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## Digital transformation: Some implications for financial and macroeconomic stability

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**ADB Working Paper Series**

**DIGITAL TRANSFORMATION: SOME  
IMPLICATIONS FOR FINANCIAL AND  
MACROECONOMIC STABILITY**

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**Asian Development Bank Institute**

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**Abstract**

Digital transformation is changing how and by whom financial services are provided, how payments are made within an economy and across borders, and how and where goods and services are produced in a globalized economy. These transformations bring significant benefits in the form of greater variety and convenience of financial services, faster speed of payment transactions, and more efficient production processes. But there are also potential costs. Traditional commercial banking models are challenged by unregulated FinTech and BigTech firms, possibly threatening systemic financial stability. Globalization of production processes has led to greater spillovers of economic fluctuations across borders, thereby complicating macroeconomic policy decisions.

This paper reviews how digital transformation is likely to impact financial stability, payment systems, and macroeconomic stability, and discusses the need for changes in regulatory and macroeconomic policies to mitigate the associated risks. The paper ends with reflections on the possible consequences of the current Coronavirus pandemic for the analysis and conclusions.

**Keywords:** digital transformation, financial intermediation, FinTech, BigTech, global value chains

**JEL Classification:** E31, F62, G21, G22

# Contents

1.	INTRODUCTION .....	1
2.	IMPLICATIONS FOR THE BANKING SYSTEM AND FINANCIAL STABILITY .....	1
2.1	The Advent of Big Data and Data Analytics .....	1
2.2	Implications of Digital Finance for Traditional Financial Intermediation.....	2
2.3	The Challenge from BigTech.....	4
2.4	Financial Stability Impact and Required Regulatory Response.....	5
3.	DIGITAL TRANSFORMATION OF THE PAYMENT SYSTEM .....	6
4.	MACROECONOMIC CONSEQUENCES OF DIGITAL TRANSFORMATION .....	7
4.1	Will Digital Transformation Bring about a New Industrial Revolution? .....	7
4.2	Global Value Chains, the Phillips Curve, and Monetary Policy .....	9
5.	REFLECTIONS ON THE POSSIBLE IMPLICATIONS OF THE CORONAVIRUS PANDEMIC .....	12
	REFERENCES .....	13

## 1. INTRODUCTION

Increased use of computers, machine learning, robots, and artificial intelligence has been compared with the introduction of the steam engine and electricity as drivers of economic progress. Some scholars have suggested that we are at the beginning of a Second Machine Age (Brynjolfsson and McAfee 2014), where technology-driven changes in market structures based on ideas rather than physical goods will lead to large increases in welfare not measured well by traditional metrics such as GDP. Others see much less promise in the new technologies (Gordon 2016). According to these views, measured productivity is likely to decrease, leading to slower future economic growth.

Other scholars have debated the future of traditional banking and payment practices. They ask whether digital transformation will mean that financial technology firms, online commerce and payment platforms, or social media platforms will replace traditional banks as providers of financial and payment services.

This paper does not aspire to pass judgment on these opposing views, but rather to ask what challenges the new technologies might pose for policymakers, particularly those responsible for maintaining monetary and financial stability.

In approaching this subject, the paper will focus on how new digital-based technologies have transformed, and are likely to further transform, the function of financial intermediation (Section II) and payment systems (Section III), and the production and pricing of goods and services (Section IV). The paper ends with some brief reflections on the possible consequences the current Coronavirus pandemic might have for the analysis and conclusions reached.

## 2. IMPLICATIONS FOR THE BANKING SYSTEM AND FINANCIAL STABILITY

### 2.1 The Advent of Big Data and Data Analytics

“Big data” and “data analytics” are important drivers of the digital transformation in banking and the financial system more broadly. Although there is no universally agreed definition, “big data” generally refers to very large structured and/or unstructured data sets containing tens of thousands of observations on bank customers, holders of insurance policies, users of online payment platforms, etc. Textual data can also be digitized and made available for computer-aided analysis of content. Examples include the digitization of documents containing the latest financial regulations so that these can be incorporated in compliance routines, newspaper articles to aid in the search for indicators of economic uncertainty, and reports by investment banks that may reveal market sentiment providing useful information for regulators.

These sources of information have, of course, existed for a long time, but it is only with the advent of inexpensive data storage facilities, huge increases in computing power, and new analytical techniques capable of dealing with very large data sets that the full benefits of big data have been realized.

The analytical techniques that have enabled financial institutions to take advantage of big data are commonly known as “machine learning” (ML) or “artificial intelligence” (AI). Logistic regressions, decision trees, random forests, and neural networks are examples of these techniques, which are sophisticated methods for discovering intricate, often

nonlinear, relationships between variables. While the methods rely on advanced computer algorithms to discover patterns in the data, they do not do so without human input. First of all, the algorithms are conceived by humans, and humans typically decide which variables these algorithms will have access to when they search for patterns. But humans may also be involved in the process by which computers learn from the data. For example, in “supervised learning” by the computer, the analyst will tell the computer which variable is to be explained (e.g. the occurrence of a nonperforming loan), and which variables are to be used as possible explanatory factors, but the analysis need not impose a particular functional relationship between them. “Unsupervised learning,” on the other hand, refers to a situation where the computer is simply given a data set and is tasked with finding patterns among the variables without being told specifically what to look for. A combination of the two ML methods is also possible where the analyst takes the output from the unsupervised learning, imposes some further structure on it, and proceeds to supervise the computer in a follow-up learning step. This method is referred to as “reinforced learning.”

It is important to realize that in all three cases the methods typically cannot determine underlying causal structures, and that it is often quite difficult to explain the underlying reasons for the relationship patterns they identify.

## 2.2 Implications of Digital Finance for Traditional Financial Intermediation

Digitalization, and FinTech more generally, has already changed many aspects of financial intermediation, and will continue to do so in the coming years. The changes apply both to the way intermediaries operate internally and to the products, services, and experiences offered to customers. This section deals with traditional banks as well as new FinTech institutions. The reason for combining the two is that FinTech companies themselves are unlikely to pose existential challenges to the traditional banks as the latter will either adopt FinTech solutions themselves or acquire FinTech start-ups. The case of BigTech may be different, and the challenges they pose will be taken up in Section 3 below.

A number of back office and analytical functions are transformed. Electronic *record keeping and account management* have of course been available for a long time, but it is now possible to use information from movements in accounts when proposing new investment products to customers or granting loans. Banks and other financial firms have introduced so-called “*chatbots*,” which are virtual assistants like Apple’s Siri except for financial services, that use natural language-processing technology to interact with customers. While early versions of these chatbots mostly dealt with providing account information, they are increasingly turning to giving advice on financial planning and investments.

Institution-wide *risk management* is another function that can be affected. Effectiveness can be improved by having a more comprehensive and precise view of the quantity and prices of assets and liabilities on the consolidated balance sheet, and algorithms can be designed to calculate risk measures and conduct stress tests based on alternative scenarios. Automatization of gathering and treatment of the data decreases costs, makes it possible to obtain more timely indications of changes in risk profiles, and allows management to concentrate on analyzing the results and take appropriate decisions rather than on searching for information.

Algorithm-aided *assessment of the creditworthiness* of borrowers can help reduce the incidence of nonperforming loans. Big data and sophisticated classification algorithms are being used to estimate the probability that a loan will get repaid in full based on a number of characteristics of the potential borrower using supervised learning algorithms. Credit scoring techniques have of course already been used to assess creditworthiness, but the new algorithms are typically designed to detect more subtle relationships and are potentially more accurate.

Financial institutions that engage in *asset allocation activities* either on their own account or as a service to clients are using ML to aid in the set allocation. ML algorithms can in principle detect correlation patterns between asset classes that are difficult to discern with traditional methods, thereby improving the risk-return profile of the investment portfolio.

Most traditional models employed to *forecast macroeconomic outcomes* use conventional linear regression techniques with varying degrees of complexity. ML may be able to improve on the accuracy of such forecasts by allowing for possible nonlinear relationships. A recent publication from the Bank of England, for example, argues that neural network models can beat conventional forecasting models of inflation in the United Kingdom. Private sector financial institutions are heavy users of forecasts both for internal use and in communications with clients, and ML is making inroads.

A survey of the use of AI in financial services conducted jointly by the Cambridge Centre for Alternative Finance (CCAF) and the World Economic Forum (CCAF 2020) found that between 70% and 80% of the firms surveyed had already implemented or were in the process of implanting some form of AI solution in their business model.<sup>1</sup> Not surprisingly, FinTech firms were in general more active users of AI, although only by a relatively small margin.

Risk management was the area where AI had been implemented most, followed by revenue-generating introductions of new products, customer service, process automation, and client acquisition (see Figure 1). With business domains, payment processes benefited from AI, particularly with respect to automation and risk management, whereas in investment management the generation of new revenue through new products and processes was the dominant incentive.

Another survey by the CCAF focusing on the FinTech industry in the ASEAN region revealed that a majority of the firms in the industry were focusing on digital lending (32%) or digital payments (26%).<sup>2</sup> In terms of lending, peer-to-peer (P2P)-type lending to businesses was the dominant activity (52%) followed by P2P-type lending to consumers. In the payment space, mobile money/wallets/P2P transfers was the dominant segment (67%) followed by remittances and international transfers (65%).

Predictive analytics, e.g. logistic regression and decision trees, based on the availability of big data were by far the most common techniques used by the ASEAN FinTech firms.

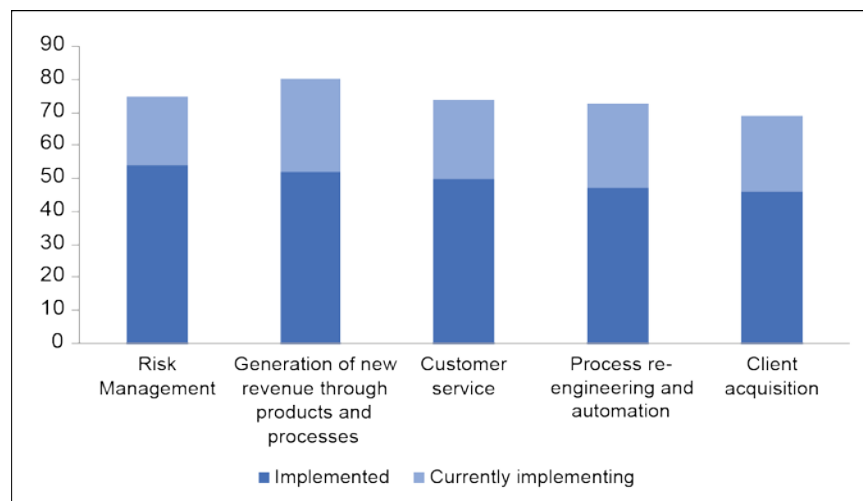
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<sup>1</sup> The survey obtained responses from 151 firms from 33 countries. Among the respondents, 54% were FinTech firms with the remainder being incumbent financial institutions.

<sup>2</sup> CCAF, ADBI, and FinTechSpace (2019). The survey received data from 173 FinTech firms operating in Cambodia, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam. Data from an additional 35 firms operating in the ASEAN region were also used in the study.



**Figure 1: Implementation of AI in FinTech and Incumbent Financial Institutions (%)**



Source: CCAF (2020).

## 2.3 The Challenge from BigTech

The developments just described will change the nature of financial services and how they are provided by incumbent financial institutions and new start-up FinTech companies. But by themselves they are not likely to pose an existential threat to the traditional financial services industry as a whole. The arrival of new institutions, so-called “BigTech firms,” may do so, however.

By BigTech institutions we mean firms like Alibaba and Tencent in the People's Republic of China (PRC); Amazon, Google, and Facebook in the US; Uber in Europe; and Grab in Southeast Asia. These companies did not start as financial services companies, but taking advantage of their vast networks of customers and the consequent huge amount of data generated by the actions of these customers, they have entered into the financial services business. In advanced economies their activities have so far focused mainly on payment services, but in emerging and developing markets they also offer lending, insurance, and asset management products (Financial Stability Board 2019).

BigTech companies are a source of numerous direct benefits for consumers, especially in emerging and developing economies where they have contributed substantially to the financial inclusion of previously unserved segments of the populations. Particularly important has been their engagement with small and medium-sized enterprises (SMEs), which traditional financial institutions have not served adequately. Particularly in lending, BigTech firms can use their wealth of data on payments and receipts of SMEs to assess creditworthiness and hence be in a better position to grant loans.

BigTech companies are also a source of indirect benefits for consumers by providing technology infrastructure to traditional financial institutions, and by encouraging innovation, diversification, and efficiency.

With their size and their extensive customer base and access to customer information, BigTech companies constitute a competitive threat to traditional banks that goes beyond that of FinTech start-ups. While incumbent financial service providers can and do replicate many of the innovations of FinTechs, it is much more difficult to replicate the business model of BigTech because of the advantages the latter can extract from their vast information database on just about all aspects of their customers' behavior.

Hence it does not come as a surprise that incumbent firms view BigTech companies as a major competitive threat (Bank for International Settlements 2019 and CCAF 2020).

## **2.4 Financial Stability Impact and Required Regulatory Response**

Financial liberalization and financial innovation have traditionally preceded stresses in the financial system. The title of an article published in 1985 by the eminent Latin American economist Carlos Diaz-Alejandro is telling. Describing the experience of some Latin American economies in the late 1970s and early 80s he chose to entitle his article “Good-bye Financial Repression, Hello Financial Crash.” This title also describes the chain of events that led to the financial crisis in Scandinavia in 1991–1992, and with some adjustments to the Asian financial crisis in the late 1980s and the North Atlantic crisis of 2008–2009.

The basic mechanism is as follows. Financial deregulation and financial innovation create opportunities to expand credit extension and engage in new financial ventures without adequate understanding and appreciation of the underlying risks. The extension of credit leads to economic expansion, which makes the increased debt burden of the borrower seem tolerable, and the riskiness of new financial products is not well understood because, by definition, there is no or very little past data to guide decisions. The result is overextended borrowers and over-leveraged lenders, and when the tide turns, turmoil and even havoc ensue.

What does this have to do with digital transformation of finance? There are several possible reasons why financial stability may be at risk. The emergence of new types of institutions providing financial services is akin to financial liberalization, as some of the activities of these institutions lie outside the perimeter of the regulatory system. Innovations brought by FinTech and BigTech include the introduction of products whose risk characteristics are not well known and which can have systemic stability consequences. For example, rapid growth of P2P lending by FinTech firms may in some jurisdictions lead to an increased incidence of nonperforming loans in the absence of a robust regulatory response. Indeed, according to the survey by the Cambridge Centre for Alternative Finance on practices in ASEAN economies, a number of activities of FinTech companies are unregulated. In addition, greater competitive pressures, particularly from BigTech firms, may reduce the franchise value of incumbent institutions, inducing increased risk taking on their part.

Machine learning and artificial intelligence may also amplify systemic risk as risk management functions in financial institutions are employed to optimize compliance with the existing regulatory framework. If the optimization algorithms lead to solutions that are similar across institutions, the result may be a financial system that is increasingly procyclical when shocks materialize (Danielsson, Macrae, and Uthemann 2017).

Similarly, if a number of traditional financial service providers rely significantly on a small number of BigTech firms to provide technological solutions to some of their business processes, a type of single-point-of-failure risk may materialize for a large number of the traditional firms.

Regulators must be vigilant and ready to adapt to the new financial landscape. New entrants that are not yet included in the perimeter of the regulatory system must be monitored, and potential systemic consequences of new sources of risk to individual institutions must be continuously assessed. As some activities of unregulated institutions are indistinguishable from the same activities in regulated institutions, there is a risk of regulatory arbitrage taking place. It is therefore imperative that regulatory frameworks be adjusted to focus on activities rather than on institutions.

### **3. DIGITAL TRANSFORMATION OF THE PAYMENT SYSTEM**

Payment systems have evolved and digitization has been an important contributor. Transfers are now more rapid as real-time gross settlement systems have been introduced in many jurisdictions for wholesale payments and fast payments for retail transactions are becoming more common.

The decreased cost of cross-border transfers has been noted as one of the important potential benefits of using financial technology. This is the case in particular for the cost of remittances. According to World Bank data quoted by the *Economist* (2019), in 2018 the average costs of sending \$200 through banks and FinTech firms were 8% and 4%, respectively, with traditional money transfer firms lying in between. These differences lead to huge benefits for countries like the Philippines where remittances amount to close to 10% of GDP.

Financial technology applied to payments has also contributed significantly to financial inclusion, whereby formerly nonbanked individuals and households have not only been able to carry out transactions via mobile phones, but also access simple financial services in the form of placing deposits and receiving loans.

The systemic financial stability risks of the entrance of FinTech companies operating in the payment system are modest as long as their operations are limited to facilitating transactions, and as long as they do not constitute a substantial portion of the overall payment system. If payment innovators use their position to enter credit extension activities this benign state of affairs may change, particularly if they remain unregulated as lenders. As noted above, if they encroach on the credit extension business of traditional financial intermediaries, the franchise value of the latter may be threatened, inducing them to pursue riskier lending to preserve their market share. As with the entrance of BigTech companies in the credit extension business, regulators will need to monitor payment innovators and regulate them on an activity basis rather than on an institutional basis.

While FinTech payment companies do not constitute a threat to the business model of banks, another innovation made possible by advances in technology might: cryptocurrencies. The threat is not from the current collection of privately issued cryptocurrencies such as Bitcoin and the like. These should not be considered money in the conventional sense of being units of account, means of payment, and stores of value. They are speculative assets, and as such they do not encroach significantly on intermediation activities of banks and other financial institutions. The Libra project floated by Facebook could have had an impact on the structure of banking, not principally through its role as a payment vehicle but rather as a means for Facebook to enter the financial services industry providing deposit, lending, and asset management facilities.

Unlike Bitcoin and other similar cryptocurrencies, Libra promised to maintain a stable value relative to a government fiat currency or a basket of such currencies. This

constitutes its fatal flaw, because we have learned from countless efforts to fix currency values that success in doing so requires holding inventories of the fiat currency that are at least as large as the outstanding stock of the Libra. Combined with the unreceptive attitude of central banks and regulators towards the project, the threat from Libra to banks is not likely to be significant.

A threat to bank intermediation could, however, come from crypto-, or digital, currencies issued by central banks, so-called “Central Bank Digital Currencies,” or CBDCs. These are digital means of payments guaranteed in value by the central bank in terms of the domestic fiat currency. The central bank can live up to this promise because it is the issuer of the domestic currency. The CBDC can take one of two forms: a token-based form that is issued by the central bank but managed by the banking system, or an account-based form whereby individuals would have accounts with the central bank denominated in the CBDC. It is the second form that could lead to substantial challenges for the private sector intermediation system. Since accounts with the central bank would be less risky than accounts with commercial banks, there is a risk that such a system would lead to disintermediation of the banking system. For this reason, it is likely that the implementation of any CBDC would be a token-based model.

## **4. MACROECONOMIC CONSEQUENCES OF DIGITAL TRANSFORMATION**

Digital transformation is also taking place in the nonfinancial sectors of the economy. Industrial robots are increasingly used in manufacturing, online commerce has been growing rapidly, globalization of production chains has upended traditional production processes, etc.<sup>3</sup> These changes have important implications for how we should think about prospects for economic growth and for the sources and consequences of macroeconomic fluctuations and what the appropriate policy responses should be. In this section we discuss each of these issues in turn.

### **4.1 Will Digital Transformation Bring about a New Industrial Revolution?**

The conventional way to think about economic growth is in terms of a relationship between the economy’s output per capita and inputs such as physical and human capital per capita on the one hand and a residual that captures the state of the available technology, broadly defined, on the other. Economic growth in this framework can come about through investment in physical and human capital in excess of population growth and technological progress.

In a balanced growth environment where investments are just enough to equip the growing labor force with the existing amount of capital and skills, growth will come about exclusively through technological progress, or “total factor productivity” as it is called in the technical literature. The issue of whether digital transformation will bring about a burst of economic growth then hinges on its effect on this total factor productivity.

Nobel Laureate Robert Solow famously said about the effect of computers on economic growth that “[y]ou can see the computer age everywhere but in the productivity statistics,”

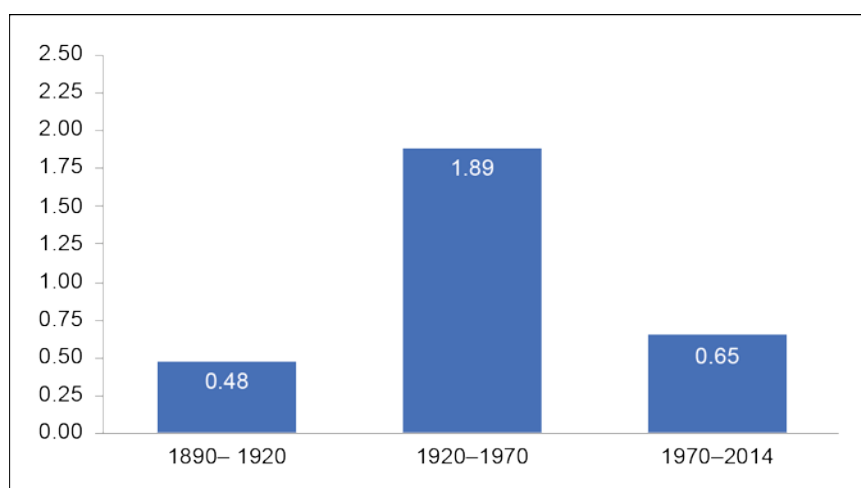
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<sup>3</sup> The importance of global production chains, and the disruption that ensues when the chains are damaged, is being demonstrated all too clearly as this is being written (March 2020) in the midst of the Coronavirus pandemic.

suggesting that early digitalization did not lead to measurable increases in growth (Solow 1987). Could it be that the effects of more recent developments in robotics, autonomous vehicles, and internet availability will also fail to show up in productivity statistics?

One of the proponents of this view is Robert Gordon, who points to the decline in total factor productivity (TFP) growth in the United States since 1970 to less than 1% per year, following the historically high growth rate of close to 2% during the 50 years from 1920 to 1970 (Figure 2). According to Gordon, the strong TFP growth in that period was the consequence of the application of electricity in manufacturing, transport, and communication, the internal combustion engine, and devices such as the telephone and the radio, and to the increasing availability of running water and sewage that improved health and longevity.<sup>4</sup>

**Figure 2: Average Annual Growth Rates of Total Factor Productivity**



Source: Gordon (2015).

Gordon's views have not gone unchallenged. According to some authors, digital transformation of the entire economy, not just the financial sector – industrial robots, self-driving cars and trucks, “the internet of things” – driven by AI has the potential to increase productivity far beyond what we have seen in the recent past.<sup>5</sup>

According to this view, a number of features of the current wave of digital transformation are said to be different from past ICT developments and will therefore have a greater effect on productivity and well-being. First, much of the current digital transformation is about the production of ideas rather than the production of goods. Furthermore, ideas are public goods, and because a large proportion of them are shared on the internet, their reach is global and available for anyone to build on and improve. Networks of innovators can be formed, and the shared knowledge and progress will be much more rapid and widespread, spurring additional ideas. Second, many of the internet-based services that have great value (e.g., online shopping, online translation) are available free of charge and are therefore not measured in GDP and hence in productivity statistics even though they are of great value.

In contrast to these optimistic scenarios, the easy scalability of digital transformations may contain seeds whose effects are less benign. Combined with large setup costs and

<sup>4</sup> For a comprehensive treatment, see Gordon (2016).

<sup>5</sup> See, for example, Brynjolfsson E. and A. McAfee (2014).

very low marginal costs of expansion, it is possible that concentration and market dominance will emerge. That in turn could lead to increased inequality and reduced motives for innovation.

I will not attempt to evaluate which of the two views of the future of growth will prevail.<sup>6</sup> Instead I will briefly discuss what the potential consequences could be for macroeconomic stability and stabilization policy, the principal objective of this paper.

Stabilization policy is by definition concerned with short- to medium-term fluctuations in economic activity around its longer-run potential path. If the longer-run path is uncertain, so will be any measure of the deviation therefrom. If monetary and fiscal policies are calibrated to erroneous measures of economic activity gaps, the resulting policy stance will be inappropriate.

A related issue concerns modeling, and particularly standard modeling of inflation. The conventional approach is to relate inflation pressures to some measure of slack in the economy, usually measured by an output gap measure. Could it be that difficulties encountered in explaining inflation are due to difficulties in measuring the relevant output gap?<sup>7</sup> More research on these issues is warranted.

## 4.2 Global Value Chains, the Phillips Curve, and Monetary Policy

This is being written as the Coronavirus pandemic is ravaging the globe. The economic fallout of the pandemic and the measures taken in attempts to contain it have brought home how immensely interwoven a country's different economic regions and sectors are. A manufacturing firm in one region has to curtail its operations because it cannot obtain the required parts that are produced by another firm in another region. As a consequence, our firm is unable to ship its products that are crucial for the assembly of the final product, which is carried out in yet another region by yet another firm.

Replace regions in this example with countries in the global economy and we have a description of global value chains (GVCs). The importance of these GVCs has increased over time as digitalization has facilitated fragmentation and outsourcing of production to take advantage of different comparative advantages across economies and economies of scale in production. As illustrated in Figure 3, the importance of GVCs increased steadily during the period from 1970 to the great financial crisis, after which it declined somewhat.

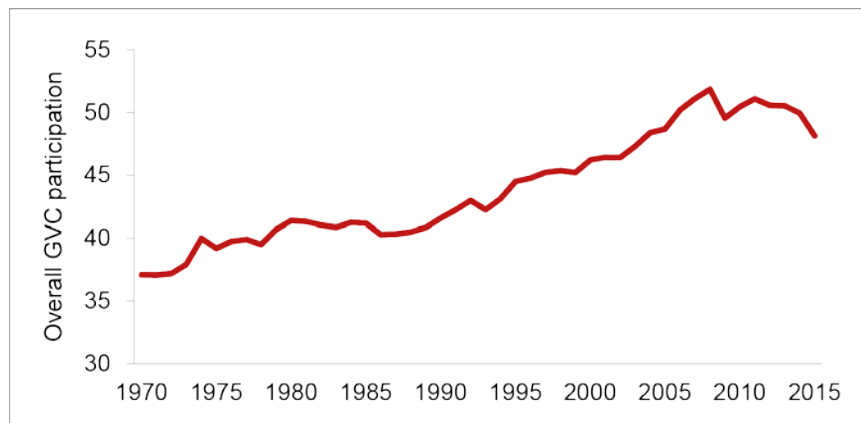
The implications of production chains, and global value chains in particular, is that they tie regions and economies more closely together. A dislocation in supply in one part of the chain, a supply shock, will propagate throughout the system causing a decrease in output in the system as a whole, be it the entire domestic economy in the case of domestic supply chains or the world as a whole in the case of GVCs.

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<sup>6</sup> Making any long-term economic predictions is notoriously difficult, but it is perhaps particularly hazardous when it involves new technologies. Many embarrassing quotes can be mentioned, but one of the classics is attributed to *Ken Olsen, founder of Digital Equipment Corporation, who in 1977 allegedly opined that "[t]here is no reason anyone would want a computer in their home."*

<sup>7</sup> Remember that one of the consequences of digital transformations in the economy is that GDP is a flawed measure of economic activity.

**Figure 3: The Evolution of Global Value Chains\***  
(%)



\* The chart measures “GVC participation,” which is defined as the share of world exports that flow through at least two borders.

Source: World Bank (2020).

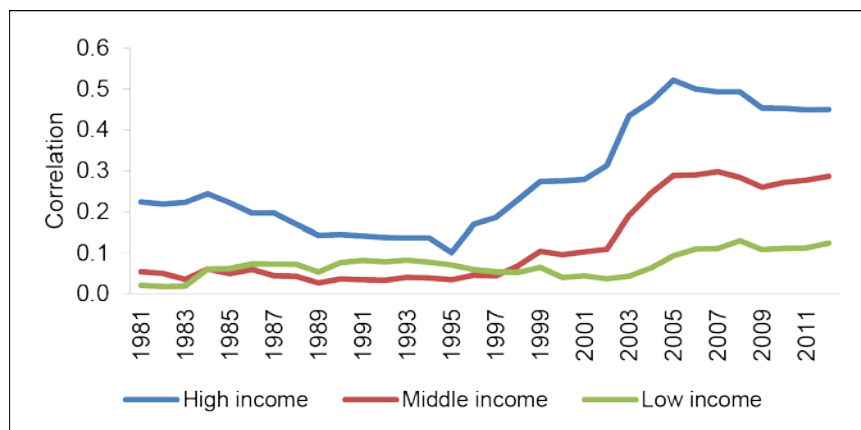
Likewise, an increase in demand for the final output will propagate throughout the production system as the demand for intermediate inputs will increase.

Price developments will also become more global, as the price of the final output will depend not only on the cost of production locally but on the additions to cost throughout the value chain. Inflation rates will become more closely linked across economies.

Data on linkages across economies are consistent with these predictions. Figures 4 and 5 show the correlations of business cycles and inflation rates, respectively, across countries. For high-income countries in particular, the increase in these correlations is similar to the increase in GVC participation shown in Figure 3.

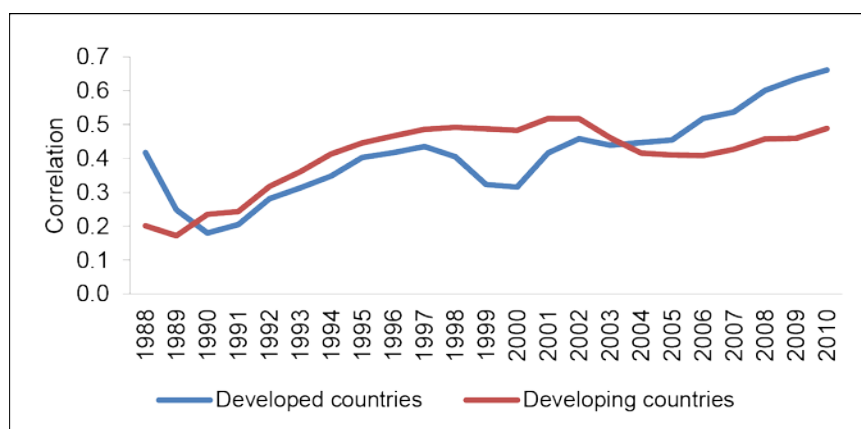
Statistical work presented in the World Bank’s 2012 World Development report lends some formal support to the visual impressions in the graphs. Country pairs that have greater trade connectedness also have higher correlations of business cycles and inflation (World Bank 2020, Chapter 4).

What are the implications for macroeconomic stability and macroeconomic stabilization policies? The most obvious is that greater connectedness means that policy spillovers will be stronger, making some form of policy consultation between country authorities more desirable. To some extent this is already taking place in fora such as the G20, the BIS, and the IMF. While formal policy coordination may not be achievable because authorities in every country are accountable to their own constituents, some tacit agreement to proscribe policies that directly harm others, so-called “beggar-thy-neighbor policies,” would be desirable.

**Figure 4: Correlation between Business Cycles\***

\* Each year represents the midpoint of a 10-year moving window. Each line represents the average of all detrended country-pair GDP correlations, taken over all country pairs containing at least one country in the income group considered (high, middle, and low).

Source: World Bank (2020).

**Figure 5: Correlation of CPI Inflation Rates\***

\* Note: For each country, the correlation is measured between domestic and world inflation. An average is then taken across two income groups separately. Each year represents the midpoint of a 15-year rolling window.

Source: World Bank (2020).

At the national level, the increased importance of GVCs appears to have changed inflation dynamics. A study by Auer, Borio, and Filardo at the BIS indicates that as GVCs have increased in importance, the role of the domestic output gap in domestic inflation has decreased, and the role of a measure of a global output gap increased (Auer, Borio, and Filardo 2017). There are also studies suggesting that the Phillips curve has become flatter, i.e., that the coefficient on domestic economic slack (or overheating) in an estimated inflation equation has become smaller (See, for example, Carney 2017). If this last finding is indeed a feature of the new economic structure central banks are facing, it begs the question as to how they can hope to implement inflation targeting strategies successfully.



## **5. REFLECTIONS ON THE POSSIBLE IMPLICATIONS OF THE CORONAVIRUS PANDEMIC**

As already noted, this is being written in the midst of the 2020 Coronavirus pandemic that has created unimaginable human suffering and great economic upheaval. As it unfolds, it is hard to imagine that the world will return to what it was only half a year ago. In this final section I will look at only a small corner of this very broad and important question. Specifically, I will make two brief remarks on how the analysis and conclusions in this paper could be affected by this momentous experience.

A salient feature of the digital transformation of finance is that virtual AI-assisted financial intermediation is challenging financial intermediation and payment services that are based on personal contacts. The social-distancing behavior that has been mandated or highly recommended during the pandemic increases the competitive advantage of the virtual business model. Entities that have a very broad access to potential customers, either through their social media presence or their internet-based commerce engagement, will be particularly strongly positioned to expand in this environment. These are the BigTech firms.

I have already suggested that, because of their ability to take advantage of scale, there is a risk of greater concentration in the financial intermediation industry, and hence a greater risk of monopoly pricing, cybersecurity challenges, and too-big-to-fail problems. Regulatory authorities must be vigilant and make sure that the financial services activities of these firms are appropriately regulated.

The discussion on the macroeconomic stability effects of digital transformation focused primarily on the consequences of increased interconnectedness brought about by production chains, both regional and global. Some of the economic havoc brought about by the Coronavirus pandemic is the result of this interconnectedness. The business case for some fragmentation of production processes will certainly remain, but one cannot rule out that there will be some retrenchment. This may give back some of the effectiveness of domestic economic policies lost to global influences, but it would also reduce some of the benefits from trade, which would be particularly painful for small trade-dependent developing and emerging economies.

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