



Policy Challenges of Cross-Border Cloud Computing

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Abstract

Providers of cloud computing services are increasingly serving customers outside their home markets and using service delivery models that require the transmission of data across borders. In this article, we present an overview of the global market for cloud services and explore the role of cloud computing in U.S. exports. We then examine the main policy challenges associated with cross-border cloud computing—data privacy, security, and ensuring the free flow of information—and the ways that countries are addressing them through domestic policymaking, international agreements, and other cooperative arrangements. Finally, we identify the particular challenges faced by developing countries as they seek to participate in the market for cloud computing services. Our discussion includes case studies of two of the most important emerging markets for such services—China and India.

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Introduction

This article examines the international dimensions of cloud computing. Particularly, we are interested in exploring the many policy areas that are implicated as the cloud computing industry grows and becomes more global. We also provide some context on the pace of the industry's growth and possible level of exports. As cloud technology evolves, policies in the areas of data privacy, security, and the free flow of data struggle to keep pace. Policymakers use various tools, including international cooperative forums, bilateral and multilateral trade agreements, and domestic policy to address challenges in these areas. We review these major policy areas of importance to the cloud computing industry and the attempts to address them. Meanwhile, developing countries such as China and India seek to participate in this growing industry and need to consider both international policy uncertainties related to the cloud as well as their own domestic infrastructure and regulatory challenges in order to effectively contribute to the development of the industry. We provide brief case studies of what each of these countries is doing to meet these challenges.

Definition

The term “cloud computing” has entered common usage and has been used to describe a wide range of services offered over the Internet. As such, it can be difficult to differentiate the cloud from other, related Internet and IT services. Some familiar examples help highlight the characteristics that define cloud-based services. Among the cloud services most familiar to consumers are Web-based email (e.g., Gmail), photo hosting sites (e.g., Snapfish), and online financial management programs (e.g., mint.com). What all three of these familiar programs share is that they allow customers to access their data from any Internet-enabled device without installing any files on their computer. Emails, photos, and financial records are stored on the cloud provider's servers, and the provider supplies access to them anytime at the customer's request.

There are several additional technical aspects of cloud computing that differentiate it. The most commonly accepted definition of cloud computing was developed by the National Institute for Standards and Technology (NIST). According to that definition, “Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”²

² USDOC, *The NIST Definition of Cloud Computing*, September 2011.

NIST goes on to describe five essential characteristics of cloud computing. These characteristics can be summarized as follows:

- On-demand self-service: This means that the customer can access and manipulate his or her data without interacting with the cloud service provider and that the service will adjust automatically to meet these needs.
- Broad network access: Because cloud services are accessed over a network, they can usually be accessed through any Internet-capable device. For example, a user of cloud-based email can access their up-to-date email inbox through a smartphone or any Internet-connected computer. Any changes the user makes will be reflected when they open their email inbox from another device, and newly received emails will be available.
- Resource pooling: Resources are shared between many or all of the customers of a cloud service provider. Although the service can often be customized to meet security requirements, generally, the provider's storage, processing, and network bandwidth capabilities (among other resources) are shared among customers.
- Rapid elasticity: The allocation of resources is easily adjusted as customers' needs change (that is, as a customer's demand for the cloud service grows or shrinks at any given time). In some cases, this can be managed automatically.
- Measured service: According to NIST, "Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service." For cloud services that are not free to the customer, the customer typically pays only for what he or she uses. This is different, for instance, from packaged software, for which a customer pays a set license fee and then receives a copy of the entire, standardized software package.³

There are three types of cloud services. Software as a Service (SaaS) is comprised of any software application accessed through the cloud. Most consumer cloud services and many business cloud services used to perform tasks by an end user (e.g., Salesforce) fall into this category. Platform as a Service (PaaS) is a cloud-based service for programmers to create or customize software applications. An example would be a platform that enables developers to create applications (apps) for a particular operating system. Finally, Infrastructure as a Service (IaaS) provides basic computing functions such as

³ Ibid.

data storage and processing via the cloud. For example, a company may archive old records in the cloud so that they do not take up space on in-house servers.

Finally, some cloud providers offer a range of options for making cloud services more private based on the customer's privacy and security requirements. At the most private level, providers may offer cloud-like services that are solely for use of the organization and are hosted in-house, sometimes being managed by the organization's own IT department. These services are cloud-like in that resources are shared and easily allocated among users, but all of the users happen to be within the organization. In between this most private option and the public cloud are a range of options. For example, multiple organizations with similar needs may agree to share a private cloud service. This is sometimes called a "community cloud." Or, a service provider may host a private cloud at its own premises rather than onsite at the organization.⁴ A public cloud is one that is available to the general public, whether for free to the user or for a fee. Of course, public cloud service providers also take many steps to ensure security and privacy and, in some cases, security measures may be customizable based on the user's needs even in a public cloud. The issues discussed in this article are most relevant to cloud services that are at least semi-public, so the public cloud will be our implicit focus.

Advantages for companies

Cloud computing offers several key benefits for businesses and consumers. As mentioned above, cloud services can usually be accessed at any time from wherever an Internet connection exists, and many cloud services offer greater potential for customization than is possible with traditional software. In some cases, data stored in the cloud may be more secure, since it is stored separately from the device. If a computer is lost, stolen, or malfunctions, the data remain secure.⁵

In addition to these benefits, the cloud also offers potential cost savings in a few ways. First, it can reduce the customer's need to hire and maintain a large in-house IT staff. Second, because most cloud services are metered and customers pay only for what they use, the costs can sometimes be lower than purchasing other forms of software to perform the same tasks. Finally, the shared nature of cloud services may provide a way for a business to access applications or computing power that would otherwise be unaffordable.⁶ Along these lines, cloud services may also reduce computer hardware costs, such as the cost of servers. The potential for cost savings varies and is dependent on, for example,

⁴ Ibid.

⁵ Nelson, "Cloud Computing and Public Policy," October 2009.

⁶ Ibid.

the nature of the individual organization's computing needs and how readily they can be served in the cloud.

The potential benefits of cloud computing need to be weighed taking into account the organization's needs in terms of privacy, security, regulatory compliance, existing hardware/infrastructure, and many other factors. Some of these factors are discussed in greater detail below. It is important to note that while the scope of the cloud is expanding, it is not suited to every application.

Market Characteristics

We now describe the global market for cloud computing services. We name some of the leading providers of these services, then explore how demand for them varies by service model, region and industry.

Leading Providers

Many companies from all corners of the broad IT and Internet-based industries are seeking to participate in the growing cloud market. This includes companies that solely offer cloud-based products, such as Salesforce, and traditional software companies such as Microsoft. It also includes companies that offer both hardware and IT services, such as IBM and HP. Finally, some of the key participants in the cloud market, such as Google and Amazon, are Internet-based companies that offer a variety of services, some of which are cloud offerings (as defined above). At present, the SaaS market is by far the largest among cloud services, while IaaS is a distant second and PaaS the smallest.⁷ Key SaaS providers include Salesforce.com, Google, Oracle, and NetSuite. In IaaS, key providers include Amazon Web Services (AWS), Rackspace, and Verizon.⁸ Top platforms (PaaS) include Microsoft's Windows Azure, Google's App Engine, and Salesforce's Force.com. As is implied in this list, many of the largest cloud service providers are U.S.-based firms, but firms from other countries are eager to participate in the market. One of the largest is SAP, a German software firm that has expanded its offerings to include SaaS for many business functions, including manufacturing, finance, and human resources.⁹

⁷ Pring et al., "Forecast: Public Cloud Services, Worldwide and Regions," June 29, 2011.

⁸ In 2011, Verizon acquired IaaS provider Terremark.

⁹ Deloitte, Cloud Computing: *Forecasting Change*, October 2009.

Demand

Estimates of the size of the global market for cloud computing services vary widely. Here, we compare recent estimates produced by two well-known IT consulting firms: Gartner and Forrester. For comparability, we focus on only a single deployment model (public cloud) and the three services models included in the NIST definition: IaaS, PaaS and SaaS.¹⁰

Table 1 compares estimates published by Gartner and Forrester in 2011 of the global market for public cloud services in 2010 and forecasts for 2015.

Table 1 Cloud market estimates and forecasts, 2010 and 2015 (\$ billions)¹

	2010				2015			
	SaaS	PaaS	IaaS	Total	SaaS	PaaS	IaaS	Total
Gartner	10.0	1.3	2.8	14.1	21.3	2.4	19.6	43.3
Forrester	13.4	0.3	1.0	14.7	78.4	9.8	5.8	94.1

Sources: Pring et al., “Forecast: Public Cloud Services, Worldwide and Regions,” June 29, 2011; Ried et al., “Sizing the Cloud,” April 21, 2011.

¹Totals do not include Gartner’s estimates of public cloud revenues from “business process services” and Forrester’s estimates for “business process as a service.”

The estimates are quite similar for 2010: both reports estimate that the global market for public cloud services totaled \$14–15 billion, with SaaS accounting for the bulk of revenues. However, the two sources’ estimates diverge markedly for 2015. While both firms predict growth across the three service models, they make very different predictions of the rate of growth in each: for example, Forrester predicts that the market for SaaS will grow nearly six-fold over the period, while Gartner expects it to double.¹¹

¹⁰ Gartner separately estimates public cloud revenues for “business process services,” which it values at \$60.3 billion in 2010, with projected growth to \$133.5 billion in 2015. The category is dominated by “cloud-based advertising services” (see the subsequent discussion above). Forrester produces estimates for a similarly-named category (“business process as a service,” or BPaaS), which it values at \$350 million in 2010, growing to \$2.9 billion in 2015. We omit Gartner’s and Forrester’s business process revenues from our analysis because the NIST Definition of Cloud Computing does not recognize BPaaS as a distinct service model.

¹¹ The factors behind the disparities in the two firms’ projections are unclear—in part because we were unable to access the full report accompanying Forrester’s data. Another well-known firm, IDC, estimated the market for public cloud services at \$21.5 billion in 2010, and forecast that it would grow to \$72.9 billion in 2015 (IDC, “Public IT Cloud Services,” June 20, 2011). We did not report these findings in the table above because we were unable to obtain disaggregated estimates for market size by service model.

Gartner separately estimates revenue “derived from [cloud-based] advertising services that is then used to deliver other IT services” at \$36.5 billion in 2010, with projected growth to \$77.1 billion in 2015. This estimate is useful because it yields a rough sense of the value of the many cloud-based applications that consumers use for free, but that generate revenues through advertising. Examples include photo-sharing applications (Flickr, Picasa), web-based e-mail (Gmail, Hotmail), and office software suites (Google Docs). Gartner’s estimates suggest that these services may yield more revenues for providers than cloud services sold directly as such.¹²

Industry estimates suggest that North America, led by the United States, is the largest consumer of cloud services. Gartner estimated that North America accounted for 61 percent of cloud revenues in 2010, followed by Western Europe (23 percent), Japan (10 percent), and other countries in the Asia Pacific region (3 percent). IDC also lists the United States as the leading market for public cloud services.¹³ These findings accord with broader trends in global spending on computer software and services, for which North America, Europe, and the Asia Pacific region are the leaders, in that order (table 2), although Gartner’s figures suggest that North America is more dominant within the market for cloud services than in the broader computer software and services markets.

Table 2 Spending on computer software and services (2009)

Region	Services	Percent of Total	Software	Percent of Total
Africa	5.4	0.8	2.8	0.9
Middle East	7.2	1.0	2.7	0.9
Latin America	12.2	1.7	4.2	1.4
Asia-Pacific	129.2	18.1	44.5	14.6
Europe	226.3	31.7	18.1	38.7
North America	334.6	46.8	132.6	43.5
Global Total	715.0		304.9	

Source: IHS Global Insight, *Digital Planet, 2010*, October 2010.

Gartner reports that the leading consumers of cloud computing services are manufacturers and financial services firms, followed by communications/high-tech companies and governments. Financial services firms are among the most important consumers of computer services more generally. For example, in fiscal year 2010, financial services firms accounted for over 40 percent of India’s exports of computer

¹² There is some debate about the extent to which advertising-related revenues should be included in estimates of the global market for cloud computing services. For example, see Treadway, “Gartner’s Cloud Numbers,” June 22, 2010.

¹³ Pring et al., “Forecast: Public Cloud Services, Worldwide and Regions,” June 29, 2011, 12; IDC, “Public IT Cloud Services,” June 20, 2011.

services and business process outsourcing exports.¹⁴ Among governments, the United States is notable for its adoption of a “Cloud First” policy requiring agencies to consider cloud options when making new investments. The Federal Cloud Computing Strategy, released in February 2011, estimates that one-fourth of federal IT spending (\$20 billion of \$80 billion) could be moved to the cloud.¹⁵

U.S. Exports of Cloud Computing Services

In this section, we estimate the value of U.S. exports of public cloud computing services. To our knowledge, we are the first to attempt such a calculation.

The base figures for our estimate are the statistics on international trade in services published by the U.S. Bureau of Economic Analysis (BEA). BEA publishes two sets of data relevant to international trade in services. The first focuses on cross-border trade, and the second on services supplied by majority-owned foreign affiliates (analogous to “Mode 3” trade under the World Trade Organization’s General Agreement on Trade in Services). We identify the categories within each dataset that appear most likely to contain cloud computing services, then estimate the share of transactions in each category that are such services.

In the cross-border trade statistics, the categories that appear most likely to include cloud computing services are computer and data processing services¹⁶ and royalties and license fees for general use computer software.¹⁷ In the affiliate sales data, those most likely to include cloud computing appear to be computer systems design and related services and software publishers. Several others also likely contain at least some cloud services, as firms in those industries are also prominent cloud services providers. Examples include telecommunications (e.g., Verizon), retail trade (e.g., Amazon.com), and computer and electronic product manufacturers (e.g., Apple).

¹⁴ NASSCOM, “Indian IT-BPO Industry,” February 2, 2011, 9. India’s 2010 fiscal year ran from April 1, 2009 to March 31, 2010.

¹⁵ Kundra, *Federal Cloud Computing Strategy*, February 8, 2011, 1–2. The date for the estimate of total federal IT spending was not stated in the text. The estimate is based on submissions by agencies to the Office of Management and Budget. One possibility is that the dates for the estimates differed by agency (although this is not indicated in the document).

¹⁶ The category is defined as follows on the form that respondents use to report revenues: “Data entry processing (both batch and remote), and tabulation; computer systems analysis, design, and engineering; custom software and programming services (including web design); integrated hardware/software systems; and other computer services (timesharing, maintenance, web site management, and repair).” USDOC, BEA, *Quarterly Survey of Transactions*, January 2010, 16.

¹⁷ Defined as “receipts and payments for rights to distribute general use software, and rights to reproduce or use general use computer software that was electronically transmitted or made from a master copy.” USDOC, BEA, *Quarterly Survey of Transactions*, January 2010, 15.

For our estimate, we assume that the share of public cloud computing in U.S. exports of computer and data processing services is equal to the ratio of global revenues from IaaS and PaaS in 2010 to global revenues for all IT services, as reported by Gartner (0.5 percent).¹⁸ The share of public cloud computing in U.S. exports of general use computer software is equal to the ratio of global revenues from SaaS in 2010 to global revenues from all enterprise software, as reported by Gartner (4.1 percent).¹⁹ Within affiliate sales, the same ratios are used for computer systems design and software publishers, respectively. We do not estimate cloud revenues for firms in other industries, even though, as noted above, firms in several of those industries are likely to sell cloud services through their foreign affiliates. Nor do we attempt to estimate the revenues from the deployment of private clouds inside individual companies. Thus, ours can be considered a conservative, lower-bound estimate.

Table 3 Estimated U.S. exports of public cloud computing services (\$ millions)¹

	Cloud	All (cloud + non-cloud)
<i>Cross-border exports (2010)</i>		
Computer and data processing services	45	8,771
General use computer software	1,436	35,040
Total	1,481	43,811
<i>Sales by majority-owned foreign affiliates (2009)</i>		
Computer systems design and related services ²	343	66,250
Software publishers	1,024	24,982
Total	1,366	257,824

Source: Cloud estimates by authors; data in "All" column from USDOC, BEA, "U.S. International Services," October 2010.

¹ See text for description of calculation method.

² Excludes Canada, for which BEA suppressed data for 2009.

These estimates require caveats. First, the cross-border and affiliate sales data should be interpreted and compared carefully due to differences in how they are reported. BEA reports cross-border transactions by the type of service delivered, regardless of the chief industry of the firm delivering the service, while it reports affiliates' services supplied by the industry of the firm, regardless of the service delivered. For example, data processing services delivered by a manufacturer to a customer in another country would be reported as "computer and data processing services" in the cross-border

¹⁸ Gartner estimated worldwide revenues from PaaS and IaaS at \$4.1 billion in 2010 (table 1), and total IT services revenues of \$793.0 billion. Gartner, "Gartner Says Worldwide IT Services Revenue Returned to Growth," May 4, 2011.

¹⁹ Gartner estimated worldwide sales of SaaS at \$4.1 billion in 2010 (table 1), and total enterprise software revenues of \$244.0 billion. Gartner, "Gartner Says Worldwide Enterprise Software," June 21, 2011.

trade data, whereas similar services sold by a manufacturer's foreign affiliate would be reported under manufacturers' sales of services in the affiliate sales data.

Secondly, it is possible that cloud services' share of traded software and IT services is different from the cloud share of the overall market for these products and services—if, for example, providers are more (or less) likely to serve foreign customers via the cloud. In light of the uncertainties about the actual share of cloud activities in each data category, the estimates should be interpreted with caution.

Despite these caveats, it seems highly likely that cloud computing is already a source of significant revenue for U.S. exporters and multinational firms. And should the global market for cloud services grow at anything approaching the rates suggested by Gartner, Forrester, and other analysts, the importance of cloud revenues for U.S. firms—and for U.S. exports—will grow rapidly in the next few years. For example, Gartner forecasts that SaaS will account for 6.1 percent of global software sales while IaaS and PaaS will account for 2.2 percent of global IT services sales in 2015.²⁰ If total cross-border exports and affiliate sales in that year were unchanged from the figures reported for 2010 and 2009, respectively (table 3), cross-border exports of public cloud services would increase by 58 percent and affiliate sales of such services would more than double.

Key Policy Issues

We now turn our attention to the principal issues that policymakers face with respect to cross-border provision of cloud computing services. We focus on three topics: data privacy, security, and restrictions on where data are housed (localization requirements).²¹

Data privacy

One area of policy that heavily affects the provision of cloud services is data privacy. Countries' domestic data privacy laws can vary quite substantially and often affect foreign companies seeking to provide any type of electronic service to consumers in that country. For example, the EU and the United States are often cited as having

²⁰ Gartner forecasts worldwide revenues from SaaS at \$21.3 billion and for PaaS and IaaS at \$22.0 billion in 2015 (table 1). It forecasts total enterprise software revenues of \$347 and total IT services revenues of \$983.0 billion. Pring et al., "Forecast: Public Cloud Services, Worldwide and Regions," June 29, 2011, 11; Gordon, "Forecast Alert: It Spending," January 3, 2012.

²¹ The section on developing countries' role in cloud computing (below) addresses several additional policy issues that are relevant, including protection of intellectual property and government filtering of Internet content.

very different domestic approaches to privacy, with the United States following a self-regulatory approach (with sector-specific regulations for certain sensitive types of data), and the EU favoring a “baseline common level of privacy...to protect the data privacy rights of Europeans regardless of where data are transferred and processed.”²² Meanwhile, third countries have their own approaches, and data privacy laws in some of these countries are in flux, creating a challenge for cross-border cloud providers and an opportunity for greater international harmonization. Here, we examine individual countries’ data privacy frameworks as well as international organizations’ efforts to address the issue.

Domestic Data Privacy Regimes *European Union*

The EU Data Privacy Directive establishes standards that member states must follow in their domestic data privacy laws. These standards apply anytime someone (whether a company or an individual) collects personal data that can be linked to a specific individual (an EU citizen). Data collection or processing that does not meet the standards is prohibited (box 1).

These standards apply to all personal data. Examples include internal personnel records that employers keep on their EU employees and online travel booking systems accepting reservations from EU customers.

The Directive has far-reaching international implications. As implied in these examples, U.S. firms must comply with the Directive whenever they possess personal data involving EU citizens. In fact, not all U.S. firms may legally possess this data. The EU prohibits export of personal data unless the importing country “ensures an adequate level of protection” as certified by the EU Commission.²³ The United States is not among the nine countries that have been recognized. However, the EU and the United States have a compromise in place, called the safe harbor provision. Under this system, U.S. firms may voluntarily self-certify that they meet the requirements of the Directive. This allows U.S. firms to qualify individually even though the United States does not qualify at the country level.²⁴

²² Movius and Krup, “U.S. and EU Privacy Policy: Comparison of Regulatory Approaches,” 2009, 172.

²³ Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the Protection of Individuals with regard to the Processing of Personal Data and on the Free Movement of Such Data.

²⁴ Wolf and Tobin, “Chapter 28: Privacy Laws,” 2007, n.p.

Box 1 Data privacy standards in the EU Privacy Directive

An international law firm summarizes the key standards in the EU Privacy Directive as follows:

1. *Fairness*: process data “fairly and lawfully”;
2. *Specific purpose*: process and store data “for specified, explicit, and legitimate purposes and not further processed in a way incompatible with those purposes”;
3. *Restricted*: ensure data are “adequate and relevant, and not excessive in relation to” the purposes for which they are collected;
4. *Accurate*: ensure data are “accurate and, where necessary, kept up-to-date,” so that “every reasonable step [is] taken to ensure” errors are “erased or rectified”;
5. *Destroyed when obsolete*: maintain personal data “no longer than necessary” for the purposes for which the data were collected and processed.
6. *Security*: data must be processed with adequate “security” (a “controller must implement appropriate technical and organizational measures to protect personal data against . . . destruction or . . . loss, alteration, unauthorized disclosure or access, in particular where the processing involves the transmission of data over a network. . . .”)
7. *Automated processing*: “decision[s]” from data processing cannot be “based solely on automated processing of data” that “evaluate[s] personal aspects.”

Source: Wolf and Tobin, “Chapter 28: Privacy Laws,” 2007, n.p.

Additionally, it is worth noting that while the Directive is intended to ensure a uniform standard of data protection throughout the EU, in practice, there is variation in how the member countries implement and interpret it. The experience of companies collecting data in EU countries confirms this reality, as reflected in a 2003 survey of European companies.²⁵

United States and other countries

The U.S. approach to data privacy is much different. Generally speaking, the United States only regulates the collection and use of personal data in certain sensitive sectors, such as healthcare (under the Health Insurance Portability and Accountability Act, or HIPAA) and financial services (under the Gramm-Leach-Bliley Act).

Outside the EU and US, data privacy regimes are mixed. A number of countries have adopted data privacy laws that, like the EU Directive, apply to all types of personal data, although many are not as wide-ranging as the EU's laws. Among the major markets that have adopted some form of comprehensive data privacy law are India, Japan, Malaysia, South Korea, and Taiwan. China, Singapore, and Thailand are among the countries that, like the U.S., have not adopted comprehensive, mandatory regulations.²⁶

The differences in data privacy laws are of major significance for cloud computing providers seeking to serve customers in multiple countries. Cloud computing providers may need to collect personal data from customers in order to serve them. For example, a cloud-based travel booking site for employees may store personal information about the users, such as their full names and addresses. Providers may also store or process personal data relating to their customers' customers. For example, a cloud-based customer relationship management database is likely to contain contact information or other personal details about the client firm's customers. Cloud providers must ensure that data storage and processing complies with laws in all relevant jurisdictions, and this can become even more complicated when data are stored and processed globally, not just in the cloud provider's home country or the customer's home country. In some cases, this complexity may limit a provider's ability to do business in multiple markets.

²⁵ EOS Gallup Europe, "Data Protection in the European Union," December 2003, 3.

²⁶ USDOC, "Selected Asia and Oceania Data Protection Laws," June 2011.

International organizations' efforts to address data privacy

Recognizing the differences in domestic data privacy regimes, there have been a number of international efforts through multilateral organizations to develop a common framework for cloud-related policy. The two most notable of these are the efforts of the Organization for Economic Cooperation and Development (OECD) and the Asia-Pacific Economic Cooperation (APEC) forum. Both organizations have focused primarily on developing a shared set of principles for data privacy.

The OECD Guidelines²⁷ were adopted in 1980, making them the first multilateral effort to address privacy issues related to cross-border data flows. The Guidelines establish several rights of the individual pertaining to his or her personal data and lay out framework principles that national governments should follow in protecting these rights. Of most relevance for international trade in cloud services are paragraphs 15–18 outlining these principles, which read as follows:

15. Member countries should take into consideration the implications for other Member countries of domestic processing and re-export of personal data.
16. Member countries should take all reasonable and appropriate steps to ensure that transborder flows of personal data, including transit through a Member country, are uninterrupted and secure.
17. A Member country should refrain from restricting transborder flows of personal data between itself and another Member country except where the latter does not yet substantially observe these Guidelines or where the re-export of such data would circumvent its domestic privacy legislation. A Member country may also impose restrictions in respect of certain categories of personal data for which its domestic privacy legislation includes specific regulations in view of the nature of those data and for which the other Member country provides no equivalent protection.
18. Member countries should avoid developing laws, policies and practices in the name of the protection of privacy and individual liberties, which would create obstacles to transborder flows of personal data that would exceed requirements for such protection.²⁸

²⁷ OECD, *Guidelines on the Protection of Privacy and Transborder Flows of Personal Data*, September 23, 1980.

²⁸ *Ibid.*

The Guidelines also encourage countries to support industry self-regulation where possible. Overall, while the Guidelines established some principles that have guided the direction of countries' data privacy laws, they also preserve a great deal of flexibility, as evidenced by the very different data privacy regimes among OECD countries.²⁹ From the perspective of one cloud policy expert, the main contribution of the OECD Guidelines is that they seek to “keep governments out of the way” in most cases.³⁰

The OECD is currently in the process of conducting a review of the Guidelines to evaluate whether they need to be revisited or revised. Clearly, cross-border data flows have increased dramatically since 1980. Highlighting the ways in which technology has changed the scope of the issue, one author noted:

In the past, transborder data flows often occurred when there was the explicit intent to transfer data internationally (e.g., when a computer file was sent to a specific location in another country). Nowadays, the architecture of the Internet means that even a transfer to a party in the same country may result in the message or file transiting via other countries, without the sender ever being aware of this.³¹

A more recent set of international principles for cross-border data privacy is the 2004 APEC Privacy Framework. While the OECD Guidelines address the rights of individuals and the responsibilities of governments, the APEC Framework primarily addresses the responsibilities of companies and organizations that collect personal data.

The core principle in the APEC Framework is “accountability” — that is, that the entity that collects personal information is responsible for ensuring it is handled in accordance with the privacy guidelines in the Framework (as implemented by the participating country), regardless of where that information travels. While cloud industry officials generally feel the APEC Framework was a good step, more than one mentioned that the implementation remains in flux.³² One commented that he found APEC's approach potentially very useful and views it as a counterbalance to the European approach.³³

²⁹ Kuner, “Regulation of Transborder Data Flows,” October 2010.

³⁰ Michael Nelson, telephone interview by USITC staff, August 11, 2011.

³¹ Kuner, “Regulation of Transborder Data Flows,” October 2010, 10.

³² Industry representatives, interviews by USITC staff, Washington, DC, August 23 and November 22, 2011.

³³ Industry representative, telephone interview by USITC staff, December 1, 2011.

The most recent effort to develop international data privacy principles is the Madrid Resolution, adopted in late 2009 by about 50 countries participating in the annual International Conference of Data Protection and Privacy Commissioners. The principles laid out in the Madrid Resolution are broadly similar to the framework of the EU Directive, but the major difference is that the Madrid Resolution is non-binding. The goal is to eventually make the principles binding on the Resolution's signatories.³⁴ The United States is not a party to the Madrid Resolution.

Security

The concept of security in the context of cloud computing generally refers to ensuring that unauthorized parties do not obtain access to sensitive data. In that sense, security is related to privacy. Indeed, certain domestic laws that obligate service providers to protect data in certain sectors, such as the Gramm-Leach-Bliley Act for financial services and HIPAA for healthcare providers can be considered both privacy and security measures.

Outside of specially protected sectors, it is usually up to the parties to include a security framework in the contract for cloud computing services. Some organizations have valid concerns about entrusting the security of their data to a third party, especially when the information being stored with the cloud provider is proprietary or sensitive. Cloud providers, however, argue that the cloud actually offers some security advantages. Because services are centralized and resources are pooled in the cloud model, providers may be able to better predict and detect threats to the network. In the event that a security breach occurs, a cloud provider may be able to more quickly eliminate the threat since the solution does not need to be applied to multiple end users' machines.³⁵ Large cloud providers are also able to recruit top computer security talent.

In some cases, governments themselves may present a threat to data security. In some countries, the instances in which government bodies, such as police or intelligence agencies may access personal data are not clear to cloud providers or their customers.³⁶ A challenge for U.S. cloud providers is convincing customers in other countries that the PATRIOT Act, which broadened the U.S. government's ability to access data in support of intelligence-gathering activities, does not present a risk that their data will

³⁴ ICDPP, "Data Protection Authorities from over 50 Countries Approve the Madrid Resolution," November 6, 2009.

³⁵ SIIA, "Guide to Cloud Computing for Policymakers," 2011, 12.

³⁶ Michael Nelson, telephone interview by USITC staff, August 11, 2011.

be turned over to the U.S. government.³⁷ While U.S. officials and cloud firms stress that concerns about the PATRIOT Act in the context of the security of cloud services are often overstated, the Act remains a sticking point for some foreign customers.³⁸

In the United States, a variety of interested firms (including a number of large cloud providers) and individuals created the Digital Due Process initiative in 2010. The initiative seeks a simpler, clearer standard for U.S. government and law enforcement access to electronic communications and other personal data and argues that the 1986 framework currently in place, called the Electronic Communications Privacy Act (ECPA), is outdated and applied in inconsistent ways.³⁹ The initiative's central goal is to persuade Congress to update ECPA to better reflect current technology.⁴⁰

In the EU, the Data Retention Directive came into force in 2006 and requires communication service providers to retain certain identifying data for all communications for 6–24 months so that they may be made available to law enforcement in connection with criminal investigations.⁴¹ The Directive is controversial, and its application has been inconsistent between countries. Courts in three countries have ruled implementing laws to be unconstitutional. The European Commission acknowledges that “the diversity of approaches—in terms of limitations to the use of data, data storage periods and other aspects...—means that there is no level playing field for service providers and consumers across the EU. This has presented considerable difficulties for the industry.”⁴² Potential modifications to the Directive are currently being considered.

Cloud providers operating in international markets are concerned that an interest in ensuring security can sometimes lead to “knee-jerk reactions” by governments.⁴³ Especially when there is a major security breach, governments are more likely to pursue tighter regulation, which may inhibit the development of the market.⁴⁴ For

³⁷ Rauf, “PATRIOT Act Clouds Picture for Tech,” November 29, 2011.

³⁸ Ibid.

³⁹ Digital Due Process Web site. <http://digitaldueprocess.org> (accessed January 18, 2012).

⁴⁰ Ibid.

⁴¹ Directive 2006/24/EC of the European Parliament and of the Council of 15 March 2006 on the Retention of Data Generated or Processed in connection with the Provision of Publicly Available Electronic Communications Services or of Public Communications Networks and Amending Directive 2002/58/EC.

⁴² European Commission Home Affairs Web site, http://ec.europa.eu/home-affairs/policies/police/police_data_en.htm (accessed April 10, 2012).

⁴³ Industry representative, interview by USITC staff, Washington, DC, August 23, 2011.

⁴⁴ Nelson, “Cloud Computing and Public Policy,” October 2009, 10.

example, in the wake of the Mumbai terrorist attacks, the Indian government invoked national security to require access to all BlackBerry communications in India.⁴⁵

In terms of international cooperation on data security policy, a set of OECD Guidelines offers basic principles. These Guidelines for the Security of Information Networks and Systems (last updated in 2002) are broad and provide suggestions for how participants in information systems and networks can better anticipate risks, design and adapt security policies, and respond to threats, while preserving the rights of individuals. There are also international standards, developed by the International Standards Organization and the International Electrotechnical Commission that provide guidance on how best to manage information security and allow organizations to seek certification of their information security controls.⁴⁶

At the international level, the U.S. preference is to preserve flexibility by specifying a common security outcome that allows for differences in how it is implemented or applied.⁴⁷

Localization requirements

Cloud providers have expressed concerns about “localization requirements” that compel firms storing and processing data for clients from a given country to locate the data in that country. Governments typically create such requirements for the ostensible purpose of keeping data private and secure. Localization requirements are problematic for cloud providers, as “location independence” is a core aspect of the cloud delivery model.⁴⁸ Policies that require providers to locate facilities in a given location may leave them with the choice of selecting a sub-optimal location or not serving the targeted market at all.

Localization requirements are most often associated with two industries: finance and government. For example, South Korea requires that financial institutions process data within South Korea unless clients provide written consent otherwise, although

⁴⁵ *Electronista*, “India Testing BlackBerry Data Snooping,” October 3, 2011. BlackBerry’s parent company, Research in Motion, ultimately granted the government access to some communications, although not to business users’ data.

⁴⁶ See, for example, ISO/IEC standards 27001 and 27002.

⁴⁷ U.S. Government representative, interview by USITC staff, Washington, DC, August 18, 2011.

⁴⁸ The NIST Definition of Cloud computing says that “there is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter).” Mell and Grance, *The NIST Definition of Cloud Computing*, September 2011, 2.

its trade agreements with the EU and United States provide exceptions to this rule.⁴⁹ Similarly, in 2011, the People's Bank of China (PBOC) issued a "Notice to Urge Banking Financial Institutions to Protect Personal Financial Information" which forbids banks from storing or processing personal financial information obtained in China outside of the country.⁵⁰

Governments may also restrict the locations at which official government data may be housed and processed. Although such requirements may sometimes be necessary to restrict access to sensitive or classified data,⁵¹ some government data may be sufficiently non-sensitive to make storage on foreign servers acceptable. The United States acknowledged this in a recent solicitation for cloud computing services, which included separate pricing for services provided from data centers within and outside the United States. This solicitation also generated a controversy that illustrates how governments' concerns about data security may conflict with their desire to promote freer trade (box 2).

⁴⁹ European Union Chamber of Commerce in Korea (EUCCK), "Trade Issues and Recommendations 2011," n.d.; Free Trade Agreement Between the United States of America and the Republic of Korea, Annex 13-B, Section B and Article 7.43. Each agreement allows a phase-in period of two years for the commitment.

⁵⁰ The PBOC branch in Shanghai reportedly issued a subsequent clarification to banks in that city outlining conditions under which branches of foreign banks could transmit such data outside of China, such as obtaining written consent from customers. Norton Rose, "Personal Financial Information in China," October 2011.

⁵¹ Commission on the Leadership Opportunity in U.S. Deployment of the Cloud (CLOUD2), *Cloud First, Cloud Fast*, August 2, 2011, 17–18.

Box 2 Security and Trade in the Cloud: Conflict at the GSA

In May 2011, the U.S. General Services Administration (GSA) issued a solicitation for a host of cloud computing applications, including e-mail, electronic record management, and other services. The solicitation provided separate pricing information for services provided from U.S. and foreign data centers. The latter were required to be based in “designated countries,” as specified under Federal Acquisition Regulation §25.003. Two firms protested that the designated-country provision was unnecessarily restrictive of competition.

GSA described the designated-country provision as a compromise between those federal agencies that wanted all of their data to remain in the United States, and the Office of the U.S. Trade Representative, which argued that such restrictions would violate U.S. trade commitments. In its decision on the protest, the U.S. Government Accountability Office (GAO) acknowledged that “it is apparent why agencies may be justified in requiring the maintenance of [some] data and data servers within the United States.” However, it ruled that the designated-country provision was unnecessarily restrictive and could not “withstand logical scrutiny.” In explaining its decision, GAO noted:

GSA has provided no explanation for why its security concerns would be less acute in relation to data stored or processed in designated countries, which include, for example, Yemen, Somalia, and Afghanistan, versus data stored or processed in non-designated countries, such as Brazil, India or South Africa.

The GAO recommended that the GSA “amend the RFQ to reflect its actual needs concerning non-U.S. data center locations.” Going forward, it is not clear what criteria GSA and other agencies will use to determine “actual needs”—but the choice of those criteria could provide a high-profile testing ground for resolving the tensions between open trade and data security concerns in the U.S. government’s cloud procurement policy.

Notes: “Designated countries” include parties to the World Trade Organization’s Government Procurement Agreement, countries with which the United States has free trade agreements, least developed countries, and Caribbean Basin countries. Brazil, China, India, and Russia are among the most notable countries absent from the list. Federal Acquisition Regulation §25.003. The firms also challenged other aspects of the solicitation which are not addressed here.

Source: U.S. Government Accountability Office (USGAO), “Decision,” October 17, 2011, 7, 13.

Cloud Computing in International Trade Agreements

We now examine the extent to which international trade agreements have addressed policy issues relevant to cloud computing, both multilaterally (at the World Trade Organization) and bilaterally (through free trade agreements). While multilateral trade agreements have included general provisions that apply to both cloud and non-cloud computer services, bilateral agreements are emerging as vehicles for addressing issues specific to cross-border cloud computing.

World Trade Organization (WTO)

No WTO members have made commitments related to cloud computing *per se*. Under the General Agreement on Trade in Services, 83 members' schedules include commitments on "computer and related services."⁵² However, most members' commitments refer to an industry definition published over twenty years ago (division 84 of the United Nations' Provisional Central Product Classification (CPC) system).⁵³ There is no consensus about the extent to which this definition applies to cloud computing activities, although some elements of it appear to be relevant (e.g., data processing).

A number of members have sought to clarify the coverage of division 84. For example, the United States and several other members submitted a proposal in 2007 that would define CPC 84 as covering "all computer and related services... regardless of whether they are delivered via a network, including the Internet."⁵⁴ But this proposal had not been adopted by members as of the time of writing of this article.

Members' commitments in telecommunication services are also relevant to cloud computing, for two reasons. First, cloud providers deliver their services over telecommunication networks, as when SaaS is delivered over the Internet. Thus, the conditions under which providers may access such networks have a direct effect on service delivery. Secondly, some activities included in WTO members'

⁵² WTO, Services Database, <http://tsdb.wto.org/default.aspx>. One of those schedules—the one for "European Communities"—pertains to twelve European countries. General Agreement on Tariffs and Trade (GATT) Secretariat, "Services Sectoral Classification List." MTN.GNS/W/120, July 10, 1991. http://wto.org/english/tratop_e/serv_e/serv_e.htm; United Nations, "Provisional Central Product Classification," 1991.

⁵³ General Agreement on Tariffs and Trade (GATT) Secretariat, "Services Sectoral Classification List." MTN.GNS/W/120, July 10, 1991. http://wto.org/english/tratop_elserv_elserv_e.htm; United Nations, "Provisional Central Product Classification," 1991.

⁵⁴ WTO, Council for Trade in Services (CTS), "Communication from Albania," January 26, 2007, 1.

telecommunication services commitments (so-called “value-added” telecommunication services) may overlap with cloud computing. For example, 60 WTO members have made commitments on “on-line information and/or data processing” within their telecommunications commitments—which could be interpreted to include some cloud computing activities.⁵⁵

As numerous observers have noted,⁵⁶ the distinctions between telecommunication, computer, and audiovisual services have grown increasingly blurred. In recognition of this reality, the United States tabled a proposal in 2010 within the WTO’s Doha Round negotiations that would “draw attention to the relationships between sectors” among various information and communication technology services.⁵⁷

Free Trade Agreements (FTAs)

The U.S.-Korea Free Trade Agreement (KORUS FTA) contains more provisions relating to the cloud than previous U.S. trade agreements. Specifically, it states, “Parties shall endeavor to refrain from imposing or maintaining unnecessary barriers to electronic information flows across borders.”⁵⁸ While this is non-binding, it is unique in U.S. trade agreements to date. The KORUS FTA also establishes principles of non-discrimination and MFN treatment for digital products.

Cloud industry officials also see the in-progress Trans-Pacific Partnership agreement as an opportunity to establish cloud-friendly trade policies, especially given that the TPP is being negotiated as a “gold standard” agreement, with commitments in emerging areas that have not previously been covered by FTAs. A recent statement issued by the National Foreign Trade Council, “Promoting Cross-Border Data Flows,” mentions the TPP as an opportunity to establish new commitments on cross-border data flows.⁵⁹ The principles outlined in the statement reflect many large cloud providers’ ambition for future FTAs (as well as for collaboration in multilateral forums). These principles call on parties to prohibit restrictions on legitimate cross-border data flows; prohibit localization requirements; promote convergence toward international

⁵⁵ The Services Sectoral Classification list includes data processing services (CPC 843) under both computer and related services and telecommunication services. 76 schedules (including twelve European members in one schedule) include commitments for data processing within their computer and related services commitments.

⁵⁶ For example, see WTO Secretariat, “Telecommunication Services: Background Note by the Secretariat,” June 10, 2009, 4.

⁵⁷ Office of the U.S. Trade Representative, *2010 Annual Report of the President of the United States on the Trade Agreements Program*, March 2011, 5.

⁵⁸ U.S.-Korea Free Trade Agreement, chapter 15.

⁵⁹ NFTC, “Promoting Cross-Border Data Flows,” November 3, 2011, 5.

standards; improve transparency; address the legal complexities of cross-border data flows (such as those discussed in this paper); expand trade in digital goods; and create trade agreements that can adapt as technology changes.⁶⁰

When asked to compare the relative importance of multilateral cooperative forums and principles and binding bilateral agreements, industry officials interviewed generally agreed that for the cloud, both the cooperative approach and binding rules are necessary and should be pursued in parallel since the two move at different speeds.⁶¹ One contact estimated that binding agreements may be ten years behind the technology, which highlights the usefulness of non-binding, collaborative activities.⁶²

Box 3 describes a non-traditional approach to fostering cooperation on cloud-related policy: the International Digital Economy Accords (IDEA) Project, led by the nonprofit Aspen Institute.

Box 3 A Private Initiative—the Aspen Institute’s IDEA Plan

In 2011, the nonprofit Aspen Institute’s International Digital Economy Accords (IDEA) Project published a draft “Implementation Plan for a Common Digital Market of Goods, Services, and Ideas.” The plan proposes a new non-governmental organization called the Protocol Certification Organization (PCO) and associated “subject matter multistakeholder organizations” (SMOs) that would seek to ensure that countries and companies uphold the “Aspen IDEA Principles.” Several of the principles relate closely to cross-border provision of cloud computing services. For example, the Principles state that “IP-based and converged services (e.g., cloud computing and environmental services)” should “enjoy maximum regulatory flexibility”; and that “Governments should allow the free flow of information globally... [they] should not require that facilities or information be located in a specific country or region.” The principles would be legally binding, but sanctions would not extend beyond “name and shame.” It is unclear what level of support the IDEA Plan enjoys among governments and the private sector, but high-level officials from the United States, the European Union, and individual European governments as well as representatives of prominent technology firms have participated in the project’s meetings.

Sources: Aspen Institute, “The Aspen IDEA Plan,” September 12, 2011, 3, 10, 11–12; Aspen Institute, “Brussels Plenary Meeting,” March 23–24, 2011.

⁶⁰ NFTC, “Promoting Cross-Border Data Flows,” November 3, 2011.

⁶¹ Industry representatives, interviews by USITC staff, Washington, DC, August 23 and November 22, 2011.

⁶² Michael Nelson, telephone interview by USITC staff, August 11, 2011.

Developing Countries in Cloud Computing

As noted above, developed countries account for most of the supply and consumption of cloud computing services, and have been at the forefront of international policymaking on cross-border data flows. Yet governments and private parties in many developing countries are eager to expand those countries' role as suppliers and consumers of cloud computing services. They see cloud computing and other IT service industries as potential sources of high-paying jobs and drivers of economic growth—both directly, through the success of firms providing IT services, and indirectly, via the “spillover” benefits to other industries of increased access to advanced technology. Some countries may also hope to reduce dependence on foreign service providers for strategic reasons.⁶³

A variety of factors determine whether a country has a propitious environment for supply and consumption of cloud computing services. The Asia Cloud Computing Association (ACCA) published a list of ten such factors for its “Cloud Readiness Index.”⁶⁴ They include:

- regulatory conditions (including intellectual property protection)
- international connectivity (including price and availability of bandwidth for international connections)
- quality of data protection policies
- broadband quality (including penetration levels as well as reliability of connections)
- power grid quality
- pervasiveness of Internet filtering
- “business efficiency” (including a variety of conditions that affect the ease of doing business, such as labor costs, productivity, financial market development, and the quality of corporate governance)
- risk (including macroeconomic, security, social, and environmental factors)

⁶³ This objective is not exclusive to developing countries. For example, the desire to counter the dominance of U.S. IT firms appears to underlie, at least in part, in the efforts of some Western European countries to expand their cloud computing industries. Rahn, “Europe Won’t Let U.S.,” January 17, 2012.

⁶⁴ Asia Cloud Computing Association, “Cloud Readiness Index,” September 2011, 4. The authors draw their data from a variety of sources; see the report for details.

- level of development of information and communication technologies (ICTs)
- level of government support for development of ICTs, and cloud computing specifically.

While the ACCA gives each of these factors equal weight, one might argue that the factors vary in importance according to the cloud service in question. For example, labor costs and workforce skills are less important for data center operations, because each center requires only a few workers.⁶⁵ On the other hand, skilled software developers are critical for the development of PaaS and SaaS. Cheap electricity and the cost and reliability of water supply are especially important for ensuring that large data centers—one of the key building blocks for IaaS—are properly cooled.⁶⁶ Internet filtering is particularly problematic for SaaS, as censors may hinder or block entirely the public’s use of specific applications, but filtering may also cause broader connectivity problems (e.g., slower data transfers) that affect the full range of cloud services.⁶⁷ There may also be factors not included in the index that are important. One example is the cost of land, which may affect providers’ decisions on where to locate data centers in light of their massive size.⁶⁸

Satisfying all of these enabling factors is challenging for any country, but particularly so for developing countries. Many developing countries have made less progress than wealthier countries in creating and enforcing legal frameworks important for cloud computing (e.g., for data privacy and protection and intellectual property rights), and the quality of water, power, and broadband infrastructure in such countries often lags that in richer countries. Yet governments and companies in numerous developing countries are working to address these challenges. The following case studies document the experiences of two such countries: China and India.

China

With the largest population of Internet users in the world, China holds promise as a market for cloud computing services. At present, however, China is mostly a potential market rather than an established one. The Asia-Pacific region (excluding Japan) only

⁶⁵ For example, Apple’s data center in Maiden, North Carolina, which cost \$1 billion to construct, employs 50 people on a full-time basis. Rosenwald, “Cloud Centers,” November 8, 2011.

⁶⁶ Industry representative, interview with USITC staff, December 1, 2011; Thibodeau, “Apple, Google, Facebook,” June 3, 2011.

⁶⁷ Bakhtiari, “Cloud Computing in China,” October 17, 2011.

⁶⁸ For example, Apple’s data center in Maiden, North Carolina is housed in a building measuring 500,000 square feet. Thibodeau, “Apple, Google, Facebook,” June 3, 2011.

accounts for 3 percent of the market for cloud services.⁶⁹ Even among the largest organizations in China, less than 20 percent use any form of cloud services, compared with over 40 percent of large organizations in the United States.⁷⁰

The Chinese government recognizes the potential for the development of the cloud in China and is seeking to ensure that Chinese researchers and firms contribute to the direction of the cloud. The government has invested heavily in the development of cloud standards.⁷¹ Most recently, cloud computing was one of seven strategic industries included in the latest Five-Year Plan (2011–15), giving it a share of a \$600 billion investment by the government.⁷² Within the plan, there is also a focus on developing indigenous hardware and software to enable the cloud.⁷³

National-level, government-funded cloud research in China is headed by the Ministry of Industry and Information Technology and centers on five research centers in major cities.⁷⁴ Investments in research and data centers have also been made by cities (such as Shanghai and Chongqing) and corporations (most notably, Chinese telecom and network companies such as China Mobile and Huawei). In total, China's investment in the cloud is expected to reach \$154 billion in the next few years.⁷⁵ Perhaps due to the current small size of the domestic market, Chinese firms are also engaging in outbound investment in the cloud. For instance, Huawei has established a cloud research center in Silicon Valley.

For foreign firms, the uncertain legal environment for cloud computing in China can create a number of challenges. Comprehensive, national regulations on data privacy remain in the draft stage,⁷⁶ so, for now, data privacy rules are “vague and at the mercy of government interpretation.”⁷⁷ Industry officials interviewed agreed that the legal framework for cloud services is flexible to the point of being unpredictable, especially since the Chinese government may claim national security as a rationale for almost any measure pertaining to data security and the Internet.⁷⁸

⁶⁹ Pring et al., “Forecast: Public Cloud Services, Worldwide and Regions,” June 29, 2011.

⁷⁰ Larson, “The Man Behind Cloud Valley,” October 24, 2011.

⁷¹ U.S. Government representative, interview by USITC staff, Washington, DC, August 18, 2011.

⁷² Larson, “The Man Behind Cloud Valley,” October 24, 2011.

⁷³ Bakhtiari, “Cloud Computing in China,” October 17, 2011.

⁷⁴ Beijing, Hangzhou, Shanghai, Shenzhen, and Wuxi.

⁷⁵ Bakhtiari, “Cloud Computing in China,” October 17, 2011.

⁷⁶ Livingston, “China's Local Data Privacy Regulations Foreshadow National Efforts,” December 16, 2011.

⁷⁷ Bakhtiari, “Cloud Computing in China,” October 17, 2011.

⁷⁸ Industry representative, telephone interview by USITC staff, December 1, 2011.

Additional challenges for foreign firms seeking to provide cloud services in China include:

- *Localization expectations.* In some cases, customers' preference for localization of certain types of data prevents companies from launching products there, if the company does not wish to or cannot establish local data centers.⁷⁹
- *Joint venture requirements.* Several cloud-related activities are only open to foreign firms via joint venture. Among these are online data processing and data hosting.⁸⁰ Several major Western software firms have formed joint cloud ventures with Chinese companies – notably, Microsoft with China Mobile and SAP with China Telecom.⁸¹
- *Infrastructure and security challenges for data centers.* Sufficient power availability for data centers remains a challenge in some locations in China. In addition, China does not yet have any data centers of the highest security level (tier 4).⁸²
- *Internet speeds when hosting outside of China.* While many multinational companies choose to host Internet-based services for the Chinese market in Singapore or Hong Kong, this can greatly reduce the speed for Chinese customers, especially given that this traffic must pass through China's firewall. The firewall adds at least 450 milliseconds to the time it takes a single object hosted on a server outside of China to load.⁸³ In addition, if a provider's content is hosted on the same server as objectionable content, it may be blocked by the firewall along with the objectionable content, even if it is perfectly legitimate.⁸⁴

India

India's rise to prominence in the global computer services industry is among the country's great economic success stories. India is the world's leading exporter of computer and information services, with exports totaling \$33.8 billion in 2009.⁸⁵

⁷⁹ Ibid.

⁸⁰ Determann, "Internet Business Law in China for U.S. Companies," April 2009.

⁸¹ Bakhtiari, "Cloud Computing in China," October 17, 2011.

⁸² Ibid.

⁸³ CDNetworks, *Webinar: Extending Your Web Business into China*, n.d.

⁸⁴ Ibid.

⁸⁵ WTO Statistics Database,

<http://stat.wto.org/StatisticalProgram/WSDBViewData.aspx?Language=E>.

Indian firms such as TCS, Wipro, and Infosys are among the most important in the industry worldwide. India's computer services industry has succeeded due to a liberal policy toward foreign investment in the industry; government support for the industry's development through programs such as the Software Technology Parks of India (STPI), which granted eligible firms benefits such as lower taxes and duty-free imports;⁸⁶ and a supply of skilled, English-speaking workers willing to work for wages lower (albeit rising) than those paid to similar workers in developed countries.

Some observers view cloud computing as a potential threat to India's computer services industry. One of the principal offerings of India's largest computer services firms is information technology outsourcing, in which the provider fulfills a broad range of information technology services for the client, such as management of data centers and processing of data (on-site or remotely). IaaS is sometimes viewed as a replacement for elements of traditional IT outsourcing—and thus, a potential threat to the present industry leaders. One recent survey of corporate decision-makers lends credence to this view: 47 percent of respondents said cloud specialist companies (such as Rackspace and Amazon Web Services) were best suited to manage private clouds, compared to 39 percent who said that traditional IT outsourcers were best.⁸⁷

At the same time, numerous information technology firms in India are moving aggressively into cloud services, across all three service models (SaaS, PaaS, and IaaS). Some are “pure play” cloud specialists—cloud services are their core, or only, offerings. For example, Cnergis is a SaaS provider notable for its early entry into the market: it began offering web-based human resources management software in 2001. It offers a range of web-based applications for managing tasks across the “employee life-cycle,” from hiring to separation.⁸⁸ OrangeScape, a PaaS provider founded in 2003, offers a “studio” for developing enterprise applications that is accessed via a Web browser.⁸⁹ Netmagic, which bills itself as India's “first and largest pure-play Managed IT Hosting Services Provider,” offers public, private, and hybrid cloud infrastructure services. It runs seven data centers in four Indian cities.⁹⁰

India's IT industry leaders have responded to the growth of customers' interest in cloud computing by developing their own cloud offerings. The firms have portrayed themselves as experts at assisting clients in their transition to the cloud. The firms'

⁸⁶ Software Technology Parks of India (Chennai) Web site, <http://www.chennai.stpi.in/scheme.htm> (accessed November 2011).

⁸⁷ PwC, “The Future of IT Outsourcing and Cloud Computing,” November 2011.

⁸⁸ Cnergis Company Web site, <http://www.cnergis.com/> (accessed December 9, 2011).

⁸⁹ OrangeScape Company Web site, <http://www.angescape.com> (accessed December 9, 2011).

⁹⁰ *BusinessWire*, “Indian IaaS Leader, Netmagic, Adds Clout to Cloud,” July 27, 2011.

services include integration of IT operations across in-house data centers and cloud infrastructure, movement (“migration”) of data to the cloud, and development of customized SaaS applications. Wipro is an example of a leading Indian IT company that offers all of these services.⁹¹ It also exemplifies another route to success in the cloud market: partnering with multinational market leaders. For example, it is a “Premier” partner of Salesforce.com, and was recently named one of the two leading companies in the world for implementation of Salesforce.com applications.⁹²

Demand for cloud computing services in India is growing along with supply. One consulting firm estimated the size of the Indian market for public cloud services at \$88 million in 2010, and the private cloud market as three-and-a-half times larger. The same source estimated that the share of India’s IT spending devoted to cloud services would increase from 1.4 percent in 2010 to 8.2 percent in 2015.⁹³

Indian firms in numerous industries are adopting cloud services. For example, Hungama, which bills itself as the “largest aggregator, developer, publisher and distributor of Bollywood and South-Asian entertainment content in the world,”⁹⁴ has moved most of its data from in-house data centers to the cloud via Amazon Web Services. The company claims to have lowered its IT costs as a result of the move.⁹⁵ Bajaj Auto Finance adopted Salesforce.com’s customer relationship management (CRM) software in 2009 in order to link over 300 employees across more than 50 cities; the company believes the software was a key factor behind the subsequent, significant increase in Bajaj’s loans.⁹⁶

While these examples suggest that Indian firms have had notable successes in supplying and adopting cloud computing, there are factors that pose long-term challenges to India’s competitiveness in cloud services provision, and IT services more broadly. One is the challenge of securing affordable and reliable sources of energy. The data centers which store and process data for cloud activities use great amounts of energy,

⁹¹ Wipro Company Web site, <http://www.wipro.com/services/cloud-services/Pages/index.aspx>.

⁹² Herbert, McCarthy, and Grannan. “Wipro is a Leader,” May 13, 2011.

⁹³ EMC Corporation and Zinnov Management Consulting, “Private Cloud Market in India,” July 19, 2011, 7 and 14. This source estimated that the global market for public cloud services totaled \$21.0 billion in 2010, larger than the estimates by Forrester and Gartner referenced above, but about equal to that produced by IDC.

⁹⁴ Hungama Company Web site, http://www.hungama.org/about_us.php (accessed December 16, 2011).

⁹⁵ Amazon Web Services, “AWS Case Study: Hungama,” n.d.

⁹⁶ Salesforce.com, “Bajaj FinServ Lending,” n.d.

but electricity is expensive, scarce, and unreliable.⁹⁷ While firms have often relied on private sources of power, such as generators, to ensure that their needs are met, the growth of data centers could ultimately be constrained by the weak electricity infrastructure.

The legal environment also poses challenges for the growth of cloud computing. India's Information Technology (Amendment) Act (ITAA), passed in 2008, includes unclear provisions relevant to firms managing large volumes of data. In particular, section 43A of the act states,

Where a body corporate, possessing, dealing or handling any sensitive personal data or information in a computer resource which it owns, controls or operates, is negligent in implementing and maintaining reasonable security practices and procedures and thereby causes wrongful loss or wrongful gain to any person, such body corporate shall be liable to pay damages by way of compensation to the person so affected.⁹⁸

Rules promulgated in 2011⁹⁹ were intended to clarify the meaning of “reasonable security practices” and the circumstances under which parties can be held liable for damages, but only led to further confusion. Notably, the extent to which the rules apply to data associated with individuals outside India (and thus, to cross-border data flows) was not made clear. The implications of this ambiguity for trade could be significant. For example, Indian providers of data storage and processing services might demand that their clients adjust their internal data protection procedures, for fear of unwittingly falling afoul of section 43A. The full implications of this provision on cross-border data flows will depend on additional government guidance.¹⁰⁰

Further Research

This article focuses on cross-border provision of cloud computing services and some of the key challenges countries and providers are facing globally as the cloud grows, such as privacy, security, and localization requirements. While we consider these challenges to be the most pressing ones at present from an international policy perspective, there are additional issues that merit further research. Among these are contract enforcement and liability of the cloud provider for service failures; intellectual property law and its

⁹⁷ Alejandro et al., “An Overview and Examination,” August 2010, 55.

⁹⁸ Information Technology (Amendment) Act, 2008, section 43A, <http://www.cyberlaws.net/itamendments/IT%20ACT%20AMENDMENTS.PDF>.

⁹⁹ *IBN Live*, “Read: The Controversial Internet Control Rules,” April 27, 2011.

¹⁰⁰ Nicholson, “New Indian Privacy and Data Security Rules,” June 2, 2011.

application to cloud providers' services that (intentionally or unintentionally) enable intellectual property infringement; the effect of national regulations on development of open cloud standards and portability of users' data between cloud providers; and whether broadband network capacity can keep pace with the growth of the cloud.

Conclusion

Estimates of the size of the global market for cloud computing services vary, but few observers doubt that it is a multi-billion dollar industry that is growing rapidly. Provision of cloud services across borders is already substantial, and is likely to grow along with the broader market for such services.

Policymakers are struggling to keep pace with the industry's growth and the rapid pace of technological change. Governments have sought to address the chief policy challenges associated with trade in cloud services—ensuring data privacy, security, and the free flow of data—through domestic policies, bilateral agreements, and multilateral institutions. On the international level, approaches have included establishing non-mandatory, best-practice guidelines as well as binding commitments. Industry observers describe both approaches as important: the former may be developed rapidly and are more able to keep pace with technological change, while the latter emerge more slowly, but provide investors a greater sense of certainty about countries' policies.

Developing countries have played a smaller role than developed countries in the market for cloud services and international policymaking related to the cloud. Many developing countries lack the domestic policies and infrastructure needed to more fully develop their cloud industries, but governments and private parties in some of these countries are seeking to address these gaps. China and India illustrate the great potential for growth of cloud computing in developing countries as well as the scope and variety of the challenges that these countries must overcome.

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