



RIETI Discussion Paper Series 19-E-088

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TOMIURA, Eiichi
RIETI

ITO, Banri
RIETI

KANG, Byeongwoo
Hitotsubashi University



The Research Institute of Economy, Trade and Industry
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Effects of regulations on cross-border data flows: Evidence from a survey of Japanese firms*

Eiichi Tomiura*

Banri Ito[§]

Byeongwoo Kang[#]

Abstract

We distributed a questionnaire to large- and mid-sized firms in the manufacturing, wholesale, and information-related service industries in Japan to investigate the firms' responses to regulations governing cross-border data transfers. Only a limited fraction of the surveyed firms regularly transfer data across national borders. However, among the firms active in collecting data from Internet of Things (IoT) devices from overseas, the EU's General Data Protection Regulation (GDPR) affects more than 20% of firms and the number of firms affected by the Cyber Security Act of China and similar regulations in other countries exceeds the number of firms that have not noticed an impact. The affected firms have responded to the regulations through measures such as changing the location of their data processing/storage, introducing firewalls, and/or assigning staff to address the issues. However, many firms have not yet taken any action.

Keywords: cross-border data transfers; survey data; Japanese firms; GDPR

JEL Classifications: F14; F23; O33

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*This study is conducted as a part of the Project "Empirical Analysis of Corporate Global Activities in the Digital Economy" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). This study utilizes the micro data of the "Survey of cross-border data flows of firms," which is conducted by RIETI. The author is grateful for helpful comments and suggestions by Makoto Yano and Discussion Paper seminar participants at RIETI.

* Faculty of Economics, Hitotsubashi University and RIETI

[§] Faculty of Economics, Aoyama Gakuin University and RIETI

[#] Institute of Innovation Research, Hitotsubashi University

1. Introduction

Cross-border data flows are increasing at an accelerating pace.² However, it is difficult to measure the economic value of such transmitted data. Simultaneously, several countries around the world have started to intervene in cross-border data transfers for privacy, national security, and other reasons.³ To understand this phenomenon, we conducted a survey of Japanese firms asking about the regulations on cross-border data transfer, such as the General Data Protection Regulation (GDPR) of the EU (European Union) and the Cyber Security Act of China. In addition, our survey asked about firms' activities regarding the collection of digital data, including the introduction of the Internet of Things (IoT). Our aim is to use our survey results to help, at least indirectly, infer the extent of firms' data transfer across borders.

Many regulations have recently been introduced worldwide on data transfer. Among them, the GDPR, instituted in May 2018, strengthens substantially regulations to protect EU citizens from privacy breaches. While GDPR clearly defines various data rights, including the right to data portability and right to be forgotten, its territorial scope is critical for our research on cross-border data transfer. GDPR requires that firms of any country provide additional safeguards, such as explicit consent from individuals, if they transfer personal data of EU citizens outside of the EU area.⁴ By contrast, China enacted the Cyber Security Act or Internet Security Law in 2017, which bans the international transfer of certain data specified as important by relevant Chinese laws. Similar regulations have been imposed or are under consideration in many other emerging and/or developing countries including Russia, Vietnam,

² McKinsey Global Institute (2016), for example, reports the explosion of data flow in terms of bytes.

³ OECD (2018), for example, refers to the proliferation of regulations of cross-border data flows.

⁴ Japan has been declared as "adequate" by the EU, which indicates that the transmission of data to Japan occurs under a comparable treatment with that within the EU. However, Japanese firms are still required to provide additional safeguards if they transfer personal data to other countries without EU's Adequacy Decision.

and India. Often, the details of the regulations in these countries are not stated clearly in these laws, leaving room for the discretion of local authorities. It is essential to evaluate the impacts of these regulations, as smooth cross-border data flows are critical for sustaining globalized business activities.

To understand e-commerce, Japan's Ministry of Economy, Trade and Industry (METI) began publishing an annual report in 1998. According to the most recent report (METI, 2019), China's combined e-commerce purchases from Japan and the U.S. reached 3.3 trillion yen in 2018, with an annual growth rate for both sources exceeding 18%. Although this estimate is impressive, cross-border e-commerce is limited to international trade ordered by electronic means. We need to expand our scope in discussing cross-border data transfers, as firms transmit data for many other purposes, such as negotiating with foreign suppliers, managing offshore subsidiaries, or providing maintenance services for customers overseas.⁵

A previous survey closely related to ours is that of the Organisation for Economic Cooperation and Development (OECD), which is briefly referred to in OECD (2018). While the OECD survey and ours gather questionnaire responses from firms on cross-border data transfer, there are several important differences. The sample size of our survey, exceeding 4,000 firms, is by far larger than that of the OECD business questionnaire, which covered 259 firms.⁶ In the OECD case, many of the firms sampled were from the Information and Communication Technology (ICT) and business service sectors. By contrast, our survey covered all manufacturing, wholesale, and information-related sectors in Japan. Further, conducted in 2019, our survey will be useful in updating the findings from the OECD, which were gathered in 2015

⁵ The U.S. ITC has compiled a series of reports capturing digital trade from various angles. See the reference lists from the U.S. ITC (2019) as one of the most recent publications from this organization as of this writing.

⁶ The respondent firms in the OECD survey are located in over 48 countries with 16 from Japan. The wide coverage of countries in the OECD survey results, with a limited observation from each country, does offer the possibility of cross-country comparison.

or 2016. As a key contribution, the OECD asked the firms to reveal how much cross-border data protection affected their costs. Although we agree with the importance of such information, we decided not to include this type of question as information-demanding quantitative questions inevitably result in many response rejections or no response cases.

The rest of this paper is organized as follows. Section 2 explains the design of our survey, including industry coverage. Section 3 reports the main survey results such as the impact of the regulations and the firms' data collection activities. Section 4 offers concluding comments.

2. Design of our survey

To collect information on cross-data flows, we surveyed firms in Japan. The “Survey of cross-border data flows of firms” was conducted by the Tokyo Shoko Research Co., Ltd. (TSR) for our research project at the Research Institute of Economy, Trade and Industry (RIETI). While surveys of consumers can be equally informative, a survey of firms is useful for policy discussions, especially for regulation of data flow, at a reasonably limited cost for conducting a survey. Here, we describe the basic design of the survey and how representative the results are considering the population of Japanese firms.

We sent the questionnaire to all large- and mid-sized firms (50 or more employees and capital of 30 million yen or more) in manufacturing, wholesale, and information-related service industries in Japan.⁷ As most small firms concentrate on the domestic market and as their activities in cross-border data transfer are likely to be limited or indirect, the omission of small firms will not affect the main results from our survey. In other words, our survey can be regarded as a reliable representation of firms in Japan for discussing cross-border data flow.

⁷ We sent the questionnaire to all firms covered by the *Basis Survey of Japanese Business Structure and Activities* (*Kigyo katsudo kihon chosa* in Japanese), which METI conducts annually by imposing legal reporting obligation in these industries.

Although we are interested mainly in data transfer by manufacturers, we include wholesalers as some manufacturing firms are categorized as wholesalers as a result of offshoring and/or the outsourcing of production.⁸ We include the following information-related service industries: software (391), information processing service (392), Internet services (401), academic, research and development institutions (710), and engineering (728) (Japanese Standard Industry Classification numbers in parentheses). After firms experiencing recent bankruptcy or mergers were dropped based on updated information from the TSR, we sent questionnaires to 19,790 firms.⁹

We distributed our survey questionnaires at the beginning of April 2019. We asked the respondents to return the surveys by April 22, but we accepted responses until August. The firms could choose to respond using the following two options: (i) fill in the survey form directly and return it in the enclosed return envelope; (ii) access the URL provided and answer the questions using the provided ID and password.¹⁰

We collected surveys from 4,227 firms, among which 2,628 were via the first option (postal mail) and 1,599 via the second option (Internet). The response rate was 21%, comparable with similar surveys conducted by the RIETI and relatively high for an academic survey. Table 1 confirms that we collect our sample from a wide range of industries with

⁸ From the wholesale sectors, we omitted the following three industries, as they are likely to be unrelated to cross-border activities or difficult to characterize: wholesalers of construction materials (531), wholesalers of renewable resources (536), and miscellaneous wholesalers (559), with Japanese industry classification numbers in parentheses.

⁹ TSR found that eight firms were integrated or dissolved among 19,790 firms.

¹⁰ In terms of our policy of confidentiality, we explained it to the respondents using the following statements. “We keep maximal confidentiality in this survey. As the survey results will be processed statistically, individual response results will never be disclosed. The information collected in this survey will be treated as confidential under the Confidential Dataset Handling Rules of RIETI, and will be used only for academic research.” All the results in our report are aggregated so that individual respondents cannot be identified.

largely similar response rates. In what follows, we summarize the main findings from this survey.¹¹

3. Main results

3.1. Impact of regulations

The main purpose of our survey was to capture cross-border data flows; however, directly quantifying data flows through a survey without reporting obligations is practically impossible. Consequently, we tried to indirectly infer the extent, depth, and intensity of the data flow by asking about the impact of the newly imposed regulations such as EU's GDPR and China's Cyber Security Act. If the firms identified serious impacts from these regulations and indicated that they increased expenditures or reorganized, we regarded this as an indication that these firms were transferring a substantial amount and/or detailed, sensitive data across borders before the introduction of the regulations. Although quantitative information cannot be derived from these types of questions, even indirect information is useful given the difficulty in capturing the current state of cross-border data transfers. For GDPR, we asked the following question.¹²

The EU decided to limit the transfer of personal data (from which a natural person is identifiable) outside of the EU through the GDPR (General Data Protection Regulation). Does this have any impact on your company?

Similarly, the question on regulations by other countries was as follows.

Under the Cyber Security Act (Internet Security Act), China has tightened restrictions on data transfer to foreign countries, such as prohibiting the cross-border transfer of data

¹¹ All the reports in this paper are based on all responses; however, obviously inconsistent responses are eliminated.

¹² Actual translation of the text used in the survey is shown in Italics. As the original questions were in Japanese, these are translated here into English for this paper.

specified by China's laws. Similar regulations are being enacted in Vietnam, India, Russia, and other countries. Do these developments have any impact on your company?

For both questions, respondents were asked to choose one of the following three options: “Some,” “Not at all,” or “I do not know GDPR (or these developments).” The distribution of the responses is shown in Table 2.

As shown in Table 2, around 8% of our sampled firms answered that the cyber security regulations introduced in China and other countries have affected their business.¹³ The ratio is lower for EU’s GDPR, less than 5%, at least partly reflecting the different extent and uncertainty between these regulations, although our question on cyber security regulations considers various countries in contrast to the question solely on the GDPR of the EU. As only a small fraction of the firms reported any impact, this implies that the share of firms involved in active cross-border data transfers is limited. However, we know from previous studies that the share of firms globalized through exports, foreign direct investment (FDI), or offshore outsourcing in any large country is limited.¹⁴ We cannot underestimate the impacts of these regulations since the firms affected may be transmitting a vast amount of detailed valuable data. We should also note that more than 20% of the firms were unfamiliar with the regulations, even among the large- and mid-sized firms in our sample that are supposed to be well prepared for regulations. This implies that some firms may not recognize the impact of these regulations even if they are actually hurting their activities.

As shown in the previous question, we asked about the impact of GDPR, which regulates personal data. However, cross-border data flows include non-personal data. The EU has

¹³ We noted variations across industries. The share of affected firms was high in industries such as Internet service and information/communication electronics. See Tables A1 and A2 in Appendix.

¹⁴ In a sample of Japanese firms, including small firms, Tomiura (2007) found that only a limited share of firms exported, outsourced overseas, or invested directly overseas. Wakasugi et al. (2011) confirmed the characteristics for export and FDI in a sample of large- and mid-sized firms based on the same official statistics as our survey.

proposed that non-personal industrial data should be freely traded across borders. Therefore, to complement the previous question, we added the following question.

While the GDPR of the EU regulates personal data, does your company transfer non-personal data on a daily basis to foreign countries including non-EU countries? Select the most appropriate option.

As shown in Table 3, even when we switch our focus from personal data to non-personal data, less than 6% of the firms are involved in cross-border data transfers. The percentage remains around 11% when we combine firms not distinguishing between personal and non-personal data.

To distinguish various types of actors in the data transmission process, we asked about the counterparts in cross-border data transfers through the following question.

Identify the senders or receivers of the daily transfer of data through the routine activities of your company. Choose all that apply as the senders/receivers of your data transfers. If you select "6. Other," explain specifically in the parentheses.

Table 4 shows the percentages of each option among the total number of respondents (4,227 firms). As firms were allowed to choose multiple options, the sum of the percentages exceeds 100. In line with other responses in this survey, around three-quarters of the firms do not regularly transfer data or are unfamiliar with their own data transfer activities. Among firms transferring data regularly, clearly more than half of them are involved in intra-firm transfers. This indicates the importance of intra-firm data transmissions within multinational enterprise groups in the discussion of cross-border data flow issues. As our sample focuses mainly on manufacturing and wholesale firms, direct data transfers to/from individual consumers were limited to less than 1%.

As we discuss cross-border data transfers, it is useful in the evaluation if we understand the data-related activities of the firms. For this purpose, we asked respondents about their

activities around collecting data and their adoption of new technologies. The question on data collection was as follows.

For the collection of data in Japan and overseas through business in your company, choose the most appropriate option from the following.

As shown in Table 5, the majority of firms were not actively collecting data. Less than 8% of the firms have introduced IoT in the home country, with this participation rate even lower at 2% overseas. Although firms can collect digital data without IoT, less than 30% of the firms indicated that they were regularly collecting digital data in Japan, even when non-IoT data are included (7.81+21.62). Firms collecting digital data overseas occupy a mere 10% (2.31+8.73) of our sampled firms.

In asking the following question, we provided an explicit definition of “data” in our survey in the following note: *“the ‘data’ refers to raw data before being processed and/or edited on the format, such as a database.”* While it was possible to consider alternative definitions of data, the main motivation here was to exclude already constructed databases from our survey.

To use any collected data, firms would need to have introduced the necessary technologies. Hence, we asked the following question to understand how active the firms had been in adopting new technologies.

Which of the following digital technologies or services does your company use? [Check all applicable.]

Each percentage shown in Table 6 is calculated relative to the number of respondent firms. The adoption of the technologies varied widely. Firms with their own websites exceeded 80%, but firms that had introduced blockchain were around 1% of the surveyed firms. Around 70% of the firms used a broadband connection, a corporate intranet, and ERP software, but the

use of social networking services, VoIP, and CRM software was limited to around 20% of the firms. The use of E-commerce platforms and cloud services fell in the intermediate range of adoption.

By combining the responses to several of the questions, we could detect indirect clues to discuss how the impact of the recent regulations relates to firms' data-related activities. An example of the cross-tabulation of multiple questions is shown in Table 7.

As expected, the share of firms affected by regulations tends to be noticeably higher among firms introducing IoT, followed by firms collecting digital data regularly albeit without IoT, than among firms not collecting data or not conscious of data collection. This share is particularly high among firms actively collecting data via IoT overseas. More than 20% (0.47/2.29) of these firms said they were impacted by GDPR. The percentage of firms affected by cyber security regulations in China or similar regulations in other countries was even higher, surpassing that of firms reporting no impact (1.04>0.87). These results show that although the number of firms affected by the regulations was limited as a percentage of the total population of firms, many of the firms were affected by the regulations if we focus on the firms engaged in digital data collection, especially the firms actively collecting data overseas through IoT.

As another exploration of new technology, we inquired about the introduction of 3D-printers, as its use increases cross-border data flows and possibly influences international trade in goods if adopted by firms across national borders. We asked the question as follows.

The “3D printer” is a new device that sends design drawings to remote locations and does not require molds or jigs. Its introduction may replace the trade in goods through digital data transfer, and may facilitate trade. Does your company use 3D printers on a daily basis for routine manufacturing operations (including prototype production, and use in affiliated companies)? Choose the most appropriate as the impact on exports and imports of goods.

1. *The introduction of 3D printers has decreased exports and/or imports of goods.*
2. *The introduction of 3D printers has increased exports and/or imports of goods.*
3. *Our company has introduced 3D printers, but there is no significant change in exports and/or imports of goods.*
4. *Our company does not use any 3D printer for routine manufacturing operations (or does not perform manufacturing operations).*

Note: “3D printer” refers to a machine that forms a solid object by stacking cross-sectional shapes from three-dimension digital data generated by computers.

Table 8 shows that the introduction of 3D printers was extremely limited. Less than 7% of our sampled firms had introduced 3D printers. While we cannot reach a decisive conclusion from such a limited number of 3D printer users, most firms using 3D printers (97% = $100 * 6.49 / (100 - 93.32)$) reported no impact on their international trade in goods, possibly due to the limited use of 3D printers or to their premature stage of 3D printer usage. The impact of 3D printers on international trade remains to be seen.

3.2. Changes in offshore activities in response to regulations

As we reviewed in the previous section, our survey collected information on the impact of regulations on cross-border data transfers. In this section, we report the results from our survey in terms of the responses and adaptation of firms to these regulations.

First, we asked the following question to firms that chose the “Some” option for the question on the impact of GDPR.

Choose all that apply for your company's responses to GDPR. For each of the choices from 1 to 4, please include not only the case that has already been carried out, but also any

case under consideration. If you select "6. Other," please fill in your response specifically in the parentheses.

Several measures have been taken by the firms that had been affected. The percentages shown in Table 9 are for the number of firms, not for the total chosen options. More than 40% of the firms strengthened in-house data management in responding to the EU requirement. However, more than 30% of the firms changed the location of their data processing and storage to affiliates located in the EU within multinational enterprise groups, suggesting that GDPR affected the data location decisions of firms. By contrast, merely around 5% of the firms started to outsource across firm boundaries to EU local firms, possibly due to concern over data leaks. Such answers suggest that GDPR appears to have impacted the locations of the data processing or storage across national borders while staying within the boundaries of the multinational enterprises. Although they recognized that GDPR was affecting their business, 17% of the firms have not planned or taken any measures as yet. A few firms, merely 1%, shut down, converted, or curtailed their business in the EU due to the GDPR.

While we asked this question of the firms that claimed they were affected by GDPR, some firms reported that they were not affected by GDPR at all. To collect information on the latter firms, we asked the following question.

Choose all that apply as the reasons that GDPR has had no impact at all on your company. If you select "5. Other," please fill in the reasons specifically in the parentheses.

Among the firms that stated they felt no impact of the GDPR, Table 10 shows that more than 80% cited no transactions with the EU as the reason for no impact. More than one-third of the firms reporting no impact said they were not involved in transfers of personal data. It is, however, difficult to determine whether they were not really transferring any data from our survey alone.

On regulations imposed by China and other countries, similarly, we asked the following question of those who believed that they were affected by the regulations.

Choose all that apply as your company's response to the data transfer regulations in countries including China. For each of the choices from 1 to 4, include not only the case that has already been carried out, but also any case under consideration. If you select "5. Other," please fill your response specifically in the parentheses.

Some contrasts with the previous question on GDPR are noted in Table 11. The percentage of firms changing, shrinking, or even stopping their business in these countries was nearly 5%, which is far higher than that in the case of GDPR. This gap indicates that cyber security regulation imposed by these countries has more serious impacts on Japanese firms in comparison with the attractiveness of doing business there, although we note that this question includes several diverse countries while the previous question concentrates solely on the EU. We also find that the share of firms not considering any measure, more than half, is also much higher than that in EU, possibly reflecting the uncertainty associated with the regulations introduced by these countries. While the frequency of outsourcing to local firms is slightly higher, the choice to shift locations for data processing/storage to local affiliates within their own enterprise groups was made with similar frequency.

To the firms that indicated no impact from the regulations, the question we asked was as follows.

As you recognize no impact on your company of data transfer regulation in China and other countries, choose all that apply as the reasons. If you select "4. Other," explain the reason specifically in the parentheses.

As in the EU case, the most frequently chosen reason for no impact, as shown in Table 12, was no transaction with relevant countries. We also noticed that many firms indicated that

they were not involved in transfers of personal data and/or regulated activities; however, it is generally difficult to determine the range of regulated data or activities under poorly clarified regulations.

3.3. Reorganization and within-firm responses

In the previous section, we reviewed how regulations on cross-border data transfers led firms to adjust their overseas activities. However, to respond to the regulations, firms may change their internal organization and/or their expenditures. To collect information on these within-firm adjustments, we introduced the following two questions.

For internal reorganization, we asked about the person in charge of cross-border data transfers and how the firms changed this assignment after the regulations. The question used in our survey was as follows.

In response to tightening regulations on cross-border data transfers by foreign countries, has your company changed its organization to manage data exchange with foreign countries, including business-to-business (B to B), individual customers (B to C), and inter-device information transmission of machine operation data (M to M)? If you have changed, how have you changed? Select the most appropriate option as the person(s) in your company primarily in charge of data transfer with foreign countries, such as the Data Protection Officer, in the past and in the present, respectively, including the case where there is no change.

Responding to new regulations, some firms indicated a recent shift in the level of the position in charge of data transfer, moving upward within the corporate hierarchy, from no assignment or staff-level to manager or executive. However, as evident in Table 13, the firms that have made such changes are relatively few with more than 70% of the firms surveyed indicating that they have not yet chosen the specific person responsible for data transfers.

In the above question, we focused on human resource allocation or delegation within corporate organizations. However, firms could respond to changes in regulations through other means. To collect information on diverse corporate responses, we introduced the following question.

In response to tightening regulations on cross-border data transfers by foreign countries, has your company tightened information security by measures other than the organizational change specified in the previous question¹⁵? Choose all that apply. If you select "7. Other," explain the measure specifically in the parentheses.

The responses by the firms varied widely, as shown in Table 14. Around 20% of the surveyed firms have tightened their security through measures such as introducing firewalls. Firms that formalized manuals or educated employees had around the same share. On the other hand, merely around 8% of the firms increased their expenses for this purpose. In line with previous responses in our survey, nearly two-thirds of the firms had not strengthened their cyber security.

For these two questions, we found that the responses of firms varied substantially. Although it is impossible to observe directly data transmission through surveys alone, we can infer indirectly that those firms that had taken substantial measures, such as increasing expenditures or changing their internal organization, were likely to be involved in active cross-border data transfers before the regulations.

4. Concluding remarks

As economies are now globally integrated, cross-border data flows are increasingly important for consumers, firms, and economies. Based on our survey of Japanese firms, we find that many

¹⁵ In the text presented to respondents, the question is identified by a serial question number.

of the firms actively collecting data overseas have been affected by the cyber security regulations, such as those imposed by China, although the vast majority of the firms surveyed were not involved in cross-border data transfers and did not recognize any impact from these regulations. However, our survey did not directly quantify the data flows; it is practically impossible for an academic survey to do so without reporting requirements that ask firms to disclose such sensitive items. To bypass this problem, we designed our survey so that we could infer indirectly the extent or intensity of cross-border data flows based on the firms' responses to newly introduced regulations such as GDPR of EU and Cyber Security Act of China. We at the same time note a caveat, as our survey evaluates the regulatory impacts based on subjective assessments of responding firms and provides no information on how firms are affected.

This report is intended to summarize the main findings from our survey of Japanese firms. While the descriptive summary of the survey results is informative for a broad range of readers, we will be able to learn more from this survey through additional investigation. Among the tasks left for future work, a linkage with official statistics will enable us to explore whether or not and how basic firm attributes relate to a firm's response to regulation on cross-border data transfers. Without such additional work, we cannot discuss how a firm's characteristics, such as size, productivity, or R&D intensity, affect the firm's data flow. Although the number of firms active in cross-border data transmission may be limited, their impact on national or even global economies may not be negligible due to their granularity, their extended trade networks based on their size, and the wide spillover effect based on their technological superiority. We are currently working on an additional research linking the survey results to firm-level data from official statistics. Through such detailed econometric analyses, we can identify relevant factors behind various corporate adaptations and contribute to discussions on desirable policy measures to improve global data flow.

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Table 1 Number of firms in our sample

A	B Industry	C Num.	D %	E Res.%	F #Firms
9	Manufacture of Food	337	8.0	22.8	1,480
10	Manufacture of Beverages, Tobacco, and Feed	34	0.8	18.3	186
11	Manufacture of Textile Products	107	2.5	24.5	437
12	Manufacture of Lumber and Wood Products	49	1.2	33.3	147
13	Manufacture of Furniture and Fixtures	36	0.9	29.5	122
14	Manufacture of Pulp, Paper, and Paper Products	90	2.1	22.8	395
15	Printing and Allied Industries	129	3.1	22.8	565
16	Manufacture of Chemical Products	121	2.9	13.3	912
17	Manufacture of Petroleum and Coal Products	7	0.2	14.0	50
18	Manufacture of Plastic Products	176	4.2	23.1	761
19	Manufacture of Rubber Products	40	0.9	26.7	150
20	Manufacture of Leather Products, Tanning, and Fur Skins	6	0.1	26.1	23
21	Manufacture of Ceramic, Stone, and Clay Products	110	2.6	23.9	461
22	Manufacture of Iron and Steel	114	2.7	26.5	430
23	Manufacture of Non-Ferrous Metals	64	1.5	18.2	352
24	Manufacture of Fabricated Metal Products	255	6.0	24.4	1,044
25	Manufacture of General-purpose Machinery	116	2.7	22.1	524
26	Manufacture of Production Machinery	204	4.8	20.0	1,019
27	Manufacture of Business-oriented Machinery	78	1.8	18.8	416
28	Electronic Parts, Devices, and Electronic Circuits	133	3.1	21.3	623
29	Manufacture of Electrical Machinery, Equipment, and Supplies	138	3.3	18.3	755
30	Manufacture of Info. & Comm. Electronics Equipment	41	1.0	18.8	218
31	Manufacture of Transportation Equipment	277	6.6	21.0	1,322
32	Miscellaneous Manufacturing Industries	63	1.5	20.1	314
39	Information Services	393	9.3	18.7	2,102
40	Services Incidental to Internet	15	0.4	7.7	195
51	Wholesale Trade (Textile and Apparel)	82	1.9	22.2	369
52	Wholesale Trade (Food and Beverages)	249	5.9	24.9	1,001
53	Wholesale Trade (Building Materials, Minerals and Metals, etc.)	219	5.2	25.5	860
54	Wholesale Trade (Machinery and Equipment)	384	9.1	21.2	1,813
55	Miscellaneous Wholesale Trade	115	2.7	23.1	497
71	Scientific Research, Professional and Technical Services	14	0.3	20.6	68
72	Professional Services, n.e.c.	31	0.7	18.1	171
	Total	4,227	100	21.4	19,782

(Notes) The column (A) shows the industry classification number at the two-digit level. (C) reports the number of firms in our sample, while the percentage of each industry is shown in (D). The column (E) reports the response rate in percentage, calculated by (C) divided by (F) (the number of firms sent questionnaires) multiplied by 100.

Table 2 Impact of regulations (%)

Response	EU GDPR	Cyber security regulation in China/other countries
Some impact	4.51	8.14
No impact	71.68	71.14
Don't know	23.80	20.72
Total	100	100

Table 3 Transfer of non-personal data (%)

<i>1. Yes</i>	5.63
<i>2. No</i>	75.17
<i>3. It is difficult to distinguish personal and non-personal data, but there is data transfer.</i>	6.04
<i>4. I do not know or do not grasp it.</i>	13.16
Total	100

Table 4 Counterparts in data transfers (%)

<i>1. Overseas affiliates of your company (including your parent company if it is located overseas)</i>	16.23
<i>2. Platform operators (e.g., Google, Amazon)</i>	3.43
<i>3. Other overseas firms</i>	9.70
<i>4. Directly to individual overseas customers (B to C) without intermediation by other firms</i>	0.64
<i>5. Foreign government, public organizations, or state-owned enterprises</i>	0.52
<i>6. Other</i>	0.57
<i>7. No daily transfer of data, or, I do not know.</i>	72.49

Table 5 Data collection activities (%)

	<i>Domestic</i>	<i>Overseas</i>
<i>Our company is continuously collecting digital data through IoT.</i>	7.81	2.31
<i>Although IoT has not been introduced, our company is regularly collecting digital data.</i>	21.62	8.73
<i>Our company is not particularly conscious of data, or not collecting data consciously.</i>	55.66	70.70
<i>I do not know whether IoT is introduced, or do not know IoT.</i>	14.91	18.26
Total	100	100

Note: "IoT" refers to various devices connected via networks for collecting digital data.

Table 6 Adoption of new technologies (%)

<i>1. Broadband connection</i>	68.32
<i>2. Website of your company</i>	80.86
<i>3. Corporate Intranet</i>	69.65
<i>4. ERP (Enterprise Resources Planning, software for managing production, sales, purchasing, inventory, accounting, personnel, and payroll)</i>	73.22
<i>5. CRM (Customer Relationship Management software)</i>	21.06
<i>6. Social media (e.g., Facebook, Twitter)</i>	16.87
<i>7. E-Commerce platform (including online ordering/settlement)</i>	41.71
<i>8. Cloud service</i>	40.08
<i>9. Voice over Internet Protocol (VoIP) service (e.g., Skype)</i>	23.44
<i>10. Blockchain</i>	1.25

Table 7a Data collection activities and impact of GDPR (%)

	<i>Some impact</i>	<i>No impact</i>	<i>Don't know</i>	Total
Domestic data				
<i>IoT</i>	0.77	5.68	1.32	7.78
<i>Collecting data w/o IoT</i>	1.78	15.66	4.19	21.63
<i>Not collecting data</i>	1.81	42.68	11.25	55.73
<i>Don't know</i>	0.12	7.66	7.08	14.86
Total	4.48	71.68	23.84	100

	<i>Some impact</i>	<i>No impact</i>	<i>Don't know</i>	Total
Overseas data				
<i>IoT</i>	0.47	1.37	0.45	2.29
<i>Collecting data w/o IoT</i>	1.34	5.64	1.76	8.75
<i>Not collecting data</i>	2.56	54.51	13.71	70.78
<i>Don't know</i>	0.20	9.79	8.20	18.19
Total	4.57	71.30	24.12	100

Table 7b Data collection activities and impacts of cyber security regulations (%)

	<i>Some impact</i>	<i>No impact</i>	<i>Don't know</i>	Total
Domestic data				
<i>IoT</i>	1.61	4.94	1.25	7.80
<i>Collecting data w/o IoT</i>	3.47	14.11	4.05	21.62
<i>Not collecting data</i>	2.70	43.56	9.41	55.67
<i>Don't know</i>	0.41	8.48	6.02	14.90
Total	8.19	71.08	20.73	100

	<i>Some impact</i>	<i>No impact</i>	<i>Don't know</i>	Total
Overseas data				
<i>IoT</i>	1.04	0.87	0.37	2.29
<i>Collecting data w/o IoT</i>	2.41	4.45	1.86	8.72
<i>Not collecting data</i>	4.27	54.71	11.75	70.73
<i>Don't know</i>	0.52	10.61	7.13	18.26
Total	8.25	70.63	21.12	100

Table 8 Impact of 3D printers on international trade in goods (%)

Trade decreased	Trade increased	Trade unchanged	No 3D printers	Total
0.07	0.12	6.51	93.30	100

Table 9 Responses to GDPR (%)

<i>1. Our company now processes and stores data at our affiliates located in the EU.</i>	31.05
<i>2. Our company now outsources data processing and storage to local companies in the EU.</i>	5.26
<i>3. Our company has converted, shrunk, or stopped business in the EU.</i>	1.05
<i>4. Our company has strengthened our in-house personal data management to be as strict as the EU.</i>	43.68
<i>5. Our company has not considered any specific measures.</i>	16.84
<i>6. Other</i>	18.95

Table 10 Reasons for no impact of GDPR (%)

<i>1. Our company has almost no transactions with EU member states.</i>	84.04
<i>2. Our company does not transfer personal data to/from EU member states.</i>	35.76
<i>3. The agreement reached between the governments of Japan and the EU will enable us to transfer personal data to Japan.</i>	0.50
<i>4. Our company manages personal data as strictly as the EU.</i>	0.86
<i>5. Other</i>	0.99

Table 11 Responses to cyber security regulations in China/other countries (%)

<i>1. Our company now processes and stores data at our affiliate in the relevant country.</i>	27.99
<i>2. Our company now outsources data processing and storage to local companies in the relevant country.</i>	8.75
<i>3. Our company has converted, shrunk, or stopped business in the relevant countries.</i>	4.66
<i>4. Our company has not considered any specific measures.</i>	56.85
<i>5. Other</i>	6.71

Table 12 Reasons for no impact of cyber security regulations in China/other countries (%)

<i>1. Our company has almost no transactions with China or other countries concerned.</i>	67.00
<i>2. Our company does not transfer personal data to/from China or other countries concerned.</i>	38.27
<i>3. Our company does not perform any regulated activities.</i>	20.19
<i>4. Other</i>	0.93

Table 13 Organizational changes (%)

	<i>Past</i>	<i>Present</i>
<i>Executives, including CIO, solely responsible for this task</i>	5.03	5.62
<i>General manager or manager of section, division, or department</i>	16.27	17.37
<i>Staff directly in charge</i>	7.10	6.57
<i>Our company has not chosen the specific person(s).</i>	71.60	70.45
Total	100	100

Table 14 Other measures to respond to regulations (%)

<i>1. Increase internal expenses such as increasing internal staff and investing in your own server</i>	7.59
<i>2. Increase (or start) outsourcing</i>	3.26
<i>3. Reduce (or stop) outsourcing</i>	0.24
<i>4. Formulation of security policies and manuals, security audits, enhancement of employee education</i>	18.71
<i>5. Security tightening measures, such as firewall installation, log recording, and encryption</i>	21.27
<i>6. Not particularly strengthened</i>	64.30
<i>7. Other</i>	1.82

Appendix Table A1 Industrial variations in effects of GDPR

	Industry	Some impact	No impact	Don't know	# Firms
9	Manufacture of Food	0.9	72.3	26.8	336
10	Manufacture of Beverages, Tobacco, and Feed	0.0	73.5	26.5	34
11	Manufacture of Textile Products	1.9	63.2	34.9	106
12	Manufacture of Lumber and Wood Products	0.0	75.5	24.5	49
13	Manufacture of Furniture and Fixtures	8.3	69.4	22.2	36
14	Manufacture of Pulp, Paper, and Paper Products	1.1	64.4	34.4	90
15	Printing and Allied Industries	2.3	80.5	17.2	128
16	Manufacture of Chemical Products	10.7	65.3	24.0	121
17	Manufacture of Petroleum and Coal Products	0.0	57.1	42.9	7
18	Manufacture of Plastic Products	1.7	69.1	29.1	175
19	Manufacture of Rubber Products	2.5	75.0	22.5	40
20	Manufacture of Leather Products, Tanning, and Fur Skins	0.0	66.7	33.3	6
21	Manufacture of Ceramic, Stone, and Clay Products	1.8	73.4	24.8	109
22	Manufacture of Iron and Steel	0.9	75.4	23.7	114
23	Manufacture of Non-Ferrous Metals	3.2	68.3	28.6	63
24	Manufacture of Fabricated Metal Products	1.6	71.0	27.5	255
25	Manufacture of General-purpose Machinery	6.0	60.3	33.6	116
26	Manufacture of Production Machinery	4.4	69.0	26.6	203
27	Manufacture of Business-oriented Machinery	12.8	57.7	29.5	78
28	Electronic Parts, Devices, and Electronic Circuits	11.4	65.9	22.7	132
29	Manufacture of Electrical Machinery, Equipment, and Supplies	5.8	69.6	24.6	138
30	Manufacture of Info. & Comm. Electronics Equipment	22.0	68.3	9.8	41
31	Manufacture of Transportation Equipment	5.1	68.5	26.4	276
32	Miscellaneous Manufacturing Industries	4.8	60.3	34.9	63
39	Information Services	6.9	86.8	6.4	393
40	Services Incidental to Internet	20.0	73.3	6.7	15
51	Wholesale Trade (Textile and Apparel)	3.8	76.3	20.0	80
52	Wholesale Trade (Food and Beverages)	2.0	66.7	31.3	249
53	Wholesale Trade (Building Materials, Minerals and Metals, etc.)	2.8	73.9	23.4	218
54	Wholesale Trade (Machinery and Equipment)	6.0	74.6	19.4	382
55	Miscellaneous Wholesale Trade	6.1	67.8	26.1	115
71	Scientific Research, Professional and Technical Services	7.1	92.9	0.0	14
72	Professional Services, n.e.c.	6.5	80.6	12.9	31
	Total	4.5	71.7	23.8	4213

(Notes) Responses are shown in percentages within each industry.

Table A2 Industrial variations in effects of cyber security regulations in China/other countries

	Industry	Some impact	No impact	Don't know	# Firms
9	Manufacture of Food	2.1	76.5	21.4	336
10	Manufacture of Beverages, Tobacco, and Feed	5.9	61.8	32.4	34
11	Manufacture of Textile Products	3.8	67.9	28.3	106
12	Manufacture of Lumber and Wood Products	6.1	69.4	24.5	49
13	Manufacture of Furniture and Fixtures	8.3	66.7	25.0	36
14	Manufacture of Pulp, Paper, and Paper Products	4.4	68.9	26.7	90
15	Printing and Allied Industries	3.1	87.5	9.4	128
16	Manufacture of Chemical Products	15.7	61.2	23.1	121
17	Manufacture of Petroleum and Coal Products	0.0	71.4	28.6	7
18	Manufacture of Plastic Products	7.4	65.9	26.7	175
19	Manufacture of Rubber Products	10.0	67.5	22.5	40
20	Manufacture of Leather Products, Tanning, and Fur Skins	0.0	50.0	50.0	6
21	Manufacture of Ceramic, Stone, and Clay Products	4.5	79.1	16.4	109
22	Manufacture of Iron and Steel	2.6	74.6	22.8	114
23	Manufacture of Non-Ferrous Metals	6.3	68.8	25.0	63
24	Manufacture of Fabricated Metal Products	5.5	72.9	21.6	255
25	Manufacture of General-purpose Machinery	8.6	61.2	30.2	116
26	Manufacture of Production Machinery	11.8	62.7	25.5	203
27	Manufacture of Business-oriented Machinery	20.5	51.3	28.2	78
28	Electronic Parts, Devices, and Electronic Circuits	16.0	64.1	19.8	132
29	Manufacture of Electrical Machinery, Equipment, and Supplies	15.9	63.0	21.0	138
30	Manufacture of Info. & Comm. Electronics Equipment	17.1	65.9	17.1	41
31	Manufacture of Transportation Equipment	6.5	68.1	25.4	276
32	Miscellaneous Manufacturing Industries	7.9	69.8	22.2	63
39	Information Services	10.7	81.4	7.9	393
40	Services Incidental to Internet	26.7	66.7	6.7	15
51	Wholesale Trade (Textile and Apparel)	15.0	63.8	21.3	80
52	Wholesale Trade (Food and Beverages)	3.6	73.8	22.6	249
53	Wholesale Trade (Building Materials, Minerals and Metals, etc.)	7.4	72.8	19.8	218
54	Wholesale Trade (Machinery and Equipment)	9.2	73.3	17.5	382
55	Miscellaneous Wholesale Trade	5.3	72.8	21.9	115
71	Scientific Research, Professional and Technical Services	21.4	64.3	14.3	14
72	Professional Services, n.e.c.	12.9	80.6	6.5	31
	Total	8.1	71.1	20.7	4213

(Notes) See notes to Table A1.