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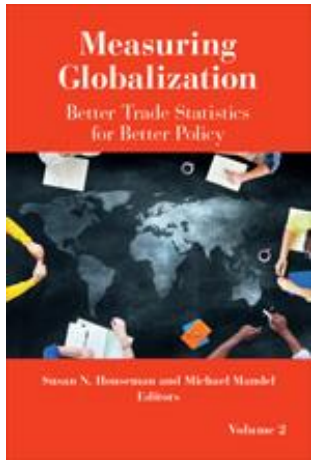
Data, Trade, and Growth



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Chapter 9 (pp. 263-286) in:
Measuring Globalization: Better Trade Statistics for Better Policy, Volume 2, Factoryless Manufacturing, Global Supply Chains, and Trade in Intangibles and Data
Susan N. Houseman and Michael Mandel, eds.
Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 2015
DOI: 10.17848/9780880994903.vol2ch9

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Data, Trade, and Growth

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The architecture of the Internet is designed as a "network of networks." As such, one of its key attributes is making the passage of data from one network to another easy. So when a user sends an e-mail, views a video, or downloads a file from a Web site, the data may pass through a large number of different networks on the way from its origin to its destination, with the routing virtually invisible to the user. This architecture has proven to be extremely flexible and powerful, both nationally and globally. People and businesses with Internet access can easily get data of all sorts from around the world. Similarly, companies can efficiently and cheaply provide services such as e-mail and Web search on a global basis, in many cases without charge.

One sign of the Internet's global success is this: the rapid growth of cross-border data flows. Cross-border data flows are growing far faster than conventionally measured trade in goods and services. According to TeleGeography, a consulting firm that keeps track of international data flows, demand for international bandwidth increased at an annual rate of 49 percent between 2008 and 2012 (TeleGeography 2012). By comparison, the overall volume of global trade in goods and services, adjusted for inflation, rose at an annual rate of 2.4 percent over the same period.

Looking at the data links between the United States and Europe in particular, the data-carrying capacity of transatlantic submarine cables rose at an average annual rate of 19 percent between 2008 and 2012. Meanwhile, the overall volume of trade in goods and services between the United States and Europe, adjusted for inflation, is barely above prerecession peaks.

Indeed, the global economic and financial system, as it stands today, would not function without cross-border data flows. Data flows

that cross national borders are essential to almost everything: manufacturing supply chains, global finance, international medical and physics research, entertainment, tourism, education, social media, and community. Indeed, cross-border data is becoming increasingly important as an input to production, and as a crucial element for economic growth. "The cross-border free flow of information enables international trade which can lead to increased innovation, productivity, and economic growth," writes Meltzer (2013, p. 11) in a paper from the Brookings Institution.

Moreover, trade in data creates positive externalities and gives an extra boost to global growth. Unlike exports of goods, data can be shipped from one country to another without depriving the first country of the benefits. All other things being equal, growth in cross-border data flows can be a far more powerful impetus to consumer welfare and economic growth than growth in trade in goods and services.

However, despite the importance of cross-border data flows, current international economic statistics are mostly uninformative and even misleading about their magnitude. First, note that cross-border data flows are not tracked as a separate category in the trade statistics. Instead, cross-border trade that involves data is lumped in with trade in services. For example, international telecommunications are treated as the export/import of a service. The World Trade Organization (WTO) estimates that global exports of telecommunications services totaled $111.5 billion in 2012 (WTO 2013).

But treating cross-border data as a service creates the real problem: By international agreement among statistical agencies, the export or import of services is defined to occur when there is a monetary payment from a resident of one country to a resident of another in exchange for the service. For example, if a U.S. business hires accountants in London, that becomes an export of accounting services from the United Kingdom to the United States.

Virtually all of the existing statistics about cross-border trade in data are based on this monetary definition of service exports and imports. The July 2013 report from the United States International Trade Commission, *Digital Trade in the U.S. and Global Economies, Part 1*, identifies the Bureau of Economic Analysis (BEA), the U.S. Census Bureau, the Organisation for Economic Co-operation and Development (OECD), and Eurostat as the main sources for statistics on "digital trade." Each of

these relies on the same basic definition of service exports and imports as being tied to a monetary exchange between residents of two different countries (U.S. Internationl Trade Commission 2013, Table 4.2, p. 4.24). Currently, international agencies such as the International Telecommunications Union (ITU) only collect fragmentary statistics on cross-border data flows, though they are putting more effort into estimating such figures (see, for example, ITU [2012]).

I will show in this chapter that the efficient global architecture of the Internet allows and even encourages data to cross national borders without leaving a significant monetary footprint. As a result, economically important cross-border data flows are simply not being counted by current international economic statistics. I will offer evidence in this chapter that both the level and rate of growth of data trade are being significantly understated.

This understatement has serious policy implications. First, the data sector is a bigger contributor to U.S. and global growth than current economic statistics show. Second, to the degree that trade negotiators prioritize their goals according to the relative magnitude of different trading sectors, trade policy should place more emphasis on maintaining the free flow of data. Similarly, international tax policy should place more emphasis on maintaining the free flow of data.

Third, attempts by various countries to implement barriers to the free flow of data may do considerably more economic damage than the current trade statistics show. This is especially important in the wake of recent revelations about the extent to which the National Security Agency (NSA) has monitored data flows around the world. This news has caused a rising demand within countries such as Brazil for certain data to be kept within national borders—so-called data localization or data protectionism. The European Union is also considering new data privacy regulations that could potentially act as an impediment to flows of data in and out of the EU.

Finally, it's becoming clear that better statistics about cross-border data flows are needed to convince policymakers of how important data is to economic health. That might help avoid trade and tax policies that are detrimental to growth. It is self-evident that good policy rests on a foundation of accurate and comprehensive knowledge about current and emerging trade flows.

HOW CROSS-BORDER DATA FLOWS ARE MEASURED TODAY

The WTO and national statistical agencies such as the BEA regularly produce figures on cross-border trade in data-related services such as telecommunications services, computer and information services, and financial services. Table 9.1, below, shows the reported dollar value of global exports of selected data-related services (WTO 2013).

According to international standards, trade in services is typically measured by monetary transactions between residents of one country and residents of another country. That's the main principle laid out in the *Manual on Statistics of International Trade in Services*, approved in 2010 by the United Nations Statistical Commission:

> The market price is used as the basis for valuation of transactions in international trade in services. Market prices for transactions are defined as amounts of money that willing buyers pay to acquire something from willing sellers. The exchanges are made between independent parties and based on commercial considerations only and are sometimes called 'at arm's length' transactions. (United Nations 2011, p. 34)

Similarly, the BEA—the statistical agency in charge of tracking service trade—measures data-related exports and imports by tracking

Table 9.1 Reported Global Exports of Selected Data-Related Services, 2012, and Annual Growth Rate, 2008–2012

Service	Global exports ($US billions)	Annual growth rate, 2008–2012 (%)
Communications services (both voice and data)	111.5	3.4
Financial services	303.1	0.3
Computer and information services (including Web search)	262.7	7.2
Royalties and license fees	289.6	5.9
Sum of selected data-related services	966.9	4.0
Merchandise exports	18,401.0	3.3

SOURCE: WTO (2013).

the money received from "foreign persons" and the money paid to "foreign persons."

The BEA collects much of its data on service sector exports and imports through surveys: specifically the BEA Benchmark (BE-120) and Quarterly (BE-125) Surveys of Transactions in Selected Services and Intellectual Property with Foreign Persons (BEA 2011). Table 9.2 shows the fairly long list of service and intellectual property export transactions that are covered in the benchmark survey. The list of service and intellectual property import transactions is similar, while the quarterly survey covers a similar but slightly shorter list of traded services. Many of these include cross-border data flows such as telecommunication services, royalties and license fees, database and other information services, and financial services.

These surveys feed into the widely cited monthly report "U.S. International Trade In Goods and Services," including the goods and services trade deficit, which is a key number for economists in government and the private sector. In addition, the BEA produces an annual report on trade in services. Table 9.3 shows statistics on exports for selected data-related services in 2012.

THE ARCHITECTURE OF THE INTERNET AND DATA TRADE

The figures in the previous section raise two disturbing questions. First, when measured as a service, the rate of growth of the cross-border data-related services is barely higher than the growth rate of merchandise trade, both for the globe and for the United States. Second, the aggregate numbers make cross-border data trade look relatively unimportant. For example, reported U.S. telecom exports of $14 billion in 2012 are roughly the same size as U.S. exports of newsprint. (Box 9.1 explains how international phone calls are treated in the trade statistics.)

The global and national statistics on trade in services are based on tracking monetary exchanges between residents of different countries. In theory, this principle can be applied to trade in data as well. If a person in the United States downloads a file from a Web site in a different country, it's theoretically possible that he or she could be charged both

Table 9.2 Selected Service and Intellectual Property Export Transactions Tracked by BEA Survey BE-120

Types of export transactions
Receipts for intellectual property
Rights related to industrial processes and products
Rights related to books, music, etc.
Rights related to trademarks
Rights related to performance and events prerecorded on motion picture film and TV tape (include digital recordings)
Rights related to broadcast and recording of live events and performances
Rights related to general use software
Business format franchising fees
Other intellectual property
Receipts for selected services
Accounting, auditing, and bookkeeping services
Advertising services
Auxiliary insurance services
Computer and data processing services
Data base and other information services
Educational and training services
Industrial engineering services
Industrial-type maintenance, installation, alteration, and training services
Legal services
Management, consulting, and public relations services (including expenses allocated by a U.S. parent to its foreign affiliates)
Merchandising services
Operational leasing services
Trade-related services, other than merchandising services
Performing arts, sports, and other live performances, presentations, and events
Research and development services
Telecommunications services
Agricultural services
Disbursements to fund production costs of motion pictures
Disbsursements to fund news-gathering costs and production costs of program material other than news
Waste treatment and depollution services
Other selected services

SOURCE: BEA Form BE-120: "Benchmark Survey of Transactions in Selected Services and Intellectual Property with Foreign Persons," p. 6, http://www.bea.gov/surveys/pdf/be120.pdf (accessed December 2013).

Table 9.3 Reported U.S. Exports of Selected Data-Related Services, 2012, and Annual Growth Rate, 2008–2012

Service	Global exports ($US billions)	Annual growth rate, 2008–2012 (%)
Communications services (both voice and data)	14.0	8.8
Financial services	76.4	4.9
Computer and information services (including Web search)	17.3	7.2
Royalties and license fees	124.2	5.0
Sum of selected data-related services	231.9	5.3
Goods exports	1,536.0	4.3

SOURCE: BEA international services statistics, Table 1: "Trade in Services, 1999–2012." http://www.bea.gov/international/xls/tab1a.xls (accessed December 2013).

for the cross-border telecommunications link and for the content in the file.

However, in practice the architecture of the Internet has developed in such a way that many or perhaps most cross-border data flows do not result in an exchange of money between residents of different countries. Let us illustrate this important point with a simple example: an American economist who visits the Web site for the Bank of Russia (www.cbr.ru) and wants to obtain statistics about the latest movement of the Russian monetary supply.

First, imagine that these statistics were in bound volumes that had to be shipped from Moscow. There's little doubt that the cost of the volumes and the shipping would be quite high and would register as imports in the trade statistics.

But when the data is downloaded, there is no charge for content. The Russian central bank is not charging U.S. economists for downloading data. So if this cross-border data transfer is going to create a monetary footprint and show up in the BEA statistics, it will happen because the telecommunications transport across national borders involves an exchange of money between a U.S. resident and a non–U.S. resident.

Obviously, the economist or his or her institution pays a domestic Internet service provider such as Comcast or Verizon for an Internet connection. But unlike an international phone call, no extra money is paid for the foreign Web site. The data request is passed from network

Box 9.1 The International Phone Call and Foreign Trade

Historically the major cross-border data flow was the conventional international phone call. In the United States, the originator of an international phone call picked up a telephone, dialed 011, then the country code and phone number, and paid an international charge to his or her phone company. The provider then paid the carrier in the receiving country according to a government-mandated settlement schedule. Conversely, the recipient of an overseas call did not pay an international charge—instead, the overseas caller paid the local provider in his or her own country, who settled up with the U.S. phone company.

Under this scheme, calls from the United States to overseas points were classified as imports, because the foreign carrier received the payments. Calls from other countries were classified as exports, since the payments came to the U.S. carriers. So if U.S. customers made more overseas calls than they received, the telecom trade balance would be negative. Indeed, that was true for many years. According to an FCC report from 1998, "U.S. carriers owe settlement payments for the services that they bill, and are owed payments for the services that the foreign carriers bill. In addition, U.S. carriers are owed payments for switched traffic that transits U.S. points. Because U.S. customers place far more calls than they receive and because U.S. carriers terminate more collect calls that generate surcharges for the originating carrier, U.S. carriers make net settlement payments to most foreign carriers. The total net payment for all U.S. carriers grew from $0.4 billion in 1980 to $5.6 billion in 1996" (Blake and Lande 1998).

Reading this explanation, however, should make it clear that this definition of telecom imports and exports is an artifact of a regulatory convention that "calling party pays" for wireline calls. Suppose instead that we had a rule that "receiving party pays," as in a collect call or an 800 number. Under that alternative regulatory regime, the toll on an outgoing international call would be collected from the recipient of the call by his or her (foreign) carrier. The foreign carrier would then remit a portion of the charge to the originating domestic carrier. As a result, with "receiving party pays," an outgoing international call would be treated as an export. Similarly, an incoming call would be treated as an import. Thus, a shift in regulatory conventions from "caller pays" to "recipient pays" would immediately turn a telecom trade deficit into a trade surplus, without altering the final allocation of revenues to the respective telecom carriers after the settlement process. In addition, outgoing and incoming international calls are physically indistinguishable, in terms of the equipment used.

to network until it reaches the Russian central bank, which then sends the money supply figures back again. At some point, that data request passes from a U.S.-owned network to a foreign-owned network. For the sake of clarity of the example, let's assume that the U.S.-owned network also owns the submarine cable between New York and the United Kingdom, so that the interchange between the U.S.-owned network and the foreign network physically occurs in the UK.[1]

Is there an exchange of money between the U.S-owned and the foreign-owned network? Now we have to delve into the architecture of the Internet. Networks are connected in two ways, by peering or by the payment of transit fees. *Peering* is an agreement between two networks to exchange traffic without exchanging money. Peering agreements, especially between large networks, are so ubiquitous that they are basically conducted on a handshake, as one authoritative OECD study shows: "A survey of 142,000 peering agreements conducted for this report shows that the terms and conditions of the Internet interconnection model are so generally agreed upon that 99.5 percent of interconnection agreements are concluded without a written contract" (Weller and Woodcock 2013, p. 3).

In fact, the largest global networks—the so-called 'Tier 1' networks—almost by definition peer with every other Tier 1 network. That means if a data packet goes from AT&T's network to British Telecom's on the way from Russia, it is unlikely that money changed hands at the interconnect between the two.

It might seem as if peering is a barter-type agreement that should generate revenue recognition on the financial books, even if no money changes hands. However, peering takes place mostly in situations of balanced traffic, so the revenues and costs would net out. The accounting firm KPMG notes that, "in our experience, peering arrangements between Tier 1 telecoms do not result in the recognition of revenue even though a service is provided and value is transferred between telecoms in much the same way as under traditional interconnect arrangements" (KPMG 2010, p. 30).

It's worth noting that peering is a key reason that you can access Web sites from all over the world without having additional charges added to your Internet bill.

Alternatively, smaller networks can connect to larger ones by paying transit fees—also known as buying Internet transit. In theory, these

Internet transit payments could show up as trade in telecommunications services if the smaller network was paying a provider from a different country for transit. However, the price of Internet transit has been dropping sharply. According to the market research firm TeleGeography, the price of IP transit at major hubs has dropped by roughly 30 percent a year over the past five years (TeleGeography 2013). To my knowledge, no statistical agency currently uses the price of Internet transit to adjust service trade.

ESTIMATING ONE COMPONENT OF DATA TRADE

For the reasons described in the previous section, we would expect that the official statistics on cross-border data trade (trade in data-related services) far understate both the actual economic value and the growth of cross-border data flows. But how big is the understatement?

In this section I will try to answer one small piece of this question. In particular, we will delve deeper into the measurement of U.S. telecom exports and construct an alternative estimate based on directly measuring cross-border data flows. For 2012, the BEA reports that exports of communications services from the United States amounted to $14 billion (payments from nonresidents to residents). Imports of communications services into the United States amounted to $8 billion (payments from residents to nonresidents). These numbers have been rising, but they are still minuscule compared to the importance and amount of international data traffic in and out of the United States.

However, a closer look helps explain why these have to be understatements. Let's start with a simple example. Suppose a major U.S. telecom provider builds its own submarine cable to Great Britain, say, or Singapore. That expenditure will show up in the company's capital spending budget, rather than as a payment for cross-border telecom services. Then, if the U.S. provider peers with foreign providers at the non-U.S. cable landing, no money will change hands at the connection point. The result: The telecom provider has made a major investment in providing cross-border data flows, none of which show up in the trade account. The export benefits of capital investment by the telecom industry are not being counted.

More generally, most submarine cables are being built these days by a consortium of companies, each of whom gets access to a share of the bandwidth. The same principle shows up as in the previous example—the spending on the cable appears as a capital investment, rather than as a payment for cross-border telecom services. From here, we can construct increasingly complicated examples that arrive at the same place—cross-border transport of data without a corresponding monetary transfer between residents and nonresidents.

How can we construct a better estimate of cross-border telecom services? In an earlier paper, I discussed the idea that the production and use of data should be treated as a fundamental component of economic activity, parallel to the production and use of goods and services (Mandel 2012). This approach leads naturally to an increased focus on directly measuring data generation, data flows, and data storage as a way of understanding economic activity.

One pioneer in such efforts has been Martin Hilbert, who has been developing a systematic methodology for comparing the communications capacity of various media, ranging from mobile to television (Hilbert and López 2011). Based on this work, the International Telecommunications Union (ITU) has been gradually moving toward direct measures of data flows, as opposed to indirect measures such as number of cellular subscriptions or broadband connections. A recent publication from the ITU notes,"Using the unifying metric of bits per second, employed for measuring global technological capacity to communicate, it is possible to compare different communication technologies. It is also possible to analyse bits per second per capita, per technology, per country, or per any other relevant socio-economic or demographic parameter" (ITU 2012, p. 167).

This section follows in the same spirit of direct measurement of data flows. For the purposes of this section, data flow is measured in terabits per second (Tbps). The telecommunications market research and consulting firm TeleGeography estimates that the United States had 23 Tbps of international Internet capacity in 2012, with an average utilization of 29 percent and a peak utilization of 49 percent.[2] This suggests that, on average, the U.S. cross-border data flow is roughly 6.7 Tbps.[3]

Is this volume of cross-border data a large number or a small number? I compare the cross-border data flow with a recent Cisco Systems–sponsored projection of data traffic, by country and type (Cisco Sys-

tems 2013).[4] For 2012, the Cisco study estimates Internet and IP traffic in the United States at 8 exabytes per month and 13 exabytes per month, respectively.[5] That translates into roughly 26.5 Tbps and 42.2 Tbps.[6]

Table 9.4, below, compares the U.S. cross-border data flows with the overall U.S. Internet and IP traffic. I find that cross-border data flows are roughly 25 percent and 16 percent of U.S. Internet and IP traffic, respectively. To put this in perspective, U.S. exports of goods and services are 14 percent of U.S. gross domestic product (GDP) in 2012, while U.S. imports of goods and services are 18 percent of U.S. GDP in 2012. (Box 9.2 briefly reports similar calculations for Europe.)

This calculation offers us a reasonable way of estimating the size of the international component of the U.S. telecom sector. According to the BEA (2014), the gross output for the telecommunications industry in 2011 was $556 billion. After adjusting for growth, that puts the gross output at roughly $575–$600 billion in 2012.

If we assume that the international component of the telecom industry is proportional to the size of the data flow, the international component of U.S. telecom would be roughly $92–$150 billion. That's compared to the $14 billion in exports and $8 billion in imports that the official statistics report.

Table 9.4 Cross-Border Data Flows, 2012: United States

	Terabits per second (except as noted)
International Internet capacity connected to the U.S.	23.0
Average utilization (%)	29.0
Average cross-border data flow (average international traffic)	6.7
All U.S. Internet traffic	26.5
All U.S. IP traffic	42.2
Average U.S. cross-border data flow as a percentage of:	
All U.S. Internet traffic (%)	25.0
All U.S. IP traffic (%)	16.0

SOURCE: International capacity and utilization estimates from TeleGeography (2014). Traffic estimates from Cisco. IP includes both Internet traffic and managed IP such as consumer video. Figures omit mobile.

Box 9.2 Europe's Data Connections

Using a similar methodology as for the United States, we can calculate interregional cross-border data flows as a share of Internet traffic for Europe. TeleGeography estimates that international bandwidth in Europe was 56.5 Tbps in 2012, but that 78 percent of that bandwidth was between cities in the same region. As a result, "interregional Internet capacity connected to Europe" equaled 12.6 Tbps in 2012. Based on this figure, we calculate that cross-border data flows between Europe and the rest of the world equaled 16 percent of the region's Internet traffic and 13 percent of the region's IP traffic.

These results, which should be viewed as highly imprecise and tentative, suggest that the United States is more interconnected with the rest of the world than Europe. The sources of error enumerated in the caveats above are potentially very significant.

Obviously, this should be viewed as an exploratory effort, with plenty of caveats. However, the revised estimates intuitively make more sense than the official statistics, in terms of measuring the importance of cross-border telecom services. Of course, these numbers are accompanied by substantial and worrisome caveats, as well as the possibility of large errors in both directions. In particular, these include the following:

- **Coverage and methodology may differ.** Cisco's projections include all IP usage. TeleGeography's estimates of international capacity by country do not include private networks such as intracorporate networks, Google and other content providers' networks, and research networks. This factor would tend to underestimate the share of cross-border traffic.
- **Double-counting is inevitable**. International Internet traffic is often routed through third-party countries before getting to its destination. Traffic between Moscow and New York might be routed through London and therefore show up as part of European cross-border data flows. Traffic between the Canadian cities of Vancouver and Toronto might be routed through the United States and therefore show up as part of U.S. cross-border data flows. And since less-developed countries may have

better Internet connections with the United States and Europe than with each other, it's possible for intra-African traffic, say, to be routed through New York or London. This factor would tend to overestimate the share of cross-border traffic.

- **When comparing estimates/forecasts from different sources, timing matters.** International Internet capacity, as estimated by TeleGeography, has been growing at almost 50 percent per year. Domestic U.S. Internet traffic, as projected by Cisco, has been growing roughly as fast. As a result, calculating cross-border data flows as a share of Internet traffic can be heavily influenced if one source is using yearly averages while the other source (TeleGeography) is using a particular point in time (April of each year). The direction of bias is uncertain.
- **Compression may distort the statistics**. Widespread and growing use of compression means that "we communicate around three times more information through the same installed infrastructure as we did in 1986" (Hilbert 2011, p. 7). It's possible that cross-border data flows may be compressed more intensively than purely domestic data flows.

MEASURING THE ECONOMIC BENEFITS OF CROSS-BORDER DATA FLOWS

Why are we concerned with correctly measuring cross-border data flows? The classic justification for the benefits of trade is that two or more countries working together can produce more than the same countries operating separately. Moreover, the size of the gain from trade is related to the magnitude of trade, all other things being equal. The more trade, the better.

Under the current trade statistics, the magnitude of trade in data is being systematically underestimated. Thus, the benefits from trade in data are being systematically underestimated as well, which, as we will see in the next section, distorts policy decisions.

Moreover, trade in data has somewhat of the characteristic of a public good, since data can be duplicated relatively costlessly. As a result,

the fact that the data is created in one country and used in another country does not deprive the first country of the use. To give a specific example, one type of intangible capital stock is "entertainment, literary, and artistic originals," including films. Licensing the right to show a film in a foreign country currently shows up as an export in the national income accounts. However, such a license generally does not reduce the ability of American consumers to view the film, and it does not reduce the intangible capital stock of "entertainment, literary, and artistic originals."

As a result, trade in data creates positive externalities and an extra boost to global growth. Unlike exports of goods, data can be shipped from one country to another without depriving the first country of the benefits. All other things being equal, growth in cross-border data flows can be a far more powerful impetus to consumer welfare and economic growth than growth in trade in goods and services. This means that data trade generates a positive externality for the global economy. If a U.S. university produces educational videos about computer science and makes them available on the Internet, then students around the world can benefit from those videos.

Now we turn to the question of how data trade figures into calculations of GDP and economic growth. As noted in an earlier paper, data can be "consumed" by individuals; can be used as an intermediate input into production; and can be an investment in intangible capital (Mandel 2012).

For trade in conventional goods and services, there is a well-established methodology for assessing such trade's contribution to economic growth. In the calculation of GDP, the dollar value of exports is a plus, while the dollar value of imports is a minus. For the calculation of gross domestic purchases—which are one measure of living standards—the dollar value of exports of goods and services is a minus, while the dollar value of imports of goods and services is a plus.

The arithmetic does not work quite the same for cross-border data flows, for two reasons. First, because data that are exported are still available domestically, exports don't need to be subtracted from gross domestic purchases. Second, imports of data potentially come in at low or zero prices, as discussed above, despite the fact that there is a positive price to originally producing the data and then transporting it across

national borders. As a result, imports of data, valued in dollars, appear not to contribute to growth.

Consider, however, that the alternative to importing the data at a low or zero price is to produce it domestically at its full cost, which would be higher than the import price. Viewed from that perspective, there is a growing body of literature about how to value the contribution to growth of imports that are priced much lower than comparable domestic products. I will show how this approach can be used to value cross-border data flows.[7]

To demonstrate how this would work, I will consider the amusing category of YouTube videos of cats involved in different activities (Illustration 9.1). Quite a few of these videos are produced in Japan and get millions of free views (Lewis-Kraus 2012). They provide pleasure for viewers in America and around the world—in that sense they are analogous to going skiing or reading a book. Thus, they raise consumer welfare in the United States for people who enjoy videos of cats. But how should the gain to the U.S economy from these "free" data flows be measured? The key is to realize that there are two relevant prices here. One is the price to Americans of consuming the Japanese-made cat video, which is zero. The second is the maximum price, P^{cat}, that an American would pay for viewing a Japanese-made cat video, measured either in dollars or in value of time. We assume that there is no way of profitably producing a comparable video with Japanese cats in the United States—in other words, in order for someone in this country to produce comparable videos domestically, the videos would have to be sold at an average price per viewing in excess of P^{cat}.

So before YouTube, it was as if the price of a Japanese cat video to Americans was equal to P^{cat}, and the volume of videos viewed was zero. After the Internet and YouTube, the price P of Japanese cat videos goes to zero, and the volume of videos viewed goes to V.

How much does this change contribute to U.S. gross domestic purchases? For the sake of simplicity, assume that X is the size of gross domestic purchases in dollars, excepting cat videos. Let's also assume that there is no inflation and that X is otherwise not changing. Then the straightforward way of calculating growth would be as $(X + P \times V)/X$, where P is the price of a cat video after the introduction of YouTube. But P is zero, so it looks like there is no gain.

Illustration 9.1 Maru the Cat, as Seen on a YouTube Video from Japan

In fact, a better approach is roughly analogous to the procedure used to calculate chain-weighted GDP growth. I take the geometric average of two growth rates—the first assuming that the price of the video is always zero, and the second assuming that the price of the video is always P^{cat}:

$$g = \sqrt{\frac{(X + 0 * V)}{X}} * \sqrt{\frac{(X + P^{Cat} * V)}{X}} = \sqrt{1 + \frac{P^{Cat} * V}{X}} \approx 1 + \frac{P^{Cat} * V}{2X} .$$

In other words, the gain to gross domestic purchases from cross-border data flows of cat videos is roughly equal to the revenue that would be generated by pricing the videos at the average of the actual price (zero) and the price that Americans would be willing to pay, P^{cat}.

Since this requires no additional domestic resources, it is also the gain to consumer welfare.

POLICY IMPLICATIONS

Trade in data is fundamentally a new phenomenon. While many people would like to fit it into the framework of previous trade deals—in particular, the WTO's General Agreement on Trade in Services (GATS)—such efforts will not work. We need new analytical tools to deal with both measuring cross-border data flows and assessing the benefits.

This chapter has made the case that, without those tools, the economic impact of cross-border data flows is being understated. What effect does this understatement have on trade and tax policy?

Trade and Tax Policy

Both trade and tax policy require a series of compromises and trade-offs. In the case of trade negotiations, a wide variety of different industries and interests—agriculture, low-tech manufacturing, high-tech manufacturing, finance, insurance—are competing for the attention of policymakers. Trade negotiators have to decide which issues are "must-haves" and which ones they can retreat on.

Similarly, tax policy requires balancing out the need to raise revenue against the negative effect of taxes on different industries. That's especially true in today's climate, where tax cuts benefiting one industry will have to be balanced by closing tax loopholes or raising taxes on other industries.

Policymakers and negotiators make these decisions partly by assessing political reality and partly by assessing economic strength. All other things being equal, industries that have a bigger positive effect on jobs and growth will fare better in trade and tax policy.

The problem is that the positive benefits of cross-border data flows—because they are such a new phenomenon—are significantly underestimated in the available official statistics. Reported exports of data-related services show up as relatively minor in the larger picture.

Under the circumstances, the impact of cross-border data flows on economic growth will be understated as well, and it will be more difficult for policymakers to set the right priorities for trade and tax policy.

There have been several recent proposals for increasing the tax rate paid by international Internet companies, or for imposing additional regulations on them. In one instance of this, a recent paper from the French government suggested a sort of tax on data (Collin and Colin 2013). Such proposals—which would be likely to discourage cross-border data flows—are more likely to be seriously considered in the absence of evidence showing the large positive economic impacts from such cross-border data flows.

Impact of Data Localization

Another example comes from the aftermath of the revelations about NSA monitoring, which created a backlash against U.S. Internet companies and intensified discussions about building "walls" that would keep certain types of personal data from leaving countries such as Brazil.

Several reports have identified the possible negative economic consequences of such actions (Castro 2013a,b; Staten 2013). However, what's missing is the ability to actually track the negative consequences from data protectionism, since we do not currently track cross-border data flows. By comparison, if a country erects trade barriers against a particular tangible product, the impact of such a policy would immediately show up in the trade statistics. It's difficult to measure the harm from barriers to data trade if we cannot measure the data flows to begin with. Weller and Woodcock (2013) note that adverse effects may be incidental:

> It is also the case that regulations that are not explicitly intended to apply to Internet traffic exchange may have that effect. For example, restrictions on the ability to export certain data, such as customer profiles, intended to protect security and privacy, may also limit the development of Internet topology and the growth of Internet assets in some regions. Similarly, tax policies in each country toward broadband and Internet businesses are likely to affect the choice of the locations for investment in Internet assets. (p. 24)

CONCLUSION: THE NEED FOR BETTER DATA ON CROSS-BORDER DATA FLOWS

Businesses in any industry are usually ambivalent about the collection of government statistics on that industry. On the one hand, objective industry-wide statistics can be extremely useful for business decision-making and planning. On the other hand, the collection process can be intrusive, and accurate statistics can potentially attract new competitors or unwanted attention from regulators.

The calculation gets even tougher for rapidly innovating tech industries. Tech companies are unlikely to call for additional investment in statistics that may be quickly rendered obsolete by technological change.

However, the balance changes in a situation where businesses need government support in order to avoid bigger problems. In particular, better information about cross-border data flows will help make the case that data protectionism and taxes on data can be economically destructive.

The bottom line is that the statistical agencies should supplement the current trade statistics with additional metrics on cross-border data flows. This should be part of a large push to better measure data consumption and investment domestically.

Notes

My thanks to the Sloan Foundation for funding this research. I thank Diana Carew of the Progressive Policy Institute, Alan Mauldin of TeleGeography, Steve Bauer and Bill Lehr of the Massachusetts Institute of Technology, and Michael Kende of Analysis Mason for very useful assistance. All mistakes and errors are my own.

1. Many large providers own their own undersea cables, have a share of a cable, or have long-term rights to use part of the bandwidth. Submarine cable is used to carry cross-border data flows across oceans but also often between countries on the same continent, because it's often easier and safer to maintain cables that run along the coast underwater than across difficult terrain. Cables are typically laid with multiple strands of optic fiber, some of which are "lit"—i.e., they have the necessary equipment to be used—and some of which are "dark," or not yet ready for use. Capacity can be increased by laying new cables, by lighting dark fiber, or by improving the capacity of already-lit fiber.

2. I thank Alan Mauldin of TeleGeography for providing these estimates.
3. These figures are based on the bidirectional averages of the average for the month of April and the peak during April of each year.
4. See also http://ciscovni.com/forecast-widget/index.html.
5. Non-Internet IP traffic in the United States is mainly consumer video.
6. 1 exabyte = 1,024 petabytes; 1 petabyte = 1,024 terabytes; 1 terabyte = 8 terabits.
7. This growing body of literature on how to assess growth when import prices are less than domestic prices includes Diewert and Nakamura (2010) and Feenstra et al. (2009).

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Measuring Globalization

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Volume 2

Factoryless Manufacturing, Global Supply Chains, and Trade in Intangibles and Data

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and
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Editors

2015

W.E. Upjohn Institute for Employment Research
Kalamazoo, Michigan

Library of Congress Cataloging-in-Publication Data

Measuring globalization : better trade statistics for better policy / Susan N. Houseman and Michael Mandel, editors.
volumes cm
Includes bibliographical references and indexes.
ISBN 978-0-88099-488-0 (v. 1 : pbk. : alk. paper) — ISBN 0-88099-488-6 (v. 1 : pbk. : alk. paper) —ISBN 978-0-88099-489-7 (v. 1 : hardcover : alk. paper) — ISBN 0-88099-489-4 (v. 1 : hardcover : alk. paper)
1. Commercial statistics. I. Houseman, Susan N., 1956- II. Mandel, Michael J.
HF1016.M44 2015
382.01’5195—dc23

2014047579

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Kalamazoo, Michigan 49007-4686

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Cover design by Alcorn Publication Design.
Index prepared by Diane Worden.
Printed in the United States of America.
Printed on recycled paper.