Patterns and Drivers of Financial Sector Growth in the Digital Age: Insights from a Study of Industrialized Economies

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Abstract

The financial sector in advanced economies has undergone significant evolution driven by restructuring, globalization, and the digital revolution, which have profoundly shaped its developmental dynamics. This study investigates the forces behind the growth and convergence of the financial sector across 13 advanced economies from 2000 to 2015, focusing on the effects of digital transformation. The investigation unveils several noteworthy findings concerning the financial sector. First, most nations experienced substantial growth in value-added, coupled with a significant decrease in employment and robust advancements in labor productivity. Next, the primary drivers of labor productivity growth and convergence across many economies were driven by total factor productivity, labor quality, and digital transformation. Lastly, digital transformation not only directly contributed to the augmentation of labor productivity, as quantified through growth accounting estimation, but also wielded a considerable impact on the expansion of total factor productivity and the streamlining of the workforce.

Keywords: financial sector; productivity; digital transformation; innovation; catchup; industrialized economies.
JEL: O16; O30; O40; O57

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1. Introduction

Numerous influential studies underscore the pivotal role of financial sector development in fostering economic growth. Levin (1997) identifies five pivotal channels through which the financial sector can drive growth: (i) pre-investment information production and capital allocation, (ii) investment monitoring and post-financing corporate governance, (iii) risk trading, diversification, and management facilitation, (iv) capital mobilization and savings aggregation, and (v) transaction facilitation. Thus, the financial sector's impact on economic growth transcends its role as a mere resource provider to that of a value generator. Moreover, the sector's evolution enhances its potential to reduce transaction costs, enhance decision-making quality, and bolster transparency, stability, credibility, and resilience within the economic system.

As such, comprehending financial sector development, its growth drivers, and catchup performance holds strategic insights and policy implications. This study capitalizes on high-quality sector-specific data available in the KLEMS database to scrutinize growth trends in the financial sectors of industrialized economies and to decipher the sources behind their growth and labor productivity catchup. The study's primary objective is to gain robust insights into the factors contributing to the rapid growth witnessed in the financial sectors of most examined economies. The study further identifies the principal drivers influencing catch-up performance on labor productivity of the financial sectors in industrialized economies in relation to the United States. Notably, this study offers significant contributions by specifically delving into the role of investments in digital and innovation capitals, in addition to overall factor productivity.

Furthermore, this paper sheds light on crucial economic development concerns. First, the literature remains divided over the determinants of financial development, productivity, and economic growth across both developed and developing nations (Voghouei, Azali, & Jamali, 2011; Gu, Gouliamos, Lobont, & Nicoleta-Claudia, 2021). Notably, the centrality of productivity, which this paper emphasizes, has been a subject of debate in contemporary and historical literature. Some studies highlight the supremacy of factor accumulation over total factor productivity (TFP) in driving economic development (Young, 1995), while others contend that cross-country TFP disparities better explain economic prosperity (Temple, 1999;

Klenow & Rodriguez-Clare, 1997; Devarajan, Easterly & Pack, 2003; Durlauf, Johnson & Temple, 2005; Asongu & Acha-Anyi, 2020). This debate is amplified by the growing influence of the digital age on economic growth determinants, particularly financial development.

Second, information technology in the digital age substantially accentuates cross-country disparities in financial development and, by extension, economic growth (Jorgenson, 2001; Hong, 2016; Niebel, 2018). Sassi and Goaied (2013) advocate this viewpoint, asserting that information technology is a crucial catalyst for productivity enhancement and value chain expansion, intertwined with factors like financial development. This study bridges gaps in existing literature by focusing on the digital age's impact on the financial sector's drivers and patterns, especially in developed countries.

Adopting the approach introduced by Vu (2020) and further developed by Vu and Hartley (2021, 2022a, 2022b), this study evaluates catch-up performance in the labor productivity of a country's financial sector and pinpoints its origins. In this context, the extent to which a country's financial sector reduces its labor productivity gap with the United States over a specific period reflects its catch-up performance. It is important to highlight that while some literature focuses on the interplay between ICT capital and productivity (Asongu & Acha-Anyi, 2020; Lee, Song & Kwak, 2020; Kim, Bounfour, Nonnis & Özaygen, 2021), this paper introduces fresh perspectives on examining labor productivity catch-up and its sources within the financial sector of 13 industrialized nations.

This paper draws upon data from the most recent release of the EU KLEMS database, renowned for furnishing detailed industry-level data (refer to Appendix 1 for description). The database has been widely employed in studies analyzing growth and productivity at both national and industry tiers. The financial sector, as contemplated in this paper, corresponds to Section K ('Financial and Insurance') in the International Standard Industrial Classification, Revision 4.0 (ISIC Rev. 4) by the United Nations. As per this classification, the financial sector (Section K) encompasses three divisions: (i) financial services except insurance and pension funding (Division 64), (ii) insurance, reinsurance, and pension funding excluding compulsory social security (Division 65), and (iii) activities auxiliary to financial services and insurance activities (Division 66).

From the vantage of the financial sector, this paper substantiates that robust growth in industrialized economies' financial sector results from vigorous restructuring and digital transformation. The scope of digital technologies encompasses the financial sector's contributions to ICT hardware capital deepening, intangible software and database capital deepening, and intangible R&D capital deepening.

With comprehensive data drawn from the EU KLEMS 2019 database, necessary for dissecting sources of productivity growth, this study centers on 13 economies with available data spanning 2000-2015. This cohort includes six G7 economies (the US, Germany, France, Italy, Japan, and the UK) and seven other European nations (Austria, Belgium, the Czech Republic, Denmark, Finland, the Netherlands, and Sweden), collectively referred to as "E13" throughout this article.

The subsequent sections of this paper are structured as follows. Section 2 presents stylized facts and offers an overview of the financial sectors in the E13 economies from a global standpoint. Section 3 examines data, emphasizing sector growth patterns in each E13 economy and the methodology employed to analyze growth and catch-up sources. Empirical results are detailed in Section 4. Section 5 summarizes outcomes, concluding with considerations and directions for future research.

2. Stylized Facts and an overview of the E13 economies' financial sectors

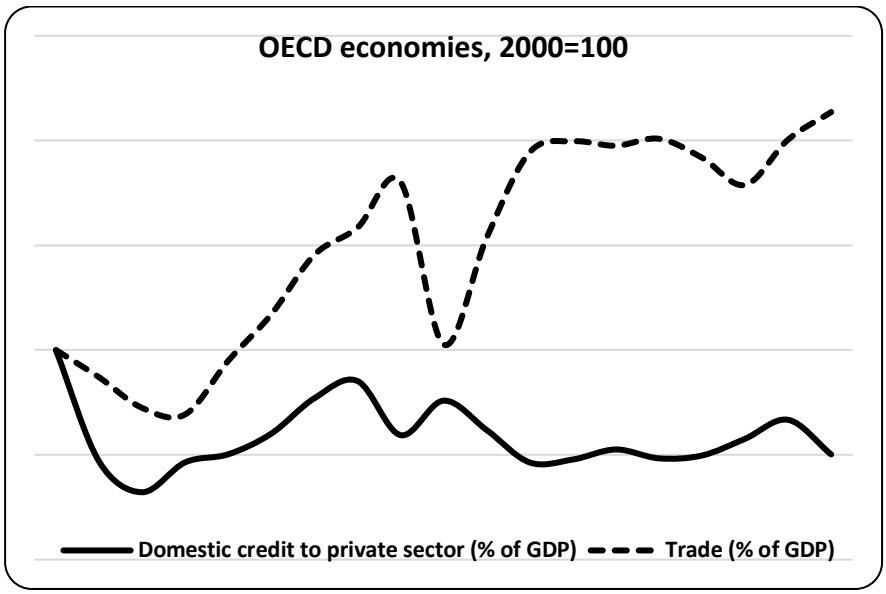
2.1. Stylized facts

In the early 21st century, the convergence of rapid technological advancements, globalization, and economic reform has exerted an unparalleled impact on financial development across nations. Within developed economies, the financial sector has undergone transformative shifts, driven by three foundational forces.

First, unlike developing countries where financial depth, as gauged by the domestic credit-to-GDP ratio, has exhibited an upward trajectory, developed economies have witnessed relative stability. This measure has hovered around 90% of the rate observed from the 2000 baseline year, in stark contrast to the ascending trend observed in developing nations (Figure 1). This

distinctive pattern underscores the intense pressure faced by developed economies' financial sectors to undergo substantial restructuring for sustained viability and competitiveness.[2]

Figure 1: Trajectories of OECD members' financial depth and openness, 2000-2018



Data source: WDI (2020)

Secondly, the financial sector in developed economies has become intricately intertwined with the process of globalization. Finance's globalization is indeed a dynamic and endogenous phenomenon. On the one hand, the financial sector assumes a pivotal role in fostering globalization. This entails facilitating international trade, financing foreign direct investments, offering insurance coverage for international activities, and underwriting merger and acquisition (M&A) transactions. On the other hand, globalization opens up new and expanded avenues for the financial sector to amplify growth and efficiency.

Table 1 presents a selection of pertinent statistics concerning the financial dimensions of globalization. The table illustrates the rapid expansion of international trade, foreign direct investment (FDI), and foreign exchange transactions during the study period from 2000 to 2015. Additionally, Figure 1 illustrates the upward trajectory of the total trade-to-GDP ratio for OECD countries, in stark contrast to the stagnant trend observed in the credit-to-private sector ratio.

[2] Cummins and Rubio-Misas (2006) and Cummins and Xie (2013) find evidence that regulatory reforms and business restructuring are important factors in driving efficiency.

Table 1: Selected indicators signifying the influence of globalization on the financial sector

Indicator	World	OECD	EU*	US	Japan
Volume					
Trade (billions of US$)					
2000	15,846	11,733	5,110	2,523	978
2010	37,228	23,517	11,459	4,201	1,662
2015	42,077	25,782	12,248	5,032	1,593
FDI outward stock (billions of US$)					
2000	7,437	6,682	3,157	2,694	278
2010	20,804	17,425	10,249	4,810	831
2015	25,045	19,441	10,649	5,983	1,227
Foreign exchange (FX) Transactions (daily averages in April)					
2001	1,705	NA	542	273	153
2010	5,045	NA	1,854	904	312
2016	6,514	NA	2,406	1,272	399
Compound Annual Growth Rate (CAGR)					
Trade					
2000-2015	6.7%	5.4%	6.0%	4.7%	3.3%
2000-2010	8.9%	7.2%	8.4%	5.2%	5.4%
2010-2015	2.5%	1.9%	1.3%	3.7%	-0.8%
FDI outward stock					
2000-2015	8.4%	7.4%	8.4%	5.5%	10.4%
2000-2010	10.8%	10.1%	12.5%	6.0%	11.6%
2010-2015	3.8%	2.2%	0.8%	4.5%	8.1%
OTC FX Transactions					
2001-2016	9.3%	NA	10.4%	10.8%	6.6%
2001-2010	11.5%	NA	13.1%	12.7%	7.4%
2010-2016	5.2%	NA	5.4%	7.1%	5.0%

Sources: WDI (2020) for data on trade and FDI outward stock; BIS (2016) for over-the-counter foreign exchange (OTC FX) transactions).

Third, the financial sector has undertaken significant strides in investing in digital technologies and embracing financial innovations. This trend is particularly evident in two key aspects: expenditures on information technology (IT) and the adoption of fintech.

In terms of IT expenditures, the financial sector stands out as one of the most substantial spenders in this domain. As indicated in Table 2, the financial sector accounted for approximately a quarter (24.5%) of the global IT spending in 2014. Within this, banking and securities constituted 17.8%, while insurance contributed 6.7%. Notably, the financial sector

has consistently outpaced the market average in its investments in emerging digital technologies. According to IDC (2019), the financial sector is projected to be the swiftest-growing industry in terms of digital transformation investments during the period spanning 2017 to 2022.

Table 2: Global ICT Spending Estimates by Industry in 2014

	Millions of US$	**Share in Total**	**Growth (%)**
Financial sector	686,335	24.5%	2.0
• *Banking & Securities*	*498,377*	*17.8%*	*2.1*
• *Insurance*	*187,958*	*6.7%*	*1.8*
Communications: Media	444,639	15.9%	1.5
Education	66,524	2.4%	1.0
Government	447,114	16.0%	-1.2
Healthcare Providers	107,934	3.9%	2.7
Manufacturing & Mining	498,995	17.8%	1.0
Retail	179,538	6.4%	2.5
Transportation	133,785	4.8%	1.6
Utilities	149,379	5.3%	1.3
Wholesale Trade	87,707	3.1%	0.69
Total Market	**2,798,950**	**100.0%**	**1.2**

Source: Garner (2015).

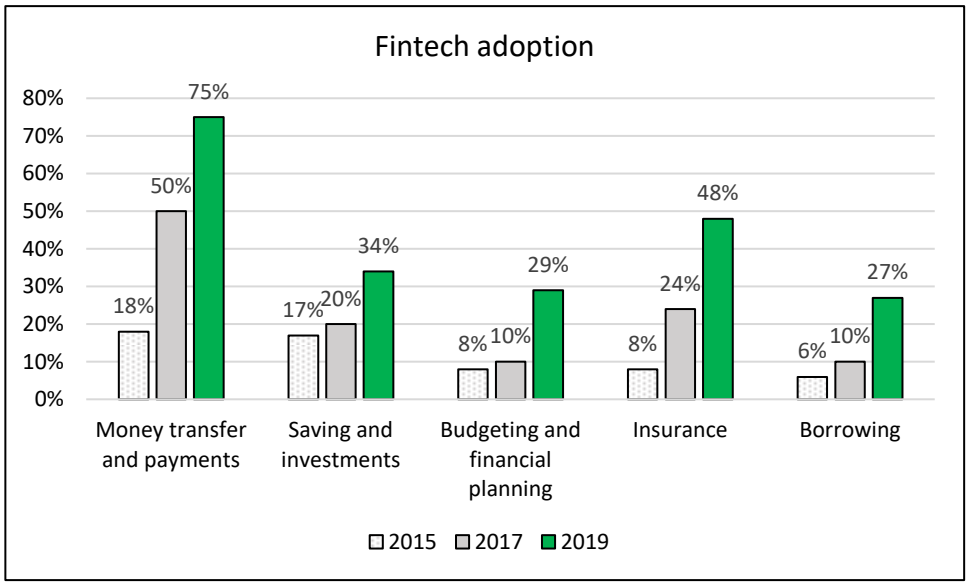
In terms of fintech adoption, the OECD (2018) outlines that the top seven emerging digital technologies - blockchain (distributed ledger), big data, Internet of Things (IoTs), cloud computing, artificial intelligence (AI), biometric technology, and augmented/virtual reality (AR/VR) - have permeated at least two core services and activities within the financial sector (Table 3). Conversely, based on extensive consumer surveys worldwide, EY (2019) underscores that fintech adoption has notably enhanced the efficiency, convenience, and scope of financial services. Consequently, consumer adoption of fintech has seen significant growth, particularly in payment services, insurance, and borrowing (Figure 2).

Table 3: Applications of new digital technologies to financial services

Financial services	Digital Technology						
	Blockchain	**Big Data**	**IoTs**	**Cloud**	**AI**	**Biometric**	**AR/VR**
Payment	X						
Advisory	X	X			X		X
Investment	X	X			X		X
Lending	X	X		X			
Insurance	X	X	X		X	X	
Security	X	X				X	
Operations	X	X		X			
Communications	X	X	X		X		X

Source: (OECD, 2018); adapted from Table 1, p. 14.

Figure 2: The rate of fintech adoption by worldwide consumers – 2015, 2017, 2019



Source: Adapted from EY (2019)

The overarching observations outlined above indicate that the financial sector within developed nations has undergone profound transformations in recent decades. This paper endeavors to illuminate these dynamics by honing in on the sector's growth patterns and the sources driving its performance. The primary research question addressed by this study centers on the influence of digital transformation and innovation on the growth trajectories and performance of the financial sector in industrialized nations since the commencement of the 21st century.

2.2. Selected indicators

Table 4 furnishes data that encapsulates the notable aspects of the financial sectors within the E13 economies across four distinct indicator categories: employment, value-added, foreign exchange (FX) transactions, and the financial sector's shares in the total economy's digital and intellectual capital stocks. Several noteworthy findings emerge from Table 4.

First, across all E13 economies, the financial sector's employment share within the overall economy - spanning from 1.7% in the Czech Republic and Finland to 4.3% in the US - remains notably smaller than its share in value-added, ranging from 2.9% in Finland to 8.5% in the Netherlands. This indicates that labor productivity within the financial sector significantly surpasses that of the broader economy.

Second, in each of the E13 economies, the financial sector plays a pivotal role in propelling digital transformation. Remarkably, the sector's share of the economy's total ICT hardware (ICTHW) capital stock spans from 1.5% in Austria to 16.2% in France. Furthermore, the financial sector exerts an even more substantial influence on the economy's total software and databases (SWDB) capital stock, spanning from 4.9% in Italy to 18% in Austria. In contrast, the financial sector's involvement in the economy's innovation (R&D) intellectual capital stock appears relatively modest.

Third, the United States emerges as the most significant contributor in terms of workforce (surpassing 6 million employees) and value-added (exceeding $1,362 billion). Following closely is Japan, with 1.5 million employees and $228 billion in value-added. The third-largest player varies depending on the metric: Germany in terms of employment (1.2 million) and the UK with regard to value-added ($178 billion).

Lastly, the United Kingdom stands out notably due to its extensive FX transactions, accounting for 36.9% of the world's total volume. The US and Japan trail behind with shares of 19.5% and 6.1% respectively. Conversely, the FX transaction share is notably more modest for France (2.8%), Germany (1.8%), and Italy (0.3%). This disparity indicates substantial variation among the G7 economies in terms of their integration with global financial markets.

Table 4: Selected indicators on the scale of E13 financial sectors, 2015

(Economies listed in descending order of value-added amount)

Economy	Employment		Value-added		FX transactions*		Share of financial sector in the economy's total capital stock by capital type		
	#Workers ('000)	Share in Economy	$US Billions	Share in Economy	Amount	Share in World	ICTHW	SWDB	R&D
Austria	127.9	2.9%	16.9	4.4%	19	0.3	1.5%	18.0%	0.5%
Belgium	125.0	2.6%	27.7	6.0%	23	0.4	5.7%	14.6%	1.4%
Czech Rep.	95.0	1.7%	13.7	4.3%	4	0.1	2.0%	17.4%	0.3%
Denmark	77.0	2.9%	14.5	6.0%	101	1.5	4.9%	17.9%	2.5%
Finland	45.0	1.7%	5.7	2.9%	14	0.2	3.2%	9.0%	1.0%
France	786.0	3.0%	108.2	4.5%	181	2.8	16.2%	9.8%	0.0%
Germany	1,187.0	3.0%	143.4	4.1%	116	1.8	4.8%	6.4%	0.2%
Italy	669.8	2.8%	112.8	5.6%	18	0.3	4.9%	4.9%	1.8%
Japan	1,527.9	2.2%	227.8	4.5%	399	6.1	5.1%	15.8%	0.0%
Netherlands	226.0	2.8%	64.8	8.5%	85	1.3	8.3%	9.8%	3.2%
Sweden	96.0	1.8%	19.5	4.6%	42	0.6	5.1%	9.0%	0.5%
The UK	1,051.5	3.6%	171.8	7.0%	2,406	36.9	3.3%	10.2%	0.5%
The US	6,274.8	4.3%	1,364.2	7.6%	1,272	19.5	8.9%	13.4%	0.7%
Selected statistics									
Min	**45.0**	**1.7%**	**5.7**	**2.9%**	**4.0**	**0.1**	**1.5%**	**4.9%**	**0.0%**
Median	**226.0**	**2.8%**	**64.8**	**4.6%**	**85.0**	**1.3**	**4.9%**	**10.2%**	**0.5%**
Max	**6,274.8**	**4.3%**	**1,364.2**	**8.5%**	**2,406.0**	**36.9**	**16.2%**	**18.0%**	**3.2%**

Sources: EUKEMS for employment and value-added; BIS (2016) for foreign exchange (FX) transactions.
*Note: *daily averages in April 2016.2.2. Financial development index*

3. Data and methodology

3.1 Dynamics and Growth Patterns of the E13 Financial Sector

This section delves into the change dynamics and growth patterns of the financial sectors across the E13 economies, with a central focus on the sector's performance within three key business metrics: value-added, employment, and labor productivity.

3.1.1 Value-added

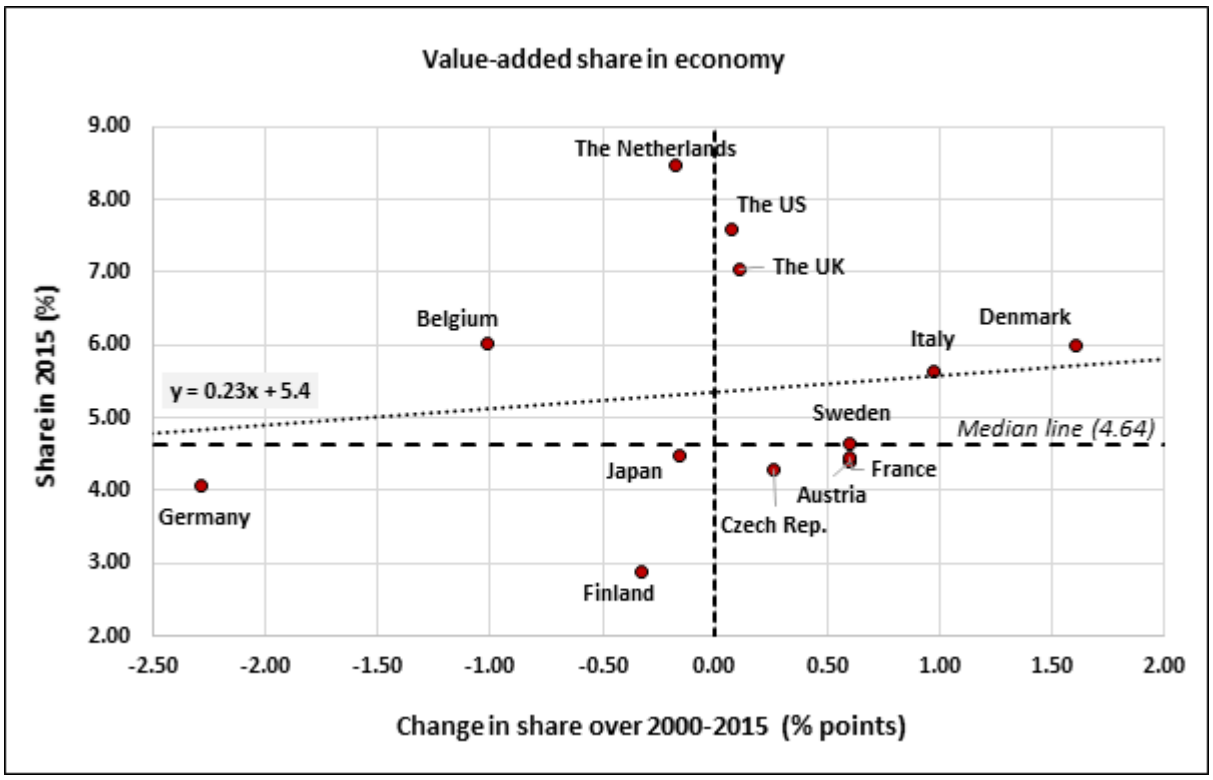
Figure 3 illustrates the value-added share of the financial sector within the total economy for the E13 nations. The y-axis represents the level of this share in 2015, while the x-axis captures the shift in this share from 2000 to 2015. The horizontal line at y = 4.64% signifies the median value-added share in 2015, and the vertical line at x = 0% divides the change in value-added share over 2000-2015 into two segments: expansion (right-hand side) and contraction (left-hand side). Several key observations emerge from Figure 3.

First, the linear relationship between the share in 2015 (the y-variable) and its alteration from 2000 to 2015 (the x-variable) is positive (with a coefficient of +0.23), signifying a noticeable upward trend. This underscores the favorable impact of enhancing the value-added share within the financial sector during 2000-2015 on its position within this metric in 2015.

Second, the financial sector excelled in terms of value-added over the national economy in eight out of the thirteen E13 economies. However, it is worth noting that although the Netherlands and Belgium are not part of the eight economies displaying this outperformance, the value-added shares of their financial sectors have been substantial, standing at 8.5% for the Netherlands and 6% for Belgium.

Third, Germany and Finland exhibit comparatively weaker performance concerning the value-added share within their financial sectors. This is marked by two primary issues. One pertains to a significant contraction in share during the period from 2000 to 2015. The other revolves around the low level of this share in 2015. While the former issue is particularly pronounced for Germany, the latter is noteworthy for Finland. These observations potentially suggest that both countries may have not exerted adequate efforts to foster growth within their respective financial sectors.

Figure 3: Financial Sector's Value Added Share in the Economy, 2000-2015



3.1.2. Employment share

Figure 4 provides insight into the employment share of the financial sector within the total economy of the E13 nations. The y-axis represents this share in 2015, while the x-axis displays the shift in this share from 2000 to 2015. Similar to Figure 3, the horizontal line at y = 2.81% signifies the median employment share level in 2015. Moreover, the vertical line at x = 0% divides the change in employment share between 2000 and 2015 into two segments: expansion (right-hand side) and contraction (left-hand side). Several key observations emerge from Figure 4.

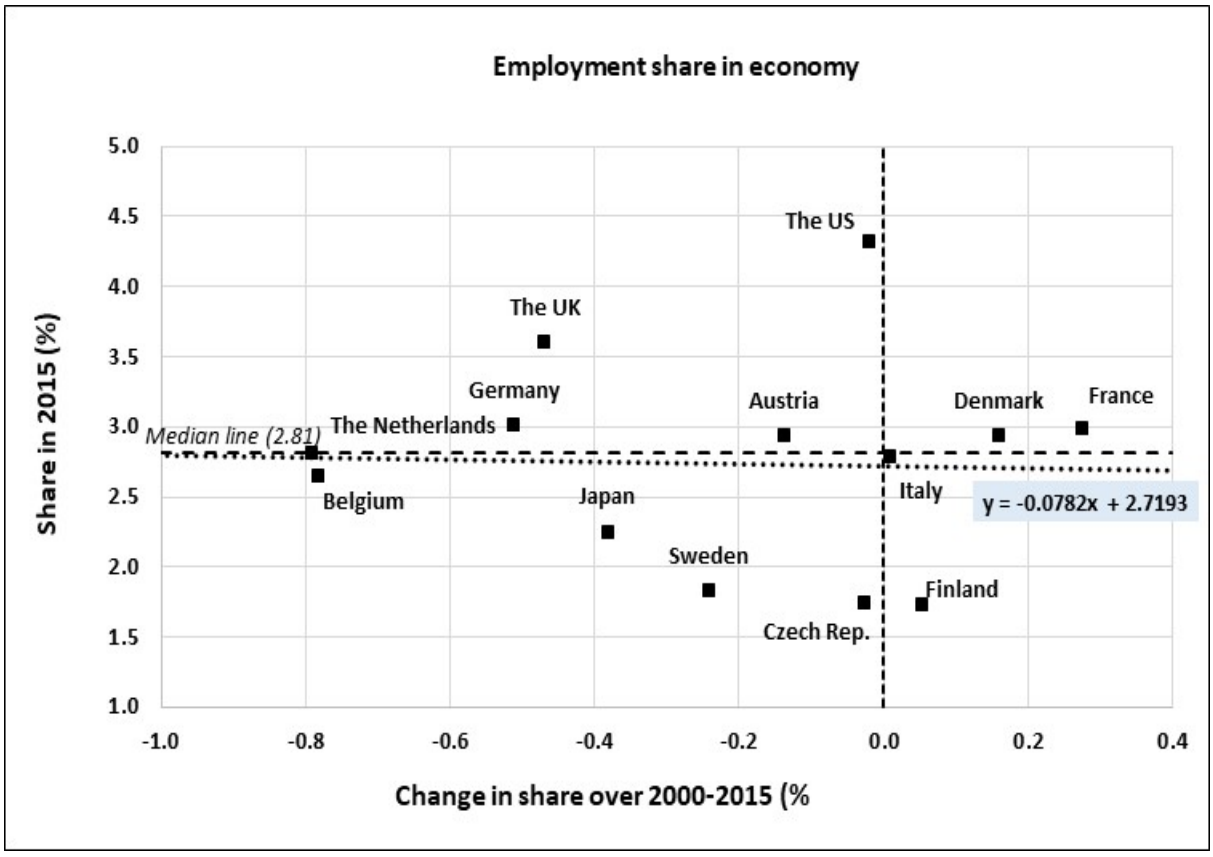
First, in contrast to the value-added share, the employment share in 2015 (on the y-axis) demonstrates a negative linear relationship with its alteration over 2000-2015 (on the x-axis). Although this negative relationship is not statistically significant (with a coefficient of -0.0782), it suggests a feeble trend where economies boasting a larger financial employment share likely experienced a reduction in staff during the 2000-2015 period.

Second, out of the E13 economies, nine witnessed a contraction in the financial employment share. Among these, six economies experienced a more pronounced contraction:

the Netherlands, Belgium, the UK, Germany, Japan, and Sweden. This prevalent trend of employment reduction across the E13 economies aligns with the projections outlined in Section 1, underscoring the substantial restructuring undertaken by the financial sector in industrialized economies over the past two decades. As we will delve into in Section 4, for most E13 economies, this noteworthy employment reduction was not a consequence of sectoral decline but rather a result of transformation, with digital technologies playing a pivotal role.

Third, the financial sector emerges as a significant source of employment for France and Denmark. In these two economies, the financial employment share not only expanded substantially from 2000 to 2015 but also exceeded the median level within the group in 2015.

Figure 4: Financial Sector's Employment Share in the Economy, 2000-2015



3.1.3 Classification of E13 Economies by Financial Sector Growth Patterns

In this segment, we delve into the growth patterns characterizing the financial sector within the E13 economies. The focus centers on the average annual growth spanning the period 2000 to 2015 across three primary measures: value-added (VA), employment measured in hours

worked (H), and labor productivity (LP). The objective is to derive a typology that categorizes countries based on their distinctive growth patterns.

Table 5 presents growth figures for VA, H, and LP, accompanied by their corresponding dummy variables: D_VA, D_H, and D_LP, respectively. The dummy variable D_X, where X = {VA, H, LP}, equals 1 if X is positive and 0 otherwise. By aggregating dummy variables across these three measures, an aggregate score is obtained, serving as an initial indicator of each country's overall performance. This section proceeds to elaborate on the six possible combinations of values for the three dummy variables, as detailed below with insights drawn from Table 5.

Group 1 (G1): Robust Growth

This group encompasses countries that attained positive growth across all three measures (D_VA=1, D_H=1, and D_LP=1). Termed "robust growth," this category includes three economies: Denmark, France, and the US. Remarkably, these nations demonstrate substantial VA growth with LP acting as a primary driver, with contributions of 90.6% for Denmark, 89.3% for the US, and 57.3% for France (Table 5).

Group 2 (G2): Competitive Growth

Comprising countries with positive growth in VA (D_VA=1) and LP (D_LP=1) yet negative growth in H (D_H=0), this category suggests effective promotion of VA and LP growth while reducing employment. Labelled "competitive growth," this group encompasses eight economies: the Czech Republic, Sweden, Austria, the UK, Italy, the Netherlands, Belgium, and Japan.

Group 3 (G3): Uncompetitive Growth

Characterized by positive growth in VA (D_VA=1) and H (D_H=1) but negative growth in LP (D_LP=0), this group relies predominantly on employment expansion to boost VA, albeit at the cost of LP, potentially undermining competitiveness. Termed "uncompetitive growth," this category includes Finland.

Group 4 (G4): Restructuring for Productivity Improvement

Encompassing countries with negative growth in VA (D_VA=0) and H (D_H=0) but positive growth in LP (D_LP=1), this pattern indicates economies that engage in extensive restructuring to enhance labor productivity while sacrificing VA and H growth. Strikingly, no E13 economy belongs to this group.

Group 5 (G5): Unproductive Employment Expansion

This category includes countries with negative growth in both VA (D_VA=0) and LP (D_LP=0) yet positive growth in H (D_H=1). Such a pattern is indicative of unproductive employment expansion, where no E13 economy falls into this group.

Group 6 (G6): Shrinking

This group pertains to countries with negative growth across all three measures (D_VA=0, D_H=0, and D_LP=0). These nations experience contractions in both value-added and employment, with VA declining more rapidly than employment, thereby leading to a decline in LP. This category solely comprises Germany.

Table 5: Classification of E13 Economies by Growth Patterns

(Countries in each group are listed by decreasing order by VAG)

Economy	Average annual growth, 2000-2015					Dummies associated with growth variable[b]			Score[c]	Group
	Growth rate (%)			Share in VA growth[a]						
	VA	H	LP	H	LP	D_VA	D_H	D_LP		
Denmark	2.94	0.28	2.67	9.4%	90.6%	1	1	1	3	**'Robust growth' (G1)**
France	2.17	0.93	1.25	42.7%	57.3%	1	1	1	3	
The US	1.82	0.19	1.63	10.7%	89.3%	1	1	1	3	
Czech	3.14	-0.18	3.33	-5.7%	105.7%	1	0	1	2	**'Competitive growth' (G2)**
Sweden	3.03	-0.21	3.24	-7.0%	107.0%	1	0	1	2	
Austria	2.41	-0.18	2.59	-7.4%	107.4%	1	0	1	2	
The UK	1.80	-0.12	1.92	-6.5%	106.5%	1	0	1	2	
Italy	1.32	-0.06	1.38	-4.6%	104.6%	1	0	1	2	
Netherlands	1.12	-1.35	2.47	-120.7%	220.7%	1	0	1	2	
Belgium	0.44	-1.17	1.61	-266.6%	366.6%	1	0	1	2	
Japan	0.32	-1.59	1.91	-489.9%	589.9%	1	0	1	2	
Finland	0.25	0.37	-0.12	146.4%	-46.4%	1	1	0	2	**'Uncompetitive growth' (G3)**
Germany	-1.73	-0.93	-0.81	53.5%	46.5%	0	0	0	0	**'Shrinking' (G6)**
Selected statistics										
# of "+"economies[d]	12	4	11	5	12					
Median	**1.82**	**-0.21**	**1.91**	**-5.7%**	**105.7%**	**1**	**0**	**1**	**2**	
Min	**-1.73**	**-1.59**	**-0.81**	**-489.9%**	**-46.4%**	**0**	**0**	**0**	**0**	
Max	**3.14**	**0.93**	**3.33**	**146.4%**	**589.9%**	**1**	**1**	**1**	**3**	

Notes: [a]*VA growth is the sum of H growth and LP growth,* using the log measure.
[b]*D_X=1 if X growth is positive and 0 otherwise; where X=VA, H, and LP;* [c]*Score is a tally of the three dummies D_VA, D_H, and D_LP.*
[d]*The number of economies with a positive sign on the measure in the corresponding column.*

Figure 5 serves as a visually intuitive reinforcement of the observations presented in Table 5. The graph portrays the performance outcomes of E13 economies within a coordinate system, where the x-axis and y-axis respectively represent the average annual growth of the financial sector in value-added (VAG) and hours worked (HG) over the 2000-2015 period. The graph is bisected by a 45-degree line, partitioning the space into two regions indicative of labor productivity growth (LPG): the upper region signifies positive LPG (VAG>HG), while the lower region signifies negative LPG.

Countries falling into each of the distinct growth pattern categories are situated in specific zones on the graph:

- "Robust Growth" (G1) countries occupy the northeast quadrant (VAG>0; HG>0) and reside above the 45-degree line (LPG>0).
- "Competitive Growth" (G2) countries are located in the northwest quadrant (VAG>0; HG<0) and are positioned unambiguously above the 45-degree line (LPG>0).
- "Uncompetitive Growth" (G3) countries are situated in the northeast quadrant (VAG>0; HG>0) but fall below the 45-degree line (LPG<0).
- "Restructuring for Productivity" (G4) countries are placed in the southwest quadrant (VAG<0; HG<0) but are positioned above the 45-degree line (VAG > HG ⇒ LPG>0).
- "Unproductive Employment Expansion" (G5) countries are positioned in the southeast quadrant (VAG<0; 0<HG) and thus fall below the 45-degree line (LPG<0).
- "Shrinking" (G6) countries are located in the southwest quadrant (VAG<0; HG<0) and are situated below the 45-degree line (LPG<0).

Several key insights emerge from Figure 5:

First, a prominent trend among E13 economies involves robust value-added growth, significant employment reduction, and labor productivity improvement. This is evident as 12 economies are placed above the x-axis, with nine in the left region of the y-axis and eleven located above the 45-degree line.

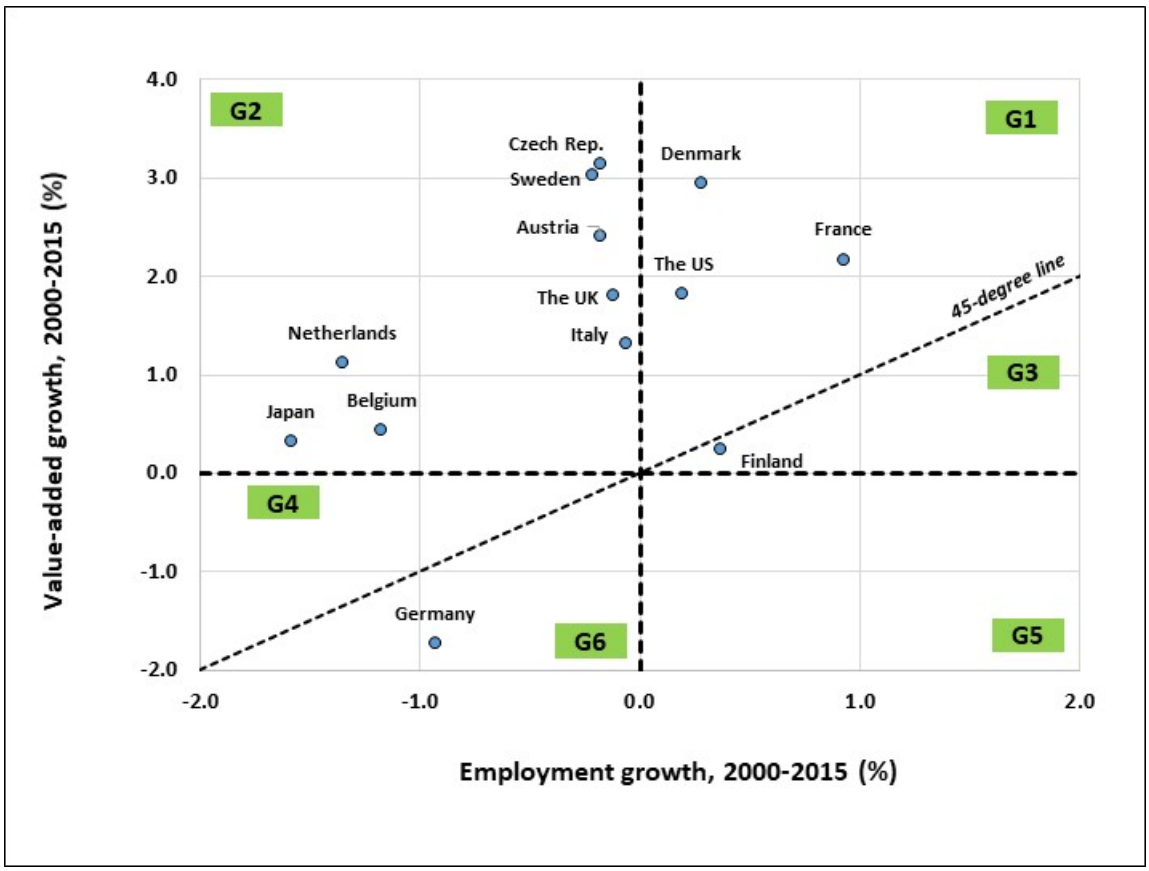
Second, the most impressive labor productivity growth (measured by the vertical distance from the 45-degree line) is witnessed in the Czech Republic, Sweden, and Denmark – also the leading performers in value-added growth. This underscores the critical role of labor productivity growth in driving value-added expansion. Among these three economies,

Denmark expanded its employment, while the Czech Republic and Sweden experienced minor staff reductions.

Third, the eight economies within the G2 group can be divided into two subgroups. The first subgroup includes five economies exhibiting robust value-added growth and a slight employment contraction: the Czech Republic, Sweden, Austria, the UK, and Italy. The second subgroup, consisting of the Netherlands, Belgium, and Japan, recorded lower value-added growth coupled with a more substantial employment reduction. Notably, the comparison between these subgroups on labor productivity growth (measured by the vertical distance from each country to the 45-degree line) indicates that, for the financial sector, a modest reduction in employment alongside robust efforts to promote value-added growth proves to be a more effective strategy than drastic employment cuts. In essence, prioritizing the capture of emerging growth opportunities outweighs employment reduction for cost-saving.

Lastly, Germany encountered the largest value-added contraction and labor productivity decline among the E13 economies, concurrently registering one of the most significant employment reductions. These challenges illuminate significant hurdles confronting Germany's financial sector growth.

Figure 5: A Graphic Display of E13 Financial Sector Growth Patterns



3.2. Framework for decomposing sources of labor productivity growth and catchup

This section introduces the analytical frameworks used to quantify the sources of labor productivity growth and catch-up in the financial sector of a given country. The variables and parameters utilized pertain to the financial sector.

3.2.1. Decomposition of Sources of Labor Productivity Growth (LPG)

Employing the growth accounting approach, one can assess the constituents of labor productivity growth (LPG) in a specific sector by dissecting the contribution of various types of capital, labor inputs, and total factor productivity growth (TFPG). This method, as expanded by Jorgenson and Griliches (1967), Jorgenson (1995a, 1995b), and Diewert (1976), offers a robust framework for studying growth sources and quantifying the influence of different capital and labor inputs. [3]

[3] For example, see Oliner and Sichel (2000), Jorgenson (2001), Oulton (2002), Pohjola (2002), Stiroh (2002), Van Ark, O'Mahony, and Timmer (2008), and Inklaar et al. (2008).

In alignment with extant literature, the framework for quantifying the sources of labor productivity growth within a specific sector in a country is constructed as follow.

$$\Delta lnLP_c = \Delta lnVA_c - \Delta lnH_c \quad (1)$$

$$\rightarrow \Delta lnLP_c = \left(\sum_i \bar{v}_{c,i}^K \Delta lnK_{ci} + \bar{v}_c^L \Delta lnH_c + \bar{v}_c^L \Delta lnLQ_c + \Delta lnA_c\right) - \Delta lnH_c \quad (2)$$

$$\rightarrow \Delta lnLP_c = \sum_i \bar{v}_{c,i}^K \Delta lnK_{ci} - (1 - \bar{v}_c^L)\Delta lnH_c + \bar{v}_c^L \Delta lnLQ_c + \Delta lnA_c \quad (3)$$

Where c denotes the country subscript; i represents four types of capital, which include non-ICT (NICT), ICT hardware (ICTHW), intangible software and database (SWDB), and intangible innovation-related assets (R&D); LP_c,VA_c,H_c, LQ_c, and A_c respectively, represent labor productivity, value-added, hours worked, labor quality, and total factor productivity (TFP); K_{ci} refers to the capital service rendered by capital type i; Δln signifies the log growth rate during the study period; $\bar{v}_{c,i}^K$ denotes the average income share of capital type i over the period; and $\bar{v}_c^L$ signifies the average income share of labor (note that $\sum_i \bar{v}_{c,i}^K + \bar{v}_c^L$=1 under the assumption of constant return to scale). A brief description of the variables is provided in Appendix 1.

As $1 - \bar{v}_c^L = \sum_i \bar{v}_{c,i}^K$, Eq. (3) can be rewritten as:

$$\Delta lnLP_c = \sum_i \bar{v}_{c,i}^K \Delta lnk_{ci} + \bar{v}_c^L \Delta lnLQ_c + \Delta lnA_c \quad (4)$$

Where $k_{ci} = K_{ci}/H_c$ represents the intensity of capital type i per hour worked.

From Eq. (4), LPG of the financial sector in country c can be decomposed into six sources, including the deepening of four types of capital, the enhancement in labor quality, and TFP growth, which are elaborated below:

(i) The contribution of non-ICT capital deepening:
$LPGcon_{c,NICT} = \bar{v}_{c,NICT}^K \Delta lnk_{c,NICT}$ (4.1)

(ii) The contribution of ICT hardware capital deepening:
$LPGcon_{c,ICTHW} = \bar{v}_{c,ICTHW}^K \Delta lnk_{c,ICTHW}$ (4.2)

(iii) The contribution of intangible software and database capital deepening:

$$LPGcon_{c,SWDB} = \overline{v}^{K}_{c,SWDB}\Delta lnk_{c,SWDB} \quad (4.3)$$

(iv) The contribution of intangible R&D capital deepening:

$$LPGcon_{c,R\&D} = \overline{v}^{K}_{c,R\&D}\Delta lnk_{c,R\&D} \quad (4.4)$$

(v) The contribution of labor quality improvement:

$$LPGcon_{c,LQ} = \overline{v}^{L}_{c}\Delta lnLQ_{c} \quad (4.5)$$

(vi) Total factor productivity growth:

$$TFPG = \Delta lnA_{c} \quad (4.6)$$

3.2.2. Sources of labor productivity catch-up

This paper introduces an innovative approach to evaluate the labor productivity catch-up performance of a country's financial sector and to quantify its underlying factors.[4] . In this context, the catch-up performance is gauged by the extent to which the financial sector of a given country narrows its labor productivity gap with the United States over a specified period. This assessment relies on the catch-up on labor productivity index (CULPI), which is defined as follows:

$$CULPI_{c}^{0,T} = ln\left[\frac{rel\_LP_{c}^{T}}{rel\_LP_{c}^{0}}\right]/T \quad (5)$$

Where $CULPI_{c}^{0,T}$ signifies the $CULPI$ of country c during the time span [0, T]; $rel\_LP_{c}^{t}$ represents the LP of country c relative to the US in year t $\left(rel_{LP}{}_{c}^{t} = LP_{c}^{t}/LP_{US}^{t}\right)$.

If a country is catching-up with the US between year 0 and T, its relative LP will rise over this interval, implying $rel\_LP_{c}^{T} > rel\_LP_{c}^{0}$, and consequently, $CULPI_{c}^{0,T} > 0$. Conversely, if a country is falling behind over the same period, its relative LP will decline, leading to $rel\_LP_{c}^{T} < rel\_LP_{c}^{0}$, and consequently, $CULPI_{c}^{0,T} < 0$.

[4] Vu (2020) introduces this approach for examining the catchup performance of the largest emerging economies.

Thus, the sign and magnitude of a country's financial sector CULPI effectively capture its catch-up performance in terms of labor productivity. Consequently, the sources underlying the catch-up performance of a country's financial sector can be quantified by decomposing its CULPI. To achieve this, Eq (5) can be reformulated as follows

$$CULPI_c^{0,T} = ln\left[\frac{\frac{LP_c^T}{LP_{US}^T}}{\frac{LP_c^0}{LP_{US}^0}}\right]/T = [\ln(LP_c^T) - \ln(LP_c^0)]/T - [\ln(LP_c^T) - \ln(LP_c^0)]/T$$

$$= \Delta\ln(LP_c^{0,T}) - \Delta\ln(LP_{US}^{0,T}) \quad (6)$$

In essence, the CULPI of a country's financial sector during the time interval [0, T] equates to the gap between that country and the US concerning the average annual labor productivity growth rate throughout this period.

Incorporating Eq. (6) with Eq. (4) leads to the following:[5]

$$CULPI_c = \Delta lnLP_c - \Delta lnLP_{US}$$

$$= \sum_i[\bar{v}_{c,i}^K \Delta lnk_{ci} - \bar{v}_{US,i}^K \Delta lnk_{USi}] + [\bar{v}_c^L \Delta lnLQ_c - \bar{v}_{US}^L \Delta lnLQ_{US}] + [\Delta lnA_c - \Delta lnA_{US}] \quad (7)$$

Therefore, similar to Eqs. (4.1)-(4.6), the catch-up performance of country c's $CULPI$ can be decomposed into six contributing sources as specified below

(i) The gap with the US on the contribution of non-ICT capital deepening:
$USGAPcon_{c,NICT} = \bar{v}_{c,NICT}^K \Delta lnk_{c,NICT} - \bar{v}_{US,NICT}^K \Delta lnk_{US,NICT}$ (7.1)

(ii) The gap with the US on the contribution of ICT hardware capital deepening:
$USGAPcon_{c,ICTHW} = \bar{v}_{c,ICTHW}^K \Delta lnk_{c,ICTHW} - \bar{v}_{US,ICTHW}^K \Delta lnk_{US,ICTHW}$ (7.2)

(iii) The gap with the US on the contribution of intangible software and database capital deepening:
$USGAPcon_{c,SWDB} = \bar{v}_{c,SWDB}^K \Delta lnk_{c,SWDB} - \bar{v}_{US,SWDB}^K \Delta lnk_{US,SWDB}$ (7.3)

(iv) The gap with the US on the contribution of intangible R&D capital deepening:

[5] The superscript [0, T] is suppressed for ease of notation.

$$USGAPcon_{c,R\&D} = \overline{v}^{K}_{c,R\&D}\Delta lnk_{c,R\&D} - \overline{v}^{K}_{US,R\&D}\Delta lnk_{US,R\&D} \quad (7.4)$$

(v) The gap with the US on the contribution of labor quality improvement:

$$USGAPcon_{c,LQ} = \overline{v}^{L}_{c}\Delta lnLQ_{c} - \overline{v}^{L}_{US}\Delta lnLQ_{US} \quad (7.5)$$

(vi) The gap with the US on TFP growth:

$$USGAP_{c,TFPG} = \Delta lnA_{c} - \Delta lnA_{US} \quad (7.6)$$

4. Decomposition results

Aligned with the study's objectives, the primary aim of productivity decomposition is twofold: (i) to comprehend the sources behind labor productivity growth (LPG) and (ii) to dissect the dynamics and origins of labor productivity catch-up. This knowledge of productivity growth sources and catch-up origins not only contributes valuable insights but also equips policymakers with targeted recommendations to enhance both productivity growth and catch-up endeavors related to labor productivity.

4.1. Sources of labor productivity growth (LPG)

Using the framework delineated in Equation (4), the LPG of a country's financial sector across the 15-year period from 2000 to 2015 can be decomposed into six distinct sources, as delineated in Equations (4.1) through (4.6). Table 6 presents these decomposition findings for the E13 economies, revealing the following noteworthy observations:

First, TFPG emerges as a pivotal driver of LPG. Notably, TFPG is positive for 12 out of the 13 E13 economies, with Germany as an exception (TFPG = -1.05% points, which is the main contributor to its negative LPG of -0.81%). The strong positive correlation between TFPG and LPG (+0.77) underscores TFPG's robust predictive capability for LPG. Notably, the top five performers in LPG (Czech Republic, Sweden, Denmark, Austria, the Netherlands) all exhibit substantial TFPG, ranging from 1.0% points for Sweden to 2.26 for the Netherlands. This suggests that a strategy focused on bolstering sector-wide efficiency, potentially through restructuring and digital transformation, has been pivotal for E13 economies to attain robust LPG, as discussed in Section 3.

Second, digital transformation emerges as a pivotal source of LPG. Notably, the two types of ICT capital, namely ICT hardware (ICTHW) and software and database (SWDB), exhibit distinct patterns in their contributions to LPG. For SWDB, the deepening of its capital yields a positive contribution for all 13 economies. Furthermore, its strong pairwise correlation (+0.59) with LPG underscores its strong correlation with labor productivity performance. The association link between SWDB's capital deepening contribution, LPG, and TFPG, as highlighted in Appendix 3, is robust and statistically significant, indicating that SWDB capital deepening bolsters LPG not only through its direct contribution but also through its robust influence on TFPG, which, in turn, enhances sector-wide efficiency. Conversely, for ICTHW, the contribution from capital deepening is positive for 10 economies and negative for three economies: Austria, Belgium, and the UK. This observation necessitates recognition of the shift towards cloud computing services in the mid-2000s, particularly pronounced within the financial sector of developed economies. Referencing Appendix 3, this transition to cloud services, specifically "Infrastructure as a Service" (IaaS), significantly curtails companies' investments in ICT hardware. Consequently, the waning contribution of ICTHW capital deepening, which mirrors the reduction in investment over time, may not accurately capture the effect of ICT hardware-related digital transformation within specific companies or sectors. Thus, the negative contribution of ICTHW capital deepening observed in countries such as Austria, Belgium, and the UK should be interpreted as a reflection of their proactive transition towards cloud computing services, rather than lagging investments in ICT hardware.

Third, labor quality emerges as a robust source of LPG. Its positive contribution holds across all 13 economies. Furthermore, the strong positive correlation (+0.78) between its contribution and LPG suggests that labor quality's influence on LPG extends beyond its direct contribution indicated by the decomposition results. This observation implies that E13 financial sectors effectively leveraged improvements in labor quality as a potent strategy to elevate labor productivity, while simultaneously embracing restructuring and digital transformation, particularly automation, to streamline employment.

Fourth, traditional (NICT) capital deepening remains a noteworthy contributor to LPG for the majority of economies. Ten out of the 13 economies witness positive contributions from NICT capital deepening, with a positive and significant pairwise correlation (+0.30) with LPG. The case of Finland underscores the significance of NICT capital in driving LPG. Despite its robust positive TFPG (0.78% points), Finland's substantial negative contribution from NICT capital deepening (-1.73% points) leads to a negative LPG (-0.12%).

Finally, innovation surfaces as a substantial source of LPG across most countries. The contribution from R&D capital deepening is positive for nine E13 economies. It is crucial to note the pairwise correlation of R&D capital deepening's contribution with TFPG (+0.19) and with LPG (-0.20), which is not explicitly presented in the table. This observation underscores that while R&D capital deepening can positively enhance LPG through its direct contribution and its impact on TFPG, it may not serve as a robust predictor of LPG. This stems from the stronger direct influence of other factors (LQ, TFPG, SWDB, and NICT) on LPG.

Table 6: Sources of the financial sector's labor productivity growth (LPG) by country, 2000-2015

(Economies listed in descending order of LPG)

Country	Group [a]	LPG (%)	Contribution to LPG by source (% points)					
			Capital deepening				LQ	TFPG
			NICT	ICTHW	SWDB	R&D		
Czech	**G2**	3.33	0.23	0.0966	0.2937	0.0216	0.58	2.10
Sweden	**G2**	3.24	0.52	0.4903	0.5080	0.0298	0.70	1.00
Denmark	**G1**	2.67	-0.78	0.1230	0.5984	0.3465	0.60	1.79
Austria	**G2**	2.59	0.12	-0.0380	0.2586	-0.0187	0.24	2.03
Netherlands	**G2**	2.47	-0.76	0.2337	0.2466	0.0833	0.40	2.26
UK	**G2**	1.92	0.84	-0.0324	0.0873	0.0202	0.49	0.51
Japan	**G2**	1.91	0.03	0.3142	0.6976	0.0015	0.20	0.67
US	**G1**	1.63	0.40	0.2714	0.2231	-0.0156	0.42	0.32
Belgium	**G2**	1.61	0.05	-0.1915	0.2061	0.0653	0.31	1.18
Italy	**G2**	1.38	0.33	0.0221	0.0002	-0.0310	0.17	0.89
France	**G1**	1.25	0.41	0.3308	0.1999	0.0000	0.29	0.01
Finland	**G3**	-0.12	-1.73	0.2788	0.0453	0.4312	0.08	0.78
Germany	**G6**	-0.81	0.002	0.0337	0.0556	0.0140	0.14	-1.05
Selected statistics								
# of economies with a "+" value [b]		11	10	10	13	9	13	12
Correlation with LPG [c]		1.00	0.30	0.12	0.59	-0.20	0.78	0.77
MEDIAN		1.91	0.12	0.12	0.22	0.02	0.31	0.89
MIN		-0.81	-1.73	-0.19	0.0002	-0.03	0.08	-1.05
MAX		3.33	0.84	0.49	0.70	0.43	0.70	2.26

Notes: [a] *E13 economies, as outlined in Section 3, are categorized into six growth patterns: "robust growth" (G1), "competitive growth" (G2), "uncompetitive growth" (G3), "restructuring for productivity enhancement" (G4), "unproductive employment expansion" (G5), and "shrinking" (G6). Note that none of the economies in this table fall into categories G4 or G5.*

[b] *The number of economies with a positive value in the corresponding column.*

[c] *The correlation of the measure in the corresponding column with Labor Productivity Growth (LPG).*

4.2. The dynamics and sources of catch-up on labor productivity

Utilizing the US as a benchmark, it is possible to scrutinize the financial sector's catch-up performance on labor productivity for economies outside the US. Before delving into the sources of catch-up performance for the 12 non-US E13 economies, understanding their catch-up dynamics is instrumental.

The dynamics of catch-up on labor productivity

Table 7 presents the Relative Labor Productivity (RLP) of the financial sectors within the E13 economies, employing the US as the reference point (where RLP=100 for the US). Two key observations emerge from Table 7.

Table 7: The dynamics of E13 financial sector catch-up on labor productivity over 2000-2015

(Economies listed in descending order of the 2000-2015 change in RLP)

Country	Group[a]	LP		RLP (US=100)		
		Level, 2015 (US$/hour)	Real Growth, 2000-2015 (%)	2000 (I)	2015 (II)	2000-2015 Change (II)-(I)
Sweden	**G2**	137.7	3.24	89.5	114.0	24.5
Netherlands	**G2**	183.4	2.47	133.8	151.9	18.1
Czech	**G2**	86.3	3.33	55.4	71.4	16.1
Denmark	**G1**	124.1	2.67	87.9	102.8	14.8
Austria	**G2**	83.8	2.59	60.1	69.4	9.3
The UK	**G2**	92.1	1.92	72.9	76.2	3.3
Japan	**G2**	90.6	1.91	71.9	75.0	3.1
The US	**G1**	120.8	1.63	100.0	100.0	0.0
Belgium	**G2**	146.9	1.61	121.9	121.7	-0.3
Italy	**G2**	96.3	1.38	82.7	79.7	-3.0
France	**G1**	87.0	1.25	76.3	72.0	-4.2
Finland	**G3**	80.7	-0.12	86.8	66.8	-20.0
Germany	**G6**	80.8	-0.81	96.4	66.9	-29.5
Selected statistics						
Median		**92.1**	**1.9**	**86.8**	**76.2**	**3.1**
Min		**80.7**	**-0.8**	**55.4**	**66.8**	**-29.5**
Max		**183.4**	**3.3**	**133.8**	**151.9**	**24.5**

Notes: [a] E13 economies, as outlined in Section 3, are categorized into six growth patterns: "robust growth" (G1), "competitive growth" (G2), "uncompetitive growth" (G3), "restructuring for productivity enhancement" (G4), "unproductive employment expansion" (G5), and "shrinking" (G6).

First, among the E13 economies, seven demonstrated an improvement in their RLP, while five experienced a decline over the 2000-2015 period. Additionally, these dynamics exhibited substantial magnitudes of increase and decrease. Notably, Sweden (+24.5) and the Netherlands (+18.1) witnessed significant RLP improvements, while Germany (-29.5) and Finland (-20.0) faced substantial declines.

Second, out of the seven economies with improved RLP, six belong to the "competitive growth" (G2) group. This suggests that achieving higher value-added growth while simultaneously reducing employment has been a predominant approach for these countries to catch-up with the US in terms of financial labor productivity.

As presented in Subsection 3.2.2, the catch-up performance of a country, as measured by its Catch-up on Labor Productivity Index (CULPI), can be dissected into six sources: NICT, ICTHW, SWDB, R&D, LQ, and TFPG. The outcomes of this decomposition analysis are presented in Table 8. Note that the contribution of each source for a given economy is the difference between that country's contribution to LPG in that measure and the US's contribution.

The following findings are deduced from Table 8.

First, for all seven economies that made progress in catchup (CULPI>0), the contribution of TFPG is both positive and substantial. This implies that outperforming the US in enhancing the sector's overall efficiency significantly contributes to driving the catchup in labor productivity. However, it is important to note that a strong TFPG alone is not always sufficient to prevent a country from lagging behind. Among the economies that fell behind—Finland, Belgium, and Italy—the contribution of TFPG to CULPI remains positive.

Second, underperforming the US in other sources of LPG, such as NICT, Labor Quality (LQ), and elements of digital transformation (ICTHW and SWDB), constitutes a noteworthy factor leading to a country's decline in catchup performance. For instance, Finland's unfavorable CULPI performance (-1.74) was largely influenced by its substantial gap with the US in terms of NICT capital deepening contribution.

Finally, the pairwise correlations with CULPI are strongest for LQ (0.79), followed by TFPG (0.78) and SWDB (0.58). This suggests that these three sources of LPG exhibit strong predictive capabilities for gauging a country's catch-up performance in financial labor productivity.

Table 8: Sources of financial labor productivity catch-up over 2000-2015 by country

(Economies listed in descending order of CULPI)

Country	Group [a]	CULPI (%)	Contribution to CULPI by source (% points)					
			Capital deepening				LQ	TFPG
			NICT	ICTHW	SWDB	R&D		
Czech Rep.	**G2**	1.70	-0.17	-0.175	0.071	0.037	0.161	1.78
Sweden	**G2**	1.61	0.11	0.219	0.285	0.045	0.273	0.68
Denmark	**G1**	1.04	-1.19	-0.148	0.375	0.362	0.173	1.46
Austria	**G2**	0.96	-0.28	-0.309	0.036	-0.003	-0.187	1.71
The Netherlands	**G2**	0.85	-1.16	-0.038	0.024	0.099	-0.018	1.94
The UK	**G2**	0.30	0.43	-0.304	-0.136	0.036	0.072	0.19
Japan	**G2**	0.28	-0.38	0.043	0.475	0.017	-0.225	0.35
Belgium	**G2**	-0.01	-0.35	-0.463	-0.017	0.081	-0.115	0.86
Italy	**G2**	-0.24	-0.07	-0.249	-0.223	-0.015	-0.250	0.57
France	**G1**	-0.38	0.01	0.059	-0.023	0.016	-0.132	-0.31
Finland	**G3**	-1.74	-2.14	0.007	-0.178	0.447	-0.344	0.46
Germany	**G6**	-2.43	-0.40	-0.238	-0.167	0.030	-0.281	-1.38
Selected statistics								
# of economies with a "+" value [b]		**7**	**3**	**4**	**6**	**10**	**4**	**10**
Correlation with CULPI [c]		**1.00**	**0.31**	**0.13**	**0.58**	**-0.21**	**0.79**	**0.78**
MEDIAN		**0.29**	**-0.32**	**-0.16**	**0.00**	**0.04**	**-0.12**	**0.62**
MIN		**-2.43**	**-2.14**	**-0.46**	**-0.22**	**-0.02**	**-0.34**	**-1.38**
MAX		**1.70**	**0.43**	**0.22**	**0.47**	**0.45**	**0.27**	**1.94**

Notes: [a] *E13 economies, as outlined in Section 3, are categorized into six growth patterns: "robust growth" (G1), "competitive growth" (G2), "uncompetitive growth" (G3), "restructuring for productivity enhancement" (G4), "unproductive employment expansion" (G5), and "shrinking" (G6)*

[b] *The number of economies with a positive value in the corresponding column.*

[c] *The correlation of the measure in the corresponding column with CULPI*

5. Summary and concluding remarks

The financial sector in industrialized economies has undergone significant changes over the past two decades, marked by transformations in private domestic credit and foreign exchange transactions, as evident in Figure 1 and Table 1, respectively. In the face of sluggish economic growth, the sector has undergone substantial restructuring, while the globalizing trends and the digital revolution have ushered in profound shifts. This study delves into the patterns and catalysts of growth and catch-up within the financial sector across 13 industrialized economies,

collectively labeled as the E13 group. The data, covering the period from 2000 to 2015 and sourced from the latest iteration of the EU KLEMS database, underpin the exploration.

The findings of this study underscore several key insights:

First, the financial sector in most countries has demonstrated robust growth through a combination of rigorous restructuring and pervasive digital transformation. Noteworthy trends include significant expansions in value-added, concurrent with substantial contractions in employment, alongside robust labor productivity growth.

Second, predominant drivers of labor productivity growth and catch-up in most countries encompass Total Factor Productivity (TFPG), Labor Quality (LQ), and digital transformation. It is observed that digital transformation significantly fuels labor productivity growth not solely through its direct contribution, as quantified via growth accounting estimation, but also via its potent influence on the expansion of Total Factor Productivity (TFP) and the reduction of hours worked.

Third, the role of digital transformation is particularly pivotal in steering labor productivity growth. Digital transformation, especially the augmentation of intangible software and databases, not only directly bolsters capital deepening but also amplifies the sector's TFP. This serves to enhance efficiency and competitiveness, underscoring that digital transformation transcends the mere acquisition of digital assets or services, necessitating comprehensive analyses of the interplay among Artificial Intelligence (AI), digitalization, and cybersecurity.

Fourth, imperative recommendations for policymakers emerge from these findings. The financial sector warrants dedicated attention and strategic alignment from governments, considering its extensive restructuring and anticipation of further transformative shifts. Key priorities include governance enhancement, digital transformation facilitation, and workforce streamlining and upskilling.

Fifth, the efficacy of fostering digital transformation in elevating growth and productivity within the financial sector is evident. Investment in digital capital, especially intangible software and databases, not only directly augments capital deepening but also catalyzes TFP. However, a comprehensive approach to digital transformation involves analyzing the intricate connections between AI, digitalization, and cybersecurity to ensure the security, efficiency, and efficacy of ICT ecosystems (Rodrigues et al., 2022).

Sixth, the existing growth accounting approach must be refined to accurately gauge the contribution of digital technologies to growth. As cloud computing services gain prominence, computing capability upgrades are captured by operating expenses (OPEX) instead of capital expenses (CAPEX) (Vu et al., 2020). This necessitates a revision of the growth accounting approach, particularly for ICT hardware.

In terms of future research directions, several avenues merit exploration. One avenue involves examining the impact of the shift to cloud computing on labor productivity and TFP growth. Another promising avenue is a comparative analysis of how the financial sector diverges from other sectors—such as transport and tourism—in terms of growth patterns, sources, and the impact of digital transformation. Additionally, a deeper investigation into why TFP and Labor Quality hold substantial influence in driving labor productivity, with a specific focus on the role of digital transformation, offers a compelling area for exploration.

As caveats, it is important to note that beyond the positive externalities of financial development, as evidenced by economic growth, financial development can also contribute to substantial economic damage, as exemplified by the global financial crisis of 2008-2009. Furthermore, the correlation between financial size and economic growth could be contingent upon specific financial sector development thresholds. It is essential to acknowledge that the proposed modeling approach does not establish causality and can be extended in future studies to provide frameworks for causal analysis. Additional caveats, relevant to future studies, warrant consideration. Furthermore, as more granular data become accessible, future studies could leverage disaggregated data within the financial sector. This is especially relevant given the distinctive characteristics of the three divisions within the financial sector: 64 - Financial service activities except insurance; 65 - Insurance; and 66 - Activities auxiliary to financial service and insurance activities.

References

Asongu, S. A., & Acha-Anyi, P. N., 2020. Enhancing ICT for Productivity in Sub-Saharan Africa: Thresholds for Complementary Policies African Journal of Science, Technology, Innovation and Development, 12(7), 831-845.

BIS 2018. Triennial Central Bank Survey, Foreign exchange turnover in April 2016. BIS.

Caselli, F. & Coleman, W. J. 2001. Cross-Country Technology Diffusion: The Case of Computers. *The American economic review,* 91 (2), 328-335.

Cummins, J. D. & Rubio-Misas, M. 2006. Deregulation, Consolidation, and Efficiency: Evidence from the Spanish Insurance Industry. *Journal of money, credit and banking,* 38 (2), 323-355.

Cummins, J. D. & Xie, X. 2012. Efficiency, productivity, and scale economies in the U.S. property-liability insurance industry. *Journal of productivity analysis,* 39 (2), 141-164.

Devarajan,S., Easterly, W.R., & Pack, H., 2003. Low Investment Is Not the Constraint on African Development. Economic Development and Cultural Change, 51 (3), 547-571.

Diewert, E. W. (1976), "Exact and Superlative Index Numbers", *Journal of Econometrics*,pp. 115-45.

Durlauf, S., Johnson, P. & Temple, J. 2005. "Growth econometrics", in Aghion, P. andDurlauf, S. (Eds.), Handbook of Economic Growth, Elsevier, North Holland.

EY 2019. Global FinTech Adoption Index 2019. EY.

Gu, J. Q., Gouliamos, K., Lobont, O. R., & Nicoleta-Claudia, M. 2021. Is the fourth industrial revolution transforming the relationship between financial development and its determinants in emerging economies? Technological Forecasting and Social Change, 165 (April), 120563.

Hong, J-P., 2016. Causal relationship between ICT, R&D investment and economic growth in Korea. *Technological Forecasting and Social Change*, 116(March), 70–75.

Hsiao, C. 2014. *Analysis of panel data,* Cambridge, Cambridge University Press.

IDC 2-19. IDC's Worldwide ICT Spending Guide by Industry and Company Size Taxonomy 2019. IDC.

Inklaar, R., Timmer, M. P. & Van Ark, B. 2008. Market services productivity across Europe and the US: MARKET SERVICES PRODUCTIVITY. *Economic policy,* 23 (53), 139-194.

Jorgenson, D. W. (2001). Information technology and the U.S. economy. *American Economic Review* 91(March): 1-32.

Jorgenson, D.W. (1995a), Productivity Volume 1: Postwar U.S. Economic Growth, MIT Press.

Jorgenson, D.W. (1995b), Productivity Volume 2: International Comparisons of Economic Growth,MIT Press.

Jorgenson, D.W, 2001. Information technology and the U.S. economy. American Economic Review 91 (1), 1–32.

Jorgenson, D.W and Griliches Z. (1967). "The Explanation of Productivity Change", *Review of Economic Studies* 34

Jorgenson, D. W., Ho, M. S. & Stiroh, K. J. 2008. A Retrospective Look at the U.S. Productivity Growth Resurgence. *The Journal of economic perspectives,* 22 (1), 3-24.

Kim, K., Bounfour, A., Nonnis, A., & Özaygen, A. 2021. Measuring ICT externalities and their contribution to productivity: A bilateral trade based approach. *Telecommunications Policy*, 45(2), 102085.

Klenow P.J. & Rodriguez-Clare, A., 1997. The Neoclassical Revival in Growth Economics: Has It Gone Too Far?.*NBER Macroeconomics Annual,* 73–114.

Lee, J.W., Song, E., & Kwak, D. 2020. Aging labor, ICT capital, and productivity in Japan and Korea. *Journal of Japanese and International Economies*, 58(December), 101095.

Levine, R. & Zervos, S. J. 1993. What we Have Learned about Policy and Growth from Cross-Country Regressions? *The American economic review,* 83 (2), 426-430.

Nomura, K. & Amano, T. 2012. Labor Productivity and Quality Change in Singapore: Achievements in 1974-2011 and Prospects for the Next Two Decades. *KEO Discussion Paper No. 129*.

OECD 2018. Financial Markets, Insurance and Private Pensions: Digitalisation and Finance. Paris: OECD.

Niebel T. 2018. ICT and economic growth – comparing developing, emerging and developed countries. World Dev.

Rodrigues, Ana Rita D., Fernando A. F. Ferreira, Fernando J. C. S. N. Teixeira, and Constantin Zopounidis, (2022), "Artificial intelligence, digital transformation and cybersecurity in the banking sector: A multi-stakeholder cognition-driven framework", Research in International Business and Finance 60 pp. 101616.

Sassi, S., &Goaied, M., 2013. Financial development, ICT diffusion and economic growth: Lessons from MENA region. *Telecommunications Policy*, 37(4), 252 261.

Scott, Hal S. and Gulliver, John and Nadler, Hillel, Cloud Computing in the Financial Sector: A Global Perspective (July 26, 2019). Program on International Financial Systems 2019, Available at SSRN: https://ssrn.com/abstract=3427220.

Temple, J. 1999. The New Growth Evidence. *Journal of Economic Literature*, 37(1), 112-156.

Timmer, M. P., O'Mahony, M. & Van Ark, B. 2007b. EU KLEMS growth and productivity accounts: an overview. *International Productivity Monitor,* 14.

Timmer, M. P. & van Ark, B. 2005. Does information and communication technology drive EU-US productivity growth differentials? *Oxford economic papers,* 57 (4), 693-716.

van Ark, B., O'Mahony, M. & Timmer, M. P. 2008. The Productivity Gap between Europe and the United States: Trends and Causes. *The Journal of economic perspectives,* 22 (1), 25-44.

Voghouei, H., Azali, M., & Jamali, M. A., 2011. A survey of the determinants of financial development. Asian Pacific Economic Literature, 25(2), pp. 1-20.

Vu, K.. 2020. Sources of Growth in the World Economy: A Comparison of G7 and E7 Economies. *In:* FRAUMENI, F. M. (ed.) *Measuring Economic Growth and Productivity: Foundations, KLEMS Production Models, and Extensions.* Academic Press 55-74.

Vu, K. Hartley K., & Kankanhalli A. (2020). Predictors of Cloud Computing Adoption: A Cross-Country Study, Telematics and Informatics, Volume 52, September.

Vu, K. and Hartley, K. (2021). Drivers of growth and catch-up in the tourism sector of industrialized economies. *Journal of Travel Research*, 1-17.

Vu, K. and Hartley, K. (2022a). Sources of transport sector labor productivity performance in industrialized countries: Insights from a decomposition analysis, *Transport Policy 129, 204-218.*

Vu, K. and Hartley, K. (2022b). Effects of Digital Transformation on Electricity Sector Growth and Productivity: A Study of Thirteen Industrialized Economies, *Journal of Utilities Policy*. Volume 74, February 2022, 101326

Young, A. 1995. The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience. *Quarterly Journal of Economics*, 110(3), 641–80.

Appendix 1: The EU KLEMS dataset – Data source and variables

The data regarding growth sources are derived from the EU-KLEMS[6] database, which stems from a research project funded by the European Commission. Covering 28 EU nations, Japan, and the US, this database furnishes industry-level metrics encompassing output, inputs, and productivity for a total of 30 countries. Construction of this database's methodology is detailed in the corresponding literature. The EU-KLEMS database serves as a comprehensive resource elucidating the origins of growth at the industry level, dissected from the analytical frameworks presented in Subsection 4.1. The selection of E13 economies underpinning this study's database hinges on the availability of detailed data for the tourism sector during the 2000-2015 timeframe. To further elaborate, the subsequent table outlines key variables extracted from Equation (1) in Section 4.

Table A1: Selected key variables of the EU KLEMS database

Variable	Description*
NICT	Tangible non-ICT capital, which is the aggregate of five principal types of traditional capital: transport equipment; other machinery and equipment; non-residential investment; and residential structures; and cultivated assets.
ICTHW	Tangible ICT capital, which is the aggregate of computing equipment and communications equipment
SWDB	Intangible ICT capital, which is the aggregate of computer software and databases.**
R&D	Intangible innovation capital, which is the aggregate of two main types of intangible capital: R&D and other intellectual property products.**
H	Total hours worked by persons engaged.
LQ	The concept of labor quality (LQ) is encapsulated within the labor composition effect. In essence, a positive upswing in LQ signifies the enhancement of human capital and/or a transition in the composition of employment from less skilled to more skilled labor (Jorgenson et al. 2008: 11; Nomura and Amano, 2012).
VAG	Value-added growth
LPG	Labor productivity growth
TFPG	Total factor productivity growth, which is the residual from the decomposition exercise.

*Note: * see Stehrer et al. (2019) for more details; ** Niebel et al. (2017) find that the contribution of intangible capitals are notably higher in manufacturing and finance sectors than in other sectors.*

[6] KLEMS stands for capital (K), labor (L), energy (E), materials (M), and services (S).

Appendix 2: Definition of the financial sector

The financial sector scrutinized within this paper is delineated by Section K (Financial and Insurance) of the UN International Standard Industrial Classification - Revision 4 (ISIC Rev. 4). This classification is expounded in Table A2 below.

Table A2: Description of Section K (Financial and Insurance) from the UN ISIC Rev. 4

Main Divisions	Sub-divisions
Division 64: Financial service activities, except insurance and pension funding	641 Monetary intermediations 6411 Central banking 6419 Other monetary intermediations 642 Activities of holding companies 6420 Activities of holding companies 643 Trusts, funds and similar financial entities 6430 Trusts, funds and similar financial entities 649 Other financial service activities, except insurance and pension funding activities 6491 Financial leasing 6492 Other credit granting 6499 Other financial service activities, except insurance and pension funding activities, n.e.c
Division 65: Insurance, reinsurance and pension funding, except compulsory social security	651 Insurance 6511 Life insurance 6512 Non-life insurance 652 Reinsurance 6520 Reinsurance 653 Pension funding 6530 Pension funding
Division 66: Activities auxiliary to financial service and insurance activities	661 Activities auxiliary to financial service activities, except insurance and pension funding 6611 Administration of financial markets 6612 Security and commodity contracts brokerage 6619 Other activities auxiliary to financial service activities 662 Activities auxiliary to insurance and pension funding 6621 Risk and damage evaluation 6622 Activities of insurance agents and brokers 6629 Other activities auxiliary to insurance and pension funding 663 Fund management activities 6630 Fund management activities

Source: UN (2020)

Appendix 3. The links between digital transformation and financial sector growth

A3.1. Theoretical grounds and practical mechanism

From a comprehensive perspective, digital transformation is recognized as a catalyst for producing substantial effects on efficiency and employment across all sectors of an economy. In theory, the impact of digital transformation on efficiency or Total Factor Productivity (TFP) growth is channeled through five mechanisms:[7] (i) Operational Cost Reduction and Revenue Increase: Automation reduces operational costs, while e-commerce generates increased revenues. This synergy strengthens TFP growth; (ii) Learning and Innovation: Digital transformation fosters learning and innovation, creating more value for customers and enhancing efficiency. This bolsters the effects of the first mechanism; (iii) Enhanced Decision Making: Investments in digital solutions like cloud computing, big data analytics, AI, machine learning, blockchain, ERP, and CRM improve decision-making quality; (iv) Synergistic Value Creation: Digital ecosystems and sharing economy models enable synergistic value creation; (v) Business Model Transformation: Firms reevaluate and reshape their business models, embracing structural changes to achieve more value with fewer resources.

In the context of the financial sector, the impact of digital transformation on productivity becomes evident through illustrative examples:

First, digital transformation allows banks to serve, attract, and engage customers far more efficiently via online platforms, which reduces the costly demand for face-to-face interactions at bank branches. As evidence, the number of bank branches in the UK has declined from 12,355 in 2012 to 10,745 in 2015 to 8,525 in 2019[8]whereas the number of bank customers increased[9].

Second, the rapid growth of fintech services[10] has induced radical innovations across areas of financial services, which include personal finance, lending, payment and billing, money transfer and remittance, insurance, capital market, risk management and regulatory compliance(Deloitte, 2021).These innovations have enabled the financial sector to make

[7] See Chou et al. (2014) and Vu et al. (2020) for more discussions.
[8] Matthew Boyle 'How many people are still using bank branches in the UK in 2020?'
Updated Oct 19, 2020; Source: https://www.finder.com/uk/banking-branch-usage, accessed Sept 20, 2021.
[9] According to Statista (2021), the total number of customers of the UK's ten largest banks rose from 101 million in 2007 to 130 million in 2017.
[10] As evidence, global investments in FinTech was more than $12 billion in 2014, more than tripled compared to 2013; while the number of fintech companies in Europe rose from a tiny number in the early 2000s to 1,080 in 2013 to 2,446 in 2016 (Deloitte, 2021).

unprecedented progresses in reducing the costs of traditional services, introducing new services, improving customer experience, and reaching out to new customers.

Third, investment in digital technologies such as AI, ML, and big data analytics allows banks and insurance companies to enhance the quality of decision that enhances operational efficiency. For example, the predictive models for preventive maintenance and cash replenishment improve the management efficiency of ATM networks. Data analytics and machine learning enhance the efficiency and accuracy of branch risk profiling, trading fraud analysis, and credit risk assessment.

Fourth, digital transformation enables financial organizations to deepen their collaboration with external partners and to reinvent their business models built on digital ecosystems, which allow them to achieve considerable value gains through synergy. For example, through application programming interface (API)enabled platforms, a bank can enable its external partners to create complementary digital offerings such as calculation of loan eligibility and redemption of loyalty points.

In conclusion, the theoretical foundations and practical mechanisms underlying digital transformation's impact on the financial sector showcase its potential to drive growth and productivity. By embracing digital transformation strategies, financial institutions can capitalize on efficiency gains, innovative services, improved decision-making, and collaborative ecosystem building. This enables them to navigate the evolving landscape and deliver enhanced value to customers and stakeholders.

Although digital transformation can significantly enhance the efficiency of the financial sector, it tends to have negative effects on the sector's employment, especially in developed nations, is three ways. First, the closure or scale-down of bank branches due to the shift to digital banking, has caused thousands of job cuts. Second, equipped with business software packages such as Enterprise Resources Planning (ERP) and Customer Resources Management (CRM), workers in the financial sector are far more productive than before, which reduces the sector's demand for labor. Third, AI and automation increasingly replace routine-task workers. For example, at the DBS bank of Singapore, the virtual assistant is able to handle over 80% of all customer requests without human intervention.[11]

[11]Banking without branches, DBS Digibank India gains 1m customers in a year; 08 Jun 2017; https://www.dbs.com/innovation/dbs-innovates/banking-without-branches-dbs-digibank-india-gains-1m-customers-in-a-year.html

This Appendix uses the data of the financial sectors of the E13 economies, to conduct a simple empirical examination of the expected links of digital transformation with productivity and employment as presented below.

A3.2. Empirical model

Panel data regression is a helpful way to detect the links between digital transformation and financial sector growth in E13 economies. For this exercise, one can extract a panel data set from the EU KLEMS database for the financial sectors of E13 economies over the period 2000-2015, which gives 195 observations (see Appendix 1 for a description of the database).

The regression model takes the following form:

$$G_{ct} = \beta_0 + \beta_1 LPGcon\_SWDB_{ct} + \beta_2 LPGcon\_ICTHW_{ct} + \beta_3 LnINC\_L1_{ct} + \omega_c + \varepsilon_{ct} \quad \text{(A1)}$$

where subscripts c and t indicate country c and year t, respectively; $\omega_c$represents country-specific characteristics; and $\varepsilon_{c,t}$ is the random error term. The variables are defined below.

G_{ct} is one of the three dependent variables to be examined: labor productivity growth (LPG), total factor productivity growth (TFPG), and hours worked growth (HG). Note that all data are at an annual frequency.

and $LPGcon\_SWDB$ and$LPGcon_ICTHW$ are the contributions to annual LPG of the two main types of ICT capital inputs —software and database (SWDB) and ICT hardware (ICTHW). These two variables, to a certain extent, capture the financial sector's efforts to embrace digital transformation. Note that the contribution of a given capital type depends on its accumulated capital stock, which means that its effects are related to not only the current but also historical investments.

$LnINC\_L1$ is the lagged value of the level of income defined as the logarithm of per capita GDP measured in constant US dollars. This variable is included to control for the effect of the level of country development.

In examining the effects of ICT from the above model, it is also important to take into consideration the trends of shifting to cloud computing services by businesses in the financial sector.

In drawing insights into the effects of digital transformation on the financial sector's performance in Model (A1) above, it is important to take into consideration the following two major issues.

First, shifting to cloud services has become a plausible choice for businesses to embrace digital capabilities since early 2000. As a result, the demand for a typical company to invest in its own ICT assets, especially ICT hardware such as servers and cables, has tended to decline.[12] This trend is particularly strong for the financial sector. For example, banks have found investment in their own data centers much less efficient than using Infrastructure-as-a-Service (IaaS) from cloud providers. Therefore, although the contribution of ICTHW capital deepening can be positive, it tends to decline over time.[13]That is, a decrease in this measure indicates a shift of the sector to cloud services rather than a decline in its efforts to benefit from ICT hardware. At the same time, this trend is less significant for ICT software and database capital, which financial businesses may want to retain as their proprietary assets. Therefore, the contribution of SWDB capital deepening can be a more straightforward indicator of the effect of digital transformation on the financial sector's performance.

Second, although the model is not rigorous enough for detecting causal effects, it provides meaningful insights. On the one hand, while parsimonious, it controls for country-fixed characteristics. This approach lessens the problem of omitted variable bias caused by unobserved variables that are potentially correlated with the explanatory variables (Hsiao, 2014). On the other hand, the strength of association links between the explanatory variables and the outcome identified by its estimated results provides preliminary insights, which are helpful for policy discussion (Levine and Zervos 1993).[14]

[12]In shifting to cloud service, a business changes the model for building its computing capabilities from CAPEX to OPEX.

[13] Controlling for the country-fixed effect, $LPGcon\_ICTHW_{ct} = 35.2 - 0.018.Year$, where both coefficients are statistically significant at the 5% significance level and R-squared is 0.15.

[14] For example, Caselli and Coleman (2001) uses this approach to reveal influential findings.

A3.3. Estimation results

Table A3 reports the estimation results from Model (A1) for three dependent variables: LPG, TFPG, and HG. The following findings stand out from Table A3.

First, the coefficient on LPGcon_SWDB is positive and statistically significant in all regressions for LPG and TFPG. These results imply that digital transformation represented by investment in software and database capital has a strong positive link with labor productivity growth and total factor productivity growth in the financial sector.

Second, the coefficient on LPGcon_SWDB is negative and statistically significant in all regressions for HG. This result suggests that digital transformation represented by investment in software and database capital has a significant negative effective on employment in the financial sector.

Third, the coefficient on LPGcon_ICTHW is negative in regressions for all three dependent variables -- LPG, TFPG, and HW although it is statistically significant only in regressions (1a), (2a), (2c), and (3a). Note that shifting to cloud computing services has been a notable trend in the financial sector, in which businesses increasingly rely on cloud services providers such as Amazon, Azure, and Google to have world-class computing capabilities without having to make investment in ICT assets, especially computing hardware (Scott et al. 2019). In this shift to the use of cloud services, capital services rendered by in-house ICT hardware assets, which is captured by LPGcon_ICTHW, tended to decline overtime. The negative sign of the coefficient on LPGcon_ICTHW, therefore, suggest that digital transformation through shifting to cloud services has a positive effect on productivity (LPG and TFG) while having a positive effect on employment.

Table A3. The links between digital transformation and the financial sector's growth

Explanatory variable	Dependent variable								
	LPG			TFPG			HG		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
LPGcon_SWDB		2.3***	2.55***		1.44*	1.89*		-1.05***	-0.97***
		(0.76)	(0.77)		(0.81)	(0.81)		(0.28)	(0.28)
LPGcon_ICTHW	-1.08		-1.64*	-2.49***		-2.9**	-0.72**		-0.51
	(0.92)		(0.91)	(0.96)		(0.96)	(0.34)		(0.33)
LnINC_L1	4.8	12.4	11.5	5.6	12.2	10.6	7.9**	5.6*	5.3*
	(8.4)	(8.4)	(8.4)	(8.7)	(9.0)	(8.8)	(3.1)	(3.1)	(3.1)
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	195	195	195	195	195	195	195	195	195
R2	0.05	0.09	0.10	0.06	0.04	0.09	0.15	0.20	0.21

*Notes: the regression uses the panel data of theE13 financial sectors over the 2000-2015 period. The figures in parentheses are robust standard errors. *p<0.10; **p<0.05; ***p<.01.*