Average Annual Per cent Change

Region	Period	Capital	Labour Quality	TFP	Labour Productivity Growth
World	**1970-1982**	1.7	0.3	0.04	2.1
	1982-1992	1.3	0.3	-0.1	1.5
	1992-2009	1.9	0.3	0.1	2.3
	2009-2019	2.0	0.3	-0.1	2.2
Advanced	**1970-1982**	1.8	0.2	0.6	2.6
	1982-1992	1.6	0.2	0.5	2.2
	1992-2009	1.5	0.3	-0.01	1.8
	2009-2019	0.7	0.3	0.1	1.1
Emerging & Developing	**1970-1982**	1.6	0.5	-0.8	1.3
	1982-1992	0.9	0.4	-1.0	0.4
	1992-2009	2.3	0.4	0.1	2.8
	2009-2019	3.1	0.4	-0.3	3.2
Emerging Asia	**1970-1982**	2.2	0.5	-1.0	1.7
	1982-1992	2.6	0.4	0.1	3.1
	1992-2009	4.4	0.4	0.2	5.0
	2009-2019	4.6	0.4	-0.2	4.8
West Asian Arab Economies	**1970-1982**	1.8	0.4	-0.8	1.4
	1982-1992	-1.1	0.4	-3.1	-3.8
	1992-2007	0.02	0.3	-0.8	-0.5
	2009-2019	1.8	0.2	-2.5	-0.5
GCC	**1970-1982**	1.3	0.4	-1.3	0.4
	1982-1992	-1.2	0.5	-2.4	-3.2
	1992-2007	-0.03	0.3	-1.6	-1.3
	2009-2019	2.0	0.2	-2.5	-0.2
Non-GCC	**1970-1982**	3.2	0.3	0.2	3.7
	1982-1992	-1.1	0.3	-5.5	-6.3
	1992-2007	0.1	0.3	1.9	2.3
	2009-2019	0.9	0.3	-2.7	-1.5

Note: Capital is the growth rate of capital services per worker, and labour quality is a measure of skill compositional differences between workers. Labour productivity growth in this table may differ from Table 1 due to differences in labour input measures. In Table 1, labour productivity is measured as output per worker. In the TED growth accounting, it is defined as output per hour whenever the data is available.
Source: The Conference Board Total Economy Database, April 2021.

factor productivity.[20] In Table 6, we compare the contribution of capital deepening, labour quality (or the changes in the educational composition of work force) and total factor productivity growth to labour productivity growth in West Asian Arab economies with averages for the global economy, advanced economies, and emerging markets. A few interesting patterns emerge.

First, although capital deepening – capital services per labour input – is a consistently dominant source of labour productivity growth in the global economy, advanced economies, emerging markets, and emerging Asia, it is not always the case in the West Asian Arab economies. Often in the Arab countries, investment in physical capital has been falling short of the rise in employment, lowering productivity growth in the 1980s and 1990s.

Second, taken together, the West Asian Arab economies group never had positive TFP growth in any of the four periods presented in the Table. Moreover, the fall in TFP has been quite substantial over the years, particularly in the GCC. In general, TFP growth has been modest in the global economy, yet it has been positive and important in the 1970s and 1980s in the advanced economies, and in the 1990s in the emerging markets. Globally, during 1992-2009 it was positive at 0.1 per cent, but it turned negative during the post-global financial crisis decade. In the advanced economies, TFP growth has been generally positive, suggesting relative improvement in overall production efficiency in these economies. However, there is a general declining trend in advanced economies' rate of productivity growth. TFP growth was positive in emerging Asia during the 1980s and 1992-2009, and negative during the 1970s and the post-2009 period.

Moreover, the TFP decline in the global and emerging Asia aggregates, whenever it happened, were relatively moderate. This was not so in the West Asian Arab economies, where the decline was quite steep in general, particularly during 1982-1992 and 2009-2019. While the TFP trend in the GCC is quite similar to the aggregate Arab economies, the non-GCC economies group showed productivity gains during the 1992-2007 period. As obvious from Table 7, this was primarily driven by Iraq. The TFP growth in Iraq was quite high during this period, even when the capital contribution was nearly zero. This period included Iraq's post-war reconstruction phases after the Gulf War in 1991 and the post-invasion period after 2003. The other Arab economies group also had positive TFP growth in the 1970s.

Third, over the last half a century, the quality of workers has improved across the board, including in the Arab states, although at varying rates, contributing positively to labour productivity growth.

Finally, the negative TFP growth is a wide-spread phenomenon in the West Asian Arab states (Table 7). Of the six GCC economies in four different periods, TFP was positive only in Saudi Arabia and Oman in the 1970s, Oman during the 1980s, Qatar and Kuwait during 1990s, and the UAE during the post-crisis period. More importantly, in the most recent period, 2009-2019, the TFP has eroded drastically in the range of 2-4 percentage points across countries, except for a moderate improvement in the UAE. All countries in the non-GCC economies group, except Yemen, had positive TFP growth in 1992-2009. However, they all had negative TFP growth in the most recent decade, and the severe slump in TFP growth in the region's two troubled economies, Syria and Yemen, has played an important role in the overall decline in the region's TFP.

The Arab economies evidently have a productivity challenge. But it is not merely a productivity challenge. It is their inability to translate investment in physical capital into productivity growth, as the heavy reliance on less productive jobs to sustain output growth seems to be an important factor (Al-Mejren and Erumban, 2021). They seem to be failing to translate the massive investment and oil resources into productivity advantage, especially in the GCC countries.

The long-term weakness of the Middle East economies in relying on capital and technology to drive economic growth is

Table 7: **Sources of Labour Productivity Growth, by Region, Average Annual Percent Change**

	Capital	Labour Quality	TFP	Capital	Labour Quality	TFP
	Bahrain			Iraq		
1970-1982	-1.5	0.2	-0.5	3.4	0.3	-0.4
1982-1992	1.2	0.3	-2.4	-2.4	0.2	-11.5
1992-2009	-0.9	0.3	-1.0	-2.6	0.03	7.3
2009-2019	2.7	0.2	-1.7	1.7	0.2	-0.02
	Kuwait			Jordan		
1970-1982	-3.4	0.7	-9.0	5.6	0.9	0.1
1982-1992	-0.8	0.4	-0.2	-0.1	0.7	-3.9
1992-2009	-1.6	0.2	2.4	0.4	0.1	0.1
2009-2019	3.3	0.03	-3.3	0.6	0.1	-1.7
	Oman			Lebanon		
1970-1982	-1.7	0.05	0.1	0.5	0.4	-0.8
1982-1992	-4.1	0.2	4.2	0.4	0.5	-3.7
1992-2009	0.8	0.3	-1.3	0.0	0.5	0.7
2009-2019	-1.0	0.2	-3.7	-0.2	0.5	-2.9
	Qatar			Syria		
1970-1982	-2.8	0.5	-2.5	3.2	0.3	2.1
1982-1992	-5.0	0.3	-3.8	0.4	0.4	-0.9
1992-2009	-1.5	0.1	1.3	0.8	0.3	0.4
2009-2019	3.4	0.03	-3.6	0.6	0.5	-7.4
	Saudi Arabia			Yemen		
1970-1982	2.7	0.3	0.2	4.4	0	2.4
1982-1992	-1.0	0.6	-2.3	-0.9	0.03	0.7
1992-2009	2.1	0.5	-2.9	1.6	0.5	-0.9
2009-2019	2.3	0.3	-3.2	-0.4	0.5	-7.0
	United Arab Emirates			West Asian Arab Economies		
1970-1982	-1.5	0.7	-1.4	1.8	0.4	-0.8
1982-1992	-1.4	0.2	-4.5	-1.1	0.4	-3.1
1992-2009	-4.9	-0.02	-0.1	0.02	0.3	-0.8
2009-2019	1.1	0.2	0.3	1.8	0.2	-2.5

Note: Please see Table 6 for notes and source.

documented by previous studies.[21] Although such studies have not paid specific attention to West Asian Arab states, and the structural dynamics, as we do here, the results we obtain for the two groups of countries – the GCC and the non-GCC – are in accordance with previous findings regarding the region. The dependency on the oil sector in most GCC economies has an additional worsening impact on overall productivity. However, as noted earlier, it is not the sole factor for the region's productivity disaster. Past studies that tried distinguishing between oil and non-oil economy also noted a weak TFP performance, even if the oil sector is removed from the analysis (IMF, 2015; Espinoza, 2012).

Challenges and Opportunities

Our aggregate productivity measure conceals the industry compositional effects, technological differences across sectors, and productivity differences between different types of workers, including the differences between natives and emigrants. Barring

21 See Abu-Qarn and Abu-Bader (2007); Van Ark *et al.* (2008); Espinoza, (2012); Andreano *et al.* (2013); Behar, (2013); Ackgoz and Ben Ali, (2019); van Ark *et al.* (2019); Al-Mejren and Erumban, (2021); and Saleh, (2021)

this caveat, the overall decline in aggregate labor productivity reported in Table 1 suggests an average worker in the region produces only about 60 percent of the output in 2019 that an average worker generated in 1982. This is a major erosion, especially when compared with nearly two times higher output per worker that the global economy has attained during this period and a more than 5-fold increase in the emerging market economies. This section documents some critical challenges and opportunities for the region to tackle this productivity weakness.

- The segmented labour market that features a continued supply of low-paid foreign workers and relatively more expensive but less productive native workers is still a challenge for the GCC, especially for the private sector.
- The lack of a solid manufacturing sector that can absorb semi-skilled and low-skilled workers in both GCC and non-GCC Arab economies limits productivity and growth potential.
- The challenges to private sector development persist in both groups of countries, and the prospect of improving policies to incentivize the private sector is substantial.
- The weak infrastructure and high and rising informal sector are major challenges, especially for the non-GCC countries.
- The fragmented regional markets offer potential for regional integration and cooperation, which can help productivity growth.
- Both groups of countries feature institutional weaknesses and poor adoption of technologies and require more attention to technology, innovation, skill development and diversification.
- The potential for increased interaction between government and business in creating a business-friendly ecosystem and improving the human capital conducive to business needs is immense

Contrasting between the GCC and the non-GCC economies in the region, the former group of economies seldom have the common problems that developing countries face, like poverty, scarcity of capital, and lack of physical infrastructure. Still, they share features such as high population growth, lack of female empowerment, weak institutions, and inadequate human capital. They also have rising challenges from a lack of economic opportunity for youth and rising unemployment in their highly segmented labour market, which features the co-existence of cheap expatriate workers and expensive local workers.

A commonly adopted policy to address these challenges is job nationalization policies aiming to replace migrant workers with the natives (Hertog, 2012), which have clear productivity implications. Unless the cost differences between migrants and natives are compensated by productivity, the competitiveness of the private sector and the region's productivity will suffer further. Moreover, if the substitution of cheap expatriate workers with natives leads to wage escalation, it can lead to inflationary pressure. This has become more apparent in the region, as the region's native workforce is increasingly entering the labour market, adding pressure to raise the overall wages. Focusing on technology and innovation and continuing the efforts to diversify away from oil is essential to create more productive jobs for the native population. That, however, does not imply that closing borders to foreign workers is the way forward. Rather, making the labour market more efficient and opening competitive opportunities for all workers according to the needs of the private sector should be the priority. The GCC economies also face external stress from volatility in oil prices, slow global growth, and the increasing shift of global energy demand towards renewable/green sources, which weakens the sustainability of the oil-based distributive system that these economies have been following. Despite boasting political stability, the GCC's reliance on oil prices makes their growth trajectory less stable, making continued efforts to diversification an inevitable strategy for future growth.

The second set of countries, the non-GCC economies, on the other hand, has limited oil reserves and features the characteristics of other developing economies. Although their low reliance on oil prices offers them the opportunity for a more steady growth trajectory than the GCC, these economies are largely political unstable making their growth less certain (Saleh, 2021). For these economies, the challenge is to catch up with the global frontiers of productivity, but the hurdles are plenty, as, unlike the GCC countries, these countries have not developed their infrastructure or financial resources.

These countries have relied on exporting workers to the GCC oil affluent economies to support their domestic markets in the early phases. However, the gradual shift in preference of the GCC for Asian workers eroded their potential in exporting workers to the oil-rich nations. In addition to the lack of a solid manufacturing sector in both the GCC and the non-GCC economies, the latter group also suffers from the presence of the informal sector, challenging their productivity-driven growth. Available estimates suggest that one fifth to one third of GDP in the Arab economies, including the GCC, is generated in the informal sector (Schneider and Abuehn, 2007), and one third to half of the non-GCC economies' total non-farm employment is informal (Charmes, 2012).

The onset of the Arab spring in 2010 and the ongoing conflicts in some countries in the region might have further fueled youth unemployment and informal jobs. Since informality can create distortions that can weaken productivity, it will have an indispensable impact on the productivity and structural change. Studies that compare productivity differences between formal and informal sectors in emerging economies suggest substantially lower productivity in the informal sector (e.g. Krishna *et al.* 2018 in the case of Indian manufacturing). Therefore, informal employment can suppress the gains from structural change if workers move to low-productive informal segments of the economy. Previous evidence suggests that while the falling informality in Brazil had a growth-enhancing structural change effect, the rising informality in India had a growth-reducing effect (de Vries *et al.* 2012). Similarly, a recent study by Voskoboynikov (2019) reports the growth-reducing effect of the reallocation of workers to informal segments in Russia. The presence of informality in the Arab economies indeed will have implications for the productivity and structural change narrative presented in this article, and future research may want to consider this aspect. A major challenge, however, would be the insufficient data on the informal sector in these economies.

Developing a vibrant private sector that can foster productivity growth is a common challenge for both groups of countries. The private sector in the region is either small or less developed than the public sector, partly due to the constraints businesses face and partly due to the fragmented market in the region.[22] Businesses are unable to enjoy scale economies and are bound to cater to small markets. As Malik and Awadallah (2013) argued, boosting private sector investment, which is key to developing a productivity-oriented growth path for the region, is both a regional and political challenge for the Arab economies.

The development of the private sector has been hindered drastically by the dominance of the public sector driven by the rent distribution model, forcing the private sector to operate under more stringent investment conditions, relying heavily on imported labour. Addressing this challenge will require an economic initiative that incentivizes private sector participation in economic activity and a change in the attitude of native workers to shift their preference from public sector jobs to private-sector jobs (Al-Mejren and Erumban, 2021).

Regionally, the fragmented markets limit the potential to achieve economies of scale and relocate activities to regions with the most appropriate resources to improve efficiency and productivity (Malik and Awadallah, 2013). Moreover, market fragmentation also raises the cost of capital and lowers the productivity of investment. The economic potential for integration is vast in the region, which shares a common language, unlike, for instance, the ASEAN or Europe, and culture. In the absence of economic integration, private sector firms' incentive to operate on a large scale is likely limited, as the size of these individual markets is small, especially when weighed against the challenges they offer. While the challenges are plenty for the region, attempts to integrate the region's economies to act as a single market (e.g. ASEAN) might help productivity growth, as it will help reduce labour market constraints, ease distortions and create scale economies.

For businesses, the weak aggregate productivity indicates the institutional weakness under which they operate. However, businesses must realize that the continued failure to recognize the importance of productivity is not sustainable, and the need for improved automation and adopting technologies to improve competitiveness should be given priority. Increased engagement with the governments, policymakers and educational institutions in stimulating a better-coordinated investment atmosphere is important for the private sector to foster productivity-oriented

22 Recent evidence suggests that private sector businesses in Arab economies such as Jordan and Lebanon are extremely skewed towards small firms employing less than 20 employees (Baduel *et al.* 2019).

business strategies. As the labour market in the GCC economies is increasingly targeting localization of the workforce, businesses are likely to face escalation in wages and loss in productivity as the expatriate workers are cheaper and more productive (Al-Mejren and Erumban, 2021).

Previous studies have observed that not many natives are equipped to work in a private sector environment, especially in professional and management fields, even in large countries like Saudi Arabia (Hertog, 2012). Therefore, the region will need to focus more on upskilling its population. The private sector businesses might resort to moving ahead, tapping the potential for automation, knowledge-based technologies, and capital intensity and improving overall production efficiency. However, it is important to realize that given the region's cultural history and political milieu, this process is more likely to happen at a modest pace rather than a radical one. As the localization process continues, businesses will have to adopt strategies to improve their technologies and train their workers to upskill the local workforce - a key aspect identified by the micro-level strategies in the International Labour Organisation productivity ecosystem (International Labour Organization, 2020a) - to enhance productivity and save on costs.[23]

Discussion and Conclusions

This article analyzed the macro trends in per capita GDP and labour productivity in 12 West Asian Arab countries. The results suggest the importance of harnessing productivity to sustain long-term growth and well-being and to foster sustainable business in the West Asian Arab region. This section summarizes the main findings of the article and highlights the major challenges and strategies that governments and businesses may consider in addressing them.

Main Findings

- The region failed to sustain the growth momentum it accomplished in the early phases of oil development in the subsequent periods.
- The region has a complex and unique productivity problem, which is distinct between the GCC and non-GCC groups and even among countries within both groups.
- The continued focus on employment-driven growth has led to a weak productivity elasticity of output and resulted in a trade-off between labour productivity and employment growth. This also resulted in a disconnect between labour productivity and per capita GDP growth.
- The region, in general, failed to create growth-enhancing structural change primarily due to a failure to diversify jobs and production to more productive sectors effectively.
- Sustained inefficiency in translating inputs into output, and in particular efficiently using investment in produc-

23 The ILO has pursued a productivity ecosystem that underscores the need for sustainable productivity gain for and through decent jobs (see International Labour Organization, 2020a).

tive ways, has resulted in weak productivity performance.

Our analysis of the region's long-run economic growth indicates that the region had its best growth performance – in terms of GDP, per capita GDP, and labour productivity – during the 1960-1970 period. While the oil-rich economies benefitted directly from the export of oil and the resulting oil revenues, other Arab nations exported workers to support various new projects financed by the oil revenues in the GCC economies.[24] However, the oil-supported economic boom was not sustained, as the GCC economies seemed to have suffered from resource dependency, with nearly no economic diversification and productivity growth. Indeed, the oil revenues helped the economies develop their infrastructure, but the lack of focus on non-oil sectors did not sustain long-term growth.

Overall, the region does have a significant productivity problem, and the problem is a complex one. The nature of the problem is different between the affluent GCC economies and non-GCC economies – even quite different across countries, especially among the non-GCC Arab countries.

Addressing these problems is challenging for the region as a group as well as within individual countries. The article discussed three different aspects of the region's productivity problem.

First, the fall in the region's per capita GDP and labour productivity growth is partly fueled by an excessive focus on employment-driven growth, tapping the cheap foreign workers.[25] The trade-off between productivity and employment is negative and more pronounced in the West Asian Arab world compared to other parts of the world. The low and weakening share of productivity in generating growth (or the weakening productivity elasticity) has deepened a disconnect between productivity growth and per capita GDP growth in the region.

Second, the region did not experience growth-enhancing structural change. Economic diversification in the GCC economies was not sufficient to facilitate the movement of workers and resources to more productive sectors of the economy. Lately, many countries in the region are increasingly trying to diversify their economies away from oil. But so far, such attempts and the resultant shift in economic activity across sectors have not turned growth-enhancing. Productivity growth within individual industries has

24 Note that although most migrant workers to the GCC came from the other Arab nations in the early phases of oil development, there has been a rapid rise in the Asian migrant inflow after the oil price rise in the mid-1970s. These migrants have contributed substantially to improving the income, production, and consumption growth in their home countries (Kapiszewski, 2015, 2017).

25 The productivity impact of migrant workers gained attention in the past literature, both from the perspective of the productivity-enhancing effect emanating from better allocation of workers to most productive locations (Borjas, 2015; Clemens and Pritchett, 2019) and the adverse effects (Algan and Cahuc, 2010). The empirical evidence for the negative impact, however, is weak, while most support a positive impact of migrants on productivity. The case of GCC is, however, unique as their labour markets are not functioning competitively. The natives are endowed with the right to work in the public sector, which is perceived as their citizenship entitlement, whereas the expatriates dominate in the private sector (Erumban and Al-Mejren, 2022). In an analysis of productivity differences between migrants and natives in non-mining, non-government sectors of Saudi Arabia and Kuwait, Erumban and Al-Mejren (2022) suggest a substantial productivity differences between migrant workers and native workers.

been negative or minimal, and workers' movement across sectors has been mostly growth-reducing.

Third, the slowdown in labour productivity is also a function of poor overall efficiency and the region's inability to translate its capital investment into productivity growth. The continued supplies of low-wage labour seemed to have lowered the amount of capital per worker in the region, reducing the productivity effect of capital investment. The historical availability of cheap expatriate workers in the GCC seems to have halted the private sector incentive to invest in technologies and management capabilities that help enhance productivity.

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Data Appendix

Palestine Data

GDP for Palestine in national currency current and constant price series are obtained from the World Bank World Development Indicators (WDI) for the period 1994-2020.[26] These are converted to PPP $ using the ICP 2011 PPPs, and converted to The Conference Board Total Economy Database (TED) base year using the relative price changes between West Bank and Gaza and the United States. For the period 1970-1994, the real GDP in PPP terms is estimated using the growth rates from the Penn World Tables (PWT). The nominal GDP series in PPP terms is then calculated using the US GDP deflators for the entire period 1970-2020.

The population is also obtained from the WDI for the period 1990-2020 and extrapolated backward to 1970 using trends from the PWT data. Employment is calculated using the employment to population (15+ ages) data multiplied by the sum of the population aged 15-64 and population aged 65+. The latter two indicators are also collected from the WDI for 1991-2020. For 1990, the trend in PWT was applied. Since there was no data in the PWT prior to 1990, we use a previous estimate of UNCTAD (Abu-Shokor, 1995) to impute employment series back to 1970. We use their estimates of employment to population ratio for the years 1970, 1975, 1980, 1985, 1988, and 1989 together with the estimates of the population from the WDI to derive employment data for these years.[27] For the years in between, we linearly interpolate the employment/population ratio. This way, we have a complete series on nominal GDP, real GDP (both in PPP terms), population, and employment for 1970-2020.

Sectoral data on employment and value added

Few databases provide consistent sectoral data on value added and employment across countries. Exceptions are the UNU-WIDER Economic Transformation Database and GGDC 10-sector database.[28] However, both these databases contain no data for the countries we consider in this study. To build the sectoral estimates of employment and GDP, we combine the United Nations National Accounts (for GDP) and ILO data on employment (International Labour Organization, 2020b).

26 Palestine is defined to include the West Bank and Gaza.

27 The WDI provides data on employment and population (both population 14+ and total population), using which we compute the employment to total population rates, which are then multiplied with the total population data from WDI for the period 1970-1989

28 Available in the following links https://www.wider.unu.edu/database/etd-%E2%80%93-economic-transformation-database and https://www.rug.nl/ggdc/structuralchange/previous-sector-database/10-sector-2014.

Appendix Table 1: Countries and Regions

Advanced economies	**Emerging & developing economies**	
	Emerging Asia	**West Asian Arab Economies**
Australia	Bangladesh	*GCC*
Austria	Cambodia	Bahrain
Belgium	China (Alternative)	Kuwait
Bulgaria	India	Oman
Canada	Indonesia	Qatar
Croatia	Malaysia	Saudi Arabia
Cyprus	Myanmar	United Arab Emirates
Czech Republic	Pakistan	*Non-GCC*
Denmark	Philippines	Iraq
Estonia	Sri Lanka	Jordan
Finland	Thailand	Lebanon
France	Vietnam	Occupied Palestinian Territory
Germany		Syria
Greece		Yemen
Hong Kong	**Other merging & developing economies**	
Hungary	Albania	Jamaica
Iceland	Algeria	Kazakhstan
Ireland	Angola	Kyrgyz Republic
Israel	Argentina	Libya
Italy	Armenia	Macedonia
Japan	Azerbaijan	Mexico
Latvia	Belarus	Moldova
Lithuania	Bolivia	Morocco
Luxembourg	Bosnia & Herzegovina	Paraguay
Malta	Botswana	Peru
Netherlands	Brazil	Russian Federation
New Zealand	Burkina Faso	Serbia
Norway	Cameroon	Sudan
Poland	Chad	Tajikistan
Portugal	Chile	Trinidad & Tobago
Romania	Colombia	Tunisia
Singapore	Congo, Republic	Turkey
Slovak Republic	Costa Rica	Turkmenistan
Slovenia	Côte d'Ivoire	Ukraine
South Korea	Dominican Republic	Uruguay
Spain	DR Congo	Uzbekistan
Sweden	Ecuador	Venezuela
Switzerland	Egypt	
Taiwan	Georgia	
United Kingdom	Guatemala	
United States	Iran	

Source: The Conference Board Total Economy Database, April 2021.

Lessons from a Career in Productivity Research: Some Answers, A Glimpse of the Future, and Much Left to Learn

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Abstract

This study presents lessons learned from a career in productivity research. It examines the extent to which the key empirical questions about productivity have been answered. Aggregate and industry growth data are reviewed and show how a few industries contribute a lot to overall growth; notable is the large contribution of high-tech manufacturing to U.S. TFP growth (also the case for Japan). There is an extended summary of the lessons learned from cross-country comparisons of the levels of productivity in different industries using business economics information. Strong competitive intensity is positive for productivity, while regulations and trade restrictions are negative. The article concludes with an optimistic note on the productivity impact of generative AI.

Productivity growth over many decades has transformed the United States, Canada, Europe, and Japan into wealthy countries. The progress made since the start of the industrial revolution has been a miracle, allowing most people in these countries to live comfortably and have a range of economic opportunities. Rising productivity is not the only factor, but it is the most important factor, improving living standards and lifting people out of poverty.

The world economy is changing. Is productivity still as important? There is well-justified concern about global warming and the need to reduce emissions. Further, economy-wide productivity increases have not contributed proportionately to workers' wages, so that there is dissatisfaction about economic performance.[2] This is a particular problem in the United States, where automation and trade have elimi-

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2 See Symposium on the Decoupling of Productivity and Pay in the United States, the United Kingdom and Canada in the Fall 2021 issue of the International Productivity Monitor (Sharpe and van Ark, 2021).

nated many of the jobs that used to provide middle-class incomes but these same forces are also at work in other advanced economies.

Despite these concerns, productivity remains very important. Meeting the challenge of climate change will mean heavy investments to switch over to non-polluting energy sources, replace the current stock of vehicles, and insulate buildings. Research and development funds are being used (correctly) to find ways to reduce emissions and many of the most talented people in the world are focused on climate change rather than on how to produce more output. Productivity growth has been slow in the advanced economies in recent years and the focus on climate change could provide a further drag on traditional measures of growth.[3] It remains just as important today to use resources as efficiently and productively as possible, subject to meeting climate goals. Moreover, even though increases in productivity have not translated one-for-one into wage increases for all workers, it is still the case that faster productivity growth means faster wage growth on average, and it makes more resources available to help those with low incomes.

This article describes lessons learned from a career of studying productivity. I have had the opportunity to work with a range of talented people coming from different backgrounds and countries. Some of this work has been in the academic tradition, published in journals or by Brookings, and some has come from a series of productivity studies carried out by the McKinsey Global Institute (MGI), the think-tank of McKinsey Company.

These two approaches to research have complemented each other. Academic studies use data that can be replicated by others and that build on the work of the many giants of the field. The disadvantage of academic studies is that the authors generally lack detailed knowledge of how companies and industries operate. The MGI studies, by contrast, included senior experts that had worked with firms and industries for many years. A disadvantage of the business research is that these studies cannot be replicated, except at great cost. To add to the economic expertise of these projects, however, a team of academic advisors was set up, with Nobel prize winner Robert M. Solow serving as the chair of the advisory committee for about a decade. I worked extensively on many of these studies.

The next section reviews the key questions productivity research has tried to answer, together with some summary facts about US and global growth. The paper then examines the contributions of each industry's TFP growth to total US business sector TFP growth. Lessons from the studies led by the McKinsey Global Institute are then presented, including the role of physical capital, human capital, and technology and innovation. The paper then describes the overall conclusions of these studies, particularly the impor-

3 There is a case for taking account of changes in the environment as part of measuring productivity. If that is done, investments to improve the environment would contribute to measured productivity. That is not done in this article where productivity is measured using traditionally measured output, for example in the productivity calculations made by the US Bureau of Labor Statistics.

tance of competitive intensity to labor productivity differences across countries. The next section summarizes productivity lessons from work on US establishment data, notably the relationship between declining dynamism and the slowdown in US productivity growth. There is then a review of the extent to which research has provided answers to the questions posed at the beginning of the paper. Research has contributed to a much deeper understanding of both productivity growth (labor and TFP) and the reasons for cross-country differences, but much remains to be learned. There is then an optimistic look at the likely contributions to future productivity growth coming from the rapid development of large language models and related software. There is a brief conclusion.

A caveat is in order. This review of lessons learned is oriented to my own interests and the studies I have been involved with. There is much excellent research not covered here.

The Questions Productivity Research has Tried to Answer

In 1957, Robert Solow found that about 80 per cent of the growth in labour productivity historically came not from increases in capital per worker but from a residual factor that is now called total factor productivity (TFP) and is often associated with technical change or technological progress.[4] Much subsequent research on productivity attempted to better understand this surprising finding and figure out what was behind the large growth residual. Solow explored models where technology is embodied in capital goods—vintage capital models. These capture important insights into the economy, highlighting the productivity advantage of operating with the most advanced machinery. However, even in these models, it remains the case that the pace of technological progress is the most important driver of long run growth. If technological progress slows, investment runs into diminishing returns because new vintages of capital do not generate much productivity advantage over prior vintages, and investment becomes less profitable for businesses. Rapid technological change is the most important driver of strong investment.

Work by Dale Jorgenson of Harvard and by Edward Denison of Brookings differed in important ways and generated disagreement, but they shared the common goal of whittling down the TFP residual.[5] They explored how the flow of capital services into production can differ from the stock of capital; how education and experience impact the productivity of the workforce; how R&D can contribute to growth; and the impact of economies of scale and regulation. Jorgenson expanded on the neoclassical growth model, and his productivity framework is now used worldwide.

Jorgenson and Denison did succeed in

4 The concept of total factor productivity was developed by Jan Tinbergen (1942). The theory of growth was developed by Solow (1956) and Swan (1956). Solow (1957) estimated the contribution of capital to growth.

5 Jorgenson's research is summarized on his Harvard University page (Jorgenson, 2022). Denison's research is described in Kendrick (1993). See also Romer (1986), who argued for understanding the sources of the TFP residual and how it was affected by economic factors.

whittling down the TFP residual, notably in identifying the contribution of human capital and the role of information and communications capital (ICT), but there remains to this day a substantial puzzle to understand the nature and determinants of the TFP growth that has been the main source of the rapid labour productivity growth that characterized the U.S. and other advanced economies in the postwar period. Understanding the determinants of the growth in TFP and the reasons for TFP differences across countries remains an important question and puzzle.

A sharp slowdown in productivity growth occurred in 1973-4 that had substantial consequences for living standards and for economic policy. The slowdown in growth altered the TFP puzzle. The decline in productivity growth was associated with a large decline in TFP growth and so the unexplained productivity residual became much smaller. Capital accumulation also slowed around the same time. Why did growth slow down sharply in the United States in the early 1970s, a slowdown that also took place in the other advanced economies?

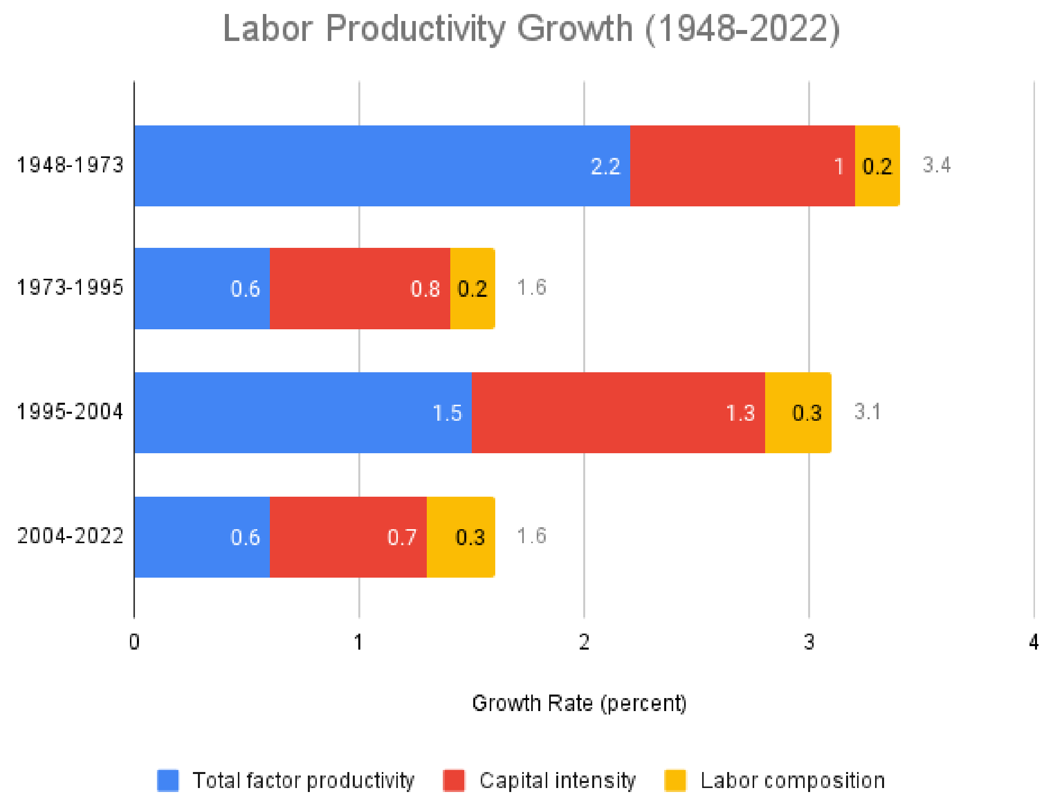
An especially puzzling feature of the slowdown in productivity growth in the early 1970s is that the drop in the speed of growth was quite abrupt. If it had been the case that TFP growth had gradually shown signs of decline over an extended period of years, it would have been natural to attribute this slowdown to a gradual exhaustion of technological opportunities. If one envisages technological progress as a process of selecting new business models or new technologies from a pool of possibilities that nature has provided to us, then it is natural to think that it might become gradually harder and harder to find new ways to increase productivity. The relentless march of growth in the period from 1950 to 1970, in this analogy, resulted in diminishing returns to the process of drawing from the limited pool of new technologies and ideas. However, the nature of the slowdown that took place in the early 1970s does not fit very well with this view of a gradual decline. The sharp drop in growth is an important feature of economic history. However, it probably is correct that the innovations that increase productivity have become harder to find.[6]

Just as economists and policymakers were adjusting to an era of much slower growth, productivity growth in the United States abruptly picked up again for almost a decade before slowing once again, leading to another growth puzzle. Why did productivity growth revive in the United States 1995-2004 and then slow again after that? There is a consensus that this was the result of the surge in investment in computers and other technology, together with the improvements in business systems that this facilitated.

Chart 1, using data from the Bureau of Labor Statistics (BLS), illustrates the different productivity periods since 1948, with estimates shown of the overall rate of labour productivity growth in the nonfarm

6 The editors of this journal commented that the oil price shock and the period of recession and rapid inflation that followed explain the abrupt productivity growth decline. My own view is that the abrupt slowdown remains a puzzle.

Chart 1: U.S. Labour Productivity Growth in the U.S. Non-Farm Business Sector in Selected Periods, 1948-2022



Source: Bureau of Labor Statistics

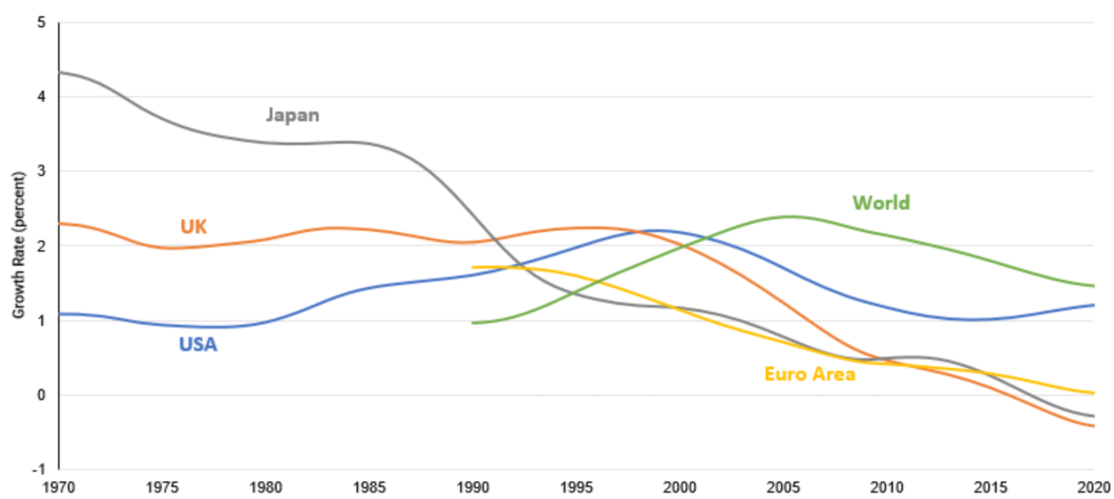
business sector by period and the contributions to that growth coming from TFP growth, capital intensity, and labour composition.[7]

The chart shows:

- The slowdown in labour productivity growth that occurred around 1973 was driven by a big drop in the TFP residual, from 2.2 per cent a year to 0.6 per cent a year.
- The contribution of labour composition remains roughly constant over the entire period. It is a consistent contributor but not large and does not explain variations in period-to-period growth.
- The contribution of capital to labour productivity growth tends to rise and fall in line with the rise and fall in TFP growth. However, the period 1995-2004 stands out as one with a very large capital intensity contribution. This was when computer prices were falling rapidly and investment in computers was booming. The estimated increase in real (quality-

7 This labour composition in the BLS estimate of the contribution of human capital improvements. Chart 1 covers non-farm business while Charts 2 and 3 cover all of GDP and Chart 4 includes the total business sector agriculture. Apologies to the reader for my lack of consistency

Chart 2: Labour Productivity Growth Per Person Employed



Source: The Conference Board Total Economy Database (adjusted version) 2021

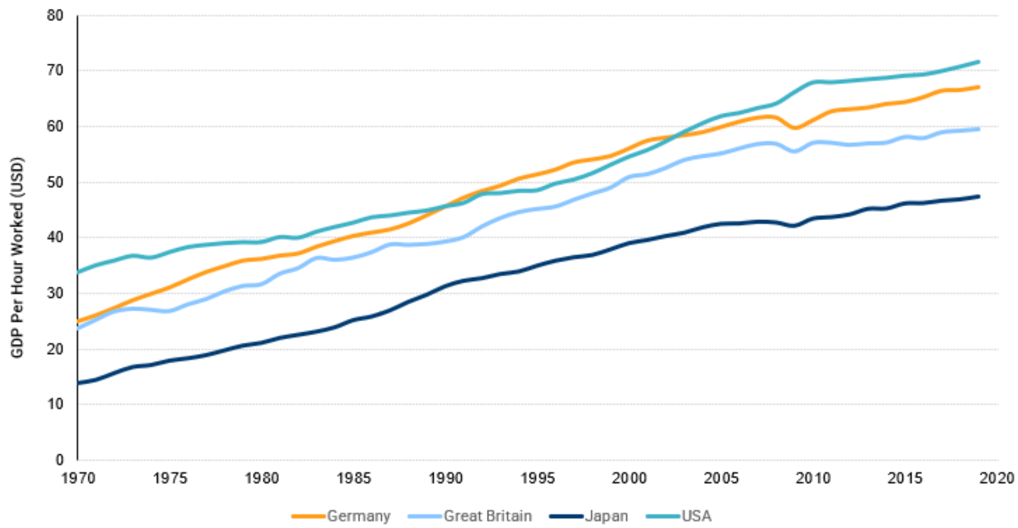
adjusted) capital was very large.

The United States is far from the only economy that has experienced a slowdown in labour productivity growth. In the 1950s, the U.S. economy had a much higher level of productivity than Japan and Europe. Of course, many of these economies had suffered severe damage during the Second World War. In the postwar period Europe and Japan grew more rapidly than did the United States, closing the productivity gap. Starting around the 1970s, however, the productivity slowdown affected almost all the advanced economies. Research from the Conference Board (which builds on data from the OECD, Eurostat and other international organizations, including the Asian Development Bank (ADB)) shows the pattern of the productivity slowdown. They use a technique called a Hodrick-Prescott filter, which takes the annual productivity data and smooths the year-by-year growth numbers to pick out the longer run trends.

Chart 2 shows their results for Japan, the UK, the United States, and the Euro area. The figure finds that productivity growth in Japan, which was very rapid in 1970 (and before), has been slowing almost continuously since then. Productivity growth in the UK was stable for a period but has been slowing dramatically since the mid-1990s. Growth was slow in the United States in the 1970s and then had a period of faster growth before slowing again (consistent with the data shown in Chart 1). The euro area has also been slowing monotonically since the data for the combined area started. The line for the world economy is also shown and reveals that global productivity growth has been slowing since the mid-2000s.

The results shown in Chart 2 must be interpreted cautiously. For example, the line for the United States shows productivity growth starting to improve by the early 1990s, a finding not visible in the year-by-year data. It happens because the Hodrick-Prescott filter program creates a smooth line and does not allow abrupt changes.

Chart 3: Labour Productivity Levels in Selected Major Economies, 1970-2019 (USD)



Source: OECD Statistics

This approach is particularly unreliable at beginning and end points of the period considered.[8] Despite this reservation, the filtered data shown in Chart 2 provides a way of seeing patterns that would otherwise be obscured by numbers that change with each new observation. The pattern shown in Chart 2 illustrates an important point: The economies of Japan and Europe grew very rapidly in the postwar period, coming close up the productivity level of the U.S. economy. However, this growth has slowed very markedly, even falling below the slow U.S. pace.

To provide additional insight into productivity patterns across countries, Chart 3 shows the levels of GDP per hour worked in four large economies: the United States, Japan, Great Britain (the UK), and Germany.[9] The calculations of GDP per hour worked are made correcting for differences in price levels using economy-wide purchasing power parity (PPP) exchange rates. By the end of the 1980s, the level of productivity in Germany had converged to that in the United States, and similar productivity convergence was true for several other European economies.[10] The period of fast growth in these converging economies had allowed them to catch up to the U.S. productivity level. However, that is not the case for Japan and Britain, and the gap is quite large for Japan following a spectacular catch up during the first few decades after the Second World War. That points to a further question or puzzle. How are the levels of productivity among different countries related and why has convergence

8 The chart shows US labour productivity of about 1 per cent in the 1970s, which is a surprising. US productivity growth was strong until around 1973 and slowed thereafter before recovering in the 1990s.

9 The OECD has constructed figures for Germany with adjustments for the effect of the reunification with East Germany.

10 Economic convergence is explored in Baumol *et al.* (1989) and Baumol *et al.* (1994).

been incomplete in some countries?

The discussion so far has been based on aggregate measures of productivity and while the study of productivity at this level is valuable, we know that the economy is made up of thousands of companies that are grouped into many different industries. The speed of productivity growth and its determinants are very different in, say, the construction industry compared to the computer industry.

In the remainder of this article, the emphasis will be mostly on lessons learned about productivity based on different industries and, in a brief discussion, lessons learned from analysis using firm or establishment-level data. Even if the ultimate goal is to understand aggregate productivity, it is important to look at the contributions of different industries.

Industry Contributions to Overall Productivity Growth

One way to determine the growth contribution of the individual sectors of the economy to overall growth is to make use of a result derived by using Domar aggregation (Domar, 1961). Evsey Domar showed how to measure the contribution of TFP growth in each industry to the overall growth of the aggregate economy. For example, we can estimate the contribution of, say, manufacturing to TFP growth in the business segment of the economy, or the contribution of retail trade, and so on for each of the parts of business. The methodology is explained in the productivity handbook written by the OECD.[11]

The results of the decomposition of TFP growth by industry for the business sector of the U.S. economy are shown in Chart 4, in the 1987-2019 period.[12] The analysis starts in 1987 because prior to that year, U.S. industries were defined differently (computers and electronics was not a separate industry prior to 1987, for example). Results are available for 2020, but the COVID-19 pandemic has impacted these and made the findings difficult to interpret.

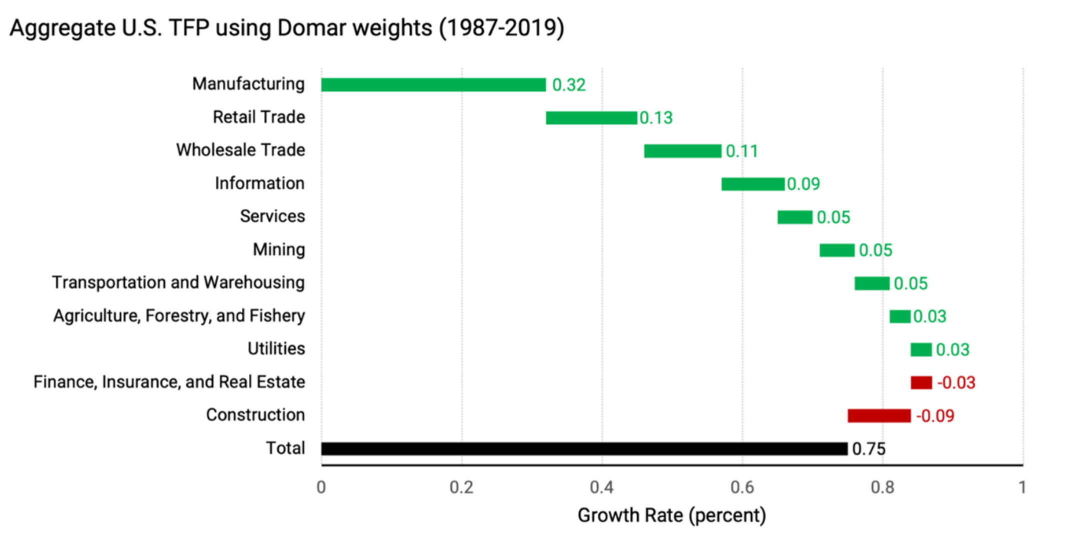
The immediate result revealed in Chart 4 is the enormous importance of a small number of industries to overall TFP growth in the United States.[13] Manufacturing, retail and wholesale trade and information account for TFP growth equal to 85 per cent of total TFP growth in the business economy. Services, mining, transportation, agriculture, and utilities all added positively to TFP growth while finance and construction both subtracted from growth, reductions in aggregate TFP growth. Perhaps the most striking result is the very large contribution from the manufacturing sector. It accounts for growth equal to 43 per cent of the total. That is not to minimize the importance of the other industries, but to note the surprising role of manufacturing given its modest size in the U.S.

11 This manual is updated regularly, see https://www.oecd.org/sdd/productivity-stats/2352458.pdf

12 This approach follows the approach pioneered by Harberger (1998).

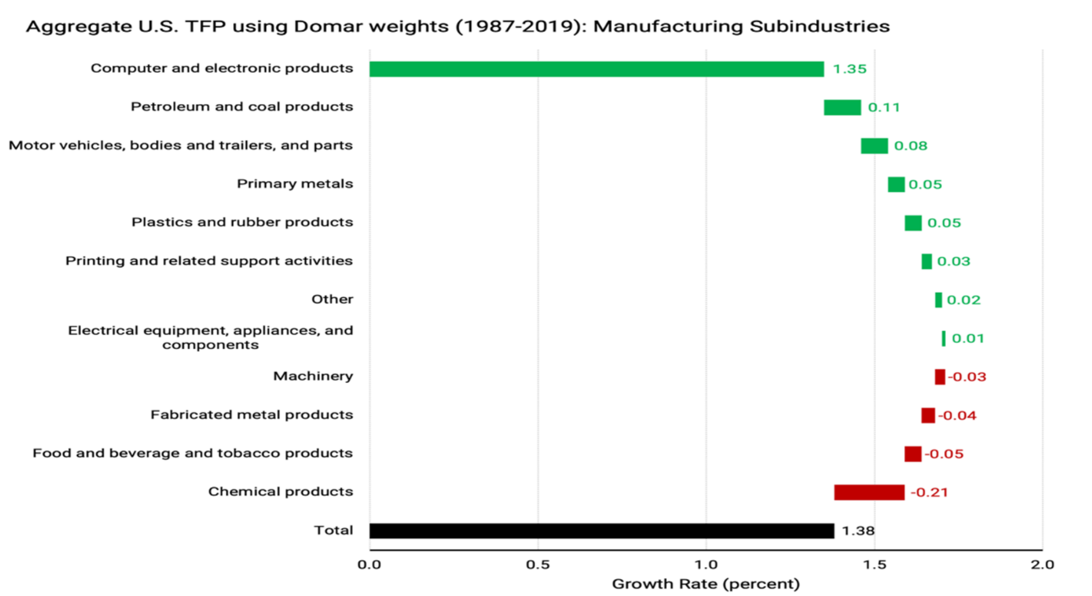
13 This statement applies to productivity calculations made using real output. Tang and Wang (2002) argue that the decline in relative prices of fast-growing industries reduces their contributions. For certain purposes, that is correct, but generally the use of real output to measure productivity contributions is preferred. See the discussion of the issue by Reinsdorf (2015).

Chart 4: Contributions by Industry to TFP Growth Using Domar Weighted in the U.S. Business Sector, (Percentage Points per Year), 1987-2019



Source: U.S. Bureau of Labor Statistics

Chart 5: Contributions by Subindustries to TFP Growth Using Domar Weighted in the U.S. Manufacturing Industries, (Percentage Points per Year),1987-2019



Source: U.S. Bureau of Labor Statistics

Table 1: Contributions to TFP Growth by Manufacturing Subindustry, Selected Periods, (Percentage Points per Year)

Subsector name	AVG 1987-2019	AVG 2014-2019
Computer and electronic products	1.352	-0.128
Petroleum and coal products	0.111	-0.021
Motor vehicles, bodies and trailers, and parts	0.079	0.005
Miscellaneous manufacturing	0.053	0.004
Primary metals	0.051	0.002
Plastics and rubber products	0.050	0.050
Printing and related support activities	0.033	-0.239
Textile mills and textile product mills	0.021	0.037
Nonmetallic mineral products	0.016	-0.016
Electrical equipment, appliances, and components	0.009	0.035
Paper products	0.004	0.036
Furniture and related products	-0.003	-0.028
Apparel and leather and allied products	-0.005	-0.094
Wood products	-0.016	0.272
Machinery	-0.031	0.038
Fabricated metal products	-0.039	-0.149
Food and beverage and tobacco products	-0.047	-0.08
Other transportation equipment	-0.050	0.024
Chemical products	-0.212	0.011
TOTAL (manufacturing):	1.377	-0.242

Source: Bureau of Labor Statistics, productivity database

economy. The contributions of retail and wholesale trade are also important.

The contribution of manufacturing is so striking that it is worth asking whereabouts in manufacturing this growth has originated. To answer this question, Domar disaggregation can also be made for the constituent parts of manufacturing. Chart 5 shows the results of doing this.

The remarkable finding from this analysis is that over the period 1987-2019 is that the TFP growth came from one industry, computer and electronic products.[14] As in Chart 4, there are positive contributions from other industries, but these are not very large and are offset by negative TFP changes elsewhere, particularly in chemical products. Chart 4 tells us that while the high-tech sector in the United States is not very large in terms of employment and share of GDP, it is very important to productivity growth.

Another important result obtained by looking at the manufacturing subindustries is to see which of them experienced slow growth in recent years. The findings are shown in Table 1 using percentage points. The most striking finding in the table is the fact that the computer and electronic products industry appears to have experienced negative TFP change over the period since 2014. Thus, by far the largest driver of manufacturing productivity over the full period and one of the largest drivers of productivity growth in the full business economy experienced a productivity setback in

14 Activities in the United States are assigned to industries on the basis of the most important activity in the establishment surveyed. Facebook, Netflix, and Google are all service industries, business or consumer services. Apple no longer manufactures in the United States. Amazon is primarily in the wholesale and retail industries.

the 5-year period prior to the start of the pandemic.

The fact that some industries and subindustries show periods of negative TFP growth is surprising. Indeed, over the short period 2014-19 the whole manufacturing sector had negative TFP growth. It is natural to think of TFP growth as representing technological progress or other business improvements. Why would companies or industries go backwards? There is no easy answer to this question, and it could reflect errors in the data. Perhaps capital or labour inputs have been miscalculated; our knowledge of productivity is imperfect, and we should not over-interpret any finding.

That said, the finding of negative TFP over a period of years may also reflect difficulties being faced by some or all the firms in an industry; perhaps their capital investment decisions were poorly made, and the capital is not being used in the way that was intended. Workers may produce output that is never sold. Keep in mind that TFP is calculated as residual, a measure of our ignorance, as Abramovitz described it.[15] Still, negative TFP is a warning of possible problems within an industry that can be investigated further.

Learning from Business Economics Research

In the early 1990s a nonprofit group, the McKinsey Global Institute was created to research important economic issues that could be informed by the knowledge provided by experienced business consultants working with leading economists.[16] It was decided that a central focus of the research would be to compare productivity across countries by industry and try to understand why differences occurred. This is a natural topic because of the knowledge consultants have of how firms and industries operate in many countries. Robert M. Solow was brought in to chair the academic advisory committees formed for each study and, for the first study, he asked Francis Bator and me to make up the other members of the committee.[17] Over time a range of different economists joined the projects with an emphasis on adding economists from the countries being studied. Leading economists such as Olivier Blanchard and Barry Bosworth contributed, as did Nobel Prize winners such as Robert Solow, Mike Spence, and Chris Pissarides. The results of the studies were always published in extended reports. Several of the studies were presented in articles in the *Brookings Papers*. William Lewis (2004), who led the

15 Abramovitz (1956). There are inevitable biases in the calculation of TFP. For example, Houseman *et al.* (2011) suggest an overestimate of productivity while Guyenen (2022) and Baily and Looney (2017) point to underestimation of productivity (an earlier version of the Guyenen article was released as a working paper in 2017).

16 The group, the McKinsey Global Institute, was and is funded by McKinsey Company, a profit-making institution, but as a research group whose results would be published and made available to everyone. The project reports are available on its website. The studies were also discussed in published articles, including Baily (1993), Baily and Gersbach (1995), Baily and Garber (1997), Baily and Zitzewitz (1998), Baily and Solow (2001), Baily *et al.* (2005), and Lewis (2004).

17 Francis Bator left the advisory group in the mid-1990s. He was the one who suggested the causal framework that was then used in all the productivity studies.

teams in the 1990s, wrote the book *The Power of Productivity* about this work, and Solow and I wrote an article in the *Journal of Economic Perspectives* (Baily and Solow, 2001).

This section will describe some of the findings from this work in some detail but first a summary paragraph highlighting the most important findings. First, the studies found that there were large differences in the levels of productivity across countries in the same industry. At the time of the research, there had not been a full productivity convergence among advanced economies at the industry level. Second, a high level of competitive intensity forces firms to achieve the level of productivity of the best performers in their industry, or close to it. And if companies compete against the most productive companies world-wide, they move closer to that best-practice productivity level. Third, certain types of regulation, as well as trade and investment restrictions, can prevent an industry in a country from achieving best-practice productivity. Fourth, operating at large scale often provided a productivity advantage. And fifth, promoting high productivity is not a simple thing. The drivers of productivity or the barriers to productivity varied by industry and country. There were occasional surprising exceptions to the general rules outlined above.

Most of the productivity studies I discuss here were carried out in the 1990s through the early 2000s, so the specific numbers used to draw the conclusions will not necessarily reflect the relative productivity status of the industries today. The competitive dynamics may have changed over time and regulation and trade rules may be different than those that applied when the studies were carried out. The lessons for productivity are not out of date, I believe, and will give insight into important determinants of productivity that still apply today.[18]

The Role of Capital

Capital goods are obviously essential to production in almost all economic activity. A modern factory is full of equipment. Offices are housed in expensive buildings, with furniture, fixtures, and office machinery, computers for all employees, mainframe computers for accounting, billing, and other tasks as well as copiers and telecommunications equipment. All high-income economies are built on a capitalist model, even those that have state ownership of some companies. It was natural for economic models of growth to single out capital as the key factor of production, and it was a shock when its importance to productivity growth turned out to be smaller than expected.

Given that history, it probably should not have come as a surprise when cross-country productivity comparisons did not find differences in capital intensity across the advanced economies to be a substantial cause of productivity differences. Cap-

18 The McKinsey Global Institute has additional work that can be found on their website https://www.mckinsey.com/mgi/overview. The article by Gouma and Inklaar (2023) in this issue of the *International Productivity Monitor* provides an excellent comparison of different data bases, including those of the Conference Board, the OECD, the KLEMS database and others.

ital might have been expected to show up as an important cause of productivity differences in manufacturing industries, but instead it was found that factories were equipped similarly across these economies. The companies that make capital goods sell them around the world, so factories in different locations generally have comparable equipment and look very much the same. There can be differences in the utilization of capital and smaller companies may not use the most up-to-date machinery, especially in developing economies.

As noted earlier, there is much complexity involved in productivity, and so there are qualifications to the above statement. Capital goods are expensive and last a long time, and they embody the technology available when they were constructed. The technology embodied in the capital can vary across economies. There were examples where a recently built factory is more productive than older factories. For example, Korea set up Pohang Steel Company that began operations in 1968 with a state-of-the-art factory supplied from Germany that was for some years one of the most productive integrated steel mills in the world (Baily and Zitzewitz, 1998). A more recent example of the value of advanced machinery, as described in press reports, is that Tesla uses very advanced capital goods to achieve high levels of productivity.[19]

The finding about the role of capital intensity has also been questioned in the UK where capital intensity is substantially lower than in Germany. On the face of it, UK companies should have good access to capital through the strong financial sector in the UK. But it is argued that UK companies demand very high rates of return on investment and seek those returns through foreign investment rather than improving productivity domestically (Bughin *et al.*, 2018).

Despite such qualifications, the productivity studies found in most cases that the way factories or offices or retail facilities were operated were much more important to productivity than differences in the capital stock. Organizational or managerial capital was very important. And there were even examples where high levels of investment had contributed almost nothing to productivity. The study of Korea, for example, found that government development policies had, in some industries, encouraged overinvestment where machinery was underutilized. Another example came from Germany where union restrictions on shiftwork meant that companies had to invest in extra capital to produce a given level of output and capital utilization was low compared to the United States.

The Role of Human Capital

The level of education of production and non-supervisory workers was not found to be an important determinant of productivity. A striking example came from a comparison of residential construction in Brazil and the United States. Productivity was very low in Brazil, only about one-fifth of the U.S. level. The conventional wisdom in

19 Rauweld (2021) describes the speech made by VW CEO Herbert Diess in which he warns VW employees they will have to improve their own productivity substantially to compete effectively against Tesla.

Brazil was that this low productivity was the result of the low educational level of the construction workers. Most had received only a few years of education, and many were unable to read and write. However, a comparison of residential construction sites in Brazil and in the United States found that most of the U.S. construction workers were immigrants (mostly from Mexico) who had also only completed a few years of education, and most were unable to read and write. Instead, the productivity difference arose from two main reasons. First, most U.S. residential construction is carried out in sites where a large area is cleared and then multiple copies of pretty much the same house is built. This allows economies of scale. Second, a U.S. construction site is carefully orchestrated by site managers. Special trade workers, such as plumbers, carpenters and electricians are brought to the site only when required. These workers move from site to site as needed. Utilization of labour is much better in residential construction in the United States.[20]

The retail industry provided another example where education was not seen as important for non-supervisory workers. Retail companies such as Wal-Mart do not require much education for their workforce. Worker productivity is achieved through training, the design of work procedures, and through performance incentives. Big-box retailers like Wal-Mart typically have very high levels of staff turnover and build productivity into the business system rather than relying on worker skill.[21]

There is a contrast with some German retailers in the 1990s that had apprenticeships where cashiers were required to memorize all the products the store so that they could cash out customers quickly without checking price labels. The arrival of universal product codes and scanners rendered that skill unnecessary. Indeed, scanners are much more productive since they can be used for inventory management.

As with the construction example, the managers and computer systems engineers at productive retailers are very skilled and designed systems to coordinate wholesale and retail functions and ensure deliveries were on time and sent to the right store.

A similar story applies to the fast-food industry, where the staff in the outlets often do not have much education. They receive basic training to perform the tasks they are assigned, and the layout of the premises and the design of the equipment allows high productivity. The cash registers make change and do not require a knowledge of English. The cooking is monitored by the fryers and ovens. This describes low-cost outlets like Mcdonald's, but even higher-priced restaurants use factory-prepared components that are cooked and assembled using carefully worked out procedures, rather than skilled chefs.

20 The MGI international comparison studies found the level of residential construction labour productivity to be relatively high. However, the growth rate of construction labour productivity in the United States has been very low or negative, see Goolsbee and Syverson (2023).

21 Some big box stores have skilled workers on the floor. Hardware store employees, for example, must provide advice and guidance if the store is to attract non-expert customers and the same is true for computer retailers and some parts of consumer electronics retailing.

The Importance of Human Capital: Can these Findings be Correct?

There is a huge economics literature that makes the case for the importance of education to wages and to the economy. Alan Krueger, for example, working with Joshua Angrist, found that the accident of birth date impacted how long some students stay in school and that even staying a few extra months in school added to lifetime earnings (Angrist and Krueger, 1991). Krueger and Orley Ashenfelter (1991) used identical twins to demonstrate the contribution of education to earnings. Claudia Goldin and Lawrence F. Katz in *The Race Between Education and Technology* in 2008 argued that the demand for and supply of human capital have shaped the distribution of earnings in the United States. Baily, Bosworth, and Kennedy (2021) argue that differences in human capital returns in Japan relative to Germany and the United States play a role in productivity differences.

It is hard fully to resolve the difference in conclusions between the productivity studies from the business consultants and the academic findings on the value of education, but the following ideas may help.

First, skilled managers, scientists, engineers, and professionals are important in creating productive companies and in developing new technologies. The strong universities in the United States have contributed to the supply of this segment of the workforce and encouraged creativity, innovation, and entrepreneurship. Nothing in the productivity studies contradicts this.

Second, there are different ways of running productive companies, described in the labour economics literature as the high road and the low road. With exceptions, U.S. companies take the low road, building productivity into their business systems, setting low wages for production and non-supervisory workers, and accepting high rates of turnover. Again, with exceptions, German companies take the high road, relying on well-trained workforces and creating high-quality outputs—using a different business system model. German manufacturing is much bigger than the sector in the United States, adjusted for the relative sizes of the two labour forces. It pays good wages and runs a huge trade surplus supplying specialized and high-quality products around the world. The two countries end up with similar productivity levels.

Third, the economy is changing. In the past, a high school diploma or a degree from a community college was enough to allow Americans to obtain a good job and earn a living wage, often in a unionized company. Even if companies did not especially value the specific knowledge acquired in high school beyond basic skills, they did value the signal provided by a diploma which demonstrated the willingness to work hard and to accept training. The widespread dissatisfaction with the available pool of jobs, and the social antagonisms that have been the result, demonstrate that America's low-road approach is creating problems. The inability of many students to handle student loans suggests that spending extra time in school does not raise wages much for many students.

The Role of Technology and Innovation

There is a great emphasis on technology, and advanced technology particularly, as a source of productivity growth. This goes back to the original growth models where the TFP residual was seen as coming from technological change. In the MGI cross-country comparison studies, however, the importance of high-tech was questioned. The high-tech sector is small in all countries, even in the United States or Japan. Its share of employment and GDP are both small. Nevertheless, the products and services of this sector could be important in influencing productivity elsewhere in the economy. The comparative studies found, however, that proprietary technology was not a major source of productivity level differences across economies. The reason for this is that most technology products are available on global markets. Machinery and equipment, including computers, are sold around the world and so is software. We gave the example earlier of the Korean steel industry, where a huge integrated steel mill was built using the most advanced available German capital goods.[22]

Product and process designs and organizational technology (called intangible capital, or sometimes "soft" technology) can be hard to transfer internationally and can depend on a company's specific skills and culture. One of the best examples of this came from the automobile industry. The Japanese auto industry in the 1990s was substantially more productive than the industry in the United States or in Germany.[23] Toyota was acknowledged to be the global productivity leader, although other Japanese companies had adopted many of the practices used by Toyota. The Toyota production system had been developing gradually for many years and it involved three main elements. First, incremental improvements were constantly made on the production line to reduce wasted time and materials and to make sure parts were available at the right time and in the right location. This efficiency was achieved by checking and redesigning the process and by using suggestions made by workers on the line.

Second, the cars were designed to make them easy to assemble. Parts were simplified and designers looked for ways to reduce the number of parts needed. Parts could be fitted together easily and secured in place with a minimum of time. One consequence of these design improvements was that the cars became much more reliable. Japanese cars sold in the United States could be priced at a premium because of the reputation they developed for reliability.

The third important element of the Toyota production system was the way in which the company worked with their suppliers as part of a keiretsu. The suppliers formed a close relationship with Toyota, a pattern that was replicated with other Japanese original equipment manufacturers (OEMs). Engineers from the OEM would visit the supplier factories and make suggestions for ways to cut costs and improve designs or quality. The OEMs would maintain their relationships with

22 I will come back to the technology issue later in this article. Another issue raised about technology, particularly information and communications technology, is how much of the value from advances in this area accrue to the innovating country and how much is transferred globally through falling prices of hardware.

23 Based on a quality-adjusted number of vehicles per hour.

their suppliers over long periods, although it was made clear that suppliers were expected to make continuous improvements. The American companies, instead, developed arms-length relationships with suppliers, generally requiring that more than one company supply components. There would then be pressure placed on the suppliers to reduce component prices. This would squeeze profitability and make it difficult for the suppliers to invest in new equipment or do R&D to improve quality or to improve designs. Over time, many parts suppliers moved operations to Mexico or other low-cost supply locations.

It proved very difficult for American companies to adopt the Toyota production system. This is surprising because it did not involve proprietary technology; indeed, Toyota formed a joint venture with General Motors in the 1980s (NUMMI) in a factory in Fremont, California. GM executives visited this factory but did not try to transfer the technology to their U.S. operations for many years. The reason for the unwillingness to adopt the Toyota-led improvements in production methods was that GM had become the largest and most successful company in the world in the post-World War II period. Its managers were convinced, they had the best ways of doing things. Major changes only happened when competition, and ultimately bankruptcy, forced the changes. Ford learned about Japanese production technology through its partnership with Mazda and did transfer some aspects of the system, notably in the design and production of the successful Ford Taurus.

What Factors in the Economic Environment Determine Productivity Differences?

Several factors have been listed above as not being central to productivity differences and one factor was listed as significant and more important than is often realized—organizational or intangible technology. This subsection takes the story further by asking what factors in the economic environment contributed to companies and industries achieving global best practice productivity. The answers are: first, competitive intensity forces improvements; second regulation can impede productivity advance; and third, scale can allow higher productivity operations.

In the comparisons of manufacturing industries across advanced economies, the most productive industry across the different countries was identified as the global leader in productivity in that industry. For example, in automobiles the Japanese industry was the leader and the industries in other countries were considered follower industries. The leader industry was then assigned productivity of 100 and the relative labour productivity of follower industries was measured relative to the leader.

A second calculation was then made as to how much the industry a country was “exposed” to the productivity leader. This calculation was based on three elements. First, does the industry compete in its home market against companies originating in the country of the productivity leader? For example, when Japanese companies built factories in the United States, this forced the U.S. auto industry to compete directly against Toyota, Nissan, and other companies. Second, does a given industry compete against the leader through trade in third markets? For example, how much does, say, the German industry compete against the Japanese industry in its export sales? And third, does an industry sell into the market of the productivity leader? These three factors were then weighted into an index, the globalization index, measuring the exposure of each of the follower industries to the productivity leader.[24]

It was then found that exposure to direct competition with the global productivity leader forced an industry to improve its own productivity in response to the competitive pressure. In contrast, those industries that were protected against competition from the global productivity leader tended to have lower productivity. Baily and Gersbach (1995: Chart 7) show the positive correlation between an industry's productivity relative to the global leader and the index of its exposure to competition is shown. The resulting correlation is not perfect, but it is strong. It shows that when a manufacturing industry competes against the best global companies in their industry, this forces them to improve their own productivity to try and keep pace.

The correlation confirmed the view of the business industry experts, and applies also, they judged, to service industries. Industries that are protected from competing against the best global companies in their industry will often form comfortable oligopolies that do not strive to be more efficient but are content to make adequate profits and avoid risky changes or expensive investments in new methods or products.

The measured level of productivity in an industry depends on both the level of output and on the level of inputs. Improving productivity will often mean finding ways to produce the same output with fewer inputs. But raising output without a comparable increase in inputs will also increase productivity. For example, products that are well-designed and reliable can be sold at a higher price, boosting output and hence productivity.[25] Alternatively, a company that understands what consumers are looking for and can follow shifting tastes can avoid excess capacity and use its workers and equipment more effectively.

The effect of *regulation* was found to be strongly linked to the competitive intensity just described. The regulations that had a negative impact on productivity were those that limited competition. These limits could come from international trade restrictions (trade barriers of all kinds). Trade restrictions apply primarily to manufactured goods. Regulations can be used to restrict land use, making it impossible for a best-practice company to enter a market or compete. Restrictions on direct foreign investment make it hard or impossible for a leading global company to enter and op-

24 The details of the index are described in Gersbach (1999). Gersbach's index weighted each of the contributors to globalization equally.

25 Measuring this contribution can be tricky as it involves assessing quality differences. However, international comparisons try to make this comparison using products that are standard across markets. Then the price premium for higher quality products can be included in real output and hence in productivity. The OECD in its comparisons tries to use this approach and MGI made its own estimates. Statistical agencies have difficulty in making quality adjustments, which is why MGI often made its own attempts to make these adjustments.

erate in a given market. For example, Sweden had restrictions that prevented foreign banks from entering their market, with the result that Swedish banks had inefficiencies in their operations. With their entry into the EU, Sweden opened its market and allowed foreign banks to enter and force the domestic banks to become more efficient.

Sometimes there were regulations that were idiosyncratic, affecting one specific industry. For example, Germany is very proud of its beer and had complex regulations arounds its production. So-called purity laws restricted how production is carried out and in some cantons the beer sold in a canton had to be manufactured within the canton. German beer is of high quality, but the proliferation of small subscale breweries resulted in low productivity. It was judged that the beer made in Germany could be made with optimal-scale plants at higher productivity without sacrificing quality if regulations were eased.[26] The production of sake in Japan also faces similar restrictions.

Labour regulations can also impact productivity in two main ways. First, union rules may restrict the ways in which companies can improve their production processes. For example, it was noted earlier that General Motors was able to see how a Toyota plant operated through its joint venture in California, but they did not bring these ideas back to their own plants in Michigan, at least not for many years. One reason was a belief that they did not need to change, but another reason was that the union did not want to operate using the Toyota production process, believing that the Toyota approach would undermine the worker protections they had in place. In addition, union pressure can lead to trade restrictions or other regulations that protect jobs but hurt productivity.

In Europe, unions in many industries resisted change on the grounds that jobs would be lost. EU rules were intended to force member countries to open their markets, but not all countries followed these rules to the same degree. Countries such as Italy and Portugal had very entrenched companies and unions that resisted change. By contrast, Sweden was able to open its economy to competition; it had unions that were more focused on international competition, and it achieved very strong productivity growth in the 1990s.

I take seriously the concerns of labour unions to protect their workers. Automation and international trade have eliminated many well-paid jobs and caused social discontent. Ideally, countries should retrain workers that are made redundant and protect them from income losses, but not all countries do this well. Sweden is a

26 The conclusion in the MGI studies about the productivity in the German beer industry was controversial, especially in Germany. One can make the argument that German consumers were simply expressing a preference for locally made beers, which were higher quality in their view. Of course, one way to test this is to deregulate and see if consumers still choose the local beers. Since this study was carried out there has been a proliferation of small-scale breweries in the United States, competing against the giants such as Budweiser and Miller. This does not undermine the argument made for Germany. The key question is whether high-productivity large-scale breweries are permitted to compete in the market. If they can, but consumers choose to buy beer from small local breweries, then the local industry is productive and efficient. The higher price of the local breweries allows their quality-adjusted productivity to match the large-scale producers.

country that combines strong productivity with protection of workers. German manufacturing unions protect their workers but also recognize that companies must remain internationally competitive. German training programs allow workers to move to different jobs when necessary.

The example of the beer industry leads into a broader discussion of scale. There are scale economies in production in many industries, in fact pretty much all industries up to a certain production level.[27] Scale economies were not found to account for large productivity differences across advanced economies for the most part. The German beer example is an exception rather than the rule. Mostly companies operate plants at sufficient scale that allows them to be productive. Still, there are some advantages to scale and access to a large market. Large companies can spread fixed costs over high production levels, giving them a better chance to spend on R&D or on other forms of product or process development. Large companies can experiment and try new products or new process designs and cover the cost if these turn out to be failures. Of course, size is no guaranty of success. General Motors was the largest auto company in the world but ended up in bankruptcy. IBM dominated mainframe computing in the past but is a much smaller company today.

The one consistent effect of scale found was that richer countries produce and sell more goods and services that are higher value-added and have higher measured productivity. Luxury cars and luxury hotels can be sold with higher margins than budget cars and motels. The United States, which has both a large market and many rich consumers, achieves a modest productivity advantage from these characteristics. The EU, of course, has now created a market that matches the U.S. market in size and China's market has grown to match these in size, although China still has a lower GDP per capita than the advanced economies.

What Determines the Productivity Leader?

The simple answer to this question is that we do not know exactly why innovation occurs in one location rather than another. There is serendipity involved in innovation; chance plays an important role. That said, there are economic conditions that favor innovation, and there are policies that can make innovation more likely. Factors that support innovation are discussed below.

A high level of competitive intensity, as we have seen, encourages companies to adopt available best practices—to catch up to the productivity leaders—but it also encourages productivity leaders to innovate to maintain an advantage over their competitors. That advantage may be only temporary, but leading companies innovate continuously to stay ahead.

Innovation involves the development of

27 An inverse U-curve has been found between productivity and size, but the specifics considerably vary by firm and industry. There may be scale advantages with large plants (up to a point). There can also be advantages to firm size, allowing more scope for experimentation and research. But there can also be problems in managing very large firms.

new products and processes.[28] Although competition favors innovation, an industry that is fragmented, consisting of large numbers of small companies, may not be innovative, at least not without help. Agriculture provides an example. In the nineteenth and early twentieth centuries, this industry in America consisted of thousands of small farms. Some farmers were innovative and found new ways to increase their production, but for the most part farmers were too busy keeping their farms operating to spend time and resources on innovation. In response, government stepped in and created research departments in universities, research laboratories, and agricultural extension programs to create and disseminate innovation to this sector. Agriculture has achieved very strong productivity growth in the United States.

The previous example illustrates one way in which government can play a positive role in innovation, and there are other examples. Government can encourage and support research efforts whose results are then available to all companies. They can also foster diffusion-oriented research to see how to obtain and adapt existing products or processes for their own companies. The German government has provided consistent financial support for the auto industry in that country, with research facilities and training. Government can also give research grants to the private sector to encourage new industries. Such grants were important in the early days of Silicon Valley, where Stanford University formed a research park to take advantage of the emerging opportunities in semiconductors. Government support has also been vital in the emergence of other research hubs, such as Research Triangle in North Carolina and the companies around Cambridge University in the UK. The Defense Advanced Research Projects Agency in the United States has famously supported innovations. Another important way in which government has supported innovation historically is as a customer. In the early days of integrated circuits, the U.S. Defense Department was the largest customer.

Another historically important role for government is through the patent system. Innovating companies can patent their inventions and create a monopoly for 20 years from the date the patent is filed in the United States and Europe. Patents are a way of providing incentives for companies to spend on R&D and product or process development. Current thinking is that the patent system has both negative and positive impacts on innovation. The industry that has benefitted most from the patent system is the pharmaceutical industry, where new drugs are patented, and the developing company can earn huge returns for their successful products. The disadvantage is that patients or insurance companies then pay high prices for medications. European countries mostly limit the ability of drug companies to charge high prices. Patents can also discourage innovation. For example, an electronics company that holds a key patent can make it

28 The diffusion of innovation involves the spread of these new products and processes around an industry or globally. As we note in this article, for many companies and countries it is most important to learn about the innovations that have already been developed and learn to use them.

costly or impossible for other companies in the industry to innovate in the same technological area. In the early days of Silicon Valley there were cross-licensing agreements that allowed different companies to use each other's patents, but today there are lengthy, expensive court battles to enforce patents, with potentially negative effects on innovation. It is important that the patent and legal system in a country sets reasonable patent fees to encourage competition and innovation, not discourage it.

Creating an industry with productivity and innovation leadership depends on the availability of talented people with the right knowledge and skills. Generally, this is thought of in terms of people with scientific and technical knowledge, and indeed these skills are important, but innovative business ideas are just as important. Entrepreneurs who develop new business models are not necessarily technology experts, rather they are people with the vision to see opportunity and the willingness to take risk. An environment where failure is allowed and where venture funds are available is important.

Consistent with the findings of the MGI studies, there is now an extensive literature on how management competency impacts the performance of firms. See for example Bloom and van Reenen (2010), who worked with McKinsey in some of their work on this topic.

Lessons from Studies of Establishment Data

This section provides a short description of some of the findings that have been obtained using government data collected from individual establishments. The US Census Bureau collects survey data on individual establishments. These differ from data on individual firms because large firms typically operate many different establishments, often in different industries. The Census Bureau's data allows for the study of specific industries, consisting of all the establishments producing roughly the same type of product automobile assembly plants, for example, or auto parts producers. The best data is available for manufacturing establishments, but there is some research that has extended to service industries as well. In an anonymized form, the data is made available to researchers. John Haltiwanger of the University of Maryland has been the economist that has helped develop the database for others to use and has published much research of his own.[29] I participated in this research effort in the 1990s.

Although this section will not do justice to the extensive literature that has emerged using the establishment data, which now extends to work in other countries, (in fact, Canada pioneered the development of such databases) here are a few important findings.

- Productivity growth in an industry comes from improvements *within* existing establishments, but also comes

29 See: https://econ.umd.edu/sites/www.econ.umd.edu/files/cv/Haltiwanger_cv_May_2023.pdf which contains extensive references to authors from around the world who have looked at micro productivity data.

from the relative expansion of the more productive plants and the relative contraction of the less productive plants.

- Plants that close (exit the industry) have lower productivity than the industry average. New entrants to the industry also tend to be lower productivity than the average, but those that remain in operation increase their productivity more than the average and move up in relative productivity.
- The distribution of productivity levels within industries has become wider. That is to say, the gap between the low-productivity establishments and the high-productivity establishments has increased.

The first two points illustrate the importance of the dynamics among plants to overall productivity growth. These findings are consistent with the results from the business studies. A competitive industry will have establishments that are more successful and some that are less successful, and if the more productive ones expand their share of the market, that is a boost to overall productivity. The establishments that are failing will eventually go out of business. Similarly, a dynamic industry will see new establishments entering the industry, starting with low productivity, but then either growing and moving up the distribution, or else dropping out.

These first two results come mostly from studies in the 1990s or early 2000s. The studies showing the increasing gap between low- and high-productivity plants come from more recent research. This is a sign that the dynamic movement of establishments within an industry that contributed to productivity in the past has slowed down. Low-productivity plants are remaining in operation even though they are not catching up to the best plants in their industry. That result is consistent with fact that productivity growth has been slower since 2004. Based on this finding, Decker, Haltiwanger, Jarmin and Miranda (Decker *et al.* 2016, 2020) find that the dynamism in the U.S. economy has declined. The gap between low- and high-productivity establishments has increased, consistent with the slowing of overall productivity growth.

The increase in the gap between the high and low-productivity plants has also been found for other countries. A study from the OECD using an international database, led by Dan Andrews, found that the most productive companies were pulling away from the rest of their industry (Andrews, Criscuolo, and Gal, 2016). The best companies had continued to see labour productivity growth even when their industry on average had shown slow or no growth. This study suggested that the declining dynamism and slowing of competitive dynamics seen in U.S. data may also be true in Europe and elsewhere (except for the firms at the very top of the productivity distribution).[30]

Have the Key Questions Been Answered?

The first four questions posed at the beginning of this article are all related. Re-

30 Gutierrez and Philipon (2017) argue that the US economy has become less competitive.

search has found that overall productivity growth is tied to TFP and has been associated with technological progress. The answers to all four of these questions are tied to an understanding of TFP—where did it come from during the period of fast growth, why did it slow down (and then speed up and slow down again), and why does its level differ across countries? While not all the puzzles have been answered, there are lessons that have contributed to an understanding of them.

- Innovation, broadly defined, must be the source of productivity growth for firms at the productivity frontier. Technological developments coming from science and engineering are one important source of innovation, but soft innovations are important also, often more important. These take the form of new business models, new products and redesign of old products, and improvements in existing processes. These innovations have contributed strongly to TFP growth over time. And differences in the application of this type of innovations help explain productivity differences across countries.
- The path to a higher level of productivity for most industries in most countries is to learn about the best-practice innovations made around the world and take advantage of them. In some cases, access to best-practice productivity can be limited by trade secrets, patents, or by the complexity of operating at the productivity frontier, but in most cases the necessary technology is available in the global market through capital goods suppliers, software suppliers, and business consultants. If it is too difficult for domestic companies to reach the productivity frontier, a country can encourage direct foreign investment to bring best-practices into their economy. At the beginning of 2022 the United States hosted over $14 trillion of foreign direct investment mostly from leading global companies.[31]
- Important reasons identified for the productivity gaps across countries are restrictions and regulations that protect companies with weak productivity, including restrictions on trade and investment. The nature of the restrictions that limit competition can vary across industry.
- The business studies suggested the educational level of production workers may not be very important to achieving best-practice productivity. However, Germany has shown that high productivity can be combined with a well-trained workforce and this path provides greater equality for the workforce and greater opportunities for those people who do not obtain a college degree. In addition, Baily, Bosworth, and Kennedy (2021) argue that advanced education is important for managerial skills, R&D, and innovation.

31 Data from the U.S. Bureau of Economic Analysis, https://www.bea.gov/sites/default/files/2022-06/intinv122.pdf

- Although this study has not emphasized the issue, there is a consensus among economists that the period of rapid TFP growth in the United States that started in the mid-1990s and lasted until around 2004 was linked to information and communications technologies. In particular, the semiconductor industry was able to cram more circuits onto a single chip and increase the power of computers. Increased competition in this industry encouraged more rapid innovation. Improved computers and communications technologies also helped other industries to advance. Another large productivity contribution came from wholesale and retail trade, where big-box retailers expanded nationwide, coordinated their wholesale and retail functions, and pushed other companies to improve their own operations. By the early 2000s these sources of growth had faded, and growth slowed again. The drop in TFP growth in the computer and electronics industries since 2014, shown earlier, is one important sign of the ending of the technology-driven productivity surge.[32]
- The biggest mystery that remains in productivity research is to explain why productivity growth has been so slow in recent years across so many economies. The default explanation for this is that the pace of productivity enhancing innovation has slowed as the best sources of innovation have dried up.[33] As we saw in Chart 2, the pattern of slow growth is widespread and long lasting. What remains puzzling is that it appears to many that the pace of innovation has not slowed at all but instead is extremely rapid, with advances such as artificial intelligence, machine learning, robots, 3-D printing, and so on, and new companies, like Amazon and Uber, that are shaking up traditional industries. Presumably, all the technological change taking place today is not the kind that generates strong positive productivity effects, at least not yet (Brynjolfsson *et al.* 2021, and Bart van Ark, 2016).
- One important result is the very large contribution of the manufacturing sector to overall productivity growth and the very large contribution of the high-tech sector to manufacturing productivity growth. This result did not emerge from the 1990s cross-country studies, which focused on productivity levels (although subsequent research from the consulting company has emphasized the value of high-tech). This result also gave some insight into the slowdown in growth, a large portion of which comes from the slowdown in the high-tech manufacturing sector, as well as the reduction in the size of this sector as a result

32 An alternative view of the speed-up in technology is described in Lewis *et al.* (2001). This study stresses the importance of increased competition and the pressure on retail productivity from the expansion of Wal-Mart.

33 See Gordon (2016). Further analyses of the slowdown are in Byrne *et al.* (2016) and Baily and Montalbano (2016).

of outsourcing.[34] This finding also suggests a reason why the productivity growth that has been achieved has not done very much for average wages. The high-tech sector, in both manufacturing and services, has generated huge wealth for some, but it has also increased inequality and has not created many good jobs for those without advanced education.

Will there be a Surge of Productivity from Generative AI? [35]

The speed of technological change and the role of technology in productivity growth are hard to assess. Robert Gordon (2016) has argued that technological change has slowed. He finds recent innovations in information and communications technology to be underwhelming. Similarly, Paul Krugman (2023) suggested the internet has not produced much in the way of productivity improvement and he doubts that the latest breakthroughs will do much for future productivity. Recent history on the role of high-tech in generating stronger labour productivity has been mixed. In the 1980s there were substantial breakthroughs in computer technology and the introduction of the PC, but productivity growth remained stubbornly slow. However, starting in the mid-1990s, as discussed earlier, there was a wave of faster productivity growth linked to the rapid increase in the speed of computers, which became both much cheaper and easier to use. There were also big advances in communications technology.

The United States and the rest of the world may now be poised for another substantial step forward in digital technologies through the development of generative AI, that can use common language to solve problems and do a variety of tasks that were previously out of reach of computers. Given the recent past, it is important to recognize the uncertainty about the future productivity impact of this rapidly developing technology, but there are reasons to be hopeful that there can be another period of stronger labour productivity growth ahead.

One reason to be optimistic comes from the extremely rapid uptake of ChatGPT, a large language model (LLM) which is reported to have reached 100 million users only two months after its launch to the public.[36] This rapid uptake is like the wave of computer investment that took place in the 1990s. The new software is relatively cheap to buy, easy to use and can be very helpful to a great many people. ChatGPT, from the company OpenAI, can generate coherent and contextually appropriate text. Microsoft has invested in this program and made it available through its search engine Bing. And there is strong competition from other providers, such as

34 Dale Jorgenson highlighted the importance of high-tech manufacturing to growth and suggested that as Moore's law is exhausted, that will lead to slower overall growth. I learned this from a presentation of his that I attended a few years ago, but I have not been able to locate a specific reference where he stated this. There is an analysis of the sources of growth in Japan in Jorgenson *et al.* (2018).

35 This section draws on Baily, Brynjolfsson and Korinek (2023).

36 This was reported by Reuters February 2, 2023 https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/

Bard from Google and Claude from Anthropic. These companies are investing heavily to improve their programs, which rely on huge server farms to support them. There are also other generative AI programs that can combine text, images, video and audio and even robotic functions.[37] One sign of the huge investment that is being made in generative AI is the amount of computing power being used to train the models has been doubling every six months over the past decade (Sevilla *et al.* 2022).

There are indicators that the impact of the new technology could be very large. Eloundrou *et al.* (2023) estimate that LLMs could affect 80 per cent of the workforce, to a greater or lesser extent (three of authors of this piece are from OpenAI while the fourth is from the University of Pennsylvania). And there are several case studies of specific jobs being made more productive described and cited in Baily *et al.* (2023). For example, software engineers were able to be twice as productive using a tool called Codex; it has been found that certain writing tasks can be completed twice as fast; and call center operators became 14 per cent more productive. Baily *et al.* (2023) also point out that the new technology has a potential to increase the returns from research and could, therefore, increase the rate of productivity growth, not just generate one-off improvements in specific tasks.

There are reservations about the impact of the new technologies. I mentioned already the skepticism about whether digital technologies can achieve much, but there are also concerns that it will have large but negative impacts. In the past 50 years technology has altered the demand for labour such that highly skilled/educated workers are in high demand while lower-skilled workers have seen weakness in their labour demand (skill-biased technical change). This is seen in the US labour market, but a similar trend has impacted other economies also. There is, therefore, a fear that there will end up being greater dispersion in wages and more dissatisfaction with the economy. This outcome is possible, particularly if firms fail to train their workers to take advantage of the new technology and if policymakers do nothing to help. However, a different outcome is possible. Many people find it hard to write coherent emails or to do mathematics. As a result, they are forced to take manual jobs with low wages. The new technologies can potentially help them to be more productive. There are signs from some of the case study evidence cited above that generative AI can help those with weaker skills become substantially more productive.

Rather than focus on the dangers of new technologies it would be better to figure out how to take advantage of them, mitigate the adverse impacts and use these breakthroughs to improve the economic future broadly.

Conclusions

While there remain unknowns, research into productivity has reached important

37 The program PaLM-SayCan combines the understanding of language models with the capabilities of a helper robot. https://sites.research.google/palm-saycan

conclusions that can provide a better understanding of the sources of growth and how business and labour leaders as well as government can contribute to faster growth. Even modest improvement in the rate of productivity growth can accumulate over time to generate substantial improvements in living standards. The world could use a boost to growth and, while much uncertainty remains, there are now new technologies that have the potential to achieve this.

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CSLS

Centre for the Study of Living Standards

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The Centre for the Study of Living Standards

THE CENTRE FOR THE STUDY OF LIVING STANDARDS (CSLS) is a national, independent, not-for-profit research organization which began operations in August 1995. Its objectives are twofold. First, to contribute to a better understanding of trends and determinants of productivity, living standards, and economic well-being in Canada through research. Second, to contribute to public debate by developing and advocating specific policies to improve the standard of living of Canadians.

The activities of the CSLS are motivated by the following general principles:

1) in the long run, productivity growth is the key to improved living standards;
2) in the short to medium term, elimination of any output gap is the most effective way to raise living standards;
3) the equitable sharing of productivity gains among all groups in society is an essential element of the economic growth process;
4) increased cooperation among the various groups which make up our society can contribute significantly to better living standards; and
5) reliable data are crucial to the monitoring and analysis of living standards and to the development of effective policies to increase living standards.

A BOARD OF DIRECTORS composed of well-known economists and persons with experience in economic policy making at a senior level directs the activities of the CSLS. The following individuals currently serve on the Board: