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PAPER SERIES: NO. 30 — APRIL 2016

Tracing the Economic Impact of Regulations on the Free Flow of Data and Data Localization

Matthias Bauer, Martina F. Ferracane and Erik van der Marel



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Published by the Centre for International Governance Innovation and Chatham House.

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This work was carried out with the aid of a grant from the International Development Research Centre (IDRC), Ottawa, Canada.

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ABOUT THE GLOBAL COMMISSION ON INTERNET GOVERNANCE

The Global Commission on Internet Governance was established in January 2014 to articulate and advance a strategic vision for the future of Internet governance. The two-year project conducts and supports independent research on Internet-related dimensions of global public policy, culminating in an official commission report that will articulate concrete policy recommendations for the future of Internet governance. These recommendations will address concerns about the stability, interoperability, security and resilience of the Internet ecosystem.

Launched by two independent global think tanks, the Centre for International Governance Innovation (CIGI) and Chatham House, the Global Commission on Internet Governance will help educate the wider public on the most effective ways to promote Internet access, while simultaneously championing the principles of freedom of expression and the free flow of ideas over the Internet.

The Global Commission on Internet Governance will focus on four key themes:

- enhancing governance legitimacy — including regulatory approaches and standards;
- stimulating economic innovation and growth — including critical Internet resources, infrastructure and competition policy;
- ensuring human rights online — including establishing the principle of technological neutrality for human rights, privacy and free expression; and
- avoiding systemic risk — including establishing norms regarding state conduct, cybercrime cooperation and non-proliferation, confidence-building measures and disarmament issues.

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EXECUTIVE SUMMARY

This paper explains how the economic costs of data localization and associated regulations on the free flow of data affect downstream economies in a group of emerging economies and the European Union. It analyzes observable regulatory barriers that explicitly inhibit the cross-border movement of data, which are currently being considered and implemented by various governments. It also calculates the costs of data regulations for domestic industries by establishing an empirical link between the regulation in data services and domestic downstream economic performance at the industry level. This methodology allows for the econometric analysis of the economic impact of data regulations. The regression analysis reveals that regulatory restrictions of the free flow of data tend to reduce productivity and economic output in those industries that depend relatively intensively on data services. Following this analysis, the paper presents an overview of recent developments in policies regarding data localization and associated data regulations for the group of countries studied. In addition, an overview of regulations on the free flow of data is provided for a number of countries that are not covered in the empirical part of this paper, but should be of concern in follow-up studies.

INTRODUCTION

Cross-border data regulation is a new type of regulation, which can impose significant costs on domestic and foreign firms (Christensen et al. 2013). There is, however, relatively little knowledge on the channels through which these data flow regulations affect the performance of the wider economy. To the knowledge of the authors, virtually no empirical assessment has been performed regarding the way in which data regulations affect the output of the wider economy. This paper presents an empirical approach to uncover the relationship between regulations in domestic and cross-border data and the performance of the domestic economy. In addition, the paper discusses the current policy debate related to data localization and its associated regulations for these emerging economies.

Regulation of data flows represents a relatively new feature in the broader spectrum of services regulation. It concerns rules on how personal data is utilized and processed by firms in the interaction between consumers and producers, or between producers. Consumers can be exposed to the release of their personal data on numerous occasions — for example, while using credit cards for economic transactions — or during instances ranging from using social media to accessing health care services. In many cases, the consumer and producer are located in different geographical locations, which motivates the transfer of data domestically or across borders. For instance, although a consumer's credit card banking service might be located in the same country as the consumer, transaction data made

are often stored on a server somewhere else, or are further processed in the banking affiliate's head offices elsewhere in the world. Data flow regulations aim to regulate this flow of data between parties or across countries.

As in all services sectors, policy makers' challenge is to find the right balance between developing necessary regulations that are linked to a particular social objective (or negative externality) and implementing these regulations at minimum cost, in terms of economic welfare, so they do not create an unnecessary cost burden for firms (Sáez et al. 2015). Yet, new rules on the regulation of cross-border consumer data for producers could also have detrimental economic effects (see Bauer et al. 2014). This is because data services regulations have a side effect of restricting transactions between domestic and foreign-using operators, which in turn limits the efficient sourcing of data processing activities.¹ More importantly, today data are used by all sorts of so-called data-using industries (for example, downstream industries) as part of their input structure for production. In fact, services sectors are the main users of data. Regulatory restrictions of data can therefore inhibit the performance of sectors such as financial or business services or even new technological sectors using platforms.

In particular, this paper shows the negative cost impact of data regulations on domestic industry performance in a select set of countries — namely emerging economies — by developing a regulatory data index that serves as a proxy indicator for regulations in data. As in Erik van der Marel, Hosuk Lee-Makiyama, Matthias Bauer and Bert Vershelde (forthcoming 2016), this paper first makes a comprehensive assessment of the different types of regulatory barriers currently existing in various Organisation for Economic Co-operation and Development (OECD) and emerging economies to create a benchmark base of regulations. It then augments this benchmark to assess the extent to which the actually observed set of regulations in data in the eight emerging economy countries has a significant impact on downstream sectors that use data. To undertake this exercise, it is assumed that more intense users of data-processing services will be hurt to a greater extent than firms, for which data only account for a small share of total input use.²

1 Domestic and foreign operators can trade these personal data as inputs at arm's length (i.e., cross-border) or in-house through various ways, depending on the sourcing strategy. Following Sebastian Miroudot, Ranier Lanz and Alexandros Ragoussis (2009), if the data is traded within the firm with a foreign country it refers to *offshoring*; if traded outside the firm within the same country it refers to *domestic outsourcing*; if traded outside the firm and with a foreign country it refers to *global or international outsourcing*. Normally, trade data is recorded both when trade takes place in-house (intra-firm), as well as arm's length (inter-firm) across borders, as it does not make a difference between the two channels.

2 The empirical strategy is borrowed from van der Marel et al. (forthcoming 2016) and follows Jens Matthias Arnold, Beata Javorcik and Aaditya Mattoo (2011) and Arnold, Javorcik, Molly Liscomp and Mattoo (2012), in which the authors have developed a similar index that identifies the extent to which downstream goods producers are affected by deregulations in services sectors.

Downstream industries that use data or data-related services to a greater degree are usually more dependent on the extent to which the transfer of data is regulated and/or freed from unnecessary cost-increasing regulatory measures than other sectors. This approach has been taken into account with the goal of assessing how regulations in data affect the overall economy. The paper develops a benchmark of currently existing regulatory administrative barriers and later adds on the regulations in data to this benchmark. In a second step, the effect of these administrative regulations are estimated, including the ones in data, on the economic performance of the downstream users in terms of total factor productivity (TFP). In other words, the paper augments a regulation index with the recently proposed data protection measures of eight countries included, and computes the precise TFP impact for these countries by sector as part of a counterfactual analysis.³ Admittedly, this approach is indirect, but robust, and borrowed from Erik van der Marel, Hosuk Lee-Makiyama, Matthias Bauer and Bert Vershelde (forthcoming 2016).

The first version of this study was conducted in 2014. In the meantime, extensive research was carried out, covering more than 60 countries around the world. Updated data will be publicly released in a comprehensive database by mid-2016. The data reveal that data regulations in general and data localization requirements in particular can take different forms, according to stated objectives, and affect downstream industries in many different economically distorting ways. A brief discussion of prominent measures and recent trends is provided after the empirical part of this paper.

ASSESSMENT STRATEGY OF THE COST OF REGULATION

This section explores how data regulation is systematically related to the performance of the economy, divided into industries and services. An identification strategy has been applied based on three of information: first, the extent to which data regulation is present across various countries; second, the performance of downstream industries in each of the countries available in the dataset; and third, a measure that links this data regulation index to downstream industry performance.

Cost Price Increases of Data Regulation for Domestic Firms

Currently, no composite index or indicator exists that measures the extent to which data and/or data services are regulated. Therefore, this paper relies on an indirect approach of taking a pre-existing measure in order to

ascertain a rough proxy indicator. This proxy index should only roughly reflect the regulations regarding data currently in place in the select countries, as it is chosen according to the types of real regulatory measures prevalent in the data usage of the select economies. The estimated outcomes of this indirect approach are then used to add on the real data regulations currently in place in the eight countries, and their inhibiting effect on economic performance are estimated.

A two-step procedure was undertaken to develop the proxy index. First, the actual regulations regarding the use, processing and cross-border transfer of data were verified across the select group of countries that are currently considering or implementing a regulatory package of data measures. By doing this, the *type* of regulations these are was examined. Put differently, this method verifies what types of regulatory measures related to data are actually observable at this moment across the selection of countries, which have either proposed or already implemented data regulations. The actual laws for each country related to these data regulations are listed in Table 1. Based on this assessment of current regulatory barriers, a rough proxy index of the existing data regulations was selected and used as a benchmark to assess the cost-effect of data regulations in the wider economy.

In order to select this rough proxy variable, a sub-indicator of the integrated structure of the OECD Product Market Regulation (PMR) in services was used (as explained in Koske et al. 2015). The relevant indicators are “regulatory and administrative opacity” and “administrative burdens on start-ups,” which relate to the approximate measures selected for this study. Within this PMR composition scheme, the sub-indicator called “data-producing sectors” was chosen. These indicators measure as close as possible the kind of prevailing regulatory barriers in the usage or process of data prevalent in sectors listed in Table 2. By doing so, this study relied on the information available on the types of regulations and market structure in these data sectors in the selected countries, as shown in Table 1.⁴ As such, this stage does not try to develop an exact index that measures the extent to which countries really regulate data, but instead makes a close match between currently existing regulations regarding data and the existing regulatory indexes currently available, sorted by the type (or based on the typology) of regulatory measures that currently prevails in data. Later, the real policy regulations of the select countries are added on to this benchmark index to estimate the real costs. As such, this rough proxy will be augmented.⁵

4 The countries selected for analysis of the prevailing (or considered) regulatory barriers in data services are the European Union, Brazil, China, Vietnam, Indonesia, Korea, Russia and India.

5 Another way of looking at this procedure is to think of a benchmark approach in which a point of reference is constructed from where those conducting the study, in a later stage, measure the costs associated with the actual implementation of data regulations observed in the countries taken up in this paper.

3 The reason for looking at productivity is because higher costs of input usage will translate into lower rates of efficient usage of inputs in a firm or industry’s production function.

Table 1: Types of Regulatory Barriers in Data Services

Type of Restriction	Regulatory Measure	Outcome
Restrictions related to the foreign supply of data services	Is there a data localization requirement?	Yes/Limited/No
Restrictions related to internal productivity losses/administrative costs	Is there a strict consent requirement for the collection, storage or dissemination of personal data?	Yes/No
	Does the law provide users with the right to review their stored information?	Yes/No
	Does the law provide users with the right to be forgotten/deleted?	Yes/No
	Is a notification of breaches toward the government/user obligatory?	Toward government/user/ government and user
	Are data protection impact assessments obligatory?	Yes/No
	Is a data protection officer required?	Yes/No/Qualified Yes
	Are there administrative sanctions for non-compliance? How high?	Varies according to height of sanctions
	Does the government require easy access to companies' data?	Yes/No
	Are companies required to retain data for a fixed period of time?	Yes/No

Data source: Authors; European Centre for International Political Economy <http://ecipe.org/>.

Table 2: Selected Sectors Related to Data Services

North American Industry Classification System 6-digit Sector	Description
511140, 511190	Directory, mailing list and other publishers
511210	Software publishers
516000	Internet publishing and broadcasting
517000	Telecommunications
518100	Internet Service Providers and Web search portals
518200	Data processing, hosting and related services
519000	Other information services
541511	Custom computer programming services
541512	Computer system design services
541513, 541519	Other computer-related services, including facilities management

Data source: BEA www.bea.gov/industry/io_annual.htm.

For the index, administrative regulations were selected, which in the PMR falls under the division “barriers to entrepreneurship” and is made up of a simple unweighted average between two indicators measuring administrative barriers: “regulatory and administrative opacity” and “administrative burdens on start-ups.” Of course, these two categories do not exactly match data regulations, but since most of the data regulations are administrative in nature, this index was used to be as close as possible for the benchmark needed for this study. In other words, most of the regulatory barriers related to data observed in

sectors (listed in Table 1) are of an administrative character, which is what these PMR sub-indexes appear to measure. So by selecting the administrative barriers, this study tries to capture at least some of the regulatory burdens that are also likely to prevail in data.⁶

As a regulatory index of data or data services was not developed over this more indirect approach, this paper tries to correct for bias as much as possible by multiplying the countrywide proxy index with the share of data services used for each sector — i.e., the so-called industry usage of data.

Downstream Linkage

How does one address the link between this proxy index of regulation to each downstream sector using data in their input production so that the potential cost of data regulation can be measured for the wider economy? Note that an unweighted approach, in which the regulatory barriers are directly linked to each downstream industry, would be insufficient to properly capture the real economic effects of the performance variable. This is because some sectors are more dependent on data than others. Hence, to finalize the benchmark approach, the proxy index of administrative regulation was connected to each individual data-using sector in the economy before measuring its impact on the economy-wide output performance of each downstream industry.

⁶ In van der Marel et al. (forthcoming 2016), other sub-indicators were checked to see if they provided different outcomes, as a robustness check.

This calculates the data intensity for each downstream using sector of data in a typical economy using US Input-Output Use tables from the U.S. Bureau of Economic Analysis (BEA). Through this, the share of data-reliance for each industry and sector for a representative economy was computed. One advantage of taking these Input-Output Use matrixes is their level of disaggregation. More than 400 sectors are specified at six-digit commodity and services code level, which makes it the most detailed input-output table currently available across the globe. This weighted approach was selected because regulation in data will be most felt in industries and services sectors that use data and data-related services most intensively as inputs for the production process of other goods and services. Put differently, the input range of the data and data-related activities is likely to be more important for some manufacturing and services industries than others, and this variability is exploited in the cross-sectional panel's empirical setting.⁷

Table 3 shows this share of data reliance, which is the proportion of input used by each sector from the data-producing sectors listed in Table 2. This list is largely based on the information technology (IT)-producing sectors put forward in Dale W. Jorgenson, Mun S. Ho and Jon D. Samuels (2005; 2007; 2010). The only difference is that sectors not included in this paper's selection are the IT equipment manufacturing sectors, which are pure goods industries that deal with the transfer of data to a much lower degree.⁸ With the distinction between data producers and users in mind, the data intensity of inputs provided by the data producers for each downstream industry can be calculated. Table 3 shows that telecommunications, information and communication technology (ICT) business services, finance and insurance are sectors that use data services most intensely, whereas the processed foods industry, metals industry and primary agriculture are sectors where data services play only a negligible role. Overall, data are used much more in services than in goods industries.

7 This approach follows the strategy taken in Arnold et al. (2011; 2012), in which the authors developed an index that identifies the extent to which downstream producers are affected by regulations in services sectors. In their seminal studies, downstream industries using services to a greater extent are considered more dependent on the degree to which services are liberalized or freed from cost-increasing regulatory measures. This section applies their dependency index, but then only for the usage of data.

8 These industries are the following: computer and peripheral equipment manufacturing; communications equipment manufacturing; and semiconductor and other electronic component manufacturing (Jorgensen, Ho and Samuels 2010). As the authors of this paper see it, cross-border data is a new emerging phenomenon that closely resembles services, as the types of regulatory barriers found in data are extremely close to those found in services sectors, hence, the interchangeable usage of data and data services and data-processing services. The selection of sectors in Table 1 was done by an expert group that worked closely with data services companies and representatives.

Table 3: Data Intensities

GTAP Sector	Sector Description	Data Intensity
communication	Post and telecommunication services	0.318
obsict	Other business and ICT services	0.069
fininsurance	Financial and insurance services	0.050
machinery	Machinery and electronic equipment	0.049
oconsumer	Other consumer services	0.048
oservices	Public services, dwellings	0.040
distribution	Trade and distribution services	0.037
water	Water and other utility services	0.034
transport	Transport services	0.032
construction	Construction	0.024
othermanuf	Manufactures nec.	0.024
fabmetals	Metal products	0.020
nonmetmin	Mineral products nec.	0.014
lumberpaper	Wood and paper products	0.014
energy	Coal, petroleum and gas production	0.011
transequip	Motor vehicles and parts	0.008
chemicals	Chemicals, rubber and plastic products	0.008
bevtextcloth	Beverages/tobacco products; clothing and leather products	0.007
metals	Ferrous metals and metals nec.	0.007
primagrother	Primary agricultural products	0.007
procfoods	Meat, vegetable oils, dairy, sugar and food products nec.	0.006

Data source: Author's calculations using BEA at www.bea.gov/industry/io_annual.htm.

Note: nec. = not elsewhere classified.

Having computed the types of information of administrative regulatory measures for each country and data services intensities for each downstream sector, these two data variables are linked into one indicator to obtain the following weighted index for the so-called data regulation linkage (DRL),

$$DRL_{oit} = \sum_k \alpha_{ik} \text{regulation index}_{ot} \quad (1)$$

where DRL stands for the data regulation linkage for sector i in a typical country o in year t , which is measured by the proportion α_{ik} of inputs sourced by both the manufacturing and services sectors i from data services sectors k , multiplied with the proxy index for data services regulation for each country o in year t . Again, the variable α_{ik} is sector-specific and calculated using the BEA's US Input-Output Use tables as presented in Table 3, while the *regulation index*_{ot} variable is computed using the administrative barriers index from the PMR structure as previously explained. Hence, according to

equation (1) the input coefficients in terms of data intensities presented in Table 3 are multiplied with the PMR regulation index numbers.⁹

Measuring the Performance of the Economy

The final stage of this first step is to measure the extent to which the benchmark of administrative regulations for data (i.e., the DRL) has an effect on the performance of the whole economy. To take stock of the economy-wide output performance, two different variables were studied, which are inversely related to each other, namely the TFP and a price index based on value added calculations (Pva). The reason for selecting TFP as an output performance measure follows standard practise in the international economic literature. More regulations will inhibit firms from sourcing input efficiently, which will show up in higher costs for firms and industries as part of their production function. This, in turn, will increase prices, which will eventually translate to lower productivity, i.e., TFP.

As an example, when data localization is put in force it means companies are prohibited from sending data back and forth freely between affiliates or companies by adhering to strict rules of local storage or other administrative regulations. This increases costs for firms to source and process data efficiently, which will increase business operations' complexity and eventually decrease productivity. Another example is data protection impact assessment implemented by countries. This regulatory barrier will affect firms working with lots of data more than other less data-related firms, which could lower their relative efficient production. In order to find out a meaningful conclusion of the impact of data regulations on downstream TFP and price performance, standard parametric estimations techniques are used. The following estimation equations are used:

$$\ln(TFP)_{oit} = \alpha_i + \beta_1 DRL_{oit} + \gamma_o + \delta_i + \zeta_t + \varepsilon_{oit} \quad (2a)$$

$$\ln(Pva)_{oit} = \alpha_i + \beta_1 DRL_{oit} + \gamma_o + \delta_i + \zeta_t + \varepsilon_{oit} \quad (2b)$$

where TFP and Pva in industry i in country o in year t is explained by the data regulation linkage index for that same industry i in country o in year t in both equation (2a) and (2b) and are put in logs. In both equations, the terms γ_o , δ_i and ζ_t stand for the fixed effect by country, sector and year respectively, which are also included in the empirical model. These fixed effects take care of the issue that other factors undoubtedly may also have an effect on TFP. For instance, the extent to which a country accumulates high-

9 Note that the group of countries over which the DRL is calculated spans a wider selection than the list of countries mentioned in footnote 4. This is because these countries are used as examples of governments where data regulations have recently been put forward that have served for selecting a close proxy of similar types of regulations. The availability of these proxy regulations from the PMR, as explained in the section on "Quantification Process," covers almost all OECD and emerging economies.

skilled labour or ICT-related capital could also affect productivity. Since the fixed effect picks up this variation by country and sector, no additional control variables will have to be included. Data for both TFP and prices are taken from the EU KLEMS database, which covers information for two-digit sectors based on the NACE classification and are calculated on a value-added basis. Finally, both equations' error term is given by ε_{oit} . Altogether, there is a small panel dataset for three years covering 21 goods and services sectors for 12 countries. Summary statistics of all these variables are given in Table 4.

Table 4: Summary Statistics for Dataset

Index Proxy	Period	Mean	Std. Dev.	Min.	Max.	No. of Observations
TFP (logs)	All	4.566	0.171	3.292	6.338	996
Pva (logs)	All	4.590	0.201	2.054	5.768	1002
DRL	All	0.084	0.136	0.004	0.965	1008

Source: Authors.

Table 5 provides the results of the regressions. The coefficients have the expected negative sign on TFP and positive sign on value-added prices. Both coefficient results for TFP and prices are statistically significant. The results suggest that administrative regulatory barriers in sectors using data-processing services most intensively exhibit a dampening effect on TFP, while also exerting an upward pressure on prices in these sectors. A one standard deviation change in the DRL variable would therefore decrease TFP on average by 3.9 percent. Similarly, for prices, a one standard-deviation change in the DRL would increase prices on average by 5.3 percent.¹⁰

Table 5: Regression Results on Prices and TFP

	(1)	(2)
	lnTFP	lnPRICE
DRL	-0.255**	0.395***
	(0.122)	(0.108)
Observations	996	1,002
R-squared	0.159	0.173
RMSE	0.164	0.187

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: Authors.

10 Van der Marel et al. (forthcoming 2016) provide further regressions output results and take stock of any endogeneity concern (which is not included in this paper). Rather than assuming regulatory policy in data services affects downstream TFP in the wider economy, taking stock of this potential endogeneity means the exclusion of any reversed causality — i.e., firms that already perform well in terms of TFP are the ones lobbying for precisely lower regulatory barriers. Taking the lag on the independent variables shifts the time frame backwards so this possibility of lobbying is ruled out, as firms cannot influence policy that took place in previous years.

APPLICATION OF COST PRICE INCREASES OF DATA REGULATION

Based on the econometric exercise, the second step performs a counterfactual analysis for various countries that have, in reality, implemented a package of regulatory measures related to data. For this paper's research purposes, various emerging market economies, plus South Korea and the European Union, were selected for the counterfactual analysis to have a small variety of different income countries where data regulations are currently observable. This is done by taking into consideration the data-processing services regulation laws currently under consideration as listed in Table 6. As a result, the elasticity results from other benchmark approaches in Table 5 are used to estimate the TFP losses associated with the actual implementation of data regulations observable in these eight countries.

Table 6: Selected Economies with Law Proposals for Data Processing

Country	Title Law for Data-processing Barriers
Brazil	Marco Civil
China	Decision on Strengthening the Protection of Information on the Internet (December 2012) and Telecommunication and Internet User's Personal Information Protection Measures (September 2013), plus Consumer Protection Law amendment of April 2013
India	Data retention provision of Information Technology Act, proposed National Security Council Secretariat strategy on cyber security plus proposed licensing requirement by Department of Telecom
Indonesia	GR 98 (2012) and EIT Law (2008)
South Korea	Personal Information Protection Act
European Union	EU General Data Protection Regulation
Vietnam	Decree 72
Russia	Federal Law No. 152-FZ and Federal Law no. 242-FZ

Source: Authors.

Quantification Process

Whereas the original index of administrative barriers was predefined and constructed as part of the OECD's PMR database, this time the index was augmented with actual observed administrative barriers in data and/or data services in the selected countries. Thus, in the quantification process, the de facto implemented regulatory barriers are added on top of the existing regulatory barriers used in the previous analysis. This is done by analyzing and quantifying the proposed data regulation laws currently in deliberation in the aforementioned countries (as presented in Table 6) in the same way as the original index of administrative barriers as part of the PMR structure.

This is done by selecting those data-related regulatory barriers that first, the selected countries have in common across their proposed law programs; and second, are likely to have a significant cost burden for firms. This selection has been carried out in close contact with experts in the field. The final selection of barriers is presented in Table 1. This selection process aims to include only those measures that have an economically important weight in terms of additional costs for the firm, as previously explained. Therefore, in order to assess whether these various barriers would really carry along significant costs for data services providers, various secondary sources were relied upon (see Christensen et al. 2013; Le Merle et al. 2012; UK Ministry of Justice 2012; PriceWaterhouseCoopers 2013; European Commission 2012). These sources give information about the excessive cost burden of the various regulatory data policies. With this selection of the regulatory data barriers at hand, appropriate weights are applied for each regulatory measure to take into account the average relative importance of each of the policy measures based on the expert judgements approach and based on these reports. The results are shown in Table 7.¹¹

Eventually, based on this coding scheme and the application of weights, a new index was derived that ranges between zero and six for each of the selected countries, which is consistent with the PMR score. The results for each country are given in Table 8. The final score is computed in the last row of the table. This measure indicates that a higher score for this index means that countries have implemented a greater degree of regulations in data services. The highest index can be found for Russia (4.82), followed by China (3.88) and Korea (3.82). Brazil (0.75), Vietnam (2.19) and India (2.36) have relatively low index levels of data restrictions. Note that this is due in large part to putting a higher weight on the barrier of data localization in this methodology. Having this type of barrier in place explains the relatively high score for Russia and China, whereas the European Union has a relatively high score because of many other domestic administrative barriers in place.

¹¹ See van der Marel et al. (forthcoming 2016) for further discussion on this issue. The discussion of data localization in various countries shows that definitions of data privacy, personal data and the obligation to store and disentangle certain categories of data creates various types of costs that can also go beyond pure administrative cost. These costs are comprised of, among others, business operation risks and the risk of additional security breaches due to external attacks by hackers. These costs also vary dramatically between those sectors that use data intensively, such as logistics and communication services, and those sectors that use data less intensively, such as primary sectors (excluding marketing and sales of commodities and raw materials).

Table 7: Quantification of Proposed Data-processing Barriers

	Weights by Theme (bj)	Question Weights (ck)	Coding of Outcome Data		
			No	Limited	Yes
Foreign supply of data services:	0.3		No	Limited	Yes
Is there a data localization requirement?		1	0	3	6
Internal administrative costs measures:	0.7				
			No		Yes
Is there a strict consent requirement for the collection, storage and dissemination of personal data?		0.050	0		6
Does the law provide users with the right to review their stored information?		0.050	0		6
Does the law provide users with the right to be forgotten, deleted?		0.047	0		6
			No	Government or user	Both
Is notification of breaches towards the government and/or users obligatory?		0.200	0	3	6
			No		Yes
Are data protection impact assessments obligatory?		0.175	0		6
Is a data protection officer required?		0.375	0		6
			No	Some	High
Are there administrative sanctions for non-compliance? How much?		0.047	0	3	6
			No		Yes
Does the government require easy access to companies' data?		0.047	0		6
Are firms required to retain data for a fixed period of time?		0.013	0		6
Country scores (0–6)	$\sum_j (b_j) \sum_k (c_k) \text{ answer}_{jk}$				

Source: Authors.

Note: Question weights are based on Christensen et al. (2013) and UK Ministry of Justice (2012).

Augmenting the Index for Administrative Barriers

The next step is to augment the existing index of administrative barriers in services with the index created for administrative barriers in data services. This is done by distinguishing between two periods of time, namely one where these data services barriers have not been put in place ($t=0$) as per today and which have been taken up in the empirical exercise in previous sections, and a hypothetical time period in which the data-related laws are implemented and are now applied in $t+1$. In other words, the initial index is augmented with the index created in Table 8, which describes what countries have implemented in terms of new data regulatory measures.

In $t=0$, a weighted average of both administrative barriers indices are applied, as defined with the DRL in the section “Cost Price Increases of Data Regulation for Domestic Firms,” plus an assumed index set to zero for administrative

barriers related to data not implemented yet in time $t=0$, the current year. Both a 0.4 weight to the two administrative barriers and only a 0.2 to the third index of data regulations are applied, because data regulations affect the use of data, which is still a part of the economy relatively lower in size than the part of the economy of all other (services) sector for which the existing barriers are targeted.¹² In the following step, data regulations in Table 8 are now implemented in time period $t+1$ as the third indicator.

¹² Obviously, this weighting scheme is somewhat arbitrary in the sense that one could also think of a lower weight. Nonetheless, from a methodological point of view, this matters less as one could adjust this weighting scheme accordingly when estimating the cost impact of data regulations.

Table 8: Index Outcomes of the Quantification Method

	Russia	China	Korea	EU	Indonesia	India	Vietnam	Brazil
Foreign supply of data services:								
Is there a data localization requirement?	6	6	3	0	6	6	6	0
Internal administrative costs measures:								
Is there a strict consent requirement for the collection, storage and dissemination of personal data?	6	6	6	3	3	6	0	6
Does the law provide users with the right to review their stored information?	6	0	6	6	6	0	0	0
Does the law provide users with the right to be forgotten, deleted?	6	6	6	6	0	0	6	6
Is notification of breaches towards the government and/or users obligatory?	6	6	6	3	3	0	0	0
Are data protection impact assessments obligatory?	0	6	0	6	0	0	0	0
Is a data protection officer required?	6	0	6	6	0	0	0	0
Are there administrative sanctions for non-compliance? How much?	6	3	3	3	3	3	0	6
Does the government require easy access to companies' data?	0	0	0	0	0	6	6	3
Are firms required to retain data for a fixed period of time?	0	0	0	6	0	6	0	6
Country scores (0–6)	4.82	3.88	3.82	3.18	2.42	2.36	2.19	0.75

Source: Authors.

In other words, this time period computes the same weighted average of the administrative barriers as defined under the “Cost Price Increases” section, plus the index obtained in Table 8 instead of the assumed index of zero for the previous time period in which no new data regulations were yet implemented. Again, the same weighted average of these three indicators is applied just in the previous time period so as to take account of the size of the data services sector in the whole economy, which will prevent any overestimation of the indexes. The difference between these two time periods is that this index now measures in a scalable way the increased regulatory costs for countries that have implemented additional real regulations on data as part of their overall set of administrative barriers. Overall, a higher index means that a country has a more restrictive data services regulatory regime.

Table 9 shows the results for both time periods. Unsurprisingly, the highest increase in the index can be observed for China, Korea and the European Union. The lowest movement between the two time periods is found for Brazil, in large part because Brazil has not implemented

laws related to data localization in addition to some of the other barriers receiving high weights in the methodology.

Table 9: Index Movements between Period (t=0) and (t+1) for Augmented Index

	Index (t=0)	Index (t+1)
Brazil	0.58	0.63
China	0.78	1.04
India	0.86	1.02
Indonesia	0.24	0.40
Korea	0.21	0.47
EU	0.34	0.56
Vietnam	0.78	0.92
Russia	0.44	0.76

Source: Authors.

Note: Each time period contains an average of the administrative barriers as outlined in the “Quantification Process” section and the regulations related to data. In t=0 the index for data processing services is set to zero, whereas in t+1 the index for data processing services is set to the level as defined in Table 8 for each country.

Calculating TFP Losses

Finally, this study calculates potential TFP losses as a consequence of the counterfactual situation in which countries are in fact implementing their regulatory law programs on data. The indices in both time periods are used and these figures are plugged into the equation (2a) so that two different TFP levels are obtained: one before the implementation of data laws ($t=0$) and one after ($t+1$). TFP calculations using equation (2a) applies the coefficient results as found in Table 5 (i.e., the β_1), information on the data intensities as presented in Table 3 and the fixed effects by sector, which are acquired from running the regressions. After plugging in the data and calculating the $\ln(\text{TFP})$ for both periods, the percentage change in TFP from taking the first difference of $\ln(\text{TFP})_{t+1}$ and $\ln(\text{TFP})_{t=0}$ is obtained.

The results of the estimated TFP changes are presented in Table 10, which gives a situation of the downstream

productivity effects as a consequence of the implementation of the current data regulations under consideration or which have already been applied. The sectors are sorted by the size of the TFP reduction. As one can see, the communication sector experiences the greatest losses since the effect in this sector is most likely caused by its high dependency on data input use. For instance, in Korea, China and the European Union, the percentage of TFP losses are estimated to be around two percent in communications. Similarly, both the ICT business services sector and the finance and insurance sector also experience relatively high TFP losses of around 0.34 percent in China. Machinery is a merchandise sector in the ranking where a relatively high TFP losses would take place. At the bottom of the list are the other primary agricultural sector and the processed foods industry with only minor TFP losses. Their input dependency on data is likely to be very small. Overall, the results show that it is the services economy that will suffer most from regulations in data services.

Table 10: TFP Changes as a Consequence of Data-processing Regulations

Sector	Brazil	China	India	India	Korea	EU	Vietnam	Russia
All sectors	-0.07	-0.35	-0.22	-0.22	-0.35	-0.29	-0.20	-0.44
Goods	-0.02	-0.12	-0.07	-0.08	-0.12	-0.10	-0.07	-0.15
Services	-0.10	-0.52	-0.32	-0.32	-0.51	-0.43	-0.29	-0.64
Business services	-0.17	-0.85	-0.52	-0.53	-0.84	-0.70	-0.48	-1.06
communication	-0.42	-2.16	-1.31	-1.35	-2.13	-1.77	-1.22	-2.68
obsict	-0.09	-0.47	-0.29	-0.29	-0.46	-0.39	-0.27	-0.57
fininsurance	-0.07	-0.34	-0.21	-0.21	-0.34	-0.28	-0.19	-0.43
machinery	-0.07	-0.34	-0.20	-0.21	-0.33	-0.28	-0.19	-0.42
oconsumer	-0.06	-0.33	-0.20	-0.20	-0.32	-0.27	-0.18	-0.41
oservices	-0.05	-0.27	-0.17	-0.17	-0.27	-0.22	-0.15	-0.34
distribution	-0.05	-0.25	-0.15	-0.16	-0.25	-0.21	-0.14	-0.32
water	-0.04	-0.23	-0.14	-0.14	-0.23	-0.19	-0.13	-0.29
transport	-0.04	-0.22	-0.13	-0.14	-0.22	-0.18	-0.12	-0.27
construction	-0.03	-0.16	-0.10	-0.10	-0.16	-0.13	-0.09	-0.20
othermanuf	-0.03	-0.16	-0.10	-0.10	-0.16	-0.13	-0.09	-0.20
fabmetals	-0.03	-0.14	-0.08	-0.08	-0.13	-0.11	-0.08	-0.17
nonmetmin	-0.02	-0.10	-0.06	-0.06	-0.10	-0.08	-0.06	-0.12
lumberpaper	-0.02	-0.09	-0.06	-0.06	-0.09	-0.08	-0.05	-0.12
energy	-0.01	-0.07	-0.05	-0.05	-0.07	-0.06	-0.04	-0.09
transequip	-0.01	-0.06	-0.03	-0.04	-0.06	-0.05	-0.03	-0.07
chemicals	-0.01	-0.06	-0.03	-0.04	-0.06	-0.05	-0.03	-0.07
bevtexcloth	-0.01	-0.05	-0.03	-0.03	-0.05	-0.04	-0.03	-0.06
metals	-0.01	-0.05	-0.03	-0.03	-0.05	-0.04	-0.03	-0.06
primagrother	-0.01	-0.04	-0.03	-0.03	-0.04	-0.04	-0.03	-0.06
procfoods	-0.01	-0.04	-0.03	-0.03	-0.04	-0.03	-0.02	-0.05

Source: Authors.

Note: Sectors follow the GTAP classification.

Simulation of Data Regulations' Impact on Economic Output and Trade

The downstream TFP estimates are applied to a computable general equilibrium (CGE) model, in which the wider macroeconomic impact of regulations in data and the impact on industrial output and trade volumes are estimated. The model applied in this study is Global Trade and Analysis Project 8, a commonly applied CGE model in the international trade literature.¹³ The simulation results are presented in Tables 11–14. Everything else being equal, the simulations indicate that in the medium- to long-term losses in economic activity (real GDP) range from 0.10 percent for Brazil to 0.48 percent for the European Union, 0.55 percent for China and 0.58 percent for Korea. Both Korea and the European Union already have fairly strict data regulations at the baseline, i.e., the scenario for which the economic impact has been estimated. In addition, their economies are specializing in sectors that are relatively data-intensive, which largely explains their great losses.

¹³ A more detailed description of the model and the applied methodology is given in van der Marel et al. (forthcoming 2016). Note that the results of estimation merely have an indicative character. CGE models are not fit for forecasting the very precise macroeconomic impact of the regulatory barriers in data services to trade. However, CGE models give us an estimate about the direction of the results of this econometric exercise, which is why it is employed in this paper.

Table 11: Simulation Results and Percentage Changes in Real GDP

Change in Real GDP	
EU28	-0.48
Brazil	-0.10
China	-0.55
India	-0.25
Indonesia	-0.23
Korea	-0.58
Vietnam	-0.24

Source: Authors' calculations.

As regards industrial output, the production of data-intensive manufacturing and services sectors shrinks in all countries, while less data-intensive sectors — such as agriculture, food and textiles — generally grow in absolute and relative terms. Losses are notably taking place in the services sectors, with greatest decrease of sectoral output in sectors such as communications and business services, as well as finance and construction. The estimated changes in the countries' production patterns are also reflected by percentage changes in industrial trade balances. The strongest sectoral impact is found for trade in communication and business services. Since domestic production of communication and business services becomes less competitive vis-à-vis foreign suppliers, exports drop.

Table 12: Simulation Results and Percentage Changes in Sectoral Production

		Grains & Crops	Meat & Livestock	Extraction	Processed Food	Textiles	Manufacturing	Distribution	Utilities	Communication Services	Business Services	Financial Services	Water	Transport Services	Construction	Other Services
EU28	Scenario 1	0.16	-0.10	0.16	-0.15	0.23	-0.04	-0.10	-0.06	-0.74	-0.25	-0.22	-0.21	-0.28	-0.56	-0.37
	Scenario 2	0.24	-0.12	0.26	-0.19	0.37	-0.06	-0.15	-0.07	-1.13	-0.25	-0.31	-0.30	-0.39	-0.79	-0.55
	Scenario 3	0.29	-0.13	0.31	-0.23	0.45	-0.07	-0.18	-0.09	-1.36	-0.30	-0.37	-0.36	-0.47	-0.94	-0.65
Brazil	Scenario 1	0.06	0.03	0.04	-0.01	-0.01	-0.02	-0.02	-0.01	-0.04	-0.04	-0.07	-0.04	-0.05	-0.14	-0.10
	Scenario 2	0.22	0.09	0.14	-0.01	-0.03	-0.09	-0.06	-0.04	-0.15	-0.06	-0.23	-0.15	-0.18	-0.47	-0.35
	Scenario 3	0.50	0.21	0.32	-0.03	-0.08	-0.21	-0.14	-0.09	-0.35	-0.14	-0.53	-0.35	-0.4	-1.07	-0.82
China	Scenario 1	0.03	-0.11	0.04	-0.06	0.23	-0.24	-0.38	-0.08	-0.59	-0.33	-0.21	-0.12	-0.17	-0.38	-0.43
	Scenario 2	0.04	-0.11	0.04	-0.08	0.23	-0.24	-0.31	-0.08	-0.59	-0.33	-0.21	-0.13	-0.17	-0.38	-0.43
	Scenario 3	0.06	-0.17	0.07	-0.12	0.38	-0.38	-0.59	-0.13	-0.91	-0.51	-0.32	-0.20	-0.26	-0.60	-0.67
India	Scenario 1	0.00	-0.10	0.05	-0.07	0.10	-0.17	0.02	-0.05	-0.60	-0.30	-0.12	-0.16	-0.13	-0.17	-0.22
	Scenario 2	0.00	-0.10	0.05	-0.07	0.10	-0.17	0.02	-0.05	-0.60	-0.30	-0.12	-0.16	-0.13	-0.17	-0.22
	Scenario 3	0.01	-0.23	0.14	-0.15	0.30	-0.42	0.07	-0.11	-1.51	-0.70	-0.27	-0.37	-0.30	-0.44	-0.23
Indonesia	Scenario 1	0.01	-0.06	0.05	-0.01	0.24	-0.18	-0.04	-0.12	-0.97	-0.24	-0.16	-0.20	-0.13	-0.25	-0.21
	Scenario 2	0.01	-0.06	0.05	-0.01	0.25	-0.17	-0.03	-0.12	-0.97	-0.33	-0.16	-0.20	-0.13	-0.26	-0.22
	Scenario 3	0.04	-0.14	0.13	0.00	0.64	-0.44	-0.09	-0.29	-2.40	-0.83	-0.40	-0.50	-0.33	-0.64	-0.53
Korea	Scenario 1	0.12	-0.17	0.18	-0.24	0.43	-0.07	-0.65	-0.02	-0.83	-0.22	-0.24	-0.19	-0.29	-0.59	-0.45
	Scenario 2	0.14	-0.21	0.23	-0.30	0.55	-0.08	-0.81	-0.02	-1.03	-0.28	-0.30	-0.23	-0.36	-0.73	-0.55
	Scenario 3	0.16	-0.27	0.30	-0.38	0.71	-0.11	-1.02	-0.03	-1.31	-0.36	-0.38	-0.29	-0.46	-0.92	-0.70
Vietnam	Scenario 1	0.06	-0.11	0.03	0.02	0.08	-0.15	0.04	-0.09	-1.19	-0.16	-0.14	-0.01	-0.18	-0.29	-0.17
	Scenario 2	0.06	-0.11	0.03	0.02	0.08	-0.15	0.04	-0.09	-1.19	-0.16	-0.14	-0.01	-0.18	-0.29	-0.17
	Scenario 3	0.18	-0.30	0.11	0.06	0.31	-0.42	0.12	-0.26	-3.28	-0.42	-0.42	-0.02	-0.50	-0.79	-0.48

Source: Authors' calculations.

Table 13: Simulation Results and Percentage Changes in Sectoral Imports

		Grains & Crops	Meat and Lifestock	Extraction	Processed Food	Textiles	Manufacturing	Distribution	Utilities	Communication Services	Business Services	Financial Services	Water	Transport Services	Construction	Other Services
EU28	Scenario 1	-0.29	-0.38	-0.01	-0.35	-0.49	-0.25	-0.39	-0.26	0.93	-0.21	-0.06	-0.53	-0.26	-0.61	-0.51
	Scenario 2	-0.38	-0.52	0.00	-0.49	-0.69	-0.33	-0.51	-0.35	1.51	-0.40	-0.06	-0.73	-0.35	-0.85	-0.71
	Scenario 3	-0.47	-0.63	0.00	-0.59	-0.83	-0.39	-0.62	-0.42	1.82	-0.47	-0.06	-0.87	-0.42	-1.01	-0.85
Brazil	Scenario 1	-0.14	-0.24	-0.03	-0.17	-0.25	-0.10	0.06	-0.11	0.84	0.07	0.00	-0.07	-0.20	-0.21	-0.19
	Scenario 2	-0.49	-0.83	-0.10	-0.57	-0.85	-0.33	0.20	-0.36	2.82	0.04	-0.03	-0.18	-0.65	-0.69	-0.63
	Scenario 3	-1.15	-1.89	-0.23	-1.34	-1.95	-0.75	0.45	-0.80	6.69	0.12	-0.04	-0.35	-1.50	-1.58	-1.43
China	Scenario 1	-0.70	-1.05	-0.29	-0.64	-0.30	0.15	0.18	-0.44	3.13	0.18	-0.24	-0.06	-0.26	-0.21	-0.44
	Scenario 2	-0.68	-1.03	-0.29	-0.56	-0.30	0.15	0.00	-0.44	3.13	0.18	-0.25	-0.06	-0.26	-0.22	-0.44
	Scenario 3	-1.06	-1.56	-0.46	-0.87	-0.50	0.24	0.27	-0.66	4.85	0.28	-0.39	-0.08	-0.41	-0.33	-0.69
India	Scenario 1	-0.58	-0.90	-0.11	-0.36	-0.41	0.04	-0.13	-0.21	1.81	0.02	-0.13	-0.41	-0.27	-0.14	-0.24
	Scenario 2	-0.58	-0.90	-0.11	-0.36	-0.41	0.04	-0.13	-0.21	1.81	0.02	-0.13	-0.41	-0.27	-0.14	-0.24
	Scenario 3	-1.42	-2.17	-0.27	-0.90	-1.00	0.12	-0.26	-0.52	4.68	0.06	-0.28	-1.02	-0.61	-0.34	-1.05
Indonesia	Scenario 1	-0.13	-0.43	-0.19	-0.25	-0.01	-0.06	0.18	-0.07	1.92	0.03	0.01	-0.02	-0.12	-0.17	-0.27
	Scenario 2	-0.14	-0.44	-0.18	-0.25	-0.01	-0.06	0.18	-0.07	1.92	0.14	0.01	-0.02	-0.12	-0.18	-0.28
	Scenario 3	-0.34	-1.11	-0.47	-0.65	-0.02	-0.14	0.43	-0.18	4.77	0.35	0.05	-0.03	-0.31	-0.43	-0.68
Korea	Scenario 1	-0.47	-0.46	0.03	-0.57	-0.45	-0.11	-0.65	-1.00	4.19	0.15	-0.32	-1.08	-0.39	-0.42	-0.73
	Scenario 2	-0.57	-0.56	0.04	-0.70	-0.57	-0.14	-0.81	-1.23	5.16	0.18	-0.40	-1.35	-0.49	-0.52	-0.91
	Scenario 3	-0.71	-0.69	0.04	-0.89	-0.72	-0.18	-1.02	-1.53	6.59	0.25	-0.50	-1.68	-0.62	-0.65	-1.14
Vietnam	Scenario 1	-0.08	-0.28	-0.09	-0.20	0.02	-0.09	-0.39	-0.63	1.36	-0.03	-0.19	-0.22	-0.17	-0.18	-0.33
	Scenario 2	-0.08	-0.28	-0.09	-0.20	0.02	-0.09	-0.39	-0.63	1.36	-0.03	-0.19	-0.22	-0.17	-0.18	-0.33
	Scenario 3	-0.24	-0.79	-0.27	-0.54	0.09	-0.25	-1.07	-1.71	3.73	-0.09	-0.52	-0.55	-0.44	-0.49	-0.90

Source: Authors' calculations.

Table 14: Simulation Results and Percentage Changes in Sectoral Exports

		Grains & Crops	Meat and Lifestock	Extraction	Processed Food	Textiles	Manufacturing	Distribution	Utilities	Communication Services	Business Services	Financial Services	Water	Transport Services	Construction	Other Services
EU28	Scenario 1	0.51	0.31	0.37	0.16	0.68	0.11	0.41	0.33	-3.09	-0.21	-0.25	0.15	-0.03	0.19	0.25
	Scenario 2	0.71	0.46	0.55	0.26	1.03	0.13	0.51	0.48	-4.87	0.14	-0.39	0.19	-0.03	0.24	0.29
	Scenario 3	0.87	0.59	0.66	0.31	1.23	0.16	0.62	0.57	-5.88	0.17	-0.48	0.22	-0.05	0.29	0.35
Brazil	Scenario 1	0.25	0.43	0.08	0.23	0.52	0.13	-0.17	0.43	-1.53	-0.09	0.02	0.14	0.14	0.22	0.15
	Scenario 2	0.84	1.48	0.31	0.81	1.79	0.37	-0.56	1.41	-5.11	0.20	0.14	0.39	0.46	0.70	0.50
	Scenario 3	0.50	0.21	0.32	-0.03	-0.08	-0.21	-0.14	-0.09	-0.35	-0.14	-0.53	-0.35	-0.40	-1.07	-0.82
China	Scenario 1	1.30	2.45	0.82	0.95	0.54	-0.54	-1.07	0.67	-6.78	-0.89	-0.05	0.30	0.07	-0.35	0.13
	Scenario 2	1.29	2.39	0.81	0.81	0.53	-0.54	-0.61	0.67	-6.77	-0.89	-0.04	0.31	0.07	-0.34	0.13
	Scenario 3	2.00	3.63	1.32	1.26	0.88	-0.85	-1.65	0.99	-10.49	-1.37	-0.06	0.47	0.11	-0.54	0.20
India	Scenario 1	0.94	1.70	0.36	0.49	0.57	-0.35	0.33	0.33	-4.16	-0.34	0.00	0.33	0.12	0.10	0.46
	Scenario 2	0.94	1.70	0.36	0.49	0.57	-0.35	0.33	0.33	-4.16	-0.34	0.00	0.33	0.12	0.10	0.46
	Scenario 3	2.35	4.15	0.89	1.28	1.47	-0.87	0.72	0.85	-10.66	-0.82	-0.01	0.83	0.27	0.26	2.81
Indonesia	Scenario 1	0.46	0.80	0.22	0.33	0.50	-0.24	-0.30	-0.14	-4.63	-0.34	-0.18	-0.22	-0.10	-0.09	0.10
	Scenario 2	0.47	0.81	0.22	0.33	0.52	-0.24	-0.30	-0.13	-4.63	-0.80	-0.18	-0.21	-0.10	-0.09	0.11
	Scenario 3	1.20	2.08	0.56	0.90	1.32	-0.61	-0.71	-0.31	-11.50	-2.03	-0.50	-0.60	-0.21	-0.24	0.28
Korea	Scenario 1	1.08	1.15	1.14	0.68	1.26	0.07	-0.28	1.23	-7.43	-0.36	0.50	1.00	0.12	0.57	0.68
	Scenario 2	1.29	1.43	1.44	0.84	1.59	0.08	-0.34	1.51	-9.15	-0.43	0.64	1.28	0.16	0.71	0.87
	Scenario 3	1.59	1.71	1.83	1.06	2.03	0.10	-0.44	1.86	-11.70	-0.61	0.78	1.55	0.19	0.89	1.07
Vietnam	Scenario 1	0.14	0.51	0.11	0.22	0.10	-0.13	0.69	1.03	-3.77	-0.29	-0.09	0.62	-0.04	-0.03	0.30
	Scenario 2	0.14	0.51	0.11	0.22	0.10	-0.13	0.69	1.03	-3.77	-0.29	-0.09	0.62	-0.04	-0.03	0.30
	Scenario 3	0.43	1.46	0.33	0.58	0.37	-0.40	1.86	2.75	-10.37	-0.76	-0.30	1.67	-0.15	-0.09	0.79

Source: Authors' calculations.

Due to the comparative disadvantages that may arise from less innovation in these sectors as a result of tighter data regulations, countries with tighter data regulations are likely to become more import-dependent in the data-intensive services sectors over time. One should note that while changes in output and trade are rather low for other sectors, the general pattern of the results indicate a shift in production from the services and manufacturing to the primary sector as a result of restrictions on the flow of data.

Note that the CGE model does not account for dynamic effects, such as the impact of regulations on competition and innovative behaviour. The results of this analysis might therefore considerably underpredict the economic losses of regulations on the free flow of data and data localization. These losses would, for example, comprise efficiency losses resulting from reduced competition and economic inefficiencies due to greater distance of domestic

data services providers and data-intensive downstream providers to the global technology frontier.

DEVELOPMENTS AND FURTHER RESEARCH

Recent Developments in Data Localization Regulations

Since the study was conducted in 2013, the authors have carried out more extensive research covering more than 60 countries around the world to be publicly released in a database by mid-2016. It identifies several regulatory measures that include data localization requirements and recent trends in this policy field. For the countries studied in this paper, a few legislative proposals were made and additional measures have been implemented. A detailed overview of relevant measures is provided in Table 15.

Table 15: Overview of Legislative Measures for the Countries under Study

Country	Law	Scope
Brazil	<ul style="list-style-type: none"> Law No 12.965 (Marco Civil), passed in March 2014 	<ul style="list-style-type: none"> The Brazilian government considered requiring Internet Service Providers to store information regarding Brazilian users only on local servers. The provision did not make it to the final version of Marco Civil.
China	<ul style="list-style-type: none"> Various laws and guidelines, including Guidelines for Personal Information Protection Within Public and Commercial Services Information Systems Standing Committee of the National People's Congress in China Decision on Strengthening Protection of Online Information Non-binding national standards related to personal information published by the Standardization Administration and the General Administration of Quality Supervision, Inspection, and Quarantine People's Bank of China Notice to Urge Banking Financial Institutions to Protect Personal Financial Information (Notice) China's Management Measures for Population Health Information 	<ul style="list-style-type: none"> A plethora of complex data privacy laws has made compliance very difficult for companies that collect personal information. Cross-border data transfer restrictions are imposed by various industry guidelines for the information-services sector. These guidelines may serve as a "regulatory baseline" for law enforcement authorities to assess whether or not a business is in compliance with Chinese data privacy laws. Banks and financial institutions are prohibited from storing, processing or analyzing any personal financial information outside China that has been collected in China. Population health information needs to be stored and processed within China. In addition, storage is not allowed overseas. Licensing system for online taxi companies that requires them to host user data on Chinese servers. Online maps are required to set up their server inside of the country and must acquire an official certificate.
India	<ul style="list-style-type: none"> Information Technology Act 2000 Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules of 2011 National Security Council Secretariat proposal for data localization of email services 	<ul style="list-style-type: none"> With its "Reasonable Security Practices and Procedures," the Indian government introduced a strict consent requirement that only allows for sensitive personal data to be transferred abroad that is necessary for the performance of a lawful contract between the body corporate (or any person acting on its behalf) and the provider of information or such transfer has been consented to by the provider of information. In February 2014, media reported on a leaked internal note from the National Security Council Secretariat, which shows that a three-pronged strategy with strong elements of data localization is being considered. The proposal included mandating all email providers to set up local servers for their India operations such that "all data generated from within India should be hosted in these India-based servers and this would make them subject to Indian laws" (Thomas 2014).

Country	Law	Scope
Indonesia	<ul style="list-style-type: none"> • Law No. 11 regarding Electronic Information and Transaction of 2008 • Government Regulation No. 82 of 2012 regarding the Provision of Electronic System and Transaction • Draft Regulation with Technical Guidelines for Data Centres • Circular Letter of Bank Indonesia No. 16/11/DKSP of 2014 regarding E-money Operations 	<ul style="list-style-type: none"> • Regulation 82 states that the storing of personal data and performing a transaction with the data of Indonesian nationals outside the Indonesian jurisdiction is restricted. This requirement would appear to apply particularly to personal data and transaction data of Indonesian nationals that is used within Indonesia and/or related to Indonesian nationals. • Regulation 82 requires “electronic systems operators for public service” to set up a data centre and disaster recovery centre in Indonesian territory for the purpose of law enforcement and data protection. • In the Annex of Circular Letter of Bank Indonesia No. 16/11/DKSP Year 2014 regarding E-money Operations, there is a requirement for all operators of e-money to localize data centres and data recovery centres within the territory of Indonesia.
Korea	<ul style="list-style-type: none"> • Regulations on Financial Institutions’ Outsourcing of Data Processing Business and IT Facilities’ approved in June 2013 • Spatial Data Industry Promotion Act 	<ul style="list-style-type: none"> • Despite provisions in its free trade agreements with EU and US to allow sending financial data across borders, Korea still prohibits outsourcing of data-processing activities to third parties in the financial services industry. Banks can therefore only process financial information related to Korean customers in-house, either in Korea or abroad, and offshore outsourcing is restricted to a financial firm’s head office, branch or affiliates. • Since June 2015, financial services institutions are allowed to offshore data processing to professional IT companies whose infrastructure is located outside of Korea. • Korea imposes a prohibition to store high-resolution imagery and related mapping data outside the country and justifies this restriction on security grounds.
Russia	<ul style="list-style-type: none"> • Federal Law No. 152-FZ “On Personal Data” as amended in July 2014 by Federal Law No. 242-FZ “On Amendments to Certain Legislative Acts of the Russian Federation for Clarification of Personal Data Processing in Information and Telecommunications Networks” • New provisions in the federal law on information, information technologies and protection of information (known as Blogger’s Law) • Federal Law No. 319-FZ “On Amendments to the Federal Law on the National Payment System and Certain Legislative Acts of the Russian Federation” 	<ul style="list-style-type: none"> • In accordance with the amendments to Federal Law No. 152-FZ of July 2006, an operator is required to ensure that the recording, systemization, accumulation, storage, clarification (updating, modification) and retrieval of Russian citizens’ personal data is to be conducted only in databases located within Russia. • The law affects all business practices that involve the processing of personal data of Russian citizens, irrespective of whether companies have a physical presence in Russia. • Blogger’s Law requires organizers of information distribution in the Internet (it is not clear which operators fall under this definition) to store on Russian territory information on facts of receiving, transfer, delivery and/or processing of voice information, texts, images, sounds and other electronic messages and information about users during 6 months from the end of these actions. • The amendments to the National Payment System Law require international payment cards to be processed locally.
Vietnam	<ul style="list-style-type: none"> • Decree No. 72/2013/ND-CP of July 15, 2013, on the Management, Provision and Use of Internet Services and Online Information 	<ul style="list-style-type: none"> • The Decree No. 72/2013 entered into force in September 2013 establishes local server requirements for online social networks, general information websites, mobile telecoms network-based content services and online games services. • All these organizations are required to establish at least one server inside the country “serving the inspection, storage, and provision of information at the request of competent state management agencies.”

Source: Authors.

For China, for example, a plethora of complex data privacy laws make compliance very difficult for companies that collect personal information. In addition, cross-border data transfer restrictions are imposed by various industry guidelines for the information services sector. These guidelines frequently serve as a “regulatory baseline” for law enforcement authorities to assess whether or not a business is in compliance with Chinese data privacy laws. Moreover, banks and financial institutions operating in China are prohibited from storing, processing or analyzing any personal financial information outside China that has been collected in China. The Vietnamese government imposed a decree establishing local server requirements for online social networks, general information websites, mobile telecoms, network-based content services and online games services. Affected organizations are required to establish at least one server inside the country “serving

the inspection, storage, and provision of information at the request of competent state management agencies.” (The Government of Vietnam 2013). As concerns Brazil, it is noteworthy that the Brazilian government considered forcing Internet Services Providers to store information regarding only Brazilian users on local servers, but respective provisions did not make it to the final version of the proposed law.

The landscape of legislative data localization requirements is highly diverse. Table 16 provides a preliminary excerpt of the ongoing research on data localization and affiliated measures beyond the set of countries studied in this paper. Some countries are imposing local storage requirements — i.e., only a copy of the data has to remain within the territory of the country. This is the case in Denmark, Germany, Greece, the Netherlands, New Zealand, Poland, Romania, Russia, Sweden and Turkey. These measures

Table 16: Overview of Subjects Targeted by Data Localization Requirements (by country)

	Light (Only Copy)	Medium (Copy and Processing)	Strong (Ban to Transfer)
Australia			health data
Brunei		all data generated within the country	
Bulgaria		Gaming data	
Canada			data of public bodies
China		all data generated within the country, taxi users data, online maps, electronic media	financial information, health data, state secrets
Denmark	Financial records		
France		Systems for interception of electronic communication	
Germany	Tax records, accounting documents and business letters, invoices		
Greece	Data on ‘traffic and localisation’		
Indonesia		financial data	personal data
Korea			financial data, high resolution imagery and related mapping data
Luxembourg		Financial data	
Netherlands	Public records		
New Zealand	Business records		
Nigeria		Subscriber and consumer data, financial data	Government Data
Pakistan			Certain countries
Poland	Gambling data		
Romania	Gambling data		
Russia	Users information	Personal data	
Sweden	Certain corporate documents, certain public data		
Taiwan			China
Turkey	Online payments		
Vietnam		Online social networks, general information websites, mobile telecoms network based content services and online games services	

Source: Authors.

are usually imposed on a specific set of data relating to corporate documents, and the local storage is usually imposed so authorities can easily access such documents.

In other cases, countries are not only imposing local storage, but also local processing requirements. This represents a more restrictive barrier accompanied by high economic costs, as businesses are required to establish data servers in the implementing country or switch to local data services suppliers. Countries imposing such strict regimes include Brunei, China, France, Indonesia, Luxembourg, Nigeria, Russia and Vietnam. In most of these cases, the legislative measures cover a broad range of types of data. In the extreme case of Russia, they apply to all personal data — i.e., virtually all data transferred cross-border. The imposition of such a regime in Russia is quite recent. The Federal Law No. 152-FZ “On Personal Data” was, in fact, amended in July 2014 by Federal Law No. 242-FZ “On Amendments to Certain Legislative Acts of the Russian Federation for Clarification of Personal Data Processing in Information and Telecommunications Networks.” Such amendments, in force since September 2015, require data operators to ensure that the recording, systematization, accumulation, storage, update/amendment and retrieval of personal data of the citizens of the Russian Federation is made using databases located in the Russian Federation (Article 18 §5).

There are also few instances of bans to the free transfer of data. In these cases, companies not only have to store and process data within the border of the country, but they are also not allowed to send a copy of the data abroad. Such measures usually apply to especially sensitive data (as in the case of Australia where there is a ban to transfer health data abroad), but have also been used more extensively in two Canadian regions, China, Indonesia, Korea, Nigeria, Pakistan and Taiwan. For example, the two Canadian regions of British Columbia and Nova Scotia require that personal information held by a public body (primary and secondary school, universities, hospitals, government-owned utilities and public agencies) must be stored or accessed only in Canada. However, a public body may override the rules where storage or access outside of the respective province is essential. Moreover, the data can be transferred outside Canada “if the individual the information is about has identified the information and has consented, in the prescribed manner, to it being stored in or accessed from, as applicable, another jurisdiction.”¹⁴

Finally, it is important to note that conditional flow regimes — i.e., regimes under which certain conditions need to be fulfilled for data to leave the implementing

jurisdiction — can also effectively result in a ban to transfer data. These regimes can be so restrictive to cause a de facto ban to transfer specific data, as is the case in China. For personal data of European citizens, companies have the possibility to fulfill certain conditions required by legislators to transfer data abroad. Under the European Directive 95/46/EC, data is freely allowed to flow outside the European Economic Area only where:

- the recipient jurisdiction has an adequate level of data protection;
- the controller adduces adequate safeguards (for instance, by using model contract clauses, binding corporate rules or other contractual arrangements);
- the data subject has given his/her consent unambiguously;
- the transfer is necessary for the performance of a contract between the data subject and the controller;
- the transfer is necessary for the performance of a contract concluded in the interest of the data subject;
- (vi) the transfer is justified by public interest;
- the transfer is necessary to protect the vital interests of the data subject; and
- the data is public.

In addition to these options, the Safe Harbour agreement acted as a self-certification system open to certain US companies for the data protection compliance until its invalidation by the European Court of Justice in October 2015. Since then, there is a high level of legal uncertainty regarding data transfers to the United States. The European Commission has proposed a new regime (the so-called Privacy Shield) to replace the Safe Harbour. However, national Data Protection Authorities in the European Union have not yet expressed their opinion on the text, and the Article 29 Working Party will give a non-binding opinion on the privacy agreement and alternative mechanisms of data transfer only in mid-April 2016. Therefore, it remains a possibility that data transfer to the United States will be further restricted, as some Data Protection Authorities have already hinted at the possibility of imposing a ban to transfer data there.

Scope for Further Research

This study is a first attempt to quantify the economic impact of several regulations of cross-border data flows and data localization measures. It applies an indirect top-down approach based on observable regulatory variables and econometric methods to calculate economic costs in terms of factor productivity losses. Using a CGE model, the losses in productivity have been translated into changes in aggregate economic

¹⁴ Freedom of Information and Protection of Privacy Act [RSBC 1996] CHAPTER 165, available at www.bclaws.ca/civix/document/LOC/complete/statreg/--%20F%20--/Freedom%20of%20Information%20and%20Protection%20of%20Privacy%20Act%20%5BRBC%201996%5D%20c.%20165/00_Act/96165_03.xml#section30.1.

activity, industrial output and industrial trade volumes. An indirect methodology, as applied here, is highly sensitive to the assumptions made for the degree of restrictiveness of the regulatory measures and the assumptions underlying the equational system of the applied CGE model.

This methodology is applied primarily due to the lack of sufficient data and sufficiently reliable information on the actual impact of certain data regulation policies at the business or industry level. Industry (survey) data for regulation-induced changes in the employment and cost of labour and capital — as well as data on the actual flows of data and data-intensive goods and services — would not only allow for greater precision in applying the indirect approach, it would also enable researchers to estimate sectoral and aggregate economic effects directly through the application of bottom-up instead of top-down approaches.

The methodology could also be improved by including different layers of data localization, from storage requirements to conditional flow regimes. In addition, a “right to be forgotten” legislation could be analyzed as a separate restriction. Again, reliable industry data on how these regulations affect businesses would significantly improve the empirical strategies applied.

CONCLUSION

The results demonstrate that communication services sectors show comparatively large productivity losses due to their high dependency on data inputs covered by data regulations. Data-intensive business and financial services also show relatively high losses in productivity. As concerns economic output, the production of data-intensive manufacturing and services sectors shrinks in all countries due to regulations on the free flow of data. Losses are notably taking place in the services sectors. The greatest declines in industry output are found for communications and business services, but also for financial services. At the same time, less data-intensive sectors are less affected by data regulations. The general patterns in the results indicate a shift in production from the services and manufacturing to the primary sector as a result of restrictions on the flow of data. Accordingly, tight regulations on the free flow of data tend to cause an economy’s production structure to shift (back) toward less innovative and relatively volatile sectors such as agriculture, raw materials and natural resources.

Acknowledgements

The authors would like to thank Sang-Seung Yi and Kyungsin Park during this research.

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