CHAPTER 2

DIGITAL GOVERNMENT

Digitalization presents both opportunities and risks for fiscal policy. It has the potential to improve the design and implementation of fiscal policy, but it also creates new challenges. This chapter first analyzes improvements in policy implementation with illustrative examples on tax compliance and spending efficiency. The analysis suggests that adopting digital tools could increase indirect tax collection at the border by up to 2 percent of GDP per year. In the future, digitalization could also help governments track down taxes on wealth sheltered in offshore financial centers, estimated at 10 percent of world GDP. On the spending side, country case studies show how digitalization can play a role in improving social protection and the delivery of public services. The chapter also discusses the design of future policy, focusing on the implications of the rapid expansion of digital firms whose business model—for example, sales with little physical presence and reliance on online customers to generate commercially valuable information—raises new questions about the allocation of international taxing rights. Finally, while digitalization offers many potential benefits, the chapter also discusses how it can create opportunities for fraud and increase government vulnerabilities—important challenges governments must address to reap its dividends.

Introduction

Digitalization—the integration in everyday life of digital technologies that facilitate the availability and processing of more reliable, timely, and accurate information—presents important opportunities and challenges for fiscal policy.

Expenditure and tax policies depend crucially on information about economic actors—their resources (such as income and wealth), their behavior (for example, labor force participation), and the transactions they make. This is true even after a policy is implemented because data on policy outcomes can inform future policy choices. However, relevant and reliable information is not always available or easy to use, constraining the design, implementation, and evaluation of tax and spending policies. At the same time, economic actors may not be able to access relevant information when interacting with public administrations, making it difficult to pay taxes, access services, and take up benefits, thus reducing the effectiveness of fiscal policy. In the extreme, nontransparent public institutions generate distrust, which is detrimental to economic growth and welfare.

With better information, governments can build better systems and design and implement better policies. More specifically, by reducing the collection and processing costs of information, digitalization can do the following:

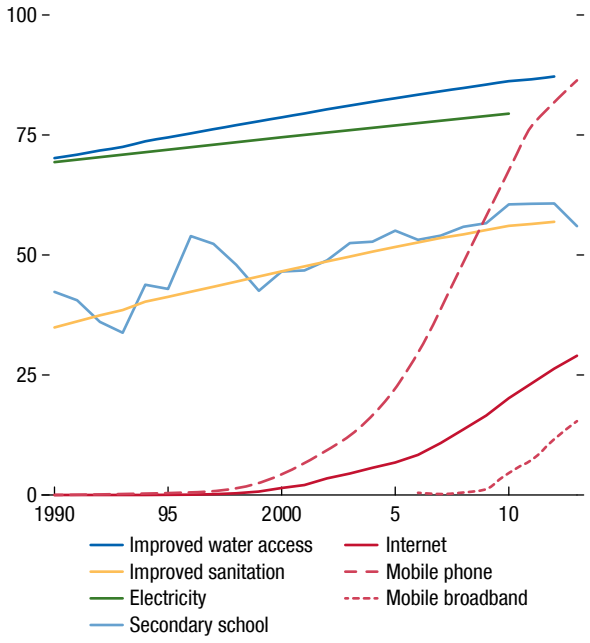
- *Improve the implementation of current policies.* Digitalization can reduce the private and public costs of tax compliance and improve spending efficiency. On the tax side, payments can be digitally facilitated and compliance could improve through greater access to taxpayer data. On the spending side, better identification and authentication systems, such as biometric technology, can reduce both leakages and the cost of reaching targeted populations. Digitalization can also enable improvements in governance and fiscal transparency, allowing better public awareness and scrutiny of the budget process.
- *Increase the range of policy options.* Greater access to information and enhanced digital capabilities open previously unavailable policy options to address new challenges. This includes, for example, the possibility of designing better domestic and international tax and spending policies for the digital economy.

However, although digitalization can reduce information barriers, it can also create challenges for the conduct of policy, requiring policymakers to:

- *Navigate unfamiliar territory*. Digitalization can pose a direct threat to tax collection and efficient spending by creating new fraud opportunities. Those intent on cheating can digitally tamper with information to hide or misrepresent themselves to the government. This includes the use of cryptocur-

Figure 2.1. Access to Public and Digital Services in Developing Countries
(Percent of population in developing countries with access to services)

The digital transformation is sometimes outpacing other services, such as secondary education.



Source: World Bank 2016.

rencies to accumulate wealth outside the reach of tax authorities or digital identity theft to illegally claim benefits. Privacy and cybersecurity can also become new sources of fiscal risks. Digital systems are vulnerable to cyberattacks, which can disrupt government functions and jeopardize citizens' digitally stored private information. Countries with weak administrative capacity or underfunded security systems will be particularly at risk. With new digital business models, firms with little physical presence in countries where they operate challenge the existing design of international taxation.

- *Overcome financing and capacity constraints*. Governments with limited fiscal space may find it difficult to mobilize resources to purchase digital tools and improve cybersecurity. Small businesses and vulnerable households can be left behind if they have little access to digital tools. Weak administrative and institutional capacity will be an obstacle to technological adoption.

This chapter examines both the opportunities and risks of digitalization. The next section describes recent trends in digitalization and documents how governments have used digital instruments for policymaking. The third section discusses how digitalization can improve the implementation of current policies, focusing on tax compliance and spending efficiency. The fourth section analyzes the design of future fiscal policies, highlighting the new challenges and opportunities of the fast-growing digital economy. The fifth section discusses what obstacles governments will need to overcome to mitigate the risks and reap the dividends of digitalization. This will require preventing new fraud opportunities, protecting privacy, ensuring digital inclusion, and building institutions and administrative capacity.

The chapter addresses the following questions:

- *How can digitalization help governments improve the implementation of current policy?* Can it help improve tax compliance in cross-border transactions and achieve greater spending efficiency through better coverage of income-support programs?
- *How can digitalization widen the range of policy options?* For instance, how can policy address corporate income tax and social insurance challenges posed by the (increasingly) digital business models?
- *What are the risks associated with digitalization?* What are the lessons from country experiences in addressing the challenges of digitalization?

The chapter uses various approaches to support the analysis, bringing together insights from existing literature, new analytical work, country case studies, and lessons from the IMF's capacity development work.

The Digital Transformation of Governments

Digital technologies have spread rapidly in much of the world. The number of Internet users worldwide has more than tripled in a decade—reaching 3.2 billion at the end of 2015—and is expected to rise further. More households in developing countries now have access to digital technology, such as the Internet and smart phones, than have access to secondary school or clean water (Figure 2.1).

This digital transformation has meant that individuals, firms, and governments are now more connected, making information more available and accessible than ever before. Vast improvements have occurred

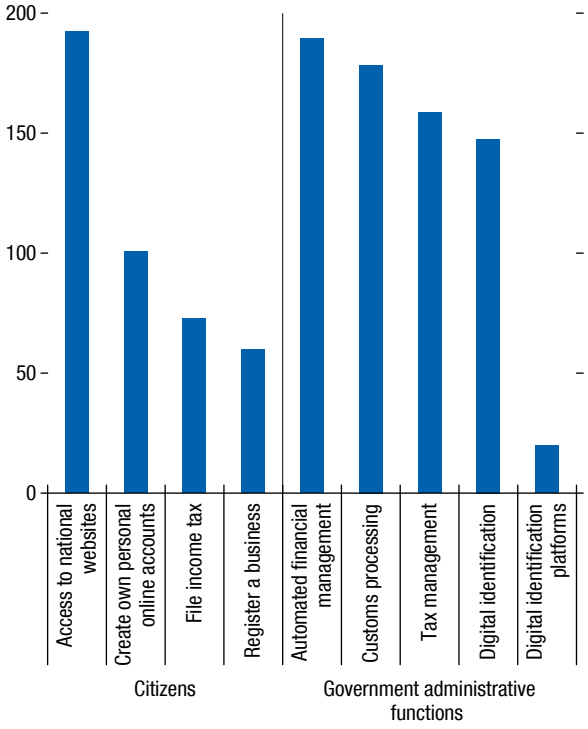
in collecting, processing, tracking, and disseminating information over the past two decades. At the turn of the century, only one-quarter of data were stored in digital form, and in less than a decade, the ratio rose to more than 95 percent in 2010 and has continued to rise (Ross 2016).

Governments are increasingly turning digital. Almost all country governments now have national websites and automated financial management systems (Figure 2.2). Greater availability and access to timely and reliable information are shaping how they conduct fiscal policy, affecting both revenues and expenditures:

- *Tax policy and administration.* Digitalization allows tax authorities to offer electronic tax filing, prepopulate tax returns, and verify customs and business activity (for example, through electronic invoicing). These advances could improve tax compliance and enforcement by reconciling payment differences, monitoring real-time revenue collection, performing audits, and using big data to assess taxpayer risks. At the same time, information from electronic transactions can be used to validate tax collections, for example, value-added tax (VAT). Electronic filing and payments have on average reduced tax-filing time by 25 percent in the five years after a digital system was introduced (World Bank 2016).
- Some countries have made substantial efforts to digitalize their tax administration. In South Africa, the use of electronic tax submissions, customs declarations, and payments has risen from below 20 percent to close to 100 percent over the past decade, following efforts to modernize and automate administrative processes in tax administration. In Estonia, tax administrators have used big data to identify high-risk and anomalous behavior of taxpayers to improve compliance (see Box 2.1 for a discussion of digitalization reforms in South Africa and Estonia). In China, the increasing use of electronic receipts has helped tax administrators authenticate and process tax rebates in the VAT (Fan and others 2017). Digitalization can also support the administration of property taxes. Distributed ledger technology can securely maintain databases for land registries (He and others 2017). Digital mapping technologies have been used successfully in Greece and the United States and offer promising avenues for property taxation in developing economies (see Box 2.2). Improvements in digital technology have facilitated the global exchange of information, possibly reducing cross-border trade fraud and expanding the tax base. One notable example is that it may now be more difficult for those sheltering income and wealth in low-tax jurisdictions—a tax base previously out of reach for governments—to evade taxes (see the section "What governments can do now: Same policies, better implemented").
- *Public spending and financial management.* Digitalization can improve financial management and ultimately the efficiency of public spending. Digital tools can improve the quality and delivery of public services, such as communicating with beneficiaries and monitoring public servants. Mobile technology and the associated lower communication costs have helped governments disseminate crucial information on health and

Figure 2.2 Government Digitalization
(Number of countries with selected digital services)

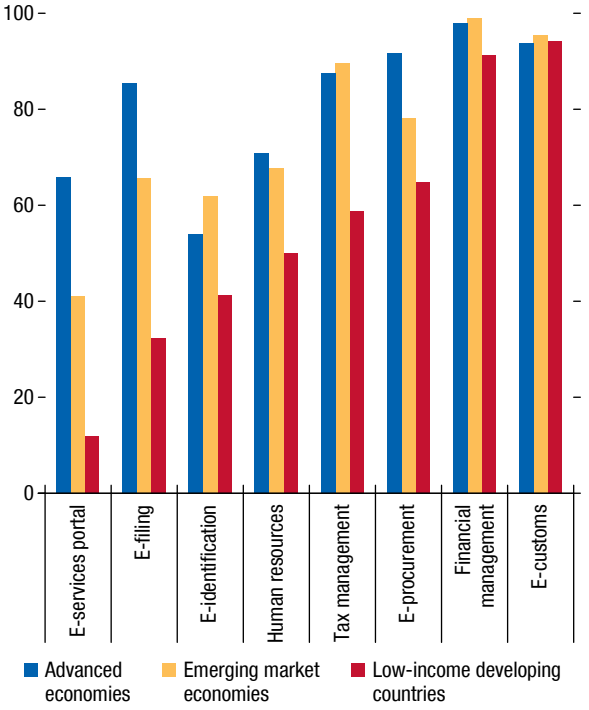
Governments are increasingly turning digital.



Sources: United Nations e-Government Survey 2016; and World Bank 2016.
Note: The United Nations tracks 193 member countries for the adoption of digital services.

Figure 2.3. Selected Areas of Government Digitalization
(Percent of total number of countries)

Digitalization is on average less common in low-income developing countries.



Source: World Bank 2016.

agricultural practices.[1] In education, digital devices have been used to monitor teacher absenteeism.[2] In addition, electronic payment systems have helped reduce fraud and corruption and have facilitated the distribution of social benefits (for a discussion of savings from digitalizing government payments, see Box 2.3). Governments have also deployed technology to manage the public sector wage bill, for example, using mobile technology to pay public sector employees to reduce leakages associated with cash payments (Lund, White, and Lamb 2017).

[1]See Aker (2010) and Aker and Blumenstock (2014) on the reduction in the costs of collecting and disseminating information with digital technology. Jiang and others (2014) and Flax and others (2014) provide evidence on the effect of using mobile technology to improve infant feeding practices, while Cole and Fernando (2016) find evidence on its effect on agricultural practices.

[2]Duflo, Hanna, and Ryan (2012) find evidence that digital monitoring can reduce teachers' absenteeism and increase student test scores.

Biometric technology to identify and authenticate individuals can help reduce leakages and improve coverage of social programs. With more than 1.2 billion registered citizens in India's biometric identification system, Aadhaar, the country stands out as a leader in this area.[3] Moreover, digitalization can facilitate stronger governance and fiscal transparency, allowing better public awareness and scrutiny of the budget process and the design of fiscal policy. In Korea, the web-based participatory budget system, D-Brain, encourages public participation in the budget system; in Brazil, daily fiscal data are available on the government's Transparency Portal (Chambers, Dimitrova, and Pollock 2012). Beyond transparency goals, high-frequency fiscal aggregates can enable real-time macroeconomic analysis (see Box 2.4).

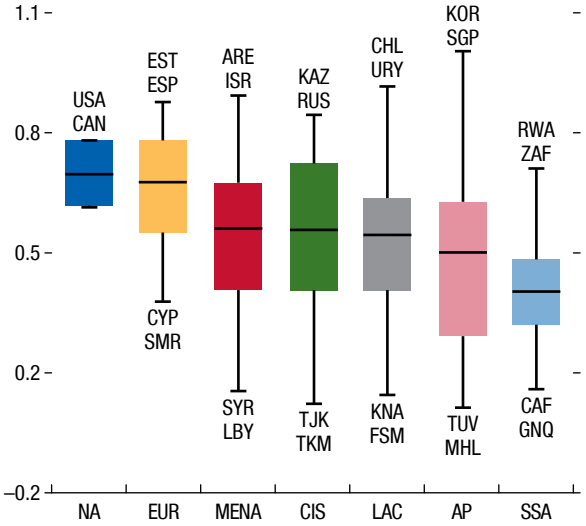
Economic size and the level of development do not perfectly predict digital progress. Developing countries on average score lower in government digital adoption than do advanced economies but stand on par in selected areas such as adoption of customs administration and financial management tools (see Figure 2.3). Governments in advanced economies have performed better on average in digital adoption, but many small or developing countries have taken the lead regionally, including Estonia in Europe, Chile in Latin America, Singapore in Asia, and Rwanda and South Africa in sub-Saharan Africa (Figure 2.4).

Country experiences demonstrate some challenges but also benefits of digital adoption. Greater potential benefits may be possible for developing countries. For example, biometric identification constitutes a technological leap over many paper-based systems; mobile devices save time given that they bypass the need for older technologies such as landlines and computers. Estonia, India, and Kenya have taken advantage of new technologies and pursued digital strategies that fundamentally affect the delivery of public services. India has applied digital tools in the distribution of social benefits, Estonia has demonstrated the benefits of an approach that affects its citizens' interactions with their government, and Kenya has leveraged the progress in financial inclusion to jump-start its digital government (see Annex 2.1 for

[3]The system provides citizens with a 12-digit unique identification number with demographic and biometric (fingerprint and iris scan) information.

Figure 2.4. Digital Government across Regions
(Digital Adoption Index for governments, latest available year)

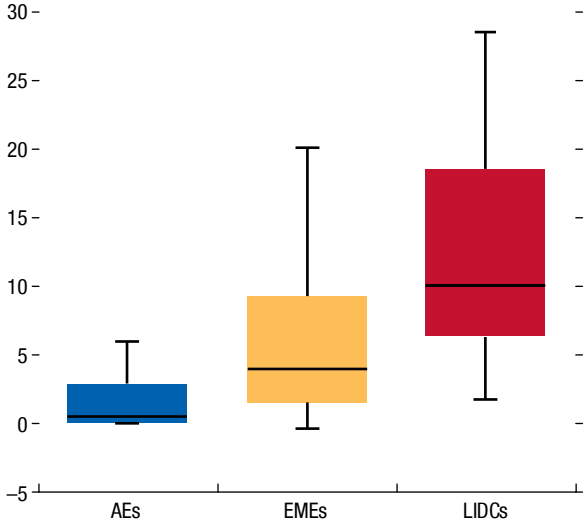
Many small or developing countries have taken the lead regionally in digitalization.



Source: World Bank 2016.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes; see "Country Abbreviations" for definitions. The World Bank's Digital Adoption Index measures the global spread of digital technologies for 171 countries. It provides a global picture of technology diffusion across businesses, people, and governments across countries. The government cluster is the average of three indices: core administrative systems, online public services, and digital identification. The countries listed are the top- and bottom-ranking countries in each region. AP = Asia and Pacific; CIS = Commonwealth of Independent States; EUR = Europe; LAC = Latin America and the Caribbean; MENA = Middle East and North Africa; NA = North America; SSA = sub-Saharan Africa.

Figure 2.5. Taxes on International Trade, 2015
(Percent of total revenue)

Trade-related taxes are an important source of revenue for emerging market and low-income countries.



Source: IMF, *World Economic Outlook*.
Note: AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

a discussion of these case studies). Their experiences suggest that countries can achieve significant benefits but only if the adoption of technology is well designed and implemented and accompanied by reforms to strengthen fiscal institutions.

What Governments Can Do Now: Same Policies, Better Implementation

Digitalization can improve how current policies are implemented. This section explores three examples. On the tax side, the analysis focuses on cross-border tax compliance problems—tax evasion associated with international trade and income and wealth sheltered in low-tax jurisdictions, issues that offer a useful perspective on digitalization. First, the digitalization of customs administration has been ongoing and offers the opportunity to analyze the cumulative impact of efforts that started some time ago. Second, serious efforts to collect tax on income sheltered in low-tax jurisdictions are relatively new but have gained momentum since the global financial crisis. On the spending side, this section discusses how digitalization can help improve access to entitlements and reduce leakages in income-support programs—key topics when considering public intervention to address poverty and equity concerns.

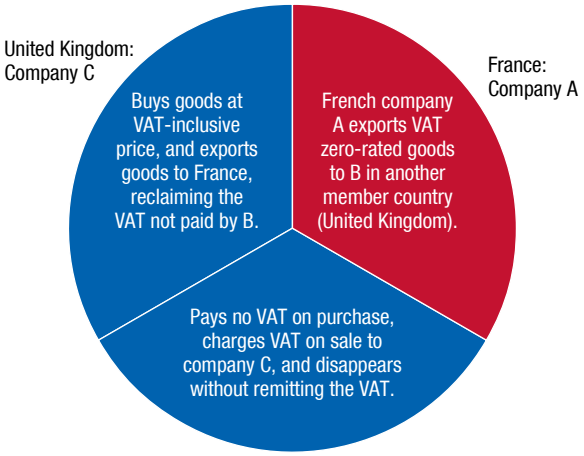
Improving Tax Compliance

Reducing Tax Evasion from Cross-Border Fraud

Could widespread use of novel electronic record technology eliminate trade fraud? Trade taxes still represent a nontrivial share of revenues—particularly in emerging market and developing economies where they constitute close to 10 percent of total revenues on average (Figure 2.5). Trade fraud can reduce customs, excise, and VAT collection at the border. Traders have clear incentives to underreport the value of goods to avoid tariffs, but VAT evasion can occur at the border as well. For example, missing

Figure 2.6. The Missing Trader and Carousel Fraud

These frauds exploit the VAT zero-rating of exports and deferral of tax on imports.



Source: Keen and Smith 2007.
Note: VAT = value-added tax.

trader intra-community fraud (also known as carousel fraud) exploits the zero-rating of export and deferral of tax on intra-EU imports that allows trading across member state borders to be VAT free. The fraud takes place when a company buys VAT-free goods from another EU Member State and sells the goods domestically, receiving the entire amount of the VAT, but then disappears without remitting this amount to the tax authority (Figure 2.6). As a result, this missing trader fraud incurs an estimated tax loss of EUR 45–60 billion to the EU annually (4–6 percent of VAT revenues).[4]

Digitalization can improve tax compliance by enhancing operational efficiency and the quality of information on trade transactions, particularly in customs unions that lack border controls. Information is crucial for collecting taxes and duties at the border—in particular, information about the product classification, volume, origin, and value of goods traded. This information is typically provided by importers and exporters, with a risk that they may misreport transactions to evade duties or taxes.

To verify information provided by importers and exporters, customs officers need access to third-party information—such as the exporter's commercial invoice, the shipping line's cargo manifest, or the bill of lading from a commercial bank. Direct access to accurate third-party information is facilitated by digitalization—it can help improve authenticity, accuracy, and completeness of information. Digital information is more resilient against manipulation than are paper documents and can facilitate the submission of *authentic* documents—for example, the shipping company can provide an electronically signed cargo manifest; the exporter's chamber of commerce can replace a paper submission with a direct electronic submission of the certificate of origin to the importing-country customs authorities. Blockchain technology could also help secure the authenticity of submitted information, given that all transactions are recorded—the initial submission, and all subsequent modifications.[5] Digitalization can also help secure the *accuracy* of reporting at the border. The analysis of historical customs transactions data—big data analysis—can enable tax administrations to discriminate more effectively between high- and low-risk declarations and to allocate their resources to prevent evasion more efficiently. However, although digitalization can significantly reduce problems related to authenticity and accuracy, obstacles remain when it comes to *completeness* of information, particularly when the trade payment involves credit and where the financial flows linked to the transaction do not sum up to the value of the goods.

Countries are already taking advantage of these methods. French customs are testing data mining methods, using big data to detect fraudulent taxpayer behavior. The Estonia Tax and Customs Board is implementing big data analysis to create risk profiles of tax payment transactions so that high-risk transactions—those with characteristics previously associated with fraud, anomalous behavior, or attributes compared to population norms—are more closely monitored (Box 2.1).

[4]See European Commission (2015) and https://www.europol.europa.eu/crime-areas-and-trends/crime-areas/economic-crime/mtic-missing-trader-intra-community-fraud.

[5]Blockchain is a list of secure, immutable records or blocks of electronic transactions stored cryptographically. The use of blockchain in customs administration remains limited so far. Some commercial banks that routinely issue trade documents are testing its application. Dubai Customs is exploring the use of blockchain for the import and re-export process of goods (Krishna, Fleming, and Assefa, 2017).

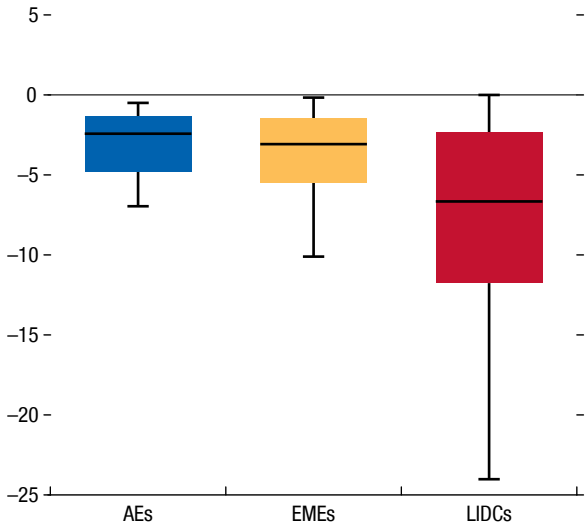
How large is cross-border trade fraud? Trade fraud leading to tax evasion can be proxied using discrepancies in trade statistics from the origin and destination countries.[6] In practice, the value reported by importers includes cost, insurance, and freight, and—in principle—should exceed the value reported by exporters that is free-on-board. This trade gap—the difference between these two reported values—provides a crude indication of trade fraud when unexplained by other factors such as valuation changes and trade-related costs. The median trade gap ratios across countries are significantly different from zero, ranging between –2.4 percent of GDP for advanced economies and –6.6 percent of GDP for low-income developing countries (Figure 2.7).

If digitalization reduces trade misreporting, it may help improve revenue collection. The analysis in Annex 2.2 reveals a strong positive association between improved digitalization indices and the trade reporting gap, suggesting a lower incidence of trade fraud when governments enhance information collection and processing through digitalization. This relationship remains significant after controlling for other key determinants, including tariffs and tax rates, the level of development, and governance. The effect points to significant potential revenue gains of digitalization from reducing trade fraud. Simulation analysis indicates that reducing the distance to the digitalization frontier by 50 percent could raise the median VAT revenue by 1.7 percent of GDP for low-income developing countries, 1.0 percent of GDP for emerging market economies and advanced economies, and 0.5 percent for the EU (Figure 2.8, panel 1). Similarly, median tariff revenue could increase by 0.5 percent of GDP for low-income developing countries, 0.3 percent of GDP for emerging market economies, and 0.06 percent of GDP for advanced economies (Figure 2.8, panel 2). These results are only indicative of potential revenue gains because reducing the distance to the digitalization frontier is likely to require significant fiscal resources and the removal of institutional barriers.

[6]Existing studies in this area typically follow the approach suggested by Fisman and Wei (2004), identifying evasion based on a correlation between tax or tariff rates and reporting discrepancies between importers and exporters (see also Javorcik and Narciso 2008; Mishra, Subramanian, and Topalova 2008; Ferrantino, Liu, and Wang 2012; Kellenberg and Levinson 2016).

Figure 2.7. Trade Gap Ratios, 2016
(Difference between importer and exporter reported values in percent of GDP)

Trade misreporting is more prevalent among developing countries.



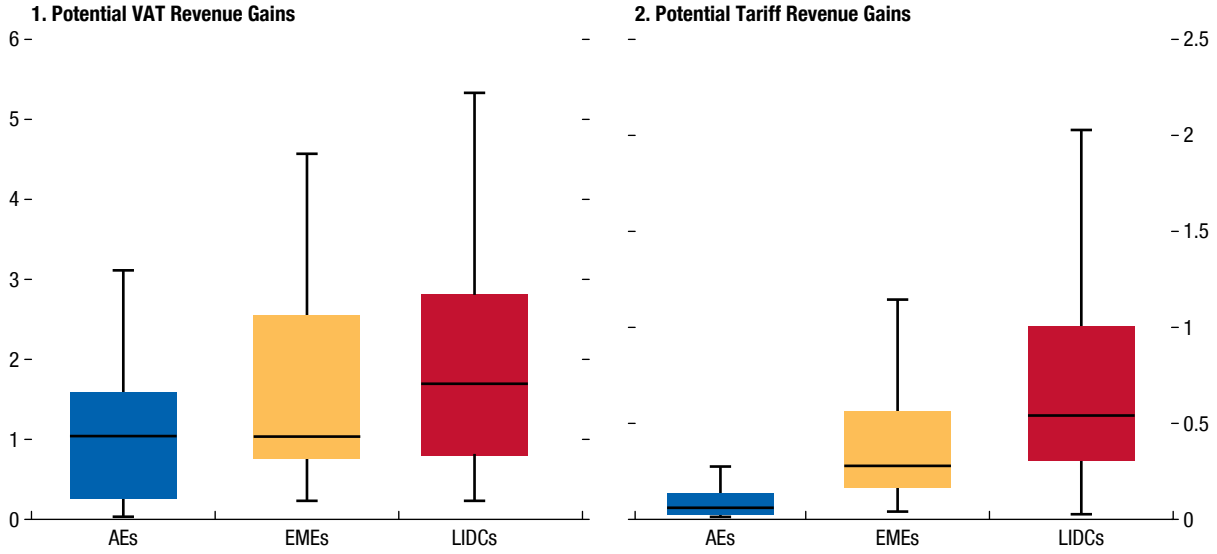
Sources: IMF, *Direction of Trade Statistics*; IMF, *World Economic Outlook*; and IMF staff calculations.
Note: The figure presents negative trade gaps as indicative proxies of trade misreporting. AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

Curbing Revenue Losses from Personal Income and Wealth Sheltered in Low-Tax Jurisdictions

In addition to increasing collection from existing tax bases, digitalization could also unlock revenues from new sources. Offshore financial wealth—as a share of overall financial wealth—has grown substantially over the course of the past century (Figure 2.9). Much of this growth occurred simultaneously with the introduction of personal income taxation in several advanced economies. However, in recent decades, digitalization has facilitated the expansion of financial transactions and capital flows through offshore financial centers for tax sheltering purposes. In addition, greater use of cryptocurrencies, as well as fintech—digital technology for the delivery of financial services—may enable new banking platforms that escape the conventional concept of domestic jurisdiction and spur further growth of financial transactions at the margins of traditionally regulated onshore financial systems. At the same time, financial opacity has increased with the complexity of available instruments and channels used to manage financial

Figure 2.8. Potential Revenue Gains from Closing Half the Distance to the Digitalization Frontier, 2016
(Percent of GDP)

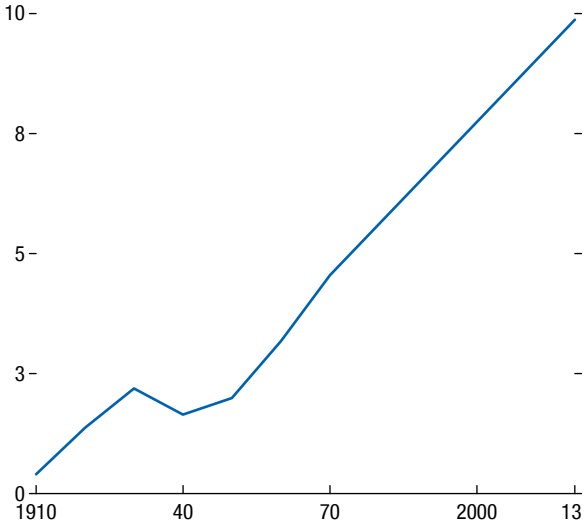
Potential VAT and tariff revenue gains from digitalization are substantial, particularly for lower-income countries.



Source: IMF staff estimates.
Note: The panels in the figure show gains from reducing the distance to the digitalization frontier by 50 percent. AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries; VAT = value-added tax.

Figure 2.9. Estimated Wealth of Europeans in Low-Tax Jurisdictions
(Percent of the financial holdings of European households)

The share of European financial wealth held in low-tax offshore jurisdictions has grown dramatically over the course of the twentieth century.



Source: Zucman 2015.
Note: The figure includes 34 European countries.

portfolios (including, for instance, derivatives and shell corporations).

Tax authorities around the world have historically remained on the sidelines of this transformation, unable to capture this "buried treasure"—the large revenue potential these flows and asset holdings represent—largely because of the absence of information on ultimate taxpayers.[7] To enforce existing tax legislation, national authorities need to know the owners, size, type, and location of offshore assets, information that ultimately requires bilateral exchanges across national borders. Until recently, a lack of comprehensive, timely, and standardized information about who owned what and where and the means to exchange this information internationally made tax collection on these assets practically impossible.

[7]Although corporations (especially multinationals) may and often do use foreign subsidiaries in offshore financial centers to engage in tax avoidance practices, associated international capital flows will generally be recorded in each relevant country's balance of payments accounts. In contrast, this section restricts its focus to wealth and income flows sheltered by individuals in offshore financial centers for tax evasion purposes; it is in the latter case that tax authorities could most tangibly benefit from improved exchange of information.

However, unprecedented changes have occurred over the past few years. In 2014, the new global standard for automatic exchange of information was created by the Organisation for Economic Co-operation and Development (OECD) and the Group of Twenty (G20) to reduce the possibility of such tax evasion. Participating jurisdictions send and receive digital information on nonresident financial accounts without the need to send a specific request—a process whose viability has been enhanced by recent developments in information and communication technology (ICT), especially in the efficiency and security of data collection and its transmission. Automatic exchange of information on the financial accounts of nonresidents across countries requires standard digital formats for data recording, substantial computing power, and secure networks for the encryption of transmitted data and access protection.[8] Taking advantage of these developments, as well as of renewed political will to combat tax evasion after the global financial crisis, the OECD's Global Forum on Tax Transparency and the G20 pushed for the creation of a Common Reporting Standard in 2014, which enables the automatic exchange of information.[9]

Could digitalization and the resulting improved exchange of information raise the potential revenue gains from personal income and wealth traditionally sheltered in low-tax jurisdictions? The existing literature suggests that a sizable portion of assets is held in low-tax jurisdictions—as much as 10 percent of the world's GDP (Zucman 2015; Alstadsaeter, Johannesen, and Zucman 2017). This section draws on individual estimates of wealth sheltered in low-tax jurisdictions in 178 countries using anomalies in global investment statistics and information on non–bank sector deposits held in offshore financial centers in 2016 (for details, see Annex 2.3).[10] The analysis suggests the following:

- *Assets held in low-tax jurisdictions are large across all country income groups*. Residents from countries across all income groups are estimated to have substantial offshore wealth, between a median of 7.6 and 10.7 percent of GDP (Figure 2.10, panel 1).
- *Current policy choices, administrative capacity, and political capture limit potential revenue gains*. Although the relevant taxable income base is potentially large, expected revenue gains are substantially lower and concentrated in advanced economies where applicable tax rates are higher on average. The estimated maximum potential tax revenue from offshore assets amounts to median tax revenue of a little more than 0.1 percent of GDP, compared with a median of 10 percent of GDP for the tax base (Figure 2.10, panel 2).[11] This is partly because of current policy choices—assuming a return on financial assets of 8 percent per year,[12] effective tax rates on wealth and the associated capital income flow from such a return average only 1.8 percent (see Annex 2.3).[13]

[8]The exchange of information usually takes place between two countries' portals over a secure network. Standard digital formats and strict data protection rules are essential for the efficient use of automatic exchange of information, and the OECD continues to develop standards for automatic exchange. High costs of ICT solutions have been frequently identified as one of the most challenging challenges for implementation of the automatic exchange of information (Global Forum on Transparency and Exchange of Information for Tax Purposes 2014).

[9]The international exchange of information network has expanded significantly to include many offshore financial centers. As of 2014, for example, the Cayman Islands, Jersey, and the British Virgin Islands had more than 200 exchange of information relationships, up from fewer than 20 in 2008. In 2017, the first exchanges under the Common Reporting Standard on Automatic Exchange of Information took place for nearly 50 jurisdictions, and with 50 more to follow in 2018. As of January 2018, there were more than 2,600 bilateral exchange relationships under the multilateral competent authority agreement. Furthermore, all major offshore financial centers have joined the Multilateral Convention on Mutual Administrative Assistance in Tax Matters, and committed to the Common Reporting Standard, starting at the latest in September 2018.

[10]Annex 2.3 presents alternative ways of estimating offshore wealth as robustness checks.

[11]The Global Forum has compiled estimates of tax revenue collected because of exchange of information requests in a few countries, such as Sweden and Australia (OECD 2014). Such estimates are about 0.02 percent of GDP, lower than those presented here—necessarily so, given that exchange of information upon request relationships are a subset of the multilateral automatic exchange of information network now being implemented.

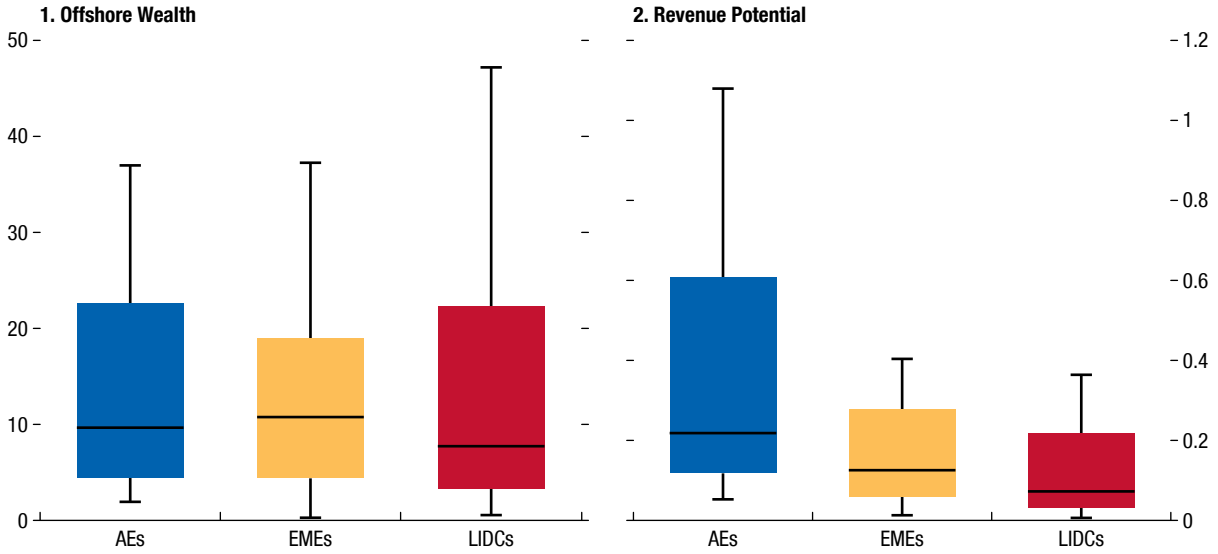
[12]The assumed rate of return is based on the 10-year returns on Vanguard diversified funds as in Zucman (2015). Halving this rate would reduce the effective tax rate from 1.8 percent to 1.2 percent.

[13]Although not explicitly modeled here, administrative and political constraints can also limit revenue potential. First, tax collectors and administrators can have the bargaining power to resist reform and can extract revenues from inefficient or even illicit tax practices for private gain. To these groups one can add politicians and officials involved in setting tax policy (Moore 2013). Second, many tax authorities still make insufficient use of advanced tax administration practices (Bräutigam, Fjeldstad, and Moore 2008; Okello 2014).

Figure 2.10. Offshore Wealth and Revenue Potential, 2016
(Percent of GDP)

Estimates of offshore financial wealth are substantial for countries across all income groups.

Under current policies, estimated potential tax revenue from offshore financial wealth is comparatively small and concentrated in advanced economies.



Source: IMF staff estimates.
Note: AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

Digitalization—and increased taxpayer information—is no silver bullet in collecting (more) taxes but could go beyond improved compliance by reformulating current policies. First, increased taxpayer information could enable countries to collect labor and capital income taxes at the source before such earnings are transferred to low-tax jurisdictions. At the current (sample) average labor income tax rates of 30 percent, for example, this could significantly affect revenues. Second, this "new" tax base could incentivize governments to consider strengthening residence-based international taxation of individual shareholders, that is, imposing capital income taxation directly on shareholders rather than using territorial corporate taxation as a withholding tax for ultimate capital owners (Toder and Viard 2016; Gupta and others 2017). Countries could thus use residence-based personal taxation (including dividends, wealth, and inheritance taxes) to maintain effective taxation of capital as source-based corporate income tax rates continue to decline. Doing so may also be equity enhancing, insofar as such a base is most likely coming from individuals with a high net worth.[14]

The likelihood of such changes will depend crucially on the design of the exchange of information systems and nontrivial challenges remain.[15] The current exchange of information network remains porous because not all countries comply and even for those that do, there are few credible or enforceable supranational sanctions in cases of noncompliance beyond reputational costs.[16] In addition, current reporting

[14]Although early theoretical models have influentially argued for an optimal zero capital income tax rate (Atkinson and Stiglitz 1976; Judd 1985; Chamley 1986), this result has been shown to break down under realistic assumptions (for example, preference heterogeneity, preferences for wealth equality, and capital-labor substitutability). Recent literature has thus argued for higher capital income and wealth tax rates (Piketty and Saez 2013; Straub and Werning 2014; Saez and Stantcheva 2016).

[15]The importance of design is highlighted by the literature on the impact of other initiatives to curb tax evasion through disclosure of taxpayer information, including tax amnesties (Stella 1991; Le Borgne and Baer 2008), sanctions, and withholding taxes (Rixen and Schwarz 2012; Byrnes and Munro 2017).

[16]The exception is the United States' Foreign Account Tax Compliance Act, which requires that foreign financial institutions and certain other nonfinancial foreign entities report foreign assets held by their US account holders or be subject to withholding penalties on US-source income; the unilateral penalty threat works because of the large amount of US securities held by the rest of the world, but it is more challenging to apply reciprocally. If not all jurisdictions participate, rather than repatriating funds away from all low-tax jurisdictions, tax evaders will shift deposits to jurisdictions not

standards do not fully identify the ultimate owners of securities unidentified by central depositories (which record only the names of the intermediaries through which securities are transferred). In 2012, the G20 developed a Global Legal Entity Identifier system to address this weakness. More than 1 million legal entities in 221 countries have registered identifiers, but currently individuals are eligible only for legal entity identifiers if acting in a business capacity, limiting the use of this system for identifying beneficial ownership. Last, concerns over the privacy and security of data exchanges remain, especially in countries with weak administrative capacity.

Without international cooperation, fiscal and regulatory competition between countries can systematically lead to loopholes. Although cooperation is necessary for a comprehensive, enforceable, and equitable system, other reforms are also needed.[17] First, significant changes to domestic legal frameworks must take place—for example, comprehensive financial information should be shared between tax authorities and financial regulatory bodies.[18] In addition, governments may need to consider making changes to tax policy rates—a crucial ingredient to the credibility of enforceability of any information exchange system.

In sum, digitalization alone is not sufficient to curb tax evasion to low-tax jurisdictions. At current tax rates, the potential revenue gains from improved digital information exchange on cross-border financial income and wealth holdings is limited and concentrated in advanced economies. A comprehensive and collaborative reform of domestic and international tax systems is necessary to capture the full potential of increased transparency.

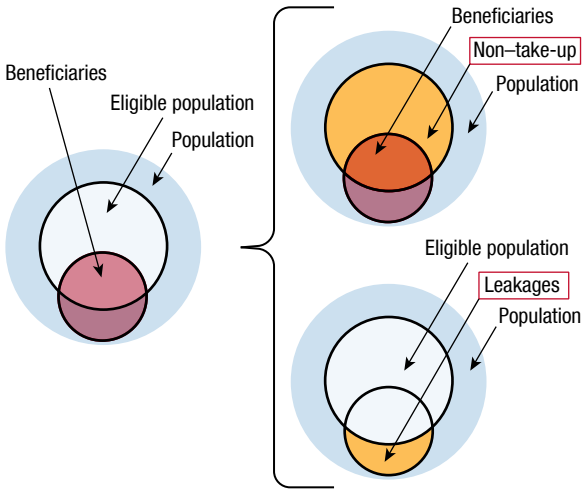
covered by an exchange of information relationship with their home country (Johannesen and Zucman 2014).

[17]Enforceability may require the introduction of noncompliance penalties in the form of withholding on resident-country-sourced payments or withholding taxes levied by host countries. Comprehensiveness requires the cross-validation of data between tax authorities and central security depositories around the world. Last, equity requires that reciprocity not be required for developing countries at an early stage if the costs of compliance are initially too high.

[18]Relatedly, offshore financial centers and those labeled as tax havens should protect their reputations by implementing strong governance, financial supervision, due diligence, and anti–money-laundering and combating the financing of terrorism (AML/CFT) systems. This should be done in addition to strengthening their frameworks for international cooperation and transparency through exchange of information. From an AML/CFT perspective, these jurisdictions are encouraged to make tax crimes a predicate offense to money laundering.

Figure 2.11. Non–Take-Up and Leakage—An Analytical Framework

Social benefits do not always reach intended beneficiaries because of non–take-up and leakage issues.



Source: IMF staff.

Strengthening Social Protection Coverage

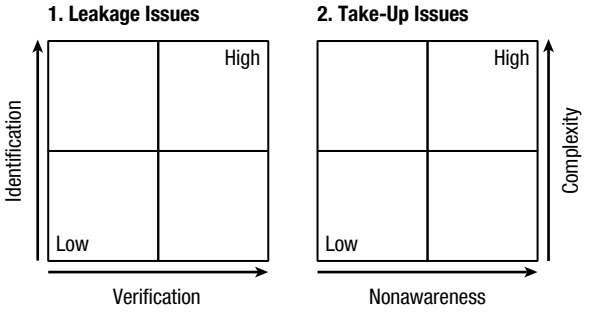
Leakage and Take-Up Problems in Social Protection

Turning to spending efficiency, this section focuses on leakages and take-up in social protection. Lack of information can lead to leakages as well as inefficient and untargeted spending through fraud, corruption, or errors in coverage.[19] When designing income-support programs, governments first define eligibility criteria that balance policy objectives (for example, poverty and inequality reduction, fiscal space, mitigation of income volatility) and administrative capacity to effectively implement selected criteria. As illustrated in Figure 2.11, there may not be a perfect overlap between the eligible population and beneficiaries because two types of errors can occur: exclusion errors (when eligible individuals do not, or only partially, receive benefits to which they are entitled) leading to non–take-up; and inclusion errors (when, knowingly or not, individuals' appropriate social benefits or

[19]*Take-up* refers to the eligible population of individuals who receive income support, *coverage* refers to the population of individuals who receive income support regardless of whether they are eligible, and *leakage* refers to the noneligible population of individuals who receive income support.

Figure 2.12. Sources of Leakage and Non–Take-Up

Leakage and non–take-up result from a combination of identification and verification problems, and complexity and lack of awareness, respectively.



Source: IMF staff.

services to which they are not entitled). Because of the former, large shares of targeted populations may be left uncovered; because of the latter, considerable leakages are generated at high fiscal cost, possibly at the expense of targeted beneficiaries. Both types of error threaten the efficiency of social insurance and public service provision, but their relevance and magnitude differ across countries.

The existing literature points to important information asymmetries to explain leakages and non–take-up. Figure 2.12 presents a taxonomy of leakage and take-up issues:

- Leakages often stem from *identification* and *verification* problems (Figure 2.12, panel 1). First, social administrations may find it difficult to identify beneficiaries or to know whether they exist (that is, "ghost" beneficiaries; Barnwal 2016). Second, when social administrations are unable to fully verify whether the program's eligibility criteria (for example, socioeconomic characteristics of beneficiaries) or objectives (benefit amount) are met, issues with fraud and misallocation of benefits arise (Brown, Ravallion, and van de Walle 2017).
- *Complexity* and *awareness* can also generate important barriers to take-up of income-support programs (Hernanz, Malherbet, and Pellizari 2004; Currie 2006; Figure 2.12, panel 2). Program complexity can take the form of high transaction costs to apply for or receive benefits such as lengthy and complicated forms, unclear links to other assistance programs, multiple administrative interlocutors, limited access to social administrations, and the absence of a functional network to distribute benefits (Gupta 2017). Eligible households may not be aware of income-support programs, preventing them from applying (Ramnath and Tong 2017).

Leakage and take-up issues of income-support programs are nontrivial and macrocritical:

- *They are sizable*. In middle- and low-income countries, undercoverage of households at the bottom of the income distribution and coverage of households at the top of the income distribution are sizable (Figure 2.13, panel 1), which indicates that both leakage and non–take-up are considerable in developing countries.[20] These issues arise in advanced economies as well.[21] One-third of total spending on *means-tested* assistance programs in the EU is given to the top six income deciles, a sign of leakages (Figure 2.13, panel 2). Analyzing recent estimates of non–take-up rates of monetary benefits in European countries, Dubois and Ludwinek (2015) find that most conservative estimates of non–take-up rates are greater than 40 percent, irrespective of benefit types.[22]
- *They have important fiscal and economic effects.* Leakages in developing countries crowd out much-needed resources, to the detriment of both eligible beneficiaries and other growth-enhancing spending such as health and education. In 2012, an estimated 36 percent of total spending on the Indian Public Distribution System never reached intended households because of ghost beneficiaries and the illegal diversion of subsidized goods by

[20]The data on undercoverage of the poor are scarce for middle- and low-income countries. Ideally, these charts would show data on *unintentional* undercoverage. Because most income-support programs are designed to cover households in the lower income decile, the data in Figure 2.13, panel 1, can be used as a first approximation of unintentional undercoverage. However, they also illustrate undercoverage of poorer households and coverage of richer households *by design*. For instance, if the program is universal, then by design, all households are entitled, irrespective of their income level; if the benefit is means-tested but conditioned on having a job, then poor unemployed individuals are excluded by design.

[21]Leakages and take-up problems are important concerns in many developing economies; in advanced economies, however, non–take-up is usually a more pressing problem than are leakages (Chantel and Collinet 2014; Auray, Fuller, and Lkhagvasuren 2017).

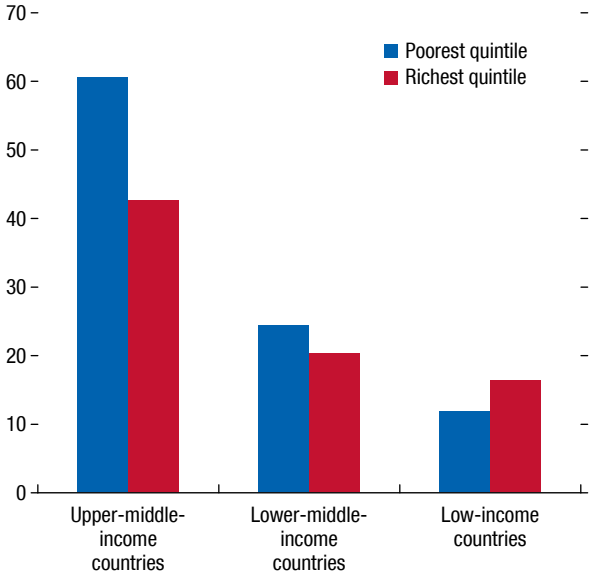
[22]Anecdotal evidence is consistent with this broad picture. In India, only 40 percent of citizens apply for the benefits they need, with application costs and complexity reported as the main hurdles (Demirgüç-Kunt and others 2017). In the United Kingdom, take-up rates for entitlements vary between 55 and 95 percent (Gandy and others 2016).

Figure 2.13. Leakage and Take-Up in Social Income Support Programs

Leakage and non–take-up are sizable in both advanced economies and developing countries.

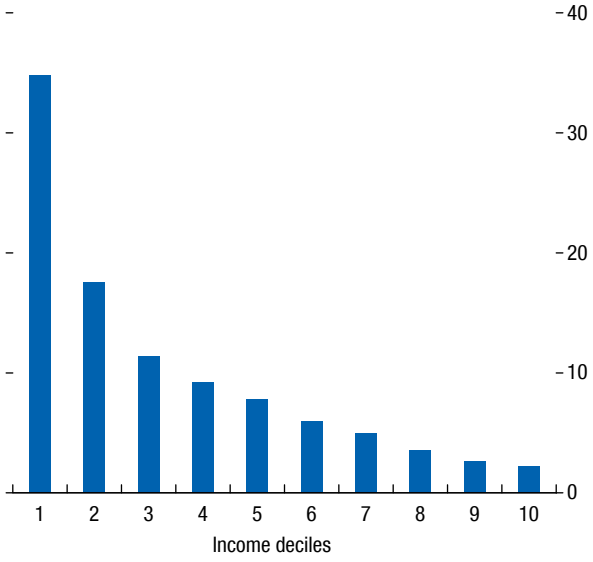
1. Household Coverage by Social Assistance Programs in Developing Countries (percent of households in income quintile)

In developing countries, coverage of the poor is relatively low and coverage of the rich comparatively high.



2. Average Share of Total Spending on Means-Tested Social Assistance Programs in EU-28 (percent of total spending across income deciles)

In the European Union, a sizable share of total spending on means-tested benefits accrues to middle- and high-income households.



Sources: EUROMOD; World Bank, Atlas of Social Protection Indicators of Resilience and Equity (ASPIRE); and IMF staff calculations.
Note: EU-28 = European Union group of 28 countries (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Sweden, Spain, United Kingdom).

intermediating dealers (Ministry of Finance, Government of India 2017). High non–take-up rates reduce the probability of income-support programs reaching their intended goals, lead to treatment inequality among eligible individuals, and reduce the capacity to accurately anticipate the fiscal costs of policy reforms. High non–take-up rates also affect macroeconomic cycles. For example, Kettemann (2017) shows that non–take-up of unemployment benefits in Austria (about half of eligible unemployed workers) amplifies aggregate labor market fluctuations (leading to a 15 to 30 percent increase in volatility).

Digital Solutions: Case Studies

Governments have initiated actions to reduce leakages of income-support programs (by uniquely identifying eligible beneficiaries) and to increase take-up (by identifying barriers to enrollment and implementing outreach programs).[23] This section analyzes four country cases (India, South Africa, France, Belgium) to illustrate how digital tools help solve leakage and take-up issues.

Reducing Leakages in India and South Africa

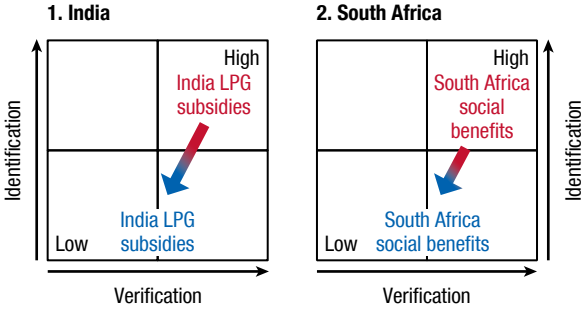
Before 2015, the subsidy on liquefied petroleum gas (LPG) in India was subject to substantial leakages because of corruption and fraud resulting from (1) a dual pricing system that allowed dealers to sell LPG cylinders to households at a subsidized price and to commercial users at market price and (2) the government's inability to authenticate program beneficiaries.

[23]Governments have also established multiple "nudging" units to explore new tools to increase individual compliance and enrollment (OECD 2017a).

Figure 2.14. Digital Solutions and Leakage Issues

In India, biometric identification and electronic payments helped reduce leakages in LPG subsidies.

In South Africa, the biometric identification system has helped decrease ghost-recipients of social benefits.



Source: IMF staff.
Note: Arrows indicate the direction of improvements after the implementation of digital solutions. LPG = liquefied petroleum gas.

The dual pricing system encouraged LPG dealers to divert subsidized LPG cylinders to the open market where prices were higher, and limited authentication led to the proliferation of ghost beneficiaries and duplicate claims. The government was also unable to verify the reported number of LPG cylinders distributed to genuine beneficiaries by LPG dealers. Verification and identification issues were substantial.

Digitalization helped reduce leakages in two ways. First, starting in 2013, beneficiaries' Aadhaar numbers were linked to the LPG program to prevent claims of benefits for ghost beneficiaries or multiple claims of the same benefit. Second, the government eliminated the dual pricing system and made electronic transfers of the subsidy directly to the Aadhaar-linked bank account of beneficiaries, bypassing dealers. By improving identification and verification, these reforms have reduced leakages substantially (Figure 2.14, panel 1) but estimates vary. Depending on assumptions and how the reduction in leakage is expressed—that is, the reduction in total transfers or wrongful payments—estimated savings from digitalization range between 0.2 and 21 percent of cash transfers and 11 to 24 percent of wrongful payments.[24]

In the early 2000s, the South African Social Security Agency also experienced high levels of fraud and corruption and an ineffective service delivery system. The burdensome paper-based proof-of-life requirements led to leakages. The administration offered social benefit payment options in the form of cash at specific pay points and as direct bank credits. Because of limited banking access for the poor and the high cost of banking, in practice most grants to these individuals were paid in cash, leading to high levels of fraud, locking beneficiaries to specific pay point and payment dates, and inflicting long waiting times.

Digital tools provided much-needed relief to the system. In 2012, the South African Social Security Agency re-registered all social grant beneficiaries and introduced a biometrically secured debit card as the payment platform for all social transfers and as the sole instrument used to identify beneficiaries. Once a month, all beneficiaries present their proof of life either by fingerprint or voice verification, thus reducing significant identification problems (Figure 2.14, panel 2). The new system eliminated 850,000 ghost beneficiary and duplicate accounts, reduced monthly per-beneficiary administrative costs by 50 percent (International Labour Organization 2016), and produced gross fiscal savings of R2 billion (US$194 million) during 2013/14 (South African Social Security Agency 2014).

Increasing Take-Up in France and Belgium

In France, take-up rates for some social benefits are surprisingly low. For example, although 95 percent of social pensioners are eligible for an income-support program to purchase complementary health insurance (called Aide à la Complémentaire Santé or ACS), only 50 percent do so (Sireyjol 2016). Low take-up rates generate additional public health spending given that those who fail to take up their ACS benefits usually delay care, resulting in a health care bill that is ultimately higher by about 30 percent. Individuals most frequently cite the complex application process and the lack of awareness about the program as reasons for low take-up.

In 2013, the French authorities implemented digital solutions by setting up a new systematic data exchange between local health and old-age administrations. The old-age administration started providing the health administration with identifying information on social pensioners. In turn, the health administration targeted these designated potential beneficiaries, either with a simplified ACS applica-

[24]For details, see Annex 2.1.

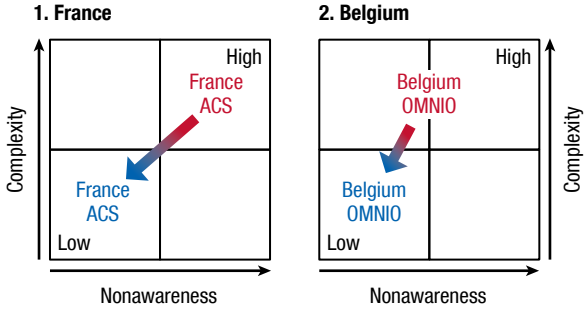
tion form, or with an ACS check ready to cash upon the purchase of complementary health insurance. As a result, the program saw an increase in take-up of 22 percent with the simplified application form and 50 percent with automatic enrollment (Figure 2.15, panel 1).

In Belgium, although low-income households were eligible for medical reimbursement topping-up the public insurance system (called OMNIO), the non–take-up rate was estimated at 60 percent in 2011 (Steenssens 2014). This was partly due to a complicated eligibility assessment that was means-tested and categorical (that is, based on characteristics such as age or disability), making the application process complex and scattered across different administrations. In 2014, the eligibility criteria and the application process were harmonized and simplified to enable data exchange between tax authorities, the national office for sickness and disability, and health insurance funds. Health insurance funds are now able to (1) automatically enroll households designated as already receiving a social benefit and (2) reach out proactively with a simplified application form to those whose income is potentially less than the eligibility threshold (Figure 2.15, panel 2).

Figure 2.15. Digital Solutions Can Help Address Take-Up Issues

In France, digital exchange of information between agencies and automatic enrollment helped increase take-up in a local experiment.

In Belgium, automatic enrollment and proactive outreach to low-income households increased uptake of a medical benefit.



Source: IMF staff.
Note: Arrows indicate the direction of improvements following the implementation of digital solutions. ACS = Aide à la Complémentaire Santé; OMNIO = medical reimbursement topping up the public health insurance system in Belgium.

Lessons from Country Experience

Although these case studies illustrate how digitalization can reduce information asymmetries, they also point to some challenges:

- It is difficult to disentangle the effect of digitalization from broader macroeconomic and policy developments. For example, the use of Aadhaar in the LPG subsidy scheme coincided with the termination of the LPG dual pricing system and the reduction in the world price of natural gas, both of which helped reduce the cost of LPG subsidies. Data limitations and lack of proper assessment frameworks constrain ex post evaluations.
- Governments should take the necessary steps to ensure privacy and security controls when implementing large identification programs. In South Africa, the lack of proper controls for the private intermediary in charge of distribution of welfare payments led to allegations of corruption and challenges to legality. The intermediary was accused of improperly using private beneficiary information and its network to sell various financial and insurance products to thousands of vulnerable beneficiaries. In India, privacy and security concerns led to alternating periods of mandatory and nonmandatory use of Aadhaar in social programs. A court decision is still pending on its compliance with the right to privacy. In a recent data breach in India, it has been reported that 135 million Aadhaar numbers were compromised, underscoring the importance of sound privacy measures.
- Digital outreach tools may not be sufficient to address coverage issues. In France, even after automatically receiving a benefit check, beneficiaries often fail to purchase complementary insurance (Michon 2014). This suggests that beneficiaries may need direct human intervention to address the lack of information about insurance plans, social isolation, and disability. In Belgium, technical and policy preconditions (that is, harmonization of rules across public agencies, creation and maintenance of high-quality data, setup of privacy rules) were crucial for the successful rollout of digital automatic enrollment. Governments also need to ensure digital inclusion to prevent the exclusion of genuine beneficiaries as was the case in India where faulty Internet connectivity led to nonpayment of benefits to eligible households (see Annex 2.1).

Addressing New Challenges

Although digitalization may help improve tax compliance and spending efficiency under current policies, there may be a case for policy change. This could be because lack of information previously prevented the implementation of better policies or because new challenges call into question policy-as-usual.

New economic trends—the emergence of digital businesses as a global force—may exacerbate challenges faced by current frameworks for international taxation as well as social protection. Digital businesses include giants, such as Amazon, Apple, and Google as well as peer-to-peer (P2P) platforms—typified by businesses such as Airbnb and Uber and their facsimiles—which have become an integral part of the global economy. This section explores the fiscal challenges associated with the growth in digital firms. First, the cross-border nature of digital activities may force new thinking on the international tax architecture.[25] Second, the expansion of digital platforms may call for a new fiscal policy approach to income insurance.[26]

The section discusses some of the emerging challenges brought on by the rapid digitalization of the economy. But much more thinking will be needed before making definitive policy prescriptions.

International Taxation and Digitalization

How should governments tax the incomes of global companies such Amazon, Apple, Facebook, and Google—and other lesser known firms—that serve so many citizens across the world using digital technology? This has proved an extremely contentious and urgent issue. Some countries have already taken action—in spring 2018, the OECD issued a report, and the European Commission proposed measures to address this issue.[27]

The first wave of expert reports argued against a special regime for digital companies (Gaspar and others 2014; OECD 2015a). Indeed, digitalization is transforming the whole economy. Even in so-called digital companies, business models vary. For example, search engines, social media networks, online retailers, P2P platforms, and on-demand subscription service companies all have very different business models, providing different types of products and services. In contrast, for companies that are not deemed as especially digital, new technologies are also integral to their operations, whether through an online presence or by collecting information on how their products are used and perform.

Recent highly contentious policy debates, however, instead raise the prospect of attempting to ring-fence specific business lines. This has become urgent in some countries, notably in Europe, and seems to reflect the public outcry over the presumed low taxation of these companies, as well as a perception that they enjoy unfair advantages over domestic competitors. However, this debate might also reflect more fundamental problems with existing international tax arrangements, which digital companies—like many other multinationals—have successfully navigated to minimize their tax burdens. The central question is thus not so much whether a special tax regime for specific digital businesses should be developed, but rather a more general one: Can the taxation of activities and businesses that are increasingly reliant on digital capabilities be accommodated within existing international arrangements? Or do they require modification of these arrangements? And if so, how?

To begin to answer these questions, consider four of the key features of archetypal digital companies and whether they might challenge current norms of international corporate taxation.

- *High profitability.* Some digital companies combine a first-mover advantage with strong network effects, giving rise to a natural monopoly. The resulting market distortions are best addressed through regulatory rather than tax measures. However, in their absence the high profit generated provides an attractive tax base, especially given that some technology giants are among the largest companies in the world (Figure 2.16). However, this point is neither new nor unique to "digital companies": it points instead to the need for more effective taxation of rents, wherever they arise.

[25]Box 2.5 discusses challenges in domestic taxation associated with P2P platforms.

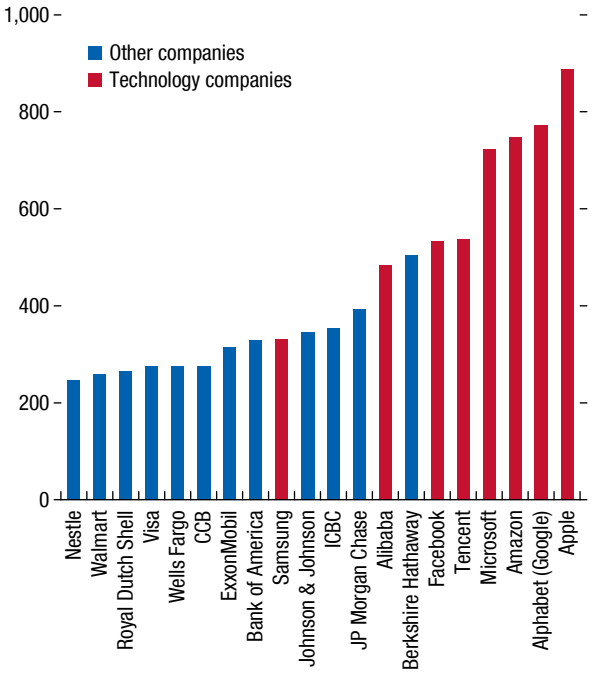
[26]"Income insurance" refers here to both publicly provided income-support mechanisms (for example, unemployment benefits, guaranteed minimum income schemes) and individual schemes to insure oneself against negative income shocks such as independent contracting on digital platforms to complement a primary job's earnings.

[27]The OECD report is an interim report following OECD (2015a), with a final report due in 2020. The European Commission published a proposal for the introduction of a "digital services tax" in March 2018. This is a new approach which will require further analysis with special emphasis on the implications for the global tax system.

Figure 2.16. Global Top 20 Firms, by Stock Market Capitalization

(Billions of US dollars, March 7, 2018)

Technology firms are amongst the most highly valued in the world.

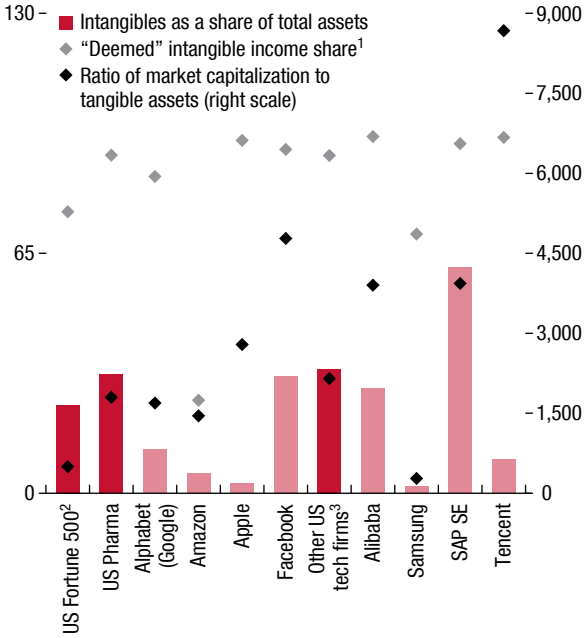


Sources: DataStream; and IMF staff calculations.
Note: Alphabet is the sum of market capitalization of Alphabet A and Alphabet C. Red bars highlight tech-related companies. CCB = China Construction Bank; ICBC = Industrial and Commercial Bank of China.

Figure 2.17. Indicators of Relative Intensity in the Use of Intangibles

(Medians; percent)

Digital companies are relatively intensive in the use of intangibles, but not uniquely so.



Sources: Bureau van Dijk Orbis; Fortune 500; and IMF staff calculations.
[1]Median of excess of income over 10 percent of value of tangible assets.
[2]Median of Fortune 500 firms matched to ORBIS data.
[3]Includes companies from multiple NACE (Nomenclature of Economic Activities) sectors, for example, 2620 (manufacture of computers and peripheral equipment), 5829 (other software publishing), 6201 (computer programming activities), and 6209 (other information technology and computer service activities).

- *Heavy reliance on intangible assets.* Relevant intangibles used by digital companies include, for example, algorithms to process data and to generate value through personalized advertising. Tax problems associated with such intangibles are widely known, given the relative ease of locating them in low-tax jurisdictions and difficulties in their valuation. But this is not unique to digital companies. Some other sectors, such as pharmaceuticals, are also highly intensive in the use of intangibles (Figure 2.17). Recent attempts to address these problems include specific action items under the G20-OECD Base Erosion and Profit Shifting project and, in the recent US tax reform, the adoption of minimum taxation for foreign income deemed to derive from intangible assets (so-called Global Intangible Low-Taxed Income, see Box 1.3 in Chapter 1).
- *Sales with little or no physical presence*. Under current international tax rules, a company is liable for corporate income tax in a country only if its physical presence there is sufficient (that is, a permanent establishment). This seems to have sparked concerns for many governments, because foreign digital companies often sell their services directly to their citizens with little or even no physical presence and, therefore, are not liable to pay income tax. Although foreign digital companies are in many cases highly visible to the public, selling without a physical presence in a country is no different from traditional exporting. The fact that digital sales do not in themselves create a tax liability under current rules opens a broader debate on the allocation of taxing rights and attribution of income to the destination country.
- *User-generated value.* When they use online services, users generate information of commercial value to

the provider and potentially many other businesses. Such information can even be generated passively, when a user simply searches for information. The information can enable the provider and those businesses it shares it with not only to better tailor their product but also, for example, to sell better targeted advertising. Again, this issue is not unique to some identifiably digital companies: many businesses, such as supermarkets and airlines, collect customer data through loyalty cards. Alternative views as to how user-generated value should affect taxing rights, however, are at the heart of the current debate.

Many, it seems, would agree that there is nothing intrinsically new or even distinctive about the first three of these features. Whether the same is true of user-generated value, however, remains controversial.

Irrespective of qualitative novelty, however, there is a question of sheer scale—whether these features, new or not, are putting so much pressure on current tax arrangements as to require fundamental changes in the international tax system to better ensure efficiency and fairness across countries in the allocation of taxing rights. Certainly, the pressures have reached the point where some countries already feel the need to respond by adopting specialized tax measures. Australia and the United Kingdom introduced special taxes on profits that are considered to be artificially diverted to other countries (called *diverted profit taxes*); India and Italy adopted levies on certain online transactions, such as advertising sales (labeled the *equalization levy* in India and the *web tax* in Italy), and India has very recently proposed an expansion to the definition of permanent establishment in its domestic tax laws.[28] These measures, however, are short-term solutions. If countries continue to pursue this route, measures should preferably be (1) internationally coordinated, at least in broad design, to limit complexity and unintended spillovers to other countries; and (2) consistent with a longer-term vision on the future state of the international tax architecture.

[28]The diverted profit tax in the United Kingdom raised £138 million in 2016/17 (plus an estimated £143 million in ordinary corporate tax because of behavioral changes); the Italian web tax is estimated to yield EUR 190 million. For both, this is approximately 0.6 percent of corporate tax revenue. India has proposed amendments its 2018 Finance Bill to such that digital transactions—irrespective of whether the nonresident has a residence or place of business in India or renders services in India—constitute a "significant economic presence," subject to application of treaties.

For this longer-term perspective, one crucial issue is how the principle of "taxing where value is created" that has been at the heart of the Base Erosion and Profit Shifting project should be applied to value generated by the users of digital services. In effect, this is a form of productive activity unlike that traditionally associated with the test of physical presence. Even if such activities have not given rise to taxable presence in the past, perhaps their sheer scale now warrants a change in approach. This view inherently admits the importance of an element of "destination-based" taxation in determining rights, meaning some element of taxation where the customer is located—although, in this case, the user generating the information can also be considered the source of the value being created.

If user-generated value were to be used as the basis of granting the destination or "market country" taxing rights, permanent establishment rules would need to be expanded. The question would then arise as to whether it is practically feasible to distinguish sales that involve user-generated value from those that do not—given that nearly all sales in any jurisdiction give rise to commercially valuable information. Some have argued that any type of sale is in itself a source of value: after all, a product or service has no value unless there is demand for it, and considerable rents can accrue from factors such as brand name loyalty or other market-specific demand-side factors. These issues surrounding a destination-based tax system remain highly controversial.

Beyond the question of whether a company is liable for corporate income tax in a jurisdiction is that of how much tax it should then pay. Significant implementation issues arise. For example, how much of its income should a globally operating social media platform assign to a particular country, based on the data it acquires from its users there? Current arrangements require that prices for goods and services transacted within the company's subsidiaries should reflect market prices. Yet, market valuations for user-generated data do not typically exist. Specific problems arise where services are provided without an explicit price being charged—reflecting a form of barter in which the customer provides information, consciously or nor, in return for the service from the digital company.[29] This is part of the wider debate on international corporate taxation, including the

[29]This also raises issues in relation to the VAT, not taken up here.

use of formula apportionment (whereby taxable income is allocated according to a formula based on assets, employment, and sales, for example) or destination-based income taxation.[30]

Whereas current discussions seem to be somewhat narrowly focused on the taxation of a limited group of digital companies, they exemplify a more fundamental debate about current international tax rules.

Social Insurance and Digital Platforms

Alternative work arrangements, which include temporary help agency workers, on-call workers, contract company workers, and independent contractors or freelancers, are often associated with greater income volatility and are on the rise. In the United States, alternative work arrangements increased by nearly 50 percent between 2005 and 2015, from more than 10 percent of the workforce to close to 16 percent, representing 94 percent of the net employment growth over the period (Katz and Krueger 2016).[31] In the United Kingdom, between 2011 and 2017, alternative work arrangements have increased faster than full-time and wage-earning employment—about 30 percent for agency workers and 300 percent for zero-hour contracts (Coyle 2017).[32] At the same time, the increase in alternative work arrangements tends to exacerbate the income volatility of many workers as they experience lower weekly pay, fewer and less predictable hours worked, and reduced social insurance coverage compared with full-time wage-earning jobs (Farrell and Greig 2016; European Parliament 2017).

Although the growth in alternative work arrangements precedes the emergence of the "gig" economy, it has been mirrored in the emergence of work on digital platforms. Digital platforms are ubiquitous and digitally intermediated P2P activities (that is, matching users on both sides of a market) have emerged as an increasingly popular way to organize activity and provide goods and services. What distinguishes recent P2P activity is the use of digital technology to significantly reduce transaction costs associated with running a business or supplying labor, allowing smaller-scale activity to proliferate. Positive network externalities have boosted the overall number of buyers and sellers transacting over platforms. Empirical evidence suggests that the number of participants on both sides of digital platforms (supplier and consumer sides) is growing rapidly.[33] Between 2015 and 2016, 8 percent of adults in the United States earned money on digital platforms (Smith 2016); in the United Kingdom, an estimated 3 percent of the workforce is providing services on digital platforms (Coyle 2016).

The emergence of P2P platforms has helped mitigate some of downsides of alternative work arrangements by facilitating income smoothing and work flexibility. Many of these workers supplement their primary job income through work on digital platforms (Farrell and Greig 2016). In a survey of online workers at Microworkers—an international platform for micro-tasks with many participants from developing countries—respondents list the ability to earn extra money and flexible work hours as the top reasons for platform work (World Bank 2016). The same is true for Uber drivers (Hall and Krueger 2016; Chen and others 2017).

Nonetheless, the growing importance of these platforms presents challenges for social insurance. If an increasing share of the labor force engages in platform work, this could exacerbate complications traditionally associated with self-employment. Social protection traditionally associated with wage-earning contracts is usually not available to self-employed digital workers. Moreover, the more dependent platform workers are on the platform as a primary source of income, the less likely they are to have access to social protection (European Parliament 2017). Private insurance markets do not function well in addressing this issue because of both adverse selection and moral hazard.

[30]These options and the destination-based cash flow tax are discussed in IMF (2014c) and Box 1.1 in the April 2017 *Fiscal Monitor*, respectively.

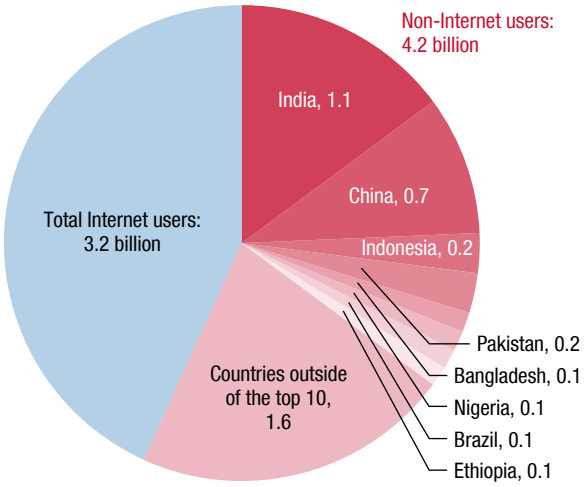
[31]For example, Hall and Krueger (2016) report that the number of Uber drivers has nearly doubled every six months from mid-2012 to the end of 2015.

[32]In the United Kingdom, zero-hour contracts, or "casual contracts," are for piecework or on-call (for example, interpreter) work. Workers are entitled to the minimum wage and statutory annual leave.

[33]The rapid increase in suppliers is mirrored by the rise in final consumers on digital platforms. For example, the estimated number of US users of ride-sharing services has more than doubled from 8.2 million in 2014 to 20.4 million in 2020; Didi Chuang, the Chinese ridesharing company, claims to have 250 million users in 360 Chinese cities. The number of employers billing per quarter on Upwork (formerly oDesk)—the largest online marketplace for contract labor in terms of earnings—increased by more than 800 percent between 2009 and 2013 (Agrawal and others 2013).

Figure 2.18. The Digital Divide

A majority of the world's population still cannot access or afford the Internet.



Source: World Bank 2016.
Note: Numbers are in billions of people. Red colored areas refer to the population that cannot access or afford the Internet in the top eight countries.

How should policy address these challenges? Much of the debate has focused on labor regulation (Agrawal and others 2013; Berg 2016). Treating digital workers as employees under the law would force platforms—now considered employers—to provide some form of social insurance (for example, paid sick leave). However, introducing labor regulations and standards may be counterproductive if it reduces the flexibility in schedule and hours adjustment offered by digital platforms relative to more traditional employment contracts.

The trends in employment previously discussed may spur policymakers to proactively address these issues. Fiscal policy instruments may be needed to more directly address social insurance needs, such as unemployment benefits, access to health care, and pensions. Reducing or eliminating the minimum income thresholds for social insurance and introducing contributions based on a percentage of income could help provide social protection to these workers (European Parliament 2017). In addition, although it is usually more difficult to collect social contributions or taxes from self-employed workers, platforms provide an opportunity to gather more information about these workers. In many cases, they collect information about transactions and wages as they charge workers a commission based on transactions. As discussed in Box 2.5, platforms can report earnings to the tax administration and potentially withhold taxes and contributions.

What Stands in the Way: Lessons from Country Experience

Although digitalization brings dividends for governments, it also comes with many challenges. Success is not guaranteed and governments must find ways to mitigate new risks, including the following:

Digital exclusion. Digitalization requires that a majority of individuals, firms, and governments have access to the digital world. New technology may impose a disproportionate burden on small businesses and vulnerable households who have limited access to or knowledge of new digital tools (Chaudhury and others 2006; Olken 2006). Although the use of smartphones and the Internet is increasingly common (Smith 2016), more than half of the world's population does not have access to the Internet, particularly in developing countries (Figure 2.18). Greater use of technology may create a "digital divide" in which a large portion of citizens could be excluded from access to digital public services. For example, fewer than half of the population of Africa subscribes to a mobile phone (GSMA 2017). New digital systems could mistakenly exclude eligible beneficiaries if they are denied payments because of technical reasons. Last, governments could also be left behind in the digitalization process. Private actors are quickly adopting digital tools—government failure to keep up may jeopardize the ability to collect taxes or spend efficiently.

Government digital initiatives will require new and smart investment to mitigate the risks of digital exclusion. First, boosting public investment in technological infrastructure and digital literacy is important to facilitate digital inclusion (World Economic Forum 2017). One smart budget strategy is to prioritize flexible digital platforms that are compatible with continuous upgrades and innovation to expand coverage of eligible entities. Some digital platforms, such as X-Road in Estonia and G-pay in Kenya, are flexible and compatible with multiple information systems enabling firms, households, and government agencies to access common digital information (see Annex 2.1). In con-

trast, without a flexible platform, digital solutions may quickly become obsolete and governments may need to unwind initial investment. Ghana faced difficulties when it expanded its coverage of digital platforms to more government agencies and services because its unique digital identification system was tied to a particular type of financial technology (Cangiano, Gelb, and Goodwin-Groen 2017).

Data quality and new fraud opportunities. Although governments can use technology to update and secure information, individuals and firms also take advantage of technology in finding loopholes to hide sensitive information, evade taxes, or qualify for government benefits for which they are not eligible. For example, the digitalization of Estonia's tax administration presented new risks (see Box 2.1): when registering and filing taxes online, individuals who engage in fraud created a large number of ghost entities to generate multiple small credit claims that fell below the threshold for audit. Retailers in many countries have also used software (for example, Zappers) at the point of sale to suppress electronic sales and evade taxes (OECD 2017b). Individuals also conduct business transactions in decentralized cryptocurrencies without leaving traceable footprints and criminals have proved to be remarkably adept in circumventing new rules (Krishna, Fleming, and Assefa 2017). Authorities in Korea recently raided the country's largest cryptocurrency exchanges for alleged tax evasion.[34]

Governments should anticipate and prepare for fraudsters. In the United Kingdom, tax authorities have used digital methods to fight tax fraud. HM Revenue and Customs' Risk and Intelligence Service Connect software merges administration and third-party databases and runs automated sweeps to catch anomalous patterns and other risky behavior (for example, businesses using the same bank accounts). Greater use of biometric identification systems can help reduce fraud and illegitimate claims (Gelb and Clark 2013). For example, some relief payments in Indonesia and the national pension systems in Nigeria and Botswana have made use of biometric information to identify and authenticate eligible individuals. In the case of point-of-sale fraud, tax administration agencies in Canada and several countries in the EU (including Belgium, Greece, and Sweden) have stepped up efforts in tackling electronic sales suppression (OECD 2017b).[35] But there is a limit to how quickly governments can respond and scale up resources to strengthen their capacity to mitigate such risks. As fraud opportunities evolve and become more complex, it will be more difficult for governments to stay ahead in the digital race.

Privacy, cybersecurity, and disruption of government functions. The real-time recording of digital information has raised concerns about how information should be regulated and protected. In many countries, citizens remain deeply conflicted about trusting their governments with private information. In a recent poll conducted in Germany, the United Kingdom, and the United States, 65 percent of respondents believed their governments abuse their power to access information on citizens.[36] In a 2015 survey conducted in the United States, less than a third of respondents were confident that the government could keep their records secure.[37] Moreover, massive data breaches and intrusions of privacy through hacking, leaks, and ransomware attacks have increased, highlighting the vulnerability of both public and private digital systems. In 2015, the Office of Personnel Management of the United States identified a cyber intrusion that potentially compromised the personal information of 4 million people. Also, in May 2017, the cyberattack on the National Health Service in the United Kingdom illustrated how privacy and cybersecurity can disrupt the provision of public health care services. Besides cyber intrusions, privacy violations may arise from inadequate safeguards in the digital design, as in the case in South Africa (see the section "What governments can do now: Same policies, better implementation"). Future attacks could be much more disruptive if they target critical infrastructure such as the power grid, taxation administration, or systemic financial entities. In 2015, coordinated attacks resulted in a blackout affecting 225,000 residents in Ukraine.[38]

[34]See https://www.cnbc.com/2018/01/10/police-tax-authorities-raid-south-korea-cryptocurrency-exchanges-for-tax-evasion.html.

[35]The OECD has established a Task Force on Tax Crimes and Other Crimes (TFTC) to combat the electronic sales suppression and the EU has set up project groups on cash registers and E-Audit.

[36]See https://www.venafi.com/blog/survey-results-consumers-skeptical-of-government-backdoors.

[37]See http://www.pewinternet.org/2015/05/20/americans-attitudes-about-privacy-security-and-surveillance.

[38]See http://www.bbc.com/news/technology-38573074.

The US Department of Energy recently warned that a cyberattack could cause widespread power outages and undermine defense infrastructure (US Department of Energy 2017).

Cybersecurity includes prevention and detection of security breaches. Building firewalls against attacks is a first step, and anticipating future threats can be facilitated by building a network of shared information about vulnerabilities across government agencies and private firms (Eggers 2016). The 2007 cyberattacks that paralyzed Estonia's online services prompted the country to strengthen its data security and implement an advanced digital identity system for user authentication. Its digital identification card uses blockchain technology for security and the government plans to house backup data in a virtual embassy. In Kenya, the digital tax system (iTax) restricted access by public sector users to protect confidentiality and system security. Australia's Cyber Security Centre has built a hub for information exchange on cyber threats across the private sector and central and local governments. Notwithstanding these efforts, the number of incidents involving data breaches and cybersecurity has also risen rapidly (more than five times in the past decade in the United States), posing an ongoing challenge for governments to guard against digital piracy.[39]

Mobilizing adequate resources. Spending should also be consistent with the government's budget constraint and will require policymakers to create fiscal space for purchasing new technology, storing large amounts of data, and hiring cybersecurity experts. Cost estimates are rare and incomplete. In India, data from the Unique Identification Authority of India place the costs of Aadhaar implementation and maintenance at about US$1.5 billion or $1.25 per card between 2009 and 2017 but this compares favorably with the costs of other electronic identification systems of US$3 to US$6 per enrollee (for details, see Annex 2.1). Gelb and Diofasi Metz (2018) estimate that a low-income country would need to spend 0.6 percent of GDP to establish a national biometric identification system, with maintenance costs of 0.1 percent of GDP annually. Estonia spends approximately US$67 million (0.3 percent of GDP) per year on its digital platform.[40] In Korea, the cumulative budget spent on e-Government between 1996 and 2002 amounted to 1.3 percent of GDP (Kim and Choi 2016). Deloitte (2015) estimates that the 2015 present value cost of digitalizing customer transaction services for the Australian federal and state governments could reach US$ 4.6 billion (0.4 percent of GDP).[41] Many countries fund a government unit or structure to lead digitalization efforts—in OECD countries, their annual budget represents 0.04 percent of total public expenditure on average (OECD 2015b). However, these estimates do not include the full implementation and maintenance cost of a digital government. The costs of cybersecurity, for example, can be substantial—in the United States, some have estimated that the federal government spent at least US$28 billion (0.2 percent of GDP) on cybersecurity in 2016.[42] Last, excessive spending can also result from weak procurement procedures and the poor choice of vendors, which can lock countries into specific proprietary and inflexible technologies (Gelb and Clark 2013).

Administrative and institutional capacity. Political, institutional, and human capacity constraints could hinder governments' adoption of technology. Countries with severe institutional constraints will find it difficult to mobilize resources for digital solutions, even if digitalization can generate efficiency gains. Faced with different capacity constraints and data limitations, countries have absorbed new technology at differing paces—many countries have adopted small-scale digital initiatives and few governments have launched a foundational digital program that affects the entire public sector, in part because of capacity constraints or past failures in introducing integrated digital programs (Corydon, Ganesan, and Lundqvist 2016).

Country experience also points to a need for high-level political commitment to coordinate progress on digitalization, make a transparent assessment of its effect, and overcome political inertia. Even if

[39]See https://digitalguardian.com/blog/history-data-breaches.

[40]https://www.bloomberg.com/view/articles/2015-03-04/envying-estonia-s-digital-government.

[41]Customer transaction services include payments, applications and registrations, and complaints and resolution.

[42]The budget watchdog Taxpayers for Common Sense estimates that *unclassified* federal cyber spending rose from US$7.5 billion in 2007 to US$28 billion in 2016. See http://www.taxpayer.net/national-security/cyberspending-database/.

digital solutions offer better outcomes, stakeholders who benefited from the status quo may have little incentive for adoption, and could attempt to delay its implementation (Muralidharan, Niehaus, and Sukhtankar 2016). Vested interests whose rents are threatened may also subvert the adoption and limit its effectiveness (Krusell and Rios-Rull 1996; Parente and Prescott 2000). As in other government initiatives, pursuing digitalization without strong political support could waste resources.

Parallel efforts in strengthening fiscal institutions could help. According to a recent study, stronger institutions are positively correlated with better outcomes on digital projects (World Bank 2016). Digitalization of payments should be an integral part of broader efforts to improve public financial management institutions (Cangiano, Gelb, and Goodwin-Groen 2017). In 2016, Mexico used electronic payments for revenues and expenditures as part of its public financial management modernization reforms. In Ghana, the e-Zwich biometric system was used to achieve public financial management objectives to resolve government payroll problems by consolidating salary payments digitally across various ministries and public agencies and strengthening tax administration.

International cooperation. Resolving some of these challenges may not be possible for individual governments and may require multilateral efforts. Digital markets facilitate the mobility of capital, which can enhance productivity but also make it easier for multinational corporations to shift or keep profits offshore in low-tax jurisdictions. This may intensify tax competition and international tax planning. New tax challenges from technology, such as the digital submission of fraudulent VAT refund claims in Europe (OECD 2017b), may each be too small or too difficult for individual tax administrations to tackle, despite the significance of fraud in the aggregate. Thus, there may be room for international efforts to overcome these fraud opportunities.

Policy Implications and Conclusions

Digitalization can bridge information gaps between governments and economic actors, improving the efficiency of policy and the lives of citizens. Greater information can enable governments to better enforce tax compliance, improve the delivery of public services, ensure participation in the social safety net, and design policies that are more consistent with individual circumstances and behavior.

Even if digitalization broadens options for governments to better design and implement policies, how viable these policies are ultimately depends on political resolve. The challenge is to adopt digital tools to enhance government policies, while mitigating the risks associated with digitalization. This will require action on several fronts:

- *A comprehensive reform agenda*. Digitalization is not a substitute for administrative capacity, institution building, or structural reform. For example, the case studies in this chapter suggest that although digitalization can help improve tax compliance and the efficiency of social protection spending, its success hinges on the implementation of parallel reforms, that is, an overall reform strategy is needed. In South Africa, the digitalization of tax administration was accompanied by initiatives to improve tax compliance. In India, reductions in leakages in the distribution of LPG subsidies were achieved not only with digital tools but also with a reform of the pricing mechanism.
- *Risk mitigation*. Governments will need to address the multiple sources of digital risks. Failure to deal with privacy issues and cybersecurity could compromise digitalization efforts. Lack of trust could erode the desire to participate in e-government or undermine policy objectives. In South Africa and India, lack of attention to privacy issues initially posed some important challenges to the digital programs for social protection.
- *Adequate resources.* Digitalization will not come without cost. Participation in digital governments requires substantial investments in capacity building and digital infrastructure, as well as resources to finance recurring costs to account for regular maintenance and cybersecurity. Governments need to create fiscal space to undertake these crucial investments.
- *International cooperation*. Greater exchange of information across countries can help governments uncover and tax hidden wealth and income, but the success of these exchanges in practice requires international cooperation to ensure enforceability and security of data exchanges. Furthermore,

the increase in the scale of cross-border activities associated with digitalization may call into question the very architecture of international taxation when it comes to the allocation of taxing rights. Such changes in corporate taxation will require coordination of policies to avoid unintended spillovers, tax competition, and double taxation. With digitalization, more efficient alternatives to source-based taxation—destination-based taxation—have become more viable.

Box 2.1. Digitalization Advances in Revenue Administration in South Africa and Estonia

South Africa and Estonia have made substantial efforts to digitalize their tax administrations. This box summarizes their efforts, drawing from the IMF's Fiscal Affairs Department technical assistance provided to these countries under the Revenue Administration Gap Analysis Program (IMF 2014a, 2014b).

South Africa

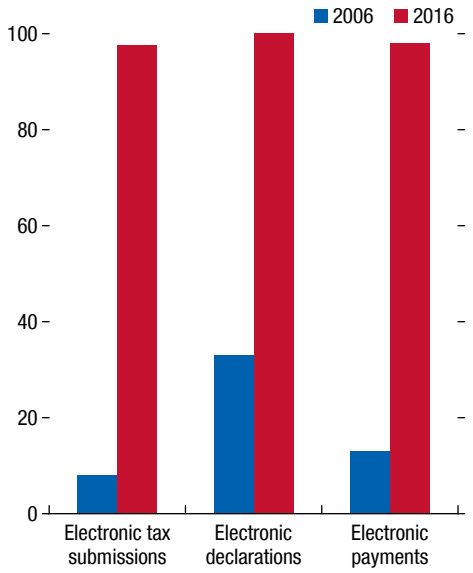
Reforms. The South African Revenue Service (SARS) implemented various initiatives to improve compliance risk management during 2001–06. These programs made extensive use of information technology (IT)–led automation and centralization. Starting in 2006, SARS modernized and automated administrative processes to achieve efficiency savings and reduce compliance costs. A national compliance analysis was introduced providing key performance indicators, and automated risk profiles were used for all taxpayers, while larger taxpayers were subject to additional checks.

Impact.[1] The VAT compliance gap trend from 2002 to 2012 shows the effects of these changes.[2] From 2002 to 2012, the VAT gap decreased from 30 percent of potential VAT to 5 percent, a substantial improvement. SARS's evaluation of individual digitalization projects and campaigns found improved service times, with automated risk processes leading to better audit results, and greater data efficiency reducing time spent by auditors on routine checks. Beyond improvements in compliance, digitalization efforts were also followed by improved revenue growth, improved service levels, and reduced costs. By 2016, service levels had measurably improved: 95 percent of personal income tax refunds were paid within 72 hours; 55 percent of value-added tax refunds were paid within 48 hours, up from 3 percent in 2006. In addition, 95 percent of personal income tax assessments were made within 3 seconds (down from 180 days in 2006), and more than 90 percent of customs transactions were processed in less than 22 minutes. The use of electronic tax submissions, customs declarations, and payments also improved substantially (Figure 2.1.1).

[1]The effects noted here relate to the period 2002 to 2016. There have been several subsequent changes in SARS management and tax administration, which may have affected revenue performance.

[2]The compliance gap is the difference between the tax that should be paid under existing law, assuming perfect compliance and no changes to economic activity, and that is actually paid.

Figure 2.1.1. Use of Electronic Transactions
(Percent of total taxpayers)



Source: South African Revenue Service and IMF staff estimates.

Moving forward, enhanced data collection should also lead to further improvements. The National Treasury and SARS have built a panel database of administration data for use by external researchers. The database merges administration data on companies and employees' earnings supplied by employers, as well as VAT and customs records from registered firms and traders. The database should enable rigorous studies of tax policy, economic analysis, compliance risks, and taxpayer behavior.

Challenges. Digitalization efforts were integral to the implementation of broader tax administration reforms. However, without sound supporting measures, leadership, and a strong commitment to improving service and reducing fraud and evasion, digitalization by itself will not produce such improvements. As a result, it is not possible to ascribe the progress observed during 2002–16 to the increased use of digital tools alone. In addition, digital inclusion remains a challenge. According to the International Telecommunications Union,

Box 2.1 *(continued)*

almost half of South Africans do not use the Internet.[3] A high VAT threshold has reduced the VAT tax base to a set of more professional taxpayers with sophisticated digital skills, a situation that cannot be replicated with broader tax bases without an adverse effect on tax revenues.[4]

Estonia

Reforms. The Estonia Tax and Customs Board (ETCB) has moved all tax processes online and made analysis of tax administration data an integral part of its operations. Micro-data from taxpayer returns and payments, merged with data from other government departments, are used to produce risk profiles and target lists. Micro-data are also used to identify emerging risks in missing trader intra-community (MITC) fraud—a type of cross-border VAT fraud and an endemic risk for Estonia as an EU member (see the section "What governments can do now: Same policies, better implementation"). In addition to more conventional methods, the ETCB Intelligence Department uses taxpayers' data to identify risks in VAT credit claims and anomalous taxpayer subpopulations. Tax officials also use longitudinal analysis of the data to identify high-risk and anomalous behavior over time (for example, rapidly repeated online adjustments by taxpayers that systematically reduce or reverse their liabilities). This more open approach to risk analysis allows the ETCB to identify and counter emerging MTIC threats more quickly.

Impact. In 2014, the ETCB introduced mandatory transaction-level e-filing for VAT and automated data matching to combat MTIC fraud. The measure made it mandatory for taxpayers to e-file purchase and sales invoices with their VAT returns. This allowed the ETCB to automatically match input tax credit claims against output tax payments, and investigate mismatches and nonmatching items. This is potentially a strong anti-MTIC measure, although it carries potentially high administrative burdens. The ETCB mitigated these by risk profiling the transactions before the data-matching stage so that only higher-risk invoices are checked. Since the measure was introduced, the compliance gap in Estonia fell from 14 percent of potential VAT in 2013 to 9 percent in 2014 and 5 percent in 2015 (one of the lowest gaps in the EU; see Center for Social and Economic Research 2017).

Challenges. The increased automation of tax administration also presents new risks. Online registration and filing allows tax fraudsters to efficiently create large numbers of entities and declarations at very low cost and rapidly generate online declarations without needing a physical presence or appearance of business. Fraudsters then react quickly to ETCB action, for example, by switching between sectors or commodities used in the fraud. It also allows fraudsters to generate multiple small credit claims with a low individual risk of detection but a high collective yield. Multiple claims of varying values and other characteristics are also submitted to test the parameters of ETCB's risk profiles, allowing the fraudsters to lower the risks of triggering an investigation or audit.

[3]The statistics may overstate the *effective* use of electronic tax filing given that although almost all personal income tax returns enter the system electronically, many are not entered by the taxpayer but rather by a SARS official in a branch office.

[4]The introduction of South Africa's high registration threshold increased net VAT revenues, as a result of the reduction in input tax credits claimed by micro businesses. Such an effect is largely unique to a VAT, and not found in other taxes.

Box 2.2. Digitalization and Property Taxation in Developing Economies

In many developing countries, property taxes are underused as a means to mobilize domestic revenues. They are only a small fraction as a percentage of GDP compared with revenues from this source in advanced economies (Figure 2.2.1), and there is widespread recognition that the revenue potential of urban property taxation in developing countries is significant (Franzsen and McCluskey 2017). Thus, these taxes could help finance infrastructure and service delivery in densely populated municipalities.

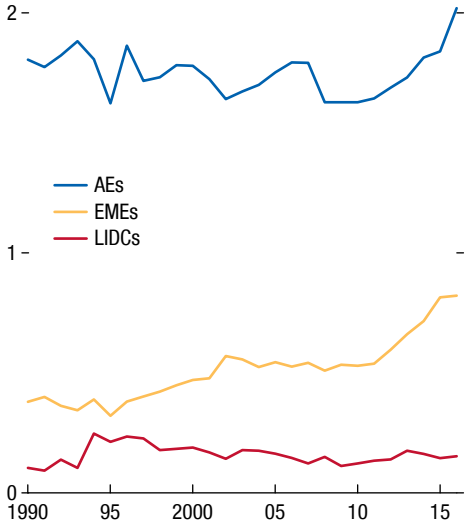
Why is collection so low? Property taxation faces many challenges in developing economies: the coverage of taxable properties is low; tax assessors inaccurately assess the value of property assets and the associated tax bill; tax administration is weak; and paper-based record-keeping facilitates the falsification of data. These combined factors contribute to poor revenue collection. Catching up with best practices in advanced economies requires an improved ability to identify property parcels and buildings, register their ownership, and map their geographic location in a central fiscal cadaster.

Advances in digital mapping technologies offer possible solutions. Before a jurisdiction can impose a property tax, it needs to identify and map all the taxable properties within its jurisdictional boundaries. Satellite imagery can be a highly effective tool to develop a powerful geographic information system (GIS)—a framework of technologies, policies, and institutional arrangements that together facilitate the creation, exchange, and use of geospatial data and related information resources across an information-sharing community of property tax designers and administrators. This can support tax administration in a cost-effective manner as the "eye from the sky" will not easily miss any expansion in capital improvements for a given property parcel. Geo-referencing can complement door-to-door field surveys on the nature, usage, type of construction, number of floors, and age of the buildings. This information can then be incorporated on a digitized map with GPS coordinates and be compared with current data on the property register, often revealing substantial information gaps. Thus, accelerated property tax collection becomes possible, even if a central (legal) cadaster of all registered properties has not yet been established.

Country experiences already validate the use of digitalization and big data manipulation to improve property tax compliance. Indian municipalities have recently made major strides in using satellite imagery to map properties and integrate this into a GIS (Kumar 2012). Recent work indicates that greater use of technology can detect pervasive property tax fraud (OECD 2017b; Ministry of Finance, Government of India 2017). In 2010, the effectiveness of satellite imagery to depict parcel characteristics proved its mettle in Greece. Taxpayers in the upmarket suburbs of Athens had to tick a box to indicate whether they owned pools. Reported pool ownership was significantly lower than the final tally, which was revealed after tax investigators perused satellite photos. This illustrates the value of applying technology against tax evasion.[1] In the United States, big data is used to identify residency and multiple property ownership

Figure 2.2.1. Average Property Tax Revenue
(Percent of GDP)

Property tax collection is relatively low in low-income developing countries.



Source: IMF, Fiscal Affairs Department World Revenue Longitudinal Dataset.
Note: AEs = advanced economies; EMEs = emerging market economies; LIDCs = low-income developing countries.

[1] *The New York Times*, May 2, 2010, "Greek Wealth Is Everywhere but Tax Forms." https://blogs.thomsonreuters.com/answerson/big-data-tax-assessors-office/.

Box 2.2 *(continued)*

to prevent fraudulent or improper tax payments.[2] By combining these data with aerial imagery and a GIS, tax authorities have detected irregularities and inconsistencies in property tax filings.[3] For example, in Anne Arundel County, Maryland, in the United States, budget constraints and rapid urban sprawl led to a situation where property appraisers could assess only a fraction of the properties under their jurisdiction. With a pilot program combining aerial imagery and property tax data, the county appraisers doubled the number of inspected properties. In the state of Louisiana, appraisers could analyze property changes using aerial images in relation to property tax records, and determine whether a field inspection was necessary. In 2014, this effort for only one parish revealed 6,000 property improvements that were not on the tax rolls, raising a further US$18.1 million in tax.

Importantly, going forward, the digitalization of property taxation opens exciting possibilities. First, the creation of a fiscal cadaster could be facilitated with satellite imagery or aerial photography by drones linked to a GIS. In addition, where valuation capacity for tax assessment is weak, digitalization could facilitate the application of area-based property taxes. The latter allows for a simplified formula approach that assigns values based on physical attributes to avoid the complexities of a value-based property tax based on annual rental value. This may provide a short- to medium-term response in countries with poorly developed property markets or limited valuation capacity.

[2]https://blogs.thomsonreuters.com/answerson/big-data-tax-assessors-office/.

[3]Under an area-based property tax, annual value is assigned based on the size of the property, and other property attributes such as location, age, nonresidential use, and occupancy.

Box 2.3. Digitalizing Government Payments in Developing Economies

In many developing economies, many government payments are transacted in cash. This includes transactions with individuals and firms, as well as between government entities. For a sample of seven emerging market economies in Asia, Africa, and Latin America,[1] representing 61 percent of developing-country GDP, Lund, White, and Lamb (2017) estimate that on average, the share of digital payments is 55 percent of the volume of government expenditures and 41 percent of the volume of government receipts. This compares to averages of 95 percent and 70 percent, respectively, in advanced economies. This suggests considerable scope to reap dividends from digitalizing government payments. In many countries, this has helped cut bureaucratic inefficiencies, reduce fraud and corruption, generate fiscal savings, and facilitate the delivery of benefits. This box summarizes the findings from Lund, White, and Lamb (2017), who provide estimates of the savings from the use of electronic payment systems for government transactions.

Lund, White, and Lamb (2017) identify three main sources of savings: reducing leakages, limiting fraudulent payments and tax evasion, and reducing the costs of processing payments within the government (Table 2.3.1). Based on existing literature, the authors estimate that 15–25 percent of the total value of payments is lost to leakage and fraud for government payments to individuals. For government payments to businesses, the leakage rate is lower, between 5 and 15 percent. For payments from individuals and firms to government, Lund, White, and Lamb (2017) assume that 5 percent of payments are lost to bribery. Savings from reductions in processing costs are estimated at $0.50 to $1.20 per transaction.

Based on these assumptions, the authors' calculations show that digitalizing government payments in developing countries could save roughly 1 percent of GDP, or about $220 billion to $320 billion in value each year. This is equivalent to 1.5 percent of the value of all government payment transactions. Of this total, roughly half would accrue directly to governments and help improve fiscal balances, reduce debt, or finance priority expenditures, and the remainder would benefit individuals and firms as government spending would reach its intended targets (Figure 2.3.1). These estimates may underestimate the value of going from cash to digital because they exclude potentially significant benefits from improvements in public service delivery, including more widespread use of digital finance in the private sector and the reduction of the informal sector.

[1]The seven countries are Brazil, China, India, Indonesia, Mexico, Nigeria, and South Africa.

Table 2.3.1. Sources of Savings from Digitalizing Government Payments

		Potential Sources of Savings		
		Leakage	**Fraud and Tax Evasion**	**Processing Costs**
Payments	To public employees	Salaries stolen by government employees	Payments to "ghost" workers	
	To individuals	Transfers stolen by government employees	Transfers to ineligible individuals	
	To businesses	Transfers or payments for procurement contracts stolen by government employees	Overbilling for goods and services	
Receipts	From individuals	Tax payments stolen by government collectors	Tax evasion by individuals	Savings from automated payments
	From businesses	Tax payments stolen by government collectors	Value-added tax collected by business but not paid to government Tax evasion by businesses	
Intragovernmental payments	Between government entities	Entities do not receive full transfers		
		Unreported payments for public goods and services		

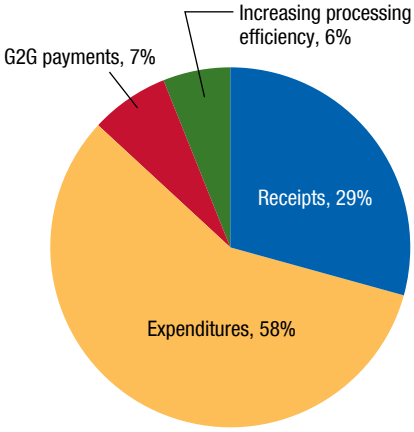
Source: Gupta and others 2017.

Box 2.3 *(continued)*

Figure 2.3.1. Savings from Digitalizing Government Payments

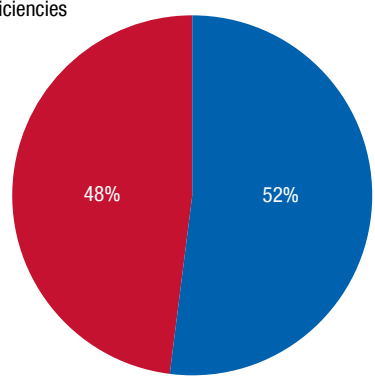
Digitalizing government payments in developing countries could save roughly 1 percent of GDP, or about $220 billion to $320 billion annually, shared equally between the private and public sectors.

1. By Source



2. By Recipient

To government from reducing leakage through fraudulent payments, leakage in G2G payments, and processing inefficiencies



To households and firms from reducing leakage in subsidies and payments

Source: Lund, White, and Lamb 2017.
Note: G2G = government to government.

Box 2.4. Using Real-Time Fiscal Data to Upgrade Macroeconomic Surveillance Systems

Traditionally, fiscal data for macroeconomic policy analysis are derived from periodic official reports, often published with significant time lags. However, countries at all levels of income are increasingly consolidating their government banking arrangements and implementing information technology systems designed to automate the management of the public finances. The digitalization of government payments and accounting systems mean that real-time daily fiscal data exist in many countries.

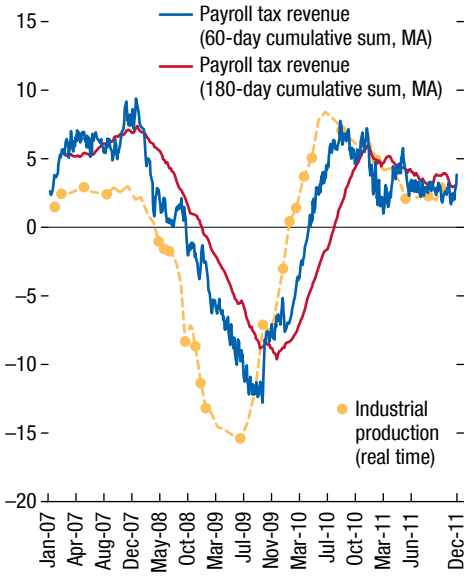
Such data can be useful to enhance macroeconomic surveillance, given their timeliness, ease of access (the infrastructure to provide high-frequency fiscal data is already in place), and relatively high reliability (they tend to have small ex post revisions, at least in cash terms). To date, this data source has largely been underexplored and underexploited, despite the seemingly obvious value that it can provide.

There are two main uses. First, real-time fiscal data can enhance the monitoring of revenue and expenditure aggregates in the context of fiscal surveillance and management. For example, they considerably improve the quality, accuracy, and timeliness of tax revenue trend and end-of-year forecast analysis (Misch and others 2017). Second, real-time fiscal data can enhance the forecasting of economic activity—the practice of nowcasting. Trends in daily tax data can mirror a large array of macroeconomic developments in real time. This is especially useful in countries where daily fiscal data are available but national accounts statistics are poor—that is, quarterly or monthly GDP data or monthly indicators of economic activity are either unavailable, unreliable, or significantly delayed.

Figure 2.4.1 illustrates that various indicators reflecting payroll tax revenue constructed from daily data from the United States mirror key features of the US business cycle (proxied by a seasonally adjusted indicator of industrial production) relatively accurately before, during, and after the global financial crisis. Importantly, the peak of the recession in 2009 is picked up by the payroll tax indicators with a lag of only a few weeks relative to the industrial production benchmark.

Figure 2.4.1. United States: Nowcasting Economic Activity
(Year-over-year change; percent)

Daily data on payroll tax revenue mirror key features of the US business cycle.



Sources: Misch and others 2017; Federal Reserve Economic Data St. Louis Fed; and United States Treasury Department.
Note: Payroll tax revenue series reflect year-over-year growth rates of cumulative payroll tax revenues. Both series have been smoothed using a moving average filter and differ in the length of the rolling window considered for the construction of cumulative sums (60 and 180 days, respectively). MA = moving average.

There are certainly drawbacks to nowcasting. The data also reflect noise and seasonality. In addition, they are largely unaudited and mostly reflect cash-based transactions only. However, taken together, there is a strong business case for much wider use of real-time fiscal data in governments and multilateral institutions alike. This will most likely disrupt the way surveillance operations are conducted, in part because the use of high-frequency real-time data requires some degree of automation to update macroeconomic analyses.

Box 2.5. Small Business Taxation and the P2P Economy

Peer-to-peer (P2P) platforms and their users have come under increasing scrutiny from governments and the public because of the perception that they are far less regulated than are traditional businesses operating in the same sectors. With increasing numbers of participants and a growing number of markets in which the P2P provision of goods and services can thrive, interest in the scale, scope, and taxation of the P2P economy is inevitable.

Some have argued that putting beneficial competitive pressure on restrictive practices is enhancing efficiency. P2P platforms could also help to formalize activities—in sectors such as household cleaning services—bringing them within reach of the regulatory and tax authorities. Others instead view a light government touch as distorting competition and giving individuals and businesses in the P2P economy an unfair advantage. If platform-based activities have tax advantages compared with traditional businesses, this violates the principle of tax neutrality. If P2P sellers/workers are indeed subject to lower taxation—because of preferential rates or simply underreporting of income—government tax revenues may also be at risk, especially if other, more tax-rich activities are being displaced. At the same time, issues such as the employment status of digital workers—employee versus self-employed—could also have important tax and expenditure implications.

If the fundamental economic activity in these new P2P businesses is different from that in traditional businesses in the same sector, are current tax policies sufficient to deal with them?

Small Is Bigger

A definitive approach for the taxation of P2P businesses depends on whether the government wants to minimize differences in tax treatment between traditional and P2P businesses, if any, or differentiate between them through the tax system. In this sense, the emergence of P2P activities does not seem to be driving a radical rethink of the tax system or the principles upon which it is based. Several of the issues in how to tax small businesses in the P2P economy are familiar.

With the growth in P2P workers/sellers, the number of unincorporated small businesses is increasing at the lower end of the income distribution (Hathaway and Muro 2013). These businesses may displace larger firms and reinforce existing well-known challenges for taxing large numbers of small businesses. Taxes are usually not only more difficult to collect from small businesses, but can be more distortionary since compliance costs are often relatively higher than for larger businesses. Moreover, tax revenues raised directly from small businesses in general remain modest. Although countries define their small business segments differently, findings suggest that they commonly account for less than 15 percent of domestic tax collections and often much less in low-income countries (IMF 2015).

The presence of more small businesses is therefore altering the revenue-compliance trade-off that has determined the choice of tax thresholds in the past: governments could consider lowering direct and indirect thresholds to bring a larger portion of small-business activity into the tax system. If so, this choice needs to be weighed against the risks of evasion, noncompliance, and higher administrative costs. For example, Figure 2.5.1 illustrates how low average annual gross incomes are in P2P accommodation rental, and subsequently fall below current indirect tax thresholds. However, lower tax thresholds come with the risk of increasing not only the implementation costs for both governments and small businesses, but also the noncompliance (legal and illegal) of the latter. Of course, if P2P sellers are recategorized as employees, these issues would become less relevant. Special tax rules for small businesses can also help, but the nature of P2P activity could amplify distortions. It is unclear how to balance the need for revenue with the distortionary impact of any special tax treatment, and, in time, the P2P economy could grow to such an extent that these special rules might become redundant—or even the norm.

A Role for Digital Platforms

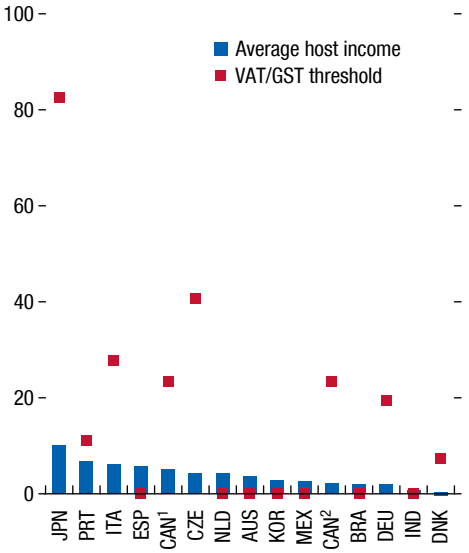
The P2P platforms present an important opportunity for tax policy and administration. As online intermediaries, they record data on the myriad of online market transactions that they oversee. Governments can cooperate with them to access these data, which would alleviate information constraints, strengthen enforcement, and allow better quantification of activity that had previously been misreported

This box is based on Aslam and Shah 2017.

Box 2.5 *(continued)*

Figure 2.5.1. Average Income from Airbnb, by Country versus Indirect Tax Thresholds
(Thousands of US dollars)

Host incomes are typically below the tax threshold.



Sources: Airbnb Inc.; and International Bureau of Fiscal Documentation.
Note: Data for each country can be either a national average or for a major city. VAT/GST = value-added tax/goods and services tax. Data labels in the figure use International Organization for Standardization (ISO) country codes.
[1]Vancouver.
[2]Montreal.

or undocumented—take, for example, the precedent set by Estonia, where P2P sellers on certain platforms can opt to have their incomes automatically reported directly to the tax authority.

Platforms can also act as custodians for the tax administration by withholding tax on behalf of sellers, something that is already taking place for single-stage indirect taxes—Airbnb's role in withholding and remitting hotel taxes in several countries is a case in point. Such arrangements could help ease compliance and administration while raising revenue, particularly in low-capacity countries, and again, allow tax authorities to revisit the revenue-compliance trade-off, and also ensure a level playing field between P2P sellers and traditional businesses operating in the same sector. However, attempting to levy direct (income) taxes through such withholding arrangements is more difficult, given that P2P sellers rarely use one platform exclusively and are likely to be earning multiple streams of income from different activities, for example, income earned both on- and off-platform, from either self-employment or employment. An end-of-the-year reconciliation based on a seller's reported income and costs might provide some solution, although at the expense of the desired simplification and lower administrative burden.

The tax treatment of the P2P economy ultimately depends on each government's preferences and capacity, and likely varies by country. Some governments may wish to minimize tax policy differences between P2P sellers and traditional businesses. Others may instead see the rise of the P2P economy as positive and choose to provide tax incentives to encourage it—for example, the United Kingdom introduced an allowance for income earned from online trading and property. Although the P2P economy has potentially exacerbated the administrative and revenue-mobilization challenges associated with small-business taxation, the technology of P2P platforms presents a valuable opportunity to eventually solve them.

Annex 2.1. The Digitalization of Public Finances: Country Case Studies

This annex summarizes digitalization efforts in Estonia, India, and Kenya that illustrate the experiences with digitalization across different income country groups.

Estonia

Reform Efforts

Estonia is one of the most digitalized countries in the world, with 99 percent of state services provided online.[43] This includes identification, signatures, tax filing, health records and prescriptions, school records, and voting. The most crucial components of Estonian e-government are digital identification of citizens and a digital data exchange system associated with a system of applications developed by different public and private institutions:

- *Digital identification*. The digital identification card, mandatory for all citizens, is an electronic chip with two pin codes for authentication and signing of online transactions, providing digital access to all of Estonia's secure e-services. The identification card is used for multiple purposes, including as a national health insurance card, proof of identification for banking services and digital signatures, to check medical records, for e-prescriptions, and for submitting tax claims.
- *Digital data exchange*. X-Road is the foundation of the e-government system of Estonia and is based on blockchain technology. It is a secure Internet-based data exchange layer that enables different information systems—public and private—to communicate and exchange data. An institution that wants to develop an online application can apply to join X-Road and obtain access to services such as client authentication, authorization, registry services, query design services to state-managed data repositories and registries, and secure data exchange. In addition to citizen-state interaction, X-Road is suitable for queries involving multiple agencies and information sources. An agency does not have to go through different databases to obtain information from various sources. Similarly, a parent wanting to apply for child benefits can use the X-Road system and gain access to all relevant data repositories (Vassil 2016).

[43]https://e-estonia.com/solutions/interoperability-services/x-road/.

The Estonian Tax and Customs Board (ETCB) was the first government body to introduce e-services (Sprackland 2017). All tax and customs declarations can be filed online. Using an identification card, a taxpayer can log online and retrieve tax forms. The system prepopulates the forms using data integrated through X-Road. The taxpayer can review the form, calculate required entries, and confirm the declaration. In addition to corporate income tax, companies can also declare social contributions.

Advances have also been made in public service delivery. In 2010, Estonia introduced electronic health records and prescriptions. The electronic health record system enables citizens to access their complete medical history from all health care providers in a national database in a standardized format. Doctors can view patients' records and review test results. E-prescriptions are also managed using a centralized database. Patients can pick up their prescriptions by using their digital identification cards.

E-school, introduced in 2003, is an online communication system among parents, teachers, and children. The purpose is to engage with parents more actively through a wide range of uses including the ability to share grades and attendance information in the system; the content of lessons, homework, and student evaluations for the teachers; access to grades and assigned homework for the students; the ability to review data entered by teachers and follow school work for parents; and access to the latest statistical reports for administrators.

Impact

Most of the services raise efficiency by saving money and time for the users as well as public officials. X-Road serves 52,000 organizations as indirect users and handles about 500 million queries each year[44] The government estimates that, in 2017, the use of digital technology and e-services saved more than 1,172 years of working time.[45] Two-thirds of the population uses the digital identification card regularly and digital signatures save five days per year.[46] About 95 percent of taxes are filed online and each filing takes on average

[44]https://e-estonia.com/solutions/interoperability-services/x-road/.

[45]This estimate assumes that every request saves 15 minutes and 5 percent of requests submitted via X-Road involve communication between people; therefore, using e-services helped save 7,182,262 working hours in the previous year. https://www.ria.ee/x-tee/fact/#eng.

[46]Government of Estonia, https://e-estonia.com/solutions/.

about three minutes. In addition to saving time, the digitalization has significantly strengthened Estonian revenue administration. The ETCB's collection efficiency was ranked among the best in the OECD, spending 40 cents to collect EUR 100 in taxes (OECD 2015c). Online services in health care and education are broadly adopted and heavily used. The e-health record receives 800,000 queries per year by doctors and patients; 97 percent of patients have digital records, and 99 percent of all prescriptions are digital. E-school is used by 85 percent of schools and has more than 200,000 active users—15 percent of the population.[47]

Risks and Challenges

A digital government provides new opportunities for fraud—in Estonia, such risks have materialized in tax administration. Cybersecurity has also been a source of concern. After its experience with the 2007 cyberattacks, Estonia developed protection against cyber vulnerabilities of a digitalized government. The country established scalable blockchain technology to mitigate risks concerning the security of data repositories and cyberattacks.[48] The blockchain technology ensures that the government and citizens have an immutable record of all data and transactions secured against manipulation by insiders or attackers. Moreover, the government plans to establish a data embassy housed in Luxembourg to provide a disaster recovery system capable of rebooting the country in the event of a cyberattack. In addition to technical infrastructure, Estonia's e-government is strongly regulated by legal acts that provide the basis for security and privacy protection of data stored in government repositories. For instance, the Personal Data Act (1996) protects the fundamental rights and freedoms of citizens.

India

Reforms Efforts

Social Spending

India's central government has implemented several digital platforms to overcome leakages in its subsidy scheme.[49] The so-called "JAM trinity" has three pillars:

1. *Jan Dhan* promotes financial inclusion, targeting universal access to banking facilities and facilitating the delivery of social benefits directly to bank accounts.
2. *Aadhaar*, the country's biometric identification system, provides each citizen with a 12-digit unique identification number with demographic and biometric information (fingerprint and iris scan). With 1.2 billion residents enrolled, this is the largest biometric program in the world.
3. *A mobile network* covering more than 1.16 billion phones[50] serves as an effective service delivery platform, especially in rural areas.

Under the Jan Dhan, bank accounts have been linked to Aadhaar cards. This has enabled the delivery of social benefits through direct electronic payments to eligible bank account holders. Programs linked to Aadhaar include the Direct Benefit Transfer scheme for LPG subsidies, the Public Distribution System for rice and wheat, and the Mahatma Gandhi National Rural Employment Guarantee Act program, which provides 100 days of work for unemployed workers in a year. In 2008, the government digitalized the program's wage payments and job applicants by linking their job cards to Aadhaar.

Public Procurement

The Indian government has also used digital technologies to enhance transparency in public procurement. E-procurement ensures secure online bid submission and access to bid opening events to all procuring entities, increases transparency of the bidding process, and reduces the corruption that was possible under offline tenders (Panduranga 2016). In October 2012, the government launched the online Central Public Procurement Portal, mandating ministries to channel all procurements above a certain threshold through the portal.[51] All ministries (and agencies under their administrative control) are required to use e-procurement (Roy and Rai 2017).

[47]https://e-estonia.com/.

[48]Estonia claims to have scaled a blockchain solution that meets higher demands in transaction volume and number of users.

[49]This annex discusses digitalization efforts of the central government. Several state governments have undertaken reforms as well.

[50]Telephone Regulatory Authority of India, Press Release No. 05/2018, January 11, 2018.

[51]The threshold was set at a value of Rs 1 million (US$58,000) in 2012 and lowered to Rs 0.2 million (US$11,600) in 2016.

Tax Collection

To prevent tax evasion, the Indian government introduced e-filing in 2007. The government made it mandatory for all firms requiring statutory audit and individuals with an income above a certain threshold to file taxes electronically.[52] At present, most taxes the central government collects are filed and deposited electronically. In 2017, the government required the Permanent Account Number—the taxpayer identification number—to be linked to Aadhaar for the processing of income tax returns. In fiscal year 2017/18, the government introduced the goods and services tax and maintained a single portal through the Goods and Services Tax Network, a nonprofit organization. The portal helps to reduce tax evasion because the central government can trace transactions and match invoices of taxable goods sold against all the taxable supplies bought by companies (Roy and Rai 2017).

Impact

Assessing the effect of digitalization is challenging. First, much of the discussion on the effect of digitalization has focused on the reduction leakages in the distribution of subsidies—the subject of some controversy. Digitalization can reduce leakages because of the elimination of ghost and duplicate beneficiaries and the reduction of corruption. Second, it is difficult to disentangle the effect of standalone digital measures. It is debatable whether Aadhaar was the sole source of savings or whether other parallel (digital) reforms contributed as well. Complicating matters, Aadhaar did not become mandatory immediately after its introduction. Various estimates have been put forward:

- Estimates of reductions in leakages through digitalization of LPG subsidies vary and are not always comparable. The Prime Minister (2015)[53] and the Ministry of Petroleum and Natural Gas (2016/17) report savings from the reform about Rs 150 billion (US$ 2.54 billion; 22 percent of major cash transfers) for 2014/15[54] whereas the Comptroller and Auditor General of India (2016) estimates savings about US$ 270 million (2 percent of major cash transfers) and Clarke (2015) around US$22 million (0.2 percent of major cash transfers). The Indian Ministry of Finance's Economic Survey estimates a reduction in leakages of 24 percent (Ministry of Finance, Government of India 2016) while Barnwal (2016) estimates a reduction in fuel diversion of 11–14 percent.
- By 2016, the Indian government reports Rs. 140 billion (US$ 2.1 billion) savings in the Public Distribution System (18 percent of major cash transfers in India)[55] as a result of the deletion of ineligible beneficiaries (23 million ration cards) and better targeting (Ministry of Petroleum and Natural Gas, Government of India 2016). Others (Khera, 2017) have questioned these savings by noting that deletions were related to beneficiaries who were not eligible for the Public Distribution System and that Aadhaar did not play a role in verifying eligibility criteria.
- Estimates of the impact of the digitalization of the Mahatma Gandhi National Rural Employment Guarantee Act program also vary considerably. The Ministry of Finance, Government of India (2017) reports that Rs 76 billion (US$1.2 billion and 11 percent of cash transfers) had been saved by 2015/16 because of Aadhaar integration and the digitalization of payments. In 2016/17, 9.3 million fake job cards were deleted.[56] However, Khera (2017) reports that about 13 percent of these cards were deleted for reasons such as erroneous identification, suggesting that a significant portion of deleted cards were not due to Aadhaar. In addition, Khera (2017) notes that the separation of implementing agency and payment agency (for example, banks and post offices) also helped in reducing fraud. Using a large-scale experiment that randomized the rollout of biometrically authenticated payments in the Mahatma Gandhi National Rural Employment Guarantee Act program for 19 million people in the state of Andhra Pradesh, Muralidharan, Niehaus, and Sukhtankar (2016) find that leakages were reduced by 41 percent relative to the control mean.

[52]Rs 0.5 million (US$29,000), about five times per capita income.

[53]http://www.pmindia.gov.in/en/news_updates/english-rendering-of-pms-address-to-the-nation-from-the-ramparts-of-the-red-fort-on-the-69th-independence-day/?comment=disable.

[54]Based on Banerjee's (2015) estimates of the value of major cash transfers in India of about US$11.3 billion. The major cash transfers are the LPG subsidy, National Rural Employment Guarantee Act (a cash-for-work-program), National Social Security Pensions, Janani Surakshana Yojana (maternal and girl child health-related incentives), and scholarships for higher education for selected communities.

[55]Based on Banerjee's (2015) estimates of the value of major cash transfers in India of about US$11.3 billion.

[56]"Fund Leakage: Nearly a Crore Fake 'Job Cards' Struck off from MGNREGA Scheme." *Hindustan Times*, April 9, 2017.

- The costs of Aadhaar implementation have been contained. Between 2009 and 2017, the Unique Identification Authority of India—responsible for Aadhaar enrollment and authentication—reports cumulative expenditures of Rs 87.9 billion (about US$1.5 billion) including operation and management of all its stages.[57] This implies a cost of US$1.25 per generated Aadhaar card. This compares favorably to the costs of other electronic identification systems of US$3 to US$6 (Gelb and Diofasi Metz 2018).

Beyond the controversy over the effect of Aadhaar on leakages, many authors have discussed its limits. Household surveys suggest that the experience of users depends positively on Internet availability. A survey of households in Rajasthan reveals problems related to authentication, with 4 percent of the respondents reporting that they could not authenticate themselves in a timely manner or at all (Gelb and others 2017). Based on a household survey in Jharkhand on the integration of Aadhaar in the Public Distribution System, Dreze and others (2017) find that exclusion errors occurred mainly because of fingerprint recognition problems and limited Internet connectivity. These surveys show the importance of establishing the appropriate digital infrastructure, including power, Internet and mobile connectivity, accurate links to Aadhaar, and alternative methods of verification (such as passwords) when biometric verifications fail. Considering these factors, the Supreme Court has recently ruled that Aadhaar can only be mandatory when citizens owe funds to the government (such as tax payments) but not in the distribution of social benefits.

Risks and Challenges

Privacy and security concerns for Aadhaar resurfaced in a landmark ruling by the Supreme Court of India in mid-2017.[58,59] The court ruled that privacy is a fundamental right, leading to uncertainty regarding the future use of Aadhaar identification. Given its broad coverage, however, it may be a challenge to phase it out. Advocates of the system assert that Aadhaar is compatible with the right to privacy because the captured biometric traits are encrypted, making it difficult for anyone who intercepts these images to access the actual content. However, the lack of sufficient security controls makes the system vulnerable to unauthorized access. In a recent data breach, it has been reported that Aadhaar numbers and the corresponding identities of 135 million Indian citizens were compromised when service providers used their access to steal identity information; privacy and security controls are therefore key when implementing large identification programs.

Kenya

Reform Efforts

Kenya stands out in sub-Saharan Africa for its success in pursuing and using digitalization. The introduction in 2007 of M-Pesa, a mobile-phone based money transfer service, has established the foundations for the use of digitalization in areas such as tax and customs administration and public financial management. M-Pesa allows users to make transfers, deposits, and withdrawals; pay bills; save and invest in small amounts; and pay taxes. M-Pesa has also spurred financial inclusion among the entire population and formal inclusion among women.[60]

Tax Administration

The Kenya Revenue Authority has implemented comprehensive reforms in revenue administration in recent times relying heavily on new technology as a key enabler. In 2013, the Kenya Revenue Authority introduced iTax, an online tax system that provides integrated and automated administration of all domestic taxes. It is a user-friendly system that allows access to multiple tax administration services. Taxpayers can register using a unique personal identification number, file and pay taxes, and monitor their tax status. Commercial banks and M-Pesa are integrated into the iTax system. In addition, several of its components help tax administration functions such as compliance, monitoring, tax return processing, enforcement of tax credits, debt management, management statistics, and reporting.

[57]https://uidai.gov.in/about-uidai/about-uidai/financials.html.

[58]"Right to Privacy Verdict Highlights: Govt Welcomes SC Judgment, Says It's a Fundamental Right, not Absolute." *Hindustan Times*, August 24, 2017.

[59]"Aadhaar Data Breaches Affected 135 Million Indians: Petitioners Tell SC." LiveLaw.in, January 7, 2018. http://www.livelaw.in/aadhaar-data-breaches-affected-135-million-indians-petitioners-tell-sc-read-rejoinder-affidavit/.

[60]Adult population served by financial services increased from 27.4 percent in 2006 to 75.3 percent in 2016 (Ndung'u 2017).

In response to the declining revenues from excises in 2013, the Kenya Revenue Authority moved to a new system to strengthen the enforcement of excise duties on all excisable products except motor vehicles. Key to the system was the rollout of the excisable goods management system, which enables the Kenya Revenue Authority to track and trace stamped and unstamped products throughout the supply chain to prevent smuggling and misreporting of volumes. The system also helps in managing stock and inventory and preventing theft of stamps (African Tax Administration Forum 2016).

Customs Administration

Since 2017, the Kenya Revenue Authority has embarked on several reforms to strengthen customs compliance and reduce revenue leakages from cargo undervaluation. In 2017, the Kenya Revenue Authority started the rollout of the Integrated Customs Management System to replace the aging web-based SIMBA system that was exploited for tax evasion (Gitaru 2017). The Integrated Customs Management System aims to consolidate all customs cargo clearance processes and includes components for functions such as automated valuation benchmarking, automated release of green-channel cargo, importer validation and declaration. In addition, the system has two-way iTax integration, which enables data sharing on importers to monitor domestic tax declarations. Another key digital initiative for customs administration is the Regional Electronic Cargo Tracking System launched in early 2017, which monitors transit cargo along the north, connecting Kenya with Uganda and Rwanda, and is expected to reduce or eliminate customs revenue leakage.

Public Financial Management

In 2014, the Kenyan government launched e-Procurement, an online system for submitting and evaluating procurement applications. The aim was to increase efficiency, strengthen governance, and reduce processing time. The system is currently only being used on simpler, more straightforward types of procurement. The government is working with the Kenyan ICT Authority to extend the coverage of the system to include all government entities (such as state-owned enterprises).

To facilitate project monitoring, the Ministry of Finance introduced the Electronic Project Monitoring Information System (e-Promis) in 2009. e-Promis aimed to coordinate and align development efforts, harmonize project delivery, measure project performance, strengthen accountability, and manage project resources and was designed to provide physical and financial project information to users throughout the government.

Impact

Through digital automation, iTax has strengthened coverage and reduced the costs of tax collection, simplified the tax-filing process, increased customer satisfaction, and reduced compliance costs. Since its introduction, the expanded tax base and administrative reforms enabled through enhanced digitalization have increased tax collection (Ndung'u 2017). iTax increased tax compliance levels while reducing human error and fraud vulnerabilities through comprehensive automation. For example, the number of steps for corporate income tax filing decreased from 59 to 16 (African Tax Administration Forum 2016).

Risks and Challenges

There are also risks and vulnerabilities in the new administrative process. System vulnerabilities arise from cybercrime, data theft, and performance challenges. It will be important to build a workforce with adequate skills and to ensure proper network coverage. Another challenge is to increase, in a population with relatively low computer literacy, the number of users who adopt digital platforms.

Annex 2.2. Estimating the Impact of Digitalization on Tax Evasion from Cross-Border Fraud

Estimating the Effect of Digitalization

Cross-border trade fraud resulting from customs duty, excise, and value-added tax (VAT) evasion has important public revenue implications. Previous empirical literature has mainly focused on documenting the extent of tariff evasion, typically relying on disaggregated industry-by-industry measures of misreporting (Fisman and Wei 2004; Mishra, Subramanian, and Topalova 2008; Jean and Mitaritonna 2010). Much less attention has been given to the implications of trade fraud on excise and VAT revenue even though the latter accounts for a large portion of the estimated

VAT gaps in the European Union (EU) (for an exception, see Gradeva 2014).[61]

This annex builds on the work of Kellenberg and Levinson (2016) to link aggregate trade misreporting to indicators of digital government and other cross-country controls. More specifically, we estimate the following:

$$\frac{V^{m}_{xmt} - V^{x}_{xmt}}{(V^{m}_{xmt} + V^{x}_{xmt})/2} = \beta_0 + \beta_1 Z^{\sigma}_{xmt} + \beta_2 Z^{m}_{xmt} + \beta_3 Z^{x}_{xmt} + a_t + a_{xm} + \varepsilon_{xmt} \quad (2.2.1)$$

where V^{m}_{xmt} is the annual total trade shipped from exporting country x to importing country m as reported by the importer; V^{x}_{xmt} is the same value as reported by the exporter. The dependent variable is defined as the difference between these two values and proxies trade misreporting. This difference is subsequently normalized by the average reported trade flow to form the so-called trade gap.[62] In general, the trade gap between two countries tends to increase with the distance between the two trading partners, since in practical terms, the value reported by exporters is free-on-board while the value reported by importers includes cost, insurance, and freight. Thus, the set of independent variables considered includes a matrix of bilateral proxies for cost, insurance and freight $Z^{\sigma}_{xm}t$ (including distance, common borders and languages as in typical gravity-type models of international trade), as well as dummies to capture year-specific (a_t) and country-pair specific fixed effects (a_{xm}) that may drive those costs.

To assess which underlying factors—including the potential role played by digitalization—determine the size of the trade gap, a gravity model approach is used. Recognizing that the trade gap could be driven by both importer and exporter characteristics, matrices of observable country characteristics ($Z^{m}_{xm}$and Z^{x}_{xm} for importers and exporters, respectively) such as VAT rates and weighted average tariff rates are included that may be related to incentives to misreport trade flows. In addition, typical trade gravity models include variables such as GDP and GDP per capita to proxy for the size and development level, respectively, of each partner, while inflation and exchange rates are also included here as they may affect the value of the transacted goods while in transit. Controlling for trade-related variables, including whether a country participates in regional trade agreements, or whether it is a member of the General Agreement on Tariffs and Trade or the World Trade Organization, is also useful in proxying for unobserved customs collaboration. Last, country-pair specific time-invariant characteristics—such as distance between two countries and dummies denoting the existence of a common language, a common currency, and a common border—are taken into account.[63]

The main regressor of interest is digitalization as proxied by the United Nation's Online Service Index. This variable assesses the scope and quality of public sector online services, including online services for tax submission and registration of businesses. The index is normalized between 0 and 1 and it is available since 2003. There are some drawbacks to this index—for example, assessments can be subjective and surveys of government sites may not be comprehensive. However, the index is significantly correlated to other digitalization indices available and was chosen because of its broader sample coverage across countries and over time compared to the World Bank's Digital Adoption Index and World Economic Forum's Government Success in ICT Promotion (see Annex Table 2.2.1).[64]

The bilateral trade data are obtained from the IMF's Direction of Trade Statistics, which reports the values of imports and exports in US dollars. The macro-variables were obtained from the *World Economic Outlook*, the World Development Indicators, and the IMF's Fiscal Affairs Department Tax Database. CEPII's Gravity Dataset was used for trade agreement participation and distance. Governance indicators on the control of corruption, the implementation of the rule of law, and effective governance were retrieved from the World Governance Indicators database (see Annex Table 2.2.2 for the variables and data sources used). Controlling for such indices prevents confound-

[61]The share of the missing trader intra-community fraud in the VAT gap has been estimated to average 24 percent, with the remainder of the VAT gap attributed to losses of revenue arising from other factors such as domestic fraud and evasion (see European Commission 2017, p. 20).

[62]The trade gap as defined can have a maximum value of 2 and a minimum value of –2. The estimation below is robust to the exclusion of such extreme values.

[63]The effect of some of these time-invariant regressors is absorbed by the country-pair fixed effects a_{xm}.

[64]The index has been combined with human capital and telecommunication technology indicators to form alternative composite digitalization indices, such as the United Nation's e-government index and the World Bank's Digital Adoption Index.

Annex Table 2.2.1. Pairwise Correlations of Digitalization Indices

		Online Service Index	E-Government Index	Digital Adoption Index	Government Success in ICT Promotion
Online Service Index	Correlation	1			
	Observations	1,488			
E-Government Index	Correlation	0.89***	1		
	Observations	1,488	1,488		
Digital Adoption Index	Correlation	0.85***	0.75***	1	
	Observations	186	186	186	
Government Success in ICT Promotion	Correlation	0.46***	0.44***	0.49***	1
	Observations	282	282	144	566

Source: IMF staff calculations.
Note: *** Statistical significance at the 1 percent level. ICT = information and communication technology.

ing the estimate of digitalization with the effect of broader governance factors.

Annex Table 2.2.3 shows the main results of estimating the gravity equation (2.2.1) on the set of determinants of bilateral trade gaps described earlier. The first three columns refer to the sample of 28 EU countries over the period 2003–16. A distinct advantage of using the EU subsample is to stress that trade misreporting may occur even within customs unions, where misreporting incentives lie on incentives to evade VAT and excises rather than customs duties.[65] Column (1) estimates the gravity equation (2.2.1) via ordinary least squares (OLS), and point estimates suggest a positive association between digitalization indices and the trade gap, implying less underreporting of imports relative to

[65]Missing trader fraud is not specific to the EU. However, the European Commission has recognized this problem to be an important one, and has incorporated estimates of VAT fraud in its VAT gap analysis.

Annex Table 2.2.2. Data Sources

Variable	Data Source
Bilateral exports	IMF: Direction of Trade Statistics
Bilateral imports	IMF: Direction of Trade Statistics
Common currency	CEPII: Gravity Dataset
Common official/primary language	CEPII: Gravity Dataset
Common religion	CEPII: Gravity Dataset
Contiguity	CEPII: Gravity Dataset
Control of corruption	WB: World Governance Indicators
Digital Adoption Index	WB: World Development Report 2016
E-Government Index	UN: E-Government Survey 2016
Exchange rate	WB: World Development Indicators
GDP	IMF: World Economic Outlook
GDP per capita	IMF: World Economic Outlook
Government effectiveness	WB: World Governance Indicators
Government success in ICT promotion	WEF: The Global Information Technology Report 2016
Inflation rate	WB: World Development Indicators
Online Service Index	UN: E-Government Survey 2016
Origin is GATT/WTO member	CEPII: Gravity Dataset
Patents filed by residents	WB: World Development Indicators
Population-weighted distance	CEPII: Gravity Dataset
R&D expenditure (percent of GDP)	WB: World Development Indicators
Regional trade agreement	CEPII: Gravity Dataset
Rule of law	WB: World Governance Indicators
Tariff rate (weighted mean)	WB: World Development Indicators
VAT rate	IMF: Tax Rate Database

Note: CEPII = Centre d'Etades Prospectives et d'Informations Internationales; GATT/WTO = General Agreement in Tariffs and Trade/World Trade Organization; ICT = information and communication technology; R&D = research and development; UN = United Nations; VAT = value-added tax; WB = World Bank; WEF = World Economic Forum.

exports when trade partners make progress in terms of digitalization.[66]

Columns (2) and (3) replicate the previous exercise via two-stage least squares (TSLS), which aims to address potential problems related to omitted variable bias and reverse causality. Such concerns could arise if, for example, a higher incidence of import misreporting mobilized public authorities of the importing country to foster digitalization efforts so as to reduce tax evasion. In such a case the estimated effect of digitalization is biased downward, given that the policy decision to improve digitalization is negatively correlated with the trade gap and positively correlated with the digitalization index. Thus, in this setting the digitalization index is treated as endogenous and two variables are used as instruments. The first is the country level of research and development (R&D) intensity (R&D expenditure in percent of GDP; Method 1). The second instrument is a measure of R&D efficiency—the ratio of patents to R&D intensity (Method 2). The exclusion restriction relies on the assumption that the trade gap itself is not correlated with differences in the instruments once macro-variables such as GDP and GDP per capita are explicitly controlled for. The last row in Annex Table 2.2.3 reports the first-stage Kleibergen-Paap F statistics, which exceed the Stock and Yogo (2005) critical values for weak instrument diagnostics, suggesting strong instruments.[67]

Results highlight a coefficient estimate for the importer's digitalization that is higher in magnitude (and equally statistically significant) than the OLS estimate. This is consistent with possible endogeneity. The negative coefficient on the importer's VAT rate is in line with the assumption that the incentive to underreport imports rises with the VAT rate.

Columns (5) and (6) broaden the sample to include all trading partners available in the Directions of Trade Statistics database, that is, a sample of 86 countries. The resulting estimates confirm the previous EU subsample conclusion that importer's digitalization index is positively associated with the reporting of imports in the TSLS estimation. The estimation includes an index to control for corruption.[68] Columns (4) to (6) show that the exporter's control of corruption is also positively associated with the trade gap, in line with the assumption that collusion with exporters and the misreporting of imports are less likely as the control of corruption is strengthened. The coefficient estimate on importer's digitalization will be used in the simulation exercise that follows, which aims to assess governments' revenue gains from advancing on digitalization.

Estimating Revenue Gains

A back-of-the-envelope calculation of the potential revenue gains accrued from reducing trade fraud exploits the regression specification (2.2.1) holding other factors constant and using column (5) or (6)'s estimated coefficient on the digitalization index (1.181 or 1.733). Denote $V^{m}_{Total} = \sum_{x} (V^{m}_{xm})$ and $V^{x}_{Total} = \sum_{x} (V^{x}_{xm})$ the aggregated bilateral trade value flows at the importing-country level. Assuming that the importer's digitalization advancements increase reported imports V^{m}_{Total} without affecting V^{x}_{Total}, one can proxy the potential revenue gain from the corresponding increase in reported imports relative to exports as follows:

$$\text{Revenue Gain}_{\tau} = \tau_{rate} \times \Delta\left(V^{m}_{Total} - V^{x}_{Total}\right) \qquad (2.2.2)$$

where τ_{rate} refers to the tax rate of interest (that is, VAT or tariff rate).

Specification (2.2.1) could be rearranged to alternatively express the right-hand-side term of equation (2.2.2) in terms of the change in the digitalization index of the importer, Δz^{m}, and its estimated impact β^{m}_{digit}:[69]

$$\text{Revenue Gain}_{\tau} = \tau_{rate} \times \frac{1}{2}\left(V^{m}_{Total} + V^{x}_{Total}\right) \beta^{m}_{digit} \times \Delta z^{m} \qquad (2.2.3)$$

Reducing the distance to the digitalization frontier for each importer by 50 percent suggests advancing digitalization from its current value z^{m} by $\Delta z^{m} = 0.5 \times (1 - z^{m})$, as the maximum value the

[66]The underreporting of imports can occur both when the gap is positive and when the gap is negative. The main channel at work is that improved digitalization of the importing country is positively correlated with the recording of imports, and therefore with the revenue resulting from imported goods.

[67]The standard errors reported in the regressions are robust to allow for different variance across country pairs. The results are robust to clustering standard errors at the country-pair level to account for bilateral trade correlation across time.

[68]Results are robust to the inclusion of alternative governance quality indicators, such as the rule of law or government effectiveness indices provided by the World Governance Indicators database.

[69]Rearranging specification (2.2.1) to obtain equation (2.2.3) assumes that, except for the digitalization index, the remaining set of determinants and imports in the denominator of the trade gap are held constant. Holding constant imports in the denominator effectively biases our estimate downward, allowing for a conservative estimate of the gains from reaching the digitalization frontier.

Annex Table 2.2.3. Trade Gap Regressions Using Intra-EU and All Partners Trade Data

Specification	(1)	(2)	(3)	(4)	(5)	(6)
Regressors/estimator/sample	OLS (EU)	TSLS-1 (EU)	TSLS-2 (EU)	OLS (All)	TSLS-1 (All)	TSLS-2 (All)
Im.Digitalization Index	0.186*	1.284**	0.841*	–0.069*	1.181**	1.733*
	(0.107)	(0.505)	(0.436)	(0.036)	(0.575)	(0.937)
Ex.Digitalization Index	0.383***	0.703	0.304	0.066*	0.054	–0.982
	(0.13)	(0.53)	(0.44)	(0.038)	(0.701)	(0.927)
log Im.GDP	0.385	1.570*	1.227*	–0.370***	–0.831***	–0.861***
	(0.61)	(0.827)	(0.721)	(0.114)	(0.191)	(0.221)
log Ex.GDP	–1.385**	–1.03	–1.599**	0.947***	1.475***	1.436***
	(0.647)	(0.829)	(0.788)	(0.107)	(0.194)	(0.225)
log Im.GDP per capita	–0.597	–1.817**	–1.427**	0.334***	0.671***	0.643***
	(0.499)	(0.753)	(0.659)	(0.12)	(0.194)	(0.241)
log Ex.GDP per capita	0.889*	0.537	1.094	–0.824***	–1.380***	–1.243***
	(0.534)	(0.756)	(0.712)	(0.111)	(0.203)	(0.25)
log Im.inflation rate	0.624	0.299	0.316	0.189*	–0.770**	–1.108**
	(0.562)	(0.629)	(0.565)	(0.112)	(0.313)	(0.56)
log Ex.inflation rate	1.177**	1.060*	1.242**	–0.157	–0.104	0.502
	(0.539)	(0.603)	(0.556)	(0.098)	(0.343)	(0.525)
log Im.exchange rate	–0.076	–0.04	–0.002	0.077**	0.184*	0.339*
	(0.113)	(0.142)	(0.121)	(0.035)	(0.094)	(0.177)
log Ex.exchange rate	0.201	0.215	0.113	–0.004	–0.052	–0.251
	(0.152)	(0.163)	(0.146)	(0.033)	(0.103)	(0.168)
Importer VAT rate	–0.004	–0.029**	–0.02	0.005	0.003	0.004
	(0.008)	(0.014)	(0.013)	(0.004)	(0.007)	(0.009)
Exporter VAT rate	–0.015	–0.022	–0.012	–0.011***	–0.001	–0.012
	(0.009)	(0.016)	(0.014)	(0.004)	(0.008)	(0.009)
Importer tariff rate				–0.005**	0.003	0.005
				(0.002)	(0.004)	(0.006)
Exporter tariff rate				–0.011***	–0.013***	–0.010*
				(0.002)	(0.004)	(0.005)
Importer corruption control				–0.063**	–0.103*	–0.141*
				(0.03)	(0.056)	(0.075)
Exporter corruption control				0.121***	0.155***	0.166**
				(0.029)	(0.059)	(0.071)
Im.Rule of Law				0.070*	0.162**	0.224**
				(0.036)	(0.077)	(0.114)
Ex.Rule of Law				–0.107***	–0.127	–0.249**
				(0.033)	(0.081)	(0.104)
Im.GATT/WTO Member				–0.158***	–0.419**	–0.548**
				(0.04)	(0.163)	(0.248)
Ex.GATT/WTO Member				–0.019	0.066	0.269
				(0.036)	(0.178)	(0.232)
Number of observations	716	716	670	36,626	13,318	10,944
R^2	0.060			0.013		
F-stat (first stage)		13.05	26.45		16.34	17.24

Source: IMF staff calculations.

Note: Robust standard errors in parentheses, *, **, *** denote statistical significance at the 10, 5, and 1 percent levels, respectively. Controls include country fixed effects, year fixed effects, and time trends (linear and quadratic) omitted for reasons of parsimony. "Im." refers to importer and "Ex." refers to exporter. TSLS-1 and TSLS-2 use as instrumental variables R&D in percent of GDP and the logarithm of patents over R&D intensity, respectively. EU = European Union; GATT/WTO = General Agreement on Tariffs and Trade/World Trade Organization; OLS = ordinary least squares; R&D = research and development; TSLS = two-stage least squares; VAT = value-added tax.

Annex Table 2.2.4. Median Revenue Gains per Country Group from Closing Half the Distance to the Digitalization Frontier, 2016
(Percent of GDP)

	VAT Revenue Gains	Tariff Revenue Gains
Advanced Economies	(0.7 – 1.0)	(0.04 – 0.06)
Emerging Market Economies	(0.7 – 1.0)	(0.2 – 0.3)
Low-Income Developing Countries	(1.2 – 1.7)	(0.4 – 0.5)
EU-28	(0.3 – 0.5)	

Source: IMF staff calculations.
Note: Latest available VAT rates were used to compute the revenue gains. EU-28 = European Union group of 28 countries (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Ireland, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Sweden, Spain, United Kingdom); VAT = value-added tax.

digitalization index can attain is one. The revenue gains reported in the main text correspond to equation (2.2.3) applying the latest country-specific VAT and weighted tariff rates, along with the average trade flow (V^{m}_{Total} - V^{x}_{Total}) reported in 2016, and assuming β^{m}_{digit} = 1.181 *or* 1.733.

The results are reported in Annex Table 2.2.4.

Annex 2.3. Estimating the Distribution of Tax Revenue Collection from Offshore Income and Wealth following Improved Cross-Country Information Exchange

Estimating Potential Tax Revenues from Low-Tax Jurisdictions

Recent studies of offshore income and wealth tax evasion (for example, Zucman 2013, 2015; Alstadsaeter, Johannesen, and Zucman 2017) have relied on either cross-border portfolio securities data from national banks or anomalies in global investment statistics to estimate the value of assets held by individuals in low-tax jurisdictions. These estimates provide an upper bound on the potential tax revenue gain from taxing offshore asset holdings, under perfect enforcement and 100 percent effective tax rates.[70] The analysis presented in this chapter estimates the size of potential revenue gains from income and wealth sheltered in low-tax jurisdictions as follows:

[70]Implicitly, these estimates also assume none of the estimated wealth and dividend income is being declared to the proper tax authorities. Furthermore, the estimates exclude potential revenue from taxation of interest payments and capital gains—the direction of the bias introduced by such assumptions on the figures above is unclear ex ante (because it depends, for example, on whether the average interest rate applicable to the share of assets held as debt securities is higher or lower than the assumed rate of return on equity). The estimates are a first approximation of potential revenue and do not account for all specific characteristics of domestic tax systems, such as thresholds for wealth taxes, whenever applicable.

Estimating the potential tax base and revenue gains. The potential tax base lying offshore is estimated by country. Zucman (2015) constructs such explicit estimates for 14 countries using Swiss National Bank data, and shows only aggregate regional estimates for Gulf countries, Africa, Latin America, and Asia. In this chapter country-by-country estimates of potential revenue are estimated as follows:

$$R^{P}_{it} = \tau^{ef}_{it} \times Country\ \ Share_{it} \times Global\ Offshore\ Wealth_{t} \quad (1)$$

where

R^{P}_{it} represents potential revenue for country i at year t,

$$\tau^{ef}_{it} = \tau^{div}_{it} \times r(nominal) + \tau^{inh}_{it} \times m + \tau^{w}_{it} \quad (2)$$

where *r(nominal)* is a nominal rate of return on offshore assets (set at 8 percent based on 10-year returns on Vanguard diversified funds as in Zucman (2015), and m represents the mortality rate (the so-called economic flow of inheritance) of offshore account holders (set at 3 percent as Zucman (2015) and constant across countries).[71] Moreover, τ^{div}_{it} stands for the country's standard dividend income tax rate, τ^{inh}_{it} the standard estate or inheritance tax rate, and τ^{w}_{it} the country's wealth tax rate, if any. Tax rates are taken from the International Bureau of Fiscal Documentation's Country Key Features Comparison Table.

- $Country\ Share_{it}$ is country i's share of Bank for International Settlements (BIS) deposits in offshore financial centers (from the locational banking statistics database) at time t.[72] This share approximates

[71]See tables and figures included here: http://gabriel-zucman.eu/hidden-wealth/. Underlying assumptions are explained in the footnote of Table Data-Fig4_Tab1.

[72]These data provide bilateral cross-border deposits by nonbank nonfinancial counterparties for more than 200 saving countries in 20 offshore financial centers that have been taken to approximate

Annex Table 2.3.1. Median Offshore Wealth and Revenue Potential, 2016
(Percent of GDP)

	Advanced Economies	Emerging Market Economies	Low Income Developing Countries	Full Sample
Offshore Wealth	11.48	12.42	6.49	10.29
Revenue Potential	0.24	0.13	0.07	0.13
Number of Countries	34	83	61	178

Sources: Bank for International Settlements; Zucman 2015; and IMF staff estimates.
Note: The number of observations corresponds to the sample with available data for offshore wealth; the samples used in estimating revenue potential are smaller because of data constraints.

the share of total savings by residents of country i at year t in low-tax jurisdictions. These data have been more recently used by Alstadsaeter, Johannesen, and Zucman (2017) to estimate several large countries' offshore wealth.[73] The resulting median shares by income country group are robust to the inclusion and exclusion of individual low-tax jurisdictions from the sample. However, this distribution is sensitive to using a country's share of bank deposits as a proxy for its share of financial wealth (*Country Share*$_{it}$). An alternative is to use data on portfolio securities. Using the Coordinated Portfolio Investment Survey's share of portfolio investment assets issued by offshore financial centers and held by residents of several of the countries with the largest BIS deposit shares across income groups suggests the distribution presented here may slightly overestimate the financial wealth allocated to residents of emerging market economies and low-income developing countries, and may underestimate the share allocated to residents of advanced economies—with the only substantially significant difference being observed for one country. Note that although the distribution of wealth across countries varies, the results on median wealth and potential revenue estimates by income country group remain.

- *Global Offshore Wealth*$_t$ is Zucman (2015)'s global offshore wealth estimate of $7.6 trillion.

The results are reported in Annex Table 2.3.1.

low-tax jurisdictions. BIS data report only direct bilateral banking relationships, so a country with a resident "depositor" is not necessarily the country of residence of the ultimate beneficiary. In addition, because BIS deposit data excludes portfolio securities holdings, the allocation described implicitly assumes the cross-country distribution of overall financial wealth mirrors that of banking deposits reported to the BIS.

[73]https://gabriel-zucman.eu/files/AJZ2017b.pdf.

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