

Measuring Cross-Border Data Flows: Data, Literature, and Considerations

Pre-reading materials for May 9, 2016 roundtable on unmet data needs

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The Internet has transformed how many Americans live, work, and play. It has connected people around the world in new ways through data flowing seamlessly across borders. Businesses rely on cross-border data flows to access global markets and information; interact with customers across the globe; find new suppliers; and communicate with their overseas affiliates. Citizens rely on cross-border data flows to access a global wealth of information; communicate with family, friends and colleagues overseas; and gain access to foreign consumer and financial markets.

A number of researchers have already begun using existing statistics and datasets (see sections 1 and 2 of this document) to provide evidence on the importance of digital data flows (see section 3 of this document). These studies are numerous and varied, focusing on both macroeconomic and microeconomic effects, domestically and internationally. However, there are no consistent definitions of what comprises the digital economy or cross-border data flows, nor is there data that is specifically intended to capture these concepts. Consequently, it is difficult to determine the accuracy of the studies or to compare estimates across them.

Therefore, although we know that cross-border data flows are impacting how businesses operate and people interact, there is only limited data available to quantify the economic effect of these flows. Policymakers, industry representatives, and researchers need improved and consistent measurement of the size of the digital economy and the economic importance of the free flow of cross-border data to make more informed policy and business decisions.

The information presented here and during the May 9 roundtable is the culmination of a nearly six month effort, initiated by the U.S. Department of Commerce (Commerce), to gather information on the unmet data needs related to measuring the economic importance of cross-border data flows and the free flow of information. To date, we have met with numerous researchers and other stakeholders (see section 4 of this document) and have conducted an extensive literature review. While this effort has focused specifically on the importance of measuring the economic impact of cross-border data flows, much of the information presented here is relevant to understanding the effect of the digital economy as a whole.

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Section 1: Examples of Relevant Statistics

The statistics presented here represent a sample of the types of information that is currently available to inform the discussion on the economic effect of cross-border data flows. This list is not intended to be comprehensive, nor is it necessarily an endorsement of the methodologies used. We have identified four categories of statistics: domestic macro-economy, domestic micro-economy, foreign economies, and bits and bytes.

Domestic Macro-Economy

- In 2014, the United States exported \$399.7 billion and imported \$240.8 billion in digitally-deliverable services, resulting in a trade surplus for digitally-deliverable services of \$158.9 billion. These exports accounted for 56 percent of total U.S. services exports and 50 percent of total U.S. services imports. Digitally-deliverable services include: charges for the use of intellectual property; other business services; financial services; telecommunications, computer, and information services; and insurance services. (Noonan, 2015)
- Digitally deliverable services¹ are also delivered through affiliates of U.S. companies located in Europe and affiliates of European companies in the U.S. In 2011, the supply of digitally deliverable services through U.S. affiliates in Europe was worth \$312 billion and Europe supplied \$215 billion worth of digitally deliverable services through U.S. affiliates. (Meltzer, 2014)
- Removing foreign barriers to digital trade in digitally intensive industries would likely result in an estimated \$16.7 billion to \$41.4 billion increase (a 0.1 percent to 0.3 percent increase) in U.S. GDP. U.S. real wages would likely be 0.7 percent to 1.4 percent higher, and the effect on U.S. total employment would range from no change to an increase of 0.4 million FTEs. (USITC, 2014)
- Revoking the Safe Harbor Framework² that had previously enabled data flows between the EU and United States could have reduced U.S. services exports to the EU by 0.2 percent to 0.5 percent. Small and medium-sized enterprises (SMEs) would be most affected by the policy change, as they would be least able to establish subsidiaries in the EU or to negotiate model contracts with business partners. (Bauer et. al, 2013)
- In the fourth quarter of 2015, retail e-commerce sales in the United States totaled \$89.1 billion, up 2.1 percent from the third quarter, and accounted for 7.5 percent of all retail sales. Retail e-commerce sales have been an important contributor to growth in the retail sales sector; e-

¹ Digitally-deliverable services are defined in Nicholson and Noonan, 2014.

² The full text of the new EU-U.S. Privacy Shield Framework was released on February 29, 2016. The Privacy Shield agreement will replace the Safe Harbor agreement once it is fully approved. See <https://www.commerce.gov/news/press-releases/2016/02/statement-us-secretary-commerce-penny-pritzker-release-eu-us-privacy>.

commerce sales increased 14.7 percent from the fourth quarter of 2014 to the fourth quarter of 2015 while total retail sales increased only 1.3 percent in the same period. (Census Bureau Quarterly Retail E-Commerce Sales report, February 17, 2016)

- In 2012, firms in digitally intensive industries³ purchased an estimated \$471.4 billion of products and services online. Just \$49.3 billion (10.5 percent) of the estimated purchases were delivered online while \$422.2 billion (89.5 percent) of these purchases were of products and services delivered physically or in person. In that same year:
 - Finance and insurance, and selected other service firms, with purchases of \$11.6 billion and \$12.2 billion, respectively, purchased the most products and services delivered over the Internet.
 - Firms in the manufacturing sector used the Internet to purchase \$157.4 billion of physically-delivered products and services—more than any other sector. (USITC, 2014)

Domestic Micro-Economy

- Most firms in digitally intensive industries use the Internet to communicate internally, to order physical products and services, and to conduct business-to-business communication. Firms also use the Internet for supply chain management and market research, but this is much more common in large companies than in SMEs. (USITC, 2014)
- In 2013, majority-owned foreign affiliates of U.S. companies supplied \$1.3 trillion of services to foreign persons. In that same year, all foreign affiliates of U.S. companies employed 14.3 million persons overseas. Cross-border data flows are a means that multinational firms use to provide services their affiliates and to transfer information, including HR information. (BEA Multinational Enterprise data)
- Of 271 tech-enabled startups surveyed by 1776 and McKinsey Global Institute (MGI), 86 percent had at least one cross-border activity; 62 percent had customers, clients or users in other countries; 47 percent hired talent from other countries; 39 percent had mentors or advisors in other countries; 36 percent sourced inputs from other countries; and 36 percent received funding from other countries. (MGI, March 2016)
- Boeing airplanes capture data inflight to reduce delays, midflight turn backs, and future cancellations. This amounts to 20 terabytes of information for a single Boeing 737 for every hour inflight. If a problem is identified, that data is transmitted to airline maintenance personnel at the destination, who can then be ready to make repairs as soon as the plane touches down. The ability to transmit data globally makes efficiencies like this possible. (Castro & McQuinn, 2015)

³ See USITC definition of digitally intensive industries at <https://www.usitc.gov/publications/332/pub4485.pdf#page=19&nameddest=Bullet10>.

- Sweden-based Hermes Medical Solutions manufactures software applications that monitor various organ functions of patients. The applications are cloud-based and all data is stored in Sweden, sent across borders and analyzed by medical centers in 30 different countries, including the United States. In fact, 95 percent of the services provided by Hermes are outside of Sweden. The company also facilitates research with over 200 hospitals worldwide, storing disease specific data on its servers that can then be used for clinical research. (Castro & McQuinn, 2015)
- Between 2000, when the EU first limited the transfer of personal data out of the region, and June 2015, over 5,000 companies self-certified under the U.S. Safe Harbor program, pledging that they will maintain privacy of the data they are transmitting. These firms come from industries throughout the economy, including computer software, computer services, and information services, but also from industries unrelated to IT such as education, health, financial, legal services, and manufacturing industries, to name a few. (Data from ITA as reported in OECD, November 2015)
- In the U.S., 59 percent of eBay enabled SMEs (sellers with at least \$10,000 in annual sales in the eBay marketplace) reached 10 or more foreign markets; the average number of markets reached was 18; 64 percent of U.S. SMEs exported to four or more continents. (eBay, 2016)

Foreign Economies

- The estimated value of global business-to-business (B2B) e-commerce in 2013 exceeded \$15 trillion with three-quarters of the total accounted for by, in order of magnitude, the United States, the United Kingdom, and China. (UNCTAD, 2015)⁴
- The global flows of goods, services, finance, and people increased GDP by at least 10 percent, or an estimated \$7.8 trillion in 2014. Of this amount, data flows accounted for an estimated \$2.8 trillion. (MGI, March 2016)
- Approximately 12 percent of global goods trade is conducted via international e-commerce. Additionally, 361 million individuals around the world participate in cross-border e-commerce. (MGI, March 2016)
- Local companies in countries that either have considered or are considering data localization measures would be required to pay an estimated 30 percent to 60 percent more for their computing needs if they were forced to maintain computing activities inside the country. Many of these countries do not have public cloud computing providers. Local businesses would have

⁴ The U.S. Census Bureau does not break out B2B e-commerce from business-to-consumer (B2C) e-commerce. It is likely that this report used manufacturing and wholesale e-commerce in the United States as a proxy for B2B e-commerce.

to rely on the purchase and maintenance of their own infrastructure, or rely on non-public cloud services. (Leviathan Security Group, 2015)

- “Small businesses worldwide are becoming ‘micro-multinationals’ by using digital platforms such as eBay, Amazon, Facebook, and Alibaba to connect with customers and suppliers in other countries. Even the smallest enterprises can be born global: 86 percent of tech-based startups we surveyed report some type of cross-border activity. The ability of small businesses to reach new markets supports economic growth everywhere.” (MGI, March 2016)
- In nine of the 18 countries and economies studied by eBay, 100 percent of eBay-enabled SMEs with \$10,000 or more in sales were exporters in 2014. These countries are Mexico, Brazil, Chile, Colombia, China, South Korea, Indonesia, Thailand, and South Africa. The country in the study with the lowest rate of eBay-enabled SMEs exporters was Australia (88 percent). The traditional “offline” SMEs in the 18 countries were much less likely to export than their online counterparts. (eBay, 2016)

Bits and Bytes

- Use of the Internet and networked devices is exploding. By 2019 there will be:
 - 168 exabytes per month of global IP traffic and 50 exabytes per month of traffic in North America.
 - Nearly 3.9 billion global Internet users (more than 51 percent of the world’s population), up from 2.8 billion in 2014.
 - 24 billion networked devices and connections globally, up from 14 billion in 2014.
 - Video will represent 80 percent of global Internet traffic, up from 67 percent in 2014. (Cisco Visual Networking Index)
- Since 2005, cross-border bandwidth usage has increased 45-fold, and it is projected to grow another 9-fold by 2020. (MGI, March 2016)
- Between 2008 and 2012, data-carrying capacity of transatlantic cables increased at an average rate of 19 percent per year, demand for broadband increased at a compound rate of 49 percent globally, while global goods and services trade rose at an average 2.4 percent per year. (Hofheinz and Mandel, May 2014).
- As of April 2016, there were 63 active or planned undersea cables that connected the United States to foreign countries. Globally, Telegeography identifies 293 active and 28 planned cable systems. (Telegeography Submarine Cable Map)
- In 2014 the total potential U.S.-EU capacity was 167 terabytes per second (Tbps), but only 27.1 Tbps were “lit” and a little over half that (15.2 Tbps) was used. Likewise, total capacity between

the U.S. and Asia was 90.2 Tbps, with 19.5 Tbps lit and 10 Tbps used. Between the U.S. and South America, total potential capacity was 105.5 Tbps, with 15.1 Tbps “lit”, and 7.9 Tbps used. (Meltzer, 2014)

Section 2: Relevant Datasets

We have identified the following datasets that contribute to measuring the economic value of cross-border data flows to the U.S. economy and foreign economies. Parallel to Section 1, these datasets are categorized into four types. The last section “Bits and Bytes” lists datasets that provide information on the amount and type of data flowing between countries.

Domestic Macro-Economy

- Bureau of Economic Analysis (BEA). Direct investment and multinational enterprise (MNE) data. Available at: <http://www.bea.gov/international/index.htm#omc>.

Dataset includes:

- Balance of payments and direct investment position data, which covers transactions and positions between parent companies and their affiliates;
- Activities of multinational enterprises including a wide variety of indicators of the financial structure and operations of the firms involved;
- U.S. direct investment abroad (outward direct investment);
- Foreign direct investment in the United States (inward direct investment); and
- Data on services supplied by affiliates and majority-owned affiliates of MNEs.

“The statistics cover transactions between majority-owned foreign affiliates (MOFAs) of U.S. enterprises and foreign residents, both in the local economy and in other foreign markets, and transactions between majority-owned U.S. affiliates (MOUSAs) of foreign enterprises and U.S. residents. Because of the importance of proximity to customers in the delivery of services, many MNEs serve foreign markets partly or wholly through their affiliates located in, or close to, the markets they serve.” (BEA Definition of International Services)

- Bureau of Economic Analysis (BEA). Input-output (I-O) accounts, annual and benchmark. Available at: <http://www.bea.gov/industry/index.htm#annual> and http://www.bea.gov/industry/index.htm#benchmark_io.

The I-O tables provide statistics on gross output (total sales or receipts), value added (contribution of an industry to GDP), the production relationship between industries, and how commodities are used for production. “They offer a wealth of information about the size of the U.S. economy, the relative size of specific industries, what and how much is produced by specific

industries, the technology used by specific industries, the incomes generated by production, and the size and scope of an industry's market."⁵ (BEA Measuring the Nation's Economy)

- Bureau of Economic Analysis (BEA). International trade in services data. Available at: <http://www.bea.gov/international/index.htm#services>.

"U.S. trade in services covers services, traded between U.S. residents and nonresidents, delivered through one of the three of the four modes of supply: cross-border supply, consumption abroad, and the presence of natural persons.⁶ Trade in services includes nine categories: maintenance and repair services not included elsewhere (n.i.e.); transport; travel (for all purposes including education); insurance services; financial services; charges for the use of intellectual property n.i.e.; telecommunications, computer, and information services; other business services; and government goods and services n.i.e. The trade statistics cover both affiliated and unaffiliated transactions between U.S. residents and foreign residents. Affiliated transactions consist of intra-firm trade within multinational enterprises—trade between U.S. parent companies and their foreign affiliates and trade between U.S. affiliates and their foreign parent groups. Unaffiliated transactions are with foreigners that neither own, nor are owned by, the U.S. party to the transaction." (BEA Definition of International Services)

- U.S. Census Bureau. Retail e-commerce report, quarterly. Available at: <https://www.census.gov/retail/index.html#ecommerce>. And electronic shopping and mail order houses sales available from the Monthly Retail Trade survey. Available at: <http://www.census.gov/retail/index.html#mrts>.

This dataset provides estimates of retail e-commerce activity (i.e. between businesses and consumers). No data is available on whether the purchasers are domestic customers or foreign customers.

- U.S. Census Bureau. E-stats data, annual. Available at: <https://www.census.gov/econ/estats/>.

This dataset provides estimates of e-commerce activity in key sectors of the U.S. economy including: manufacturing, wholesale, service, and retail businesses. Measures of total economic activity and e-commerce activity are presented for context. No data is available on whether the

⁵ While the I-O tables do not specifically measure cross-border data flows, they do allow data users to trace the use of goods or services throughout the supply chain. One example of how the I-O tables can inform the discussion of cross-border data flows is Nicholson and Noonan (2013) who traced the use of digitally-deliverable services through the supply chain as inputs to the production of other goods and services.

⁶ The fourth mode of supply is commercial presence. BEA data on services supplied through affiliates includes the commercial presence mode of supply. See BEA MNE data for more information.

transactions are domestic or foreign, or if the transactions are between businesses (B2B) or between businesses and consumers (B2C).

Domestic Micro-Economy

- Bureau of Economic Analysis (BEA). Direct investment and multinational enterprise (MNE) data. Available at: <http://www.bea.gov/international/index.htm#omc>. See details above in the section on relevant datasets for measuring the value of cross-border data flows in the domestic macro-economy.
- International Trade Administration (ITA). Administrative data on Safe Harbor self-certified firms and voluntary survey of self-certified firms. For internal use only. The information that is publicly available can be found at: <https://safeharbor.export.gov/list.aspx> (for U.S.-EU Safe Harbor) and <https://safeharbor.export.gov/swisslist.aspx> (for U.S.-Swiss Safe Harbor).

Foreign Economies

- Organisation for Economic Cooperation and Development (OECD). Key ICT Indicators. Available at: <http://www.oecd.org/internet/ieconomy/oecdkeyictindicators.htm>.

Includes data on telecommunications revenue and investment, broadband access, ICT-sector employment, labor productivity, and value added.

- Organisation for Economic Cooperation and Development (OECD) and World Trade Organisation (WTO). Trade in Value Added Statistics (TiVA). Available at: <http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm>.

The Trade in Value Added TiVA database is a joint OECD-WTO initiative. Its aim is to allow better tracking of global production networks and supply chains than is possible with conventional trade statistics. The TiVA database contains a range of indicators measuring the value added content of international trade flows and final demand.⁷ The 2015 edition of the TiVA database includes 61 economies and 34 unique industrial sectors covering years 1995, 2000, 2005 and 2008 to 2011. The indicators are derived from the 2015 version of OECD's Inter-Country Input-Output Database which, in turn, has been constructed from various national and international data sources. Notable underlying sources include: national supply and use tables (SUTs);

⁷ A complete list of over 30 indicators and their definitions is available here: http://www.oecd.org/sti/ind/tiva/TIVA_2015_Indicators_Definitions.pdf.

national and harmonized input-output tables; bilateral trade in goods by industry and end-use category; and bilateral trade in services.⁸

- United Nations Conference on Trade and Development (UNCTAD). UNCTADStat. Information Economy indicators. Available at: <http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx>.

Database includes statistics on ICT from countries and regions around the world. Indicators include: ICT producing sector core indicators, share of ICT goods as percentage of total trade, bilateral trade flows by ICT goods categories, and ICT use by businesses.

- World Bank. Trade in Services. Available at: <http://data.worldbank.org/data-catalog/trade-in-services>.

Database includes statistics on bilateral services trade flows through cross-border trade and consumption abroad for 199 countries between 1985 and 2011. Notable underlying sources include data from the OECD, Eurostat, UN and IMF. To increase the quality of statistics reported, particularly from developing countries, World Bank employs a mirror-technique to retrieve export trade flows of a reporting country by using information on imports of the partner country. Care must be used with these statistics, however, as the quality of services trade data varies dramatically between countries.

- World Bank Enterprise Survey. Available at: <http://www.enterprisesurveys.org/data/survey-datasets>.

The World Bank Enterprise Survey is a firm-level survey that asks questions related to enterprise technology use, including whether the establishment:⁹

- Uses technology licensed from a foreign-owned company, excluding office software;
- Maintains its own website; or
- Uses e-mail to communicate with clients or suppliers.

This survey also asks a number of questions about international trade by enterprises, including: proportion of sales that are exports; proportion of inputs that are imports; firm performance; and firm characteristics, including size, ownership structure and age of enterprise. The sample

⁸ The concept of “digitally-deliverable” or “ICT-enabled” services could be applied to look at how these services originating in one country are used in the production of goods and services in other countries, particularly those that are potentially enacting policies restricting the flow of data.

⁹ A complete description of the indicators is available at: <http://www.enterprisesurveys.org/~media/GIAWB/EnterpriseSurveys/Documents/Misc/Indicator-Descriptions.pdf>.

typically includes 1,200 to 1,800 firms in larger economies, 360 firms in medium-sized economies, and 150 firms in smaller economies.

Bits and Bytes

- Cisco. Visual Networking Index (VNI). Available at:
<http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html>.

Cisco publishes annual five-year forecasts on actual global and regional Internet traffic. The traffic projections are available by: type, including fixed Internet, mobile, and managed IP; segment, including consumer and business; and geographic region.

- International Telecommunications Union (ITU). ICT data. Available at:
<http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>.

Includes country data on mobile-cellular subscriptions, percentage of individuals using the Internet, fixed-broadband, and core indicators on access to and use of ICT by households and individuals.

- Telegeography. Global Bandwidth Research Service. Available at:
<https://www.telegeography.com/research-services/global-bandwidth-research-service/index.html>.

Telegeography is the largest source of data and analysis on long-haul networks and the undersea cable market. Telegeography maintains an interactive submarine cable map of active and planned submarine cable systems and their landing stations, available at:

<https://www.telegeography.com/telecom-resources/submarine-cable-map/index.html>.

Underlying data on capacity, ownership, wholesale (non-discounted) prices, and other metrics are available for subscription.

Section 3: References and Other Literature

The literature below includes examples of the types of studies available on the economic importance of cross-border data flows and potential impacts to related restrictions. This is not necessarily a comprehensive list, nor is inclusion below an endorsement of methodologies.

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Section 4: Contributors

From November 2015 through April 2016, we met or spoke with the majority of researchers and stakeholders on this list. Each has contributed to our effort to better understand the data needs around measuring the economic impact of cross-border data flows and restrictions to these flows. Several other experts contributed initially through their participation in our May 9 roundtable. We would like to express our sincere appreciation to everyone on this list.¹⁰

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