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Firm Export Heterogeneity and International Productivity Gap: Evidence from France and Japan*

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Abstract

Do exporters from one country outperform those from another country? Similarly, do non-exporters from one country outperform those from another country? Previous studies could not answer these questions because they focused on a productivity gap between firms within a single country. This paper attempts to address this issue, using firm-level data for France and Japan from 1994 to 2006. One of the contributions of this paper is that we compare directly the distribution of firm-level total factor productivity (TFP) within the same industry across two different countries. We find that the productivity advantage of French and Japanese firms is generally consistent with each country's comparative advantage. Regardless of export status, French firms outperform Japanese firms in chemical and plastic industries while Japanese firms outperform French firms in machinery industries. Besides, whatever the direction of the comparative advantage, Japanese exporters perform relatively better than French exporters. Specifically, the productivity gaps are larger in industries in which Japanese firms have comparative advantage while it is smaller in industries in which French firms have comparative advantage. These results together imply that the productivity advantage of Japanese exporters relative to French exporters reflects not only comparative advantage but also export costs.

Key words: Firm heterogeneity; Comparative advantage; Export costs; International productivity gap; Productivity distribution
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1 Introduction

Do exporters from one country outperform those from another country? Similarly, do non-exporters from one country outperform those from another country? These questions are nontrivial because, in the presence of firm heterogeneity and trade costs, a part of international productivity gaps between two countries may be attributable to differences in firm specific factors, comparative advantage and trade costs (e.g., Bernard, Redding, and Schott, 2007). In this paper, we propose an analytical framework to investigate how international productivity gaps relate to the export status of firms and to country specific trade costs.

Our motivation comes from two strands of study. One is the literature on firm export heterogeneity in international trade. With the growing studies on firm export heterogeneity in many countries, we now know that, in general, exporters perform better than non-exporters.[1] However, the previous studies on firm export heterogeneity lack a perspective of international comparison.[2] Therefore, none of the previous studies compared directly the productivity of exporters (or non-exporters) across two different countries.

The other strand is the study on international productivity gaps which is one of the central issues for the theory and empirics of economic growth.[3] Accordingly, numerous studies have attempted to measure international productivity gaps relying on country, industry, or firm levels data sets.[4] However, the previous firm-level studies on international productivity gap focused on large listed firms.[5] This in turn implies that they did not pay much attention to firm export heterogeneity because most of the listed firms are exporters.

In addition, the previous empirical studies on international productivity gap focus only on the *average* productivity of firms.[6] Note, however, that the average productivity gap does not necessarily mean that the majority of firms in one country perform better than those that in the other country. This is because there are two possible explanations behind the international productivity gap. One is that the majority of firms in one country perform

[1] Greenaway and Kneller (2007), Hayakawa, Machikita, and Kimura (2012), and Wagner (2007, 2012) provided excellent literature reviews on firm export heterogeneity.

[2] An exception is a study by International Study Group on Exports and Productivity (ISGEP) (2008) that has analyzed the export premia for 14 countries. However, their study compared the export premia, not the productivity level itself. Therefore, it is impossible to answer the aforementioned two questions.

[3] "Comparisons of productivity performance across countries are central to many of the questions concerning long-run economic growth" (Bernard and Jones, 1996, p. 1216).

[4] Baily and Solow (2001) especially emphasized the importance of the international productivity comparisons at the firm level.

[5] Exceptions are studies by Aw, Chung, and Roberts (2000) and Ahn, Fukao, and Kwon (2004). Aw, Chung, and Roberts (2000) utilized Korean and Taiwanese plant-level data but the period is different between two data sets. Ahn, Fukao, and Kwon (2004) utilized Korean plant-level data and Japanese firm-level data. Strictly speaking, therefore, some of the previous studies did not compare directly the productivity of firms (or plants) from two different countries.

[6] For example, Griliches and Mairesse (1983) compared the productivity of firms in France and the United States. Fukao, Inui, Kabe, and Liu (2008) compared the productivity of firms in China, Japan, and South Korea. Fukao, Inui, Ito, Kim, and Yuan (2011) extended the analysis, adding Taiwanese firms. Jung, Lee, and Fukao (2008) and Jung and Lee (2010) compared the productivity of firms in Japan and Korea. All of these studies focus on the difference in average productivity gap.

better than those in the other country. The other is that only a small number of leading firms perform extremely better than firms in the other country. For the majority of firms, therefore, the international productivity gap may be rather small. These two explanations have different implications for economic theory and policy.

Both strands of research have made significant contributions to the literature. However, the link between the two strands, namely the connection between firm export heterogeneity and international productivity gaps has not been fully explored yet. One of the new contributions of this paper is that we propose a framework to integrate these two strands of study and attempt to answer the questions above. We focus on French and Japanese manufacturing firms because of the relatively high comparability of the firm-level data. In this paper, productivity is measured by total factor productivity (TFP). Following Delgado, Fariñas, and Ruano (2002) and Fariñas and Ruano (2005), our empirical analysis relies on the concept of first-order stochastic dominance. Establishing stochastic dominance means that one cumulative distribution lies to the right of another. Therefore, these tests go beyond tests for differences in average productivity that are typically found in the literature on international productivity gap.

Another contribution of this paper is that we propose a framework to balance competing goals for the international comparison of firm-level productivity and the confidentiality of firm-level data sets between two countries. To relate international productivity gaps to firm characteristics, we would ideally need to merge the two country data sets in an unique data set. However, merging is not possible because of the confidentiality of firm-level data sets.

This paper is structured as follows. Section 2 provides a brief overview of the relevant theories of international trade with heterogenous firms. Section 3 presents our empirical methodology. Section 4 explains about the data. Estimation results are presented in Section 5. A summary of our findings and implications is presented in the final section.

2 Theory

A recent study by Bernard, Redding and Schott (2007) developed a general equilibrium model of comparative advantage that incorporates heterogeneous firms in order to examine how firm, country, and industry characteristics all interact as trade costs decline. They extended Melitz (2003), by introducing an additional industry and factor, and showed that the productivity differences of firms in the same industry from two different countries could be attributable to firm heterogeneity (firm-specific factors), comparative advantage or trade costs. This study has important implications to the international productivity gaps of exporters (or non-exporters) from two different countries. That is, in the presence of firm heterogeneity and trade costs, international productivity gaps between two countries can be attributable to firm specific factors, comparative advantage, and trade costs.[7]

[7] Another study by Melitz and Ottaviano (2008) found that market size was also matter in explaining the selection of firms and exporters, which could also affect the productivity distribution of firms. Although our theoretical framework relies on Bernard, Redding and Schott (2007), we will address this issue in Section 5.

Note that firm-specific factors mean that they are not common to firms within the same industry. This in turn means that firm-specific factors are expected to affect the average of the productivity, but not the entire distribution. In other words, if the productivity distribution lies to the right of another, we can interpret that the differences reflect common factors within the same industry (i.e., comparative advantage and/or export costs).

If there is no export cost, all existing firms become exporters and, therefore, non-exporters will disappear. Put it differently, if both exporters and non-exporters exist simultaneously in the same industry in one country, the difference in their productivity distributions should reflect export costs. On one hand, if the productivity distribution of exporters within the same industry is different between two countries, we can interpret that the differences reflect export costs as well as comparative advantage. On the other hand, if the productivity distribution of non-exporters within the same industry is different between two countries, we can interpret that the differences reflect comparative advantage.

A recently study by OECD (2011) attempted to estimate comparative advantage for several countries, including France and Japan. In OECD (2011), comparative advantage is measured by revealed comparative advantage (RCA) which is developed by Balassa (1965). It compares a country's share of world exports in a industry to its share of exports overall:

$$RCA_{c,k} = \frac{X^{c,k}/X^{\cdot,k}}{X^{c,\cdot}/X^{\cdot,\cdot}}, \tag{1}$$

where $X^{c,k}$ and $X^{\cdot,k}$ are exports from industry k by country c and the world, and $X_{c,\cdot}$ and $X_{\cdot,\cdot}$ are their total exports. If $RCA_{c,k}$ is greater than unity, this means that industry k in country c exports more than average. It thus can be interpreted that the industry has comparative advantage.

Table 1 presents RCA for France and Japan in 2000, by industry. Table 1 indicates that, on one hand, the RCA for France is greater than the RCA for Japan in such industries as *Chemicals and allied industries*, *Plastics / rubbers*, *Raw hides*, and *Textiles*. On the other hand, the RCA for Japan is greater than the RCA for France in such industries as *Machinery / electrical*. If the cross-country differences in the productivity distribution of firms within the same industry reflect the differences in comparative advantage, it is expected that, regardless of the export status, French firms outperform Japanese firms in chemical and plastic industries while Japanese firms outperform French firms in machinery industries. Besides, for French firms, exporting to Italy or Belgium sounds much less costly than exporting overseas like Japanese firms do. If the productivity of exporters reflects export costs as well as comparative advantage, the productivity of Japanese exporters is expected to be higher than that of French exporters, whatever the direction of comparative advantage. These implications are tested in the following sections.

=== Table 1 ===

3 Methodology

We start by describing how we compute internationally comparable TFP indices at the firm-level without having to merge French and Japanese data sets submitted to confidentiality restrictions. Then, we present the testing procedure we follow to estimate the productivity gaps between French and Japanese firms.

3.1 Multilateral firm-level TFP indices for international comparisons

International comparisons of productivity have always been challenging because of the difficulty to compare data drawn from different national sources. However, performing such exercises at the firm level rise an additional challenge, which is the confidentiality issue. Usually, national statistical offices do not allow the micro-level data they collect to be merge ones with each other.[8] In the case of France and Japan, both INSEE for France and METI for Japan impose such restrictions for the use of their comprehensive micro-level data sets.

The issue of confidentiality raises the challenge of estimating comparable TFP measures without pooling together firm-level data from different countries. For that purpose, this paper proposes to implement a non-parametric methodology based on the multilateral index number approach developed by Good, Nadiri, and Sickles (1997) (hereafter GNS).[9] The reason why we employ an index method, rather than semi-parametric approaches such as Olley and Pakes (1996) or Levinsohn and Petrin (2003), to estimate TFP is precisely that it is impossible to estimate production function, pooling together the firms in our two different countries. On the contrary, the productivity index method allows for separate (but comparable) estimates of individual TFP across countries. It thus enables us to overcome the issue of confidentiality.[10]

The original GNS methodology utilizes a hypothetical reference firm for each industry that has the arithmetic mean values of log output, log input, and input cost shares over firms belonging to that industry in each year. Each firm's output and inputs are measured relative to this reference firm. The reference firms are then chain-linked over time. Hence,

[8] Non-confidential micro-level databases exist from private sources. See, for instance, the Amadeus database which provides firm-level data for a very large number of firms located in 41 different European countries. However, those data sets are usually less comprehensive than the firm-level statistics collected by National Offices.

[9] A number of studies on firm export heterogeneity employ the multilateral index number approach. See, for example, Aw, Chen, and Roberts (2001), Aw, Chung, and Roberts (2003), Girma, Kneller, and Pisu (2005), and Kimura and Kiyota (2006).

[10] Another advantage is that the index method produces accurate productivity estimates unless the data are subject to a lot of measurement errors. On the flipside, this method should not be preferred when the data have serious measurement errors. For more detail, see van Biesebroeck (2007). As we will discuss below, both the French and Japanese data are from the government statistics whose surveys are compulsory for firms. Therefore, the data are less likely to be subject to measurement errors than the data coming from private sources. On that respect, the use of the index method may be more appropriate in our research than in the ones relying on private firm-level data sources.

the index measures the TFP of each firm in year t relative to that of the reference firm in the initial year ($t = 0$).

Let TFP_{it}^{k} and TFP_{rt}^{k} be TFP for firm i and the reference firm r operating in year t in industry k, respectively. The GNS method consists in defining the TFP index for firm i operating in industry k in year t as:

$$\begin{aligned}\ln TFP_{it}^{k} - \ln TFP_{r0}^{k} \approx & \left(\ln Y_{it}^{k} - \overline{\ln Y}_{rt}^{k}\right) + \sum_{\tau=1}^{t}\left(\overline{\ln Y}_{r\tau}^{k} - \overline{\ln Y}_{r\tau-1}^{k}\right) \\ & - \sum_{j\in\{K,L,M\}} \frac{1}{2}\left(s_{ijt}^{k} + \bar{s}_{rjt}^{k}\right)\left(\ln j_{it}^{k} - \overline{\ln j}_{rt}^{k}\right) \\ & + \sum_{\tau=1}^{t}\sum_{j\in\{K,L,M\}} \frac{1}{2}\left(\bar{s}_{rj\tau}^{k} + \bar{s}_{rj\tau-1}^{k}\right)\left(\overline{\ln j}_{r\tau}^{k} - \overline{\ln j}_{r\tau-1}^{k}\right), \end{aligned} \quad (2)$$

where $\ln Y_{it}^{k}$, $\ln j_{it}^{k}$, and s_{ijt}^{k} are the log output, log input of factor j, and the cost share of factor j for firm i in industry k, respectively. $\overline{\ln Y}_{rt}^{k}$, $\overline{\ln j}_{rt}^{k}$, and $\bar{s}_{rjt}^{k}$ are the same variables for the reference firm r and are equal to the arithmetic mean of the corresponding variable over all firms operating in industry k in year t.

The first term of the first line indicates the deviation of the firm i's output from the output of the reference firm in year t. The second term means the cumulative change in the output of the reference firm from year 0 to year t. The same operations are applied to each input j in the second and the third lines, weighted by the average of the cost shares.

We extend the GNS methodology to international firm-level comparisons in using a common reference firm to compute relative TFP indices for firms belonging to different countries. To start with, suppose that all the relevant firm-level variables are expressed in common units irrespective of the country (we will address the issue of the comparability of the data later on in the next section). Let us focus on one industry and two countries: France (FR) and Japan (JP). Define France as the country of reference. Discarding the industry subscript k for simplicity of notation, individual relative TFP indices for Japan can be computed using the following equation adapted from equation (2):

$$\begin{aligned}\ln TFP_{it}^{JP} - \ln TFP_{r0}^{FR} \approx & \left(\ln Y_{it}^{JP} - \overline{\ln Y}_{rt}^{FR}\right) + \sum_{\tau=1}^{t}\left(\overline{\ln Y}_{r\tau}^{FR} - \overline{\ln Y}_{r\tau-1}^{FR}\right) \\ & - \sum_{j\in\{K,L,M\}} \frac{1}{2}\left(s_{ijt}^{JP} + \bar{s}_{rjt}^{FR}\right)\left(\ln j_{it}^{JP} - \overline{\ln j}_{rt}^{FR}\right) \\ & + \sum_{\tau=1}^{t}\sum_{j\in\{K,L,M\}} \frac{1}{2}\left(\bar{s}_{rj\tau}^{FR} + \bar{s}_{rj\tau-1}^{FR}\right)\left(\overline{\ln j}_{r\tau}^{FR} - \overline{\ln j}_{r\tau-1}^{FR}\right), \end{aligned} \quad (3)$$

where $\ln Y_{it}^{JP}$, $\ln j_{it}^{JP}$, and s_{ijt}^{JP} are defined as previously but are now specific to Japan.

$\overline{\ln Y}_{rt}^{FR}$, $\overline{\ln j}_{rt}^{FR}$, and $\bar{s}_{rjt}^{FR}$ are the same variables for the French reference firm operating and equal to the arithmetic mean of the corresponding variable over all French firms operating in year t. Note that what we need to do is not to merge firm-level data sets between two countries but to exchange the information on French and Japanese reference firms. We thus can balance competing goals for the international comparison of firm-level productivity and the confidentiality of firm-level data sets between two countries.

To estimate equation (3), a basic requirement is that the main variables for TFP estimates are highly comparable in France and in Japan. The presentation of our French and Japanese data sets and the discussion of comparability issues are the purpose of Section 4. For now, let us suppose that the basic requirement of data comparability is fulfilled. Our next step consists in presenting the testing procedure we follow to estimate the productivity gaps between different subsets of Japanese and French manufacturing firms based on those individual TFP indices.

3.2 Testing procedure under confidentiality restrictions

To estimate the productivity gaps between French and Japanese firms, we complement the usual student t-testing equality of TFP means between French and Japanese firms with the testing procedure proposed by Delgado, Fariñas, and Ruano (2002) and Fariñas and Ruano (2005) which relies on the concept of first-order stochastic dominance. However, we have to adapt this procedure to confront the confidentiality restrictions imposed by both the French and the Japanese statistics offices.

First for what concerns the t-test, the procedure is straightforward. Both countries must share the necessary scalar statistics to compute the t-statistic. When $\sigma_{\ln TFP}^{FR}$ and $\sigma_{\ln TFP}^{JP}$ are unknown and $\sigma_{\ln TFP}^{FR} \neq \sigma_{\ln TFP}^{JP}$, the t-statistic is as follows:

$$t\text{-statistic} = \frac{\overline{\ln TFP^{JP}} - \overline{\ln TFP^{FR}}}{\sqrt{s_{JP}^2/n_{JP} + s_{FR}^2/n_{FR}}} \tag{4}$$

where $\overline{\ln TFP}$ is the sample mean of the unknown population mean $\mu_{\ln TFP}$, s is the sample value of the unknown population standard deviations $\sigma_{\ln TFP}$ and n_c $(c = (FR, JP))$ is the sample size, for both Japan and France. The above implies that to share the necessary sample statistics will allow us to compute the t-test, where the null hypothesis H_0 assumes the equality of means and the alternative hypothesis H_1 assumes that the two populations have significantly different means.[11]

Second, the first-order stochastic dominance tests that the productivity distribution of one type of firms lies to the right of another. If found to hold, the averages of the two distributions differ. Note that the difference in averages does not imply that the distribution whose average is larger stochastically dominates the other. Because the test compares the

[11] One may argue that we conduct different non-parametric tests such as Mann and Whitney test to check the equality. However, because it is impossible to merge firm-level data sets between France and Japan, this paper employs t-test.

entire distribution, it enables us to examine whether the majority of one type of firms perform better than the majority of the other type of firms.[12]

Let G^{FR} and G^{JP} denote the cumulative distribution functions of productivity level corresponding to French and Japanese firms for a given industry. First-order stochastic dominance of G^{JP} with respect to G^{FR} is defined as: $G^{JP}(z) - G^{FR}(z) \leq 0$ uniformly in $z \in \mathbb{R}$, with strict inequality for some z. The two-sided Kolmogorov–Smirnov (KS) statistic tests the hypothesis that both distributions are identical, and the null and alternative hypotheses can be expressed as:

$$\begin{aligned} H_0: &\quad G^{JP}(z) - G^{FR}(z) = 0 \quad \forall z \in \mathbb{R} \\ H_1: &\quad G^{JP}(z) - G^{FR}(z) \neq 0 \quad \text{for some } z \in \mathbb{R}. \end{aligned} \tag{5}$$

By contrast, the one-sided KS-test of the dominance of $G^{JP}(z)$ with respect to $G^{FR}(z)$ can be formulated as:

$$\begin{aligned} H_0: &\quad G^{JP}(z) - G^{FR}(z) = 0 \quad \forall z \in \mathbb{R} \\ H_1: &\quad G^{JP}(z) - G^{FR}(z) > 0 \quad \text{for some } z \in \mathbb{R}. \end{aligned} \tag{6}$$

Let i be the index of firm. Let z_i denote the productivity of firm i. Let m and n be the number of French and Japanese firms in the empirical distributions of G^{JP} and G^{FR}, respectively. Let N denote total number of French and Japanese firms ($N = n_{FR} + n_{JP}$). The KS statistic for the one-sided and two-sided tests is given by:

$$KS_1 = \sqrt{\frac{n_{FR} \cdot n_{JP}}{N}} \max_{1 \leq i \leq N} |G^{JP}(z_i) - G^{FR}(z_i)| \tag{7}$$

and

$$KS_2 = \sqrt{\frac{n_{FR} \cdot n_{JP}}{N}} \max_{1 \leq i \leq N} \left\{ G^{JP}(z_i) - G^{FR}(z_i) \right\}, \tag{8}$$

respectively. Acceptance of the null hypothesis in equation (7) implies that the distribution of G^{JP} dominates G^{FR}. To establish stochastic dominance of the distribution of G^{JP} with respect to G^{FR} requires the rejection of the null hypothesis in the two-sided test in equation (8), but only one of the one-sided test in equation (7).

Note that in equations (7) and (8), the needed information is the maximum distance between $G^{FR}(z_i)$ and $G^{JP}(z_i)$ and the number of firms n_{FR} and n_{JP} in both the French and Japanese sample. The computation of this maximum distance would necessitate that both sample be merged in order to compute it. However, to apply the KS-tests to the purpose of international firm-level TFP comparisons is not possible because merging the firm-level TFP series is not an option, again because of the confidentiality restrictions. The

[12] One may concern that the productivity difference may be attributable to other factors such as innovation activities (e.g., research and development). Note, however, that innovation activities would affect the average difference but not the entire distribution because such activities are not common across firms within the same industry. This is another reason why we compare the distribution.

confidentiality of firm-level data sets imposes restrictions on the production of tables, series of data, or summary statistics in such a way that the identification of individual firms is made impossible. Among various rules, the principal restriction implies that any cell within a produced table must ensure the anonymity of individual firms. In order to compute the maximum distance, our choice is to use $(n_{FR}/5)$-tiles and $(n_{JP}/5)$-tiles to approximate the cumulative density function $G(z)$ for France and Japan, respectively, while obtaining $(n_{FR} \cdot n_{FR})/N$ from the real number of firms.

A concern on the international comparison may be that firms faced various industry-country specific shocks such as the changes in real exchange rate. Therefore, prior to the production of t-test statistics and kernel densities, all observations have been transformed to account for shocks common to all firms within an industry-country. This was achieved by performing the following transformation:

$$\ln \widetilde{TFP_{it}^{c,k}} = \ln TFP_{it}^{c,k} - \overline{\ln TFP_{t}^{c,k}} + \overline{\ln TFP^{c,k}}, \tag{9}$$

where c and k stands for country c $(= (FR, JP))$ and industry k, respectively. Hence, $\overline{\ln TFP_{t}^{c,k}}$ is the average TFP performance in industry k for country c for a given year t, whereas $\overline{\ln TFP^{c,k}}$ is the average TFP performance in industry k for country c across all years. The former can also be extended to compare all manufacturing firms within the economy as whole by adding the overall sample mean $\overline{\ln TFP^{c}}$, not the mean specific to the industry to which the firm belongs $(\overline{\ln TFP^{c,k}})$. In Section 5 below, we present the results of KS-tests performed on the kernel densities derived from the firm data set, both at the whole manufacturing level and at the 2-digit industry level. We also present the results of those test performed separately on the subsets of exporting and non-exporting firms.

4 Data

The data step is important in our study because it explains how we proceed to overcome some data comparability issues which are central to any international comparison of productivity based on firm-level data sets. We start by presenting our data sources. Then, we address comparability issues.

4.1 Data sources

Both the French and the Japanese firm-level data used in this study are collected by national statistical offices.

Data for France are drawn from the confidential *Enquête Annuelle d'Entreprises* (*EAE*) jointly prepared by the Research and Statistics Department of the French Ministry of Industry (SESSI) and the French National Statistical Office (INSEE). The survey has been conducted annually from 1984 until 2007. It gathers information from the financial statements and balance sheets of individual manufacturing firms and includes all the relevant information to compute productivity indices as well as information on the international activities of the firms.

Data for Japan are drawn from the confidential micro database of the *Kigyou Katsudou Kihon Chousa Houkokusho* (*Basic Survey of Japanese Business Structure and Activities*: *BSJBSA*) prepared annually by the Research and Statistics Department, METI (1994–2006). This survey was first conducted in 1991, and then annually from 1994. The main purpose of the survey is to capture statistically the overall picture of Japanese corporate firms in light of their activity diversification, globalization, and strategies on research and development and information technology.

The strength of both surveys is the sample coverage and reliability of information. In France, the survey covers only manufacturing firms but it is compulsory for all firms with more than 20 employees. In Japan, the survey is compulsory for firms with more than 50 employees and with capital of more than 30 million yen in manufacturing and nonmanufacturing firms (some nonmanufacturing industries such as construction, medical services, and transportation services are not included). One common limitation is that some information on financial and institutional features are not available, and small firms (with fewer than 50 workers for Japan and fewer than 20 workers for France) are excluded.[13]

From the *EAE* and the *BSJBSA* surveys, we constructed two separate unbalanced panel data sets with the same coverage, i.e. covering the period from 1994 to 2006 and including only firms with more than 50 employees, in order to estimate equation (3). Equation (3) can be estimated without merging national firm-level data sets. Only the characteristics of the French representative firms (one for each industry) have to be shared across countries.

4.2 Some discussions on the comparability of the data

One crucial requirement for our study is that the firm-level variables built separately in different countries are much comparable. On that respect, the present study benefits from the fact that France and Japan conduct very similar types of firm-level surveys. Thanks to this similarity, we have been able to build a relevant set of comparable variables for TFP computations using firm level information for nominal output and input variables and industry level data for price indices, hours worked and depreciation rates.

Industry classification

Our first step has consisted in building a common industry classification between the French and Japanese data sets. Actually, we faced two different challenges here. First, the nomenclatures of industry codes in the two firm-level surveys, namely *BSJBSA* and *EAE*, are not the same. Second, within each country, the nomenclatures of industry codes in industry

[13]In 2002, the *BSJBSA* covered about one-third of Japan's total labour force excluding the public, financial, and other services industries that are not covered in the survey (Kiyota et al., 2009). In the same year, the *EAE* covered about 75 percent of aggregate manufacturing employment and 85 percent of aggregate manufacturing value added (Bellone, Musso, Nesta, and Quéré, 2008) excluding the *Food, Beverages, and Tobacco* industry not covered in the survey.

level databases do not always concord with the nomenclatures of industry codes in firm level databases. To overcome these difficulties, we built different concordance tables across different industry classifications as it is reported in Appendix A.

Purchasing power parity (PPP)

The second main step has consisted in converting input and output series in France and Japan in common units. For that purpose, we use industry specific PPP series from the Groningen Growth Development Center (GGDC) Productivity Level Database which provides comparisons of output, inputs and productivity at a detailed industry level for a set of thirty OECD countries.[14] In the GGDC database, both French and Japanese PPP series are expressed relatively to the United States. On this basis, we derived French-Japanese industry specific PPP series as follows.[15]

Our very first choice is simply that the burden of the PPP conversion should bear only on one country, France in our case, so that the other country (i.e. Japan) can compute its TFP indices in an independent fashion. The conversion goes as follows. Let X_{it}^{φ} be input K, L, and M or output Y of any firm i at time t, expressed in the local currency φ. Discarding subscripts i and t for simplicity of notation, the conversion into US\$ PPP reads:

$$X^{\$} = \frac{X^{\varphi}}{PPP^{X}_{\varphi \to \$}}$$

Knowing that $PPP^{X}_{\$ \to \varphi} = [PPP^{X}_{\varphi \to \$}]^{-1}$, the conversion of $X^{€}$ into $X^{¥}$ implies that we express € in US\$ PPP first, to then express $X^{\$}$ in ¥ as in the following:

$$X^{¥,FR} = \frac{X^{€,FR}/PPP^{X}_{€ \to \$}}{PPP^{X}_{\$ \to ¥}} = X^{€,FR} \times \frac{PPP^{X}_{¥ \to \$}}{PPP^{X}_{€ \to \$}},$$

where FR represents French firms. Variable $X^{¥,FR}$ is the nominal value of X in ¥, to which the national industry-specific deflator is then applied. Note that whether we compute the conversion before or after deflating the series makes no difference in the final result.

The GGDC PPP series provide information on the purchasing power parities for Y, K, L and M, but they do not provide series on investments. Inklaar and Timmer (2008), however, provides us with the road to follow. Noting $PPP^{K}_{\varphi \to \$}$, the purchasing power parity for capital K between currency φ and the US dollars, we know that:

$$PPP^{K}_{€ \to \$} = PPP^{I}_{€ \to \$} \times \frac{p^{K}_{FR}/p^{I}_{FR}}{p^{K}_{US}/p^{I}_{US}},$$

where p^{K}_{FR} denotes the user cost of capital in France, and p^{K}_{US} the user cost of capital in

[14] See Inklaar and Timmer (2008) for a comprehensive description of the database and of the methodology followed to construct the PPP series.

[15] We also used industry classification concordance tables for that purpose. See Appendix A

the United States (Inklaar and Timmer, 2008, p. 35). Similarly, p^I_{FR} and p^I_{US} denotes the current investment price in France and in the United States, respectively. Noting that for our base year 1997, p^I_{FR} and p^I_{US} are set to unity, we express investment PPP as a function of capital PPP as in the following:

$$PPP^I_{€\to\$} = PPP^K_{€\to\$} \times \frac{p^K_{US}}{p^K_{FR}}$$

Based on all the above, the conversion of investment series $I^{€}$ into $I^{¥}$ is:

$$I^{¥,FR} = I^{€,FR} \times \frac{PPP^I_{¥\to\$}}{PPP^I_{€\to\$}} = I^{€,FR} \times \frac{PPP^K_{¥\to\$}}{PPP^K_{€\to\$}} \times \frac{p^K_{JP}}{p^K_{FR}},$$

where p^K_{JP} represents the user cost of capital in Japan. Based on this new series of investments, we could compute capital stock K using the permanent inventory method.

Thanks to the PPP series built from GGDC series, and to the common industry classification for Japan and France, we have been able to estimate equation (3) on each of our French and Japanese data sets separately. We ended up with comparable relative TFP indices for each individual firms belonging to a same industry in France and in Japan. To check the reliability of our indices, our last data step will consist in comparing our TFP estimates (based on firm-level data) with the ones obtained from industry-level databases.

4.3 Comparisons with the industry-level data

In this subsection, we propose to compare our TFP indices with the ones computed from detailed industry-level data from the GGDC Productivity Levels Database. Our main concern here is whether firm-level TFP estimates are consistent with the TFP estimates from industry-level data because our data do not cover all firms but only firms above the +50 employees threshold. In this subsection, we address this issue.

Inklaar and Timmer (2008) provides TFP based on gross output comparison for a set of detailed industries for 20 OECD countries including France and Japan for the benchmark 1997 year. Table 2 summarized some of their main findings. Table 2 shows industry-specific TFP productivity based on gross output for six selected countries: France, Germany, Italy, Japan, the United Kingdom, and the United States. Globally, the figures in Table 2 show an average lead of French manufacturing over Japanese one in terms of TFP. Specifically, relative TFP in manufacturing in Japan is 86 percent of France for the 1997 benchmark year. However, the most interesting feature of Table 2 is that the relative TFP of France and Japan differ substantially across industries. The TFP levels of Japan relative to France range from 49.9 percent in the *Rubber and Plastic* industry to 128.4 percent in the *Transport Equipment* industry.

=== Table 2 ===

Turning to our own computations, we also find substantial differences in the relative TFP of France and Japan across our 18 industries. Table 3 presents the unweighted TFP mean as well as the weighted TFP mean in Japan and France respectively for each of our 18 industries. Actually, cross industries differences are even larger in our slightly more desegregated industrial classification. Specifically the TFP levels of Japan relative to France range from 35 percent in the *Rubber and Plastic* industry to *Textile* industry to 227 percent in the *Textile* industry.

=== Table 3 ===

To facilitate further the comparison between GGDC measures and our own measures, we use the concordance table provided in Appendix A which allows to pass from our FJ Classification to the EUKLEMS ones. Table 4 presents comparatively the relative TFP levels of Japan and France for 11 industries for which we are able to provide comparable figures.[16]

=== Table 4 ===

Table 4 shows strong consistence between the GGDC measures based on industry-level data and our own measures based on firm-level data. In eight over 11 industries the relative rankings of France and Japan are consistent from one series to the other. Among them, Japan has the productivity lead in three industries (*Textiles, textile products, leather and footwear*, *Transport equipment*, and *Electrical and optical equipment*) while France has the productivity lead in five industries (*Wood and products of wood and cork, Chemicals and chemical products, Other non-metallic mineral products, and Manufacturing nec; recycling*). In the remaining three industries for which the ranking is not consistent, Table 4 reveals minor rather than radical differences. In the *Basic metals and fabricated metal products* and in the *Machinery, nec* industries, Japan is slightly more productive than France (less than five percent more productive) according to the GGDC series while Japan is slightly less productive than France (less than five percent less productive) according to our own series. The strongest difference exists for the *Pulp and paper, printing and publishing* industry for which Japan is almost as productive as France according to the GGDC series and 16 percent more productive than France according to our own series.

Another interesting feature of Table 4 is that the dispersion of the TFP measures based on firm-level data seems to be larger than the dispersion of the TFP measures based on industry-level data. For each of the industries where a clear productivity lead exists for Japan or for France, the productivity advantage of the leader is always higher in our computations than in the computations by Inklaar and Timmer (2008).

The strong concordance between industry data-based TFP series and firm data-based TFP series give us some confidence in the robustness of our firm-level relative TFP indices.

[16] This excludes the *Food products, beverages and tobacco* industry and the *Coke, refined petroleum products and nuclear fuel* industry for which we lack from firm-level data in the *EAE* and/or *BSJBSA*) surveys. We also exclude the *Post and Communications* industry which is not part of manufacturing and for which we do not have corresponding firm-level data in the *EAE* survey.

We are now ready to move on the results we get from the estimates of international productivity gaps across different subsets of manufacturing firms within industries.

5 Results

In this section, we start by showing some descriptive statistics about our different subsets of exporting and non-exporters in France and in Japan respectively. We then move to cross-country comparisons of productivity distributions between these different subsets of firms by industry.

5.1 Exporters and non-exporters in France versus Japan

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Let us first show some basic comparative statistics about the commitment of French and Japanese firms into exporting activities. The exporter participation rate (defined as the percentage of exporting firms), the export intensity (defined as the average share of exports in total sales for exporting firms) and the contribution of different groups of exporters to aggregate exports in both France and Japan are reported for the benchmark 1997 year in Table 5.

=== Table 5 ===

Table 5 documents that both the exporter participation rate and the export intensity are much higher in France in comparison to Japan. According to the information reported for the whole manufacturing, the average share of firms with at least 50 employees that export in France is about 85 per cent while it is only about 28 per cent in Japan. As regards the export intensity, the discrepancy is smaller but still the average export intensity is more than two times larger in France than in Japan. Altogether, these figures suggest that being a part of a large integrated market, as France is in Europe, makes a big difference in terms of both the extensive and the intensive margins of international trade.[17]

A last feature shown in Table 5 refers to the contributions to aggregate exports of exporters occupying the top positions (one, five, and 10 per cent) in the ranking of exporting firms. Consistently with previous evidence reported by Bernard et al. (2007), Melitz and Ottaviano (2008) and ISGEP (2008), they suggest that aggregate exports are driven by a reduced number of top exporters both in France and in Japan. However in Japan, this pattern is even more pronounced as on average the top 10 per cent of exporters concentrate more than 99 per cent of total export while the corresponding figure for France is 81 per cent which is consistent with the average figure (of about 80 per cent) reported for the group of European countries in the ISGEP (2008).[18]

[17] In the Appendix B we show that this feature holds within each of our 18 industries even the ones in which Japanese firms are known to be very internationalized as *Motor vehicles* industry or some other machinery or equipment industries (See Table B1).

[18] Here again, the feature holds within each of our 18 industries as shown in the Appendix B.

To investigate further the differences between France and Japan in terms of firm export participation and intensity, we refine those statistics for different firm size classes. Basically we distinguish between small and medium enterprises (SMEs) defined as firms with 50 to 249 employees, Intermediary firms with 249 to 500 employees and large firms with more than 500 employees. We also look at the beginning and end of our period of observation, basically years 1994 and 2005, to see how those statistics have evolved in France comparatively to Japan over time. The results are displayed in Table 6.

=== Table 6 ===

Table 6 shows than the largest gaps between France and Japan in terms of the extensive margin of international trade are found for the small and medium firms. While 83 per cent of French SMEs were exporting in 1994, only 18 per cent of their Japanese counterparts were also exporting at that time. In contrast, almost 60 per cent of large Japanese firms were exporters in 1994 against 96 per cent of their French counterparts. Considering the export intensity, one interesting feature is that export intensity increases far less with firm size in Japan than in France. In consequence, the largest gaps in terms of the intensive margin of international trade between France and Japan are found for the category of large firms. Table 6 also shows that the concentration of exports among a few top exporters is more pronounced among small and among large firms than among intermediary firms. This feature holds both in France and in Japan. Finally, the comparison of the export participation rates and export intensities across two extreme years, basically 1994 and 2005, show an expected increasing trend in both countries. However, while most of the increase in the export commitment of Japanese firms has proceeded through the extensive margin (i.e. non-exporters becoming exporters), in the French case, most of that increase has proceeded through the intensive margin (exporting firms increasing their export intensity).[19]

Our last experiment consists in computing the so-called exporter productivity premia, defined as the ceteris paribus percentage difference of productivity between exporters and non-exporters. Basically, in each country separately, we regress the log of firm TFP on the current export status dummy and on a set of industry-year dummy variables. We perform this exercise first for the whole set of manufacturing firms and then for the different firm size classes. Results are reported in Table 7 below.

=== Table 7 ===

Table 7 shows the existence of an export premium both in France and in Japan. However, the premium is higher in Japan. It is about five per cent in Japan while it is only 1.4 per cent in France when estimated on the whole set of manufacturing firms. The breakdown of the sample by size class shows that in France, an export premium exists only within the group of SMEs. On the reverse, within the groups of intermediary and French large

[19] Obviously, this does not mean than French exporters have not entered new markets. Actually, Mayer and Ottaviano (2008) showed than the largest part of the growth of French exports over the last two decades was due to the increase in the number of markets served by exporting firms.

firms, being an exporter does not discriminate the most productive firms. This finding is consistent with the fact that most of French firms export towards the large and integrated European market without much trade costs. As a consequence, being an exporter in France is not much discriminating in terms of productivity performance. Only French SMEs may face specific trade barriers even within Europe which show up in a low but still positive and significant export premium of about one per cent. By contrast, an export premium exists within each group of small and medium, intermediary and large firms in Japan. As expected it is higher within the group of SMEs than within the group of large firms. However, the export premium for large firms in Japan is still 2.6 per cent.

In the next subsection, we investigate further our working hypothesis that Japanese firms face on average higher trade costs than French firms by comparing directly the productivity distribution of different subsets of French and Japanese firms. If Japanese exporters face higher trade costs than French ones, then part of the productivity gap between French and Japanese exporters in a given industry should be related to trade costs differences rather than to mere comparative advantage.

5.2 Tests of stochastic dominance across countries

In this Section, we present the results of KS-tests of stochastic dominance performed across different subsets of French and Japanese firms. Recall that the KS-test are performed on the kernel densities derived from the firm data set, both at the whole manufacturing level and at the 2-digit industry level. Recall also that, at this stage of our testing procedure, all observations have been transformed to account for shocks common to all firms within an industry-country.

We start with graphical descriptions of comparable cumulative distributions of French and Japanese firms for the whole manufacturing. Specifically, Figure 1 displays the size (measured as the number of employees) and TFP distributions for all manufacturing firms in France and in Japan.[20] Figure 1 shows that the size distribution of Japanese manufacturing Firms dominates the one of their French counterparts. This feature is consistent with previous findings in the Industrial Organization literature which emphasizes for instance the specific ownership structures of Japanese firms (see, for instance, Lee and O'Neill, 2003). On the other hand, Figure 1 also shows that Japanese manufacturing firms (slightly) outperform their French counterparts in terms of TFP. Contrary to the previous finding, this one is at odds with the existing literature which usually ranks France above Japan in terms of productivity. For instance, recall the GGDC figures reported in Table 2 showing that Japan were exhibiting a productivity disadvantage of 14 percent relative to France in *Total manufacturing, Excluding Electrical* (Mexelec) in 1997.

=== Figure 1 ===

[20]Further detailed graphical descriptions of cumulative French and Japanese size and TFP distributions by industry are presented in Appendix C.

One way to reconcile the findings in Figure 1 with the ones in Table 2 is to acknowledge that the selection of manufacturing industries in the present study is biased towards industries in which Japan performed relatively well compared to France. Specifically, our data set excludes some industries in which Japan is particularly badly performing according to the GGDC measures as the *Food products, beverages and tobacco* and the *Coke, refined petroleum products and nuclear fuel* industries. Moreover, contrary to the coverage of Mexelec in the GGDC classification, our coverage of manufacturing includes the *Electric machinery and apparatus* industry in which Japanese firms are known to perform better than French firms.

To comfort further this interpretation, we perform the KS-tests of stochastic dominance across the Japanese and French TFP distributions both at the level of the whole manufacturing and by industry. The results are presented in Table 8 below. Tables 9 and 10 are the results of t-test.

=== Tables 8 to 10 ===

The first and second columns in Table 8 are the results for all firms. The results indicate that the productivity distribution of Japanese firms stochastically dominates the one of French firms, with the distance about -0.081 at the level of the whole manufacturing. However by industry, the picture changes dramatically from one industry to the other. Although the TFP distribution of Japanese firms strongly dominates the one of their French counterparts in a number of industries such as *Machinery for office and services*, *Electric machinery and apparatus*, and *Motor vehicles*, the opposite holds for a number of other industries such as the *Manufacture of Wood*, *Chemical products* and *Rubber and plastic*. Moreover, at the industry level, the ranking of France and Japan is generally consistent with the GGDC figures reported in Table 2 for comparable industries.

While the consistency of our (firm data based) international productivity gap estimates with the (industry data based) ones is a primary concern for our analysis, it is not our primary focus. Our primary focus is about how international productivity gaps are related to differences in comparative advantage and export costs across countries. To highlight this relationship, we perform further tests of stochastic dominance which discriminate firms according to their export status. As previously, we start by some graphical descriptions at the level of the whole manufacturing and then we present the detailed results of the KS-tests both at the aggregate level and by industry.

Figure 2 displays comparable cumulative TFP distributions of French and Japanese separately for the subset of exporters and non-exporters at the level of the whole manufacturing.[21] Figure 2 shows that the productivity gap between France and Japan seems to be larger among the exporters than among the non-exporters or the manufacturing firms as a whole.

=== Figure 2 ===

From the third and fourth columns in Table 8 indicate the results for exporters while the fifth and sixth columns indicate those for non-exporters. Major findings are threefold. First,

[21] Further detailed graphical descriptions by industry and by export status are presented in Appendix C.

the KS test statistic between Japanese and French exporters are larger across exporters than across non-exporters at the level of the whole manufacturing. Basically, Japanese manufacturing exporters outperform their French counterparts with the distance −0.199 while the distance computed for all manufacturing firms was only −0.081. On the other hand, non-exporters outperform by only −0.079 their French counterparts.

Second, regardless of export status, French firms have the productivity lead in such industries as *Chemical products* and *Rubber and plastic* while both Japanese exporters and non-exporters have the productivity lead in such industries as *Electric machinery and apparatus* and *Motor vehicles*. These findings are generally consistent with each country's comparative advantage confirmed in Table 1. The productivity advantage of firms in one country over those in another country reflects each country's comparative advantage.

Finally, whatever the direction of the comparative advantage, Japanese exporters perform relatively better than French exporters. Specifically, the distance is larger in industries in which Japanese firms have comparative advantage while it is smaller in industries in which French firms have comparative advantage. In light of the recent models of international trade with export costs and firm heterogeneity, we interpret these findings as suggesting that export costs are larger for Japanese firms compared to French firms. In other words, the productivity advantage of exporters reflects not only comparative advantage but also export costs. This interpretation is consistent with the observation that French firms have a large European export market nearby to which then can export without much costs while Japan firms have to export oversea whatever they export.[22] More generally, our results are consistent with models of heterogeneous firms which suggest that international productivity gap reflects firm-specific factors, comparative advantage, and trade costs.

6 Concluding Remarks

In this paper, we measured international productivity gaps between French and Japanese manufacturing firms considering those firms as a whole, by industry, and by export status. Using firm-level data for France and Japan from 1994 to 2006, one of the contributions of the paper has been to compare directly the distribution of firm-level total factor productivity (TFP) within the same industry across two different countries. Following Delgado, Fariñas, and Ruano (2002) and Fariñas and Ruano (2005), our empirical analysis has relied on the concept of first-order stochastic dominance. Another contribution of this paper has been to propose a framework to balance competing goals for the firm-level analysis and the confidentiality of firm-level data sets between two countries.

Major findings are twofold. First, regardless of export status, French firms have the productivity lead in such industries as *Chemical products* and *Rubber and plastic* whereas

[22]In another paper, working with data from the French Innovation Survey 2005, Bellone, Guillou, and Nesta (2009) shown that on average, French firms which export only within Europe do not perform better than their non-exporting counterparts. Only French firms which export outside Europe display a productivity premium of about 7 percent over their competitors. These results are consistent with the idea that export costs are low for French firms exporting only within Europe.

Japanese firms have the productivity lead in such industries as *Electric machinery and apparatus* and *Motor vehicles*. These patterns are generally consistent with each country's comparative advantage. The results suggest that the productivity advantage of firms in one country over those in another country reflects each country's comparative advantage. Second, whatever the direction of the comparative advantage, Japanese exporters perform relatively better than French exporters. Specifically, the productivity gaps are larger in industries in which Japanese firms have comparative advantage while it is smaller in industries in which French firms have comparative advantage.

In light of the recent models of international trade with export costs and heterogeneous firms, we interpret these results as suggesting that the productivity advantage of Japanese exporters relative to French exporters reflects not only comparative advantage but also export costs: export costs are larger for Japanese firms compared to French firms. This interpretation is consistent with the observation that French firms have a large European export market nearby to which then can export without much cost while Japan firms have to export oversea whatever they export.

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Appendix A: Data

Main variables for TFP computation

Output is defined as total nominal sales deflated using industry-level gross output price indices drawn respectively from *INSEE* for France and from the Japan Industrial Productivity (JIP) 2009 database for Japan.[23]

Labour input is obtained by multiplying the number of employees by the average hours worked by industry. Industry level worked hours data for France are drawn from the EU-KLEMS data set of the Groningen Growth Development Center (GGDC) for France.[24] and from the JIP 2009 database for Japan. Note that in France, a large drop in hours worked occurs from 1999 onwards because of the 35 hours policy: worked hours fell from 38.39 in 1999 to 36.87 in 2000.

Variables for intermediate goods consumption are available both in the *EAE* and in the *BSJBSA* surveys. In both surveys, intermediate inputs are defined as: operating cost (= sales cost + administrative cost) − (wage payments + depreciation cost). They are deflated using industry price indices for intermediate inputs published by *INSEE* for France and by the JIP 2009 database for Japan.

Capital stocks are computed from investments and book values of tangible assets following the traditional perpetual inventory method (industry subscript k and country superscript c are discarded to simplify the notation):

$$K_{it} = K_{it-1}(1 - \delta_{t-1}) + I_{it}/p_{It}, \tag{A-1}$$

where K_{it} is the capital stock for firm i operating in year t; δ_{t-1} is the depreciation rate in year t; I_{it} is investment of firm i in year t;[25] and p_{It} is the investment goods deflator for industry k.[26] Both investment price indices and depreciation rates are available at the

[23] The JIP database has been compiled as a part of a research project by the Research Institute of Economy, Trade, and Industry (RIETI) and Hitotsubashi University. For more details about the JIP database, see Fukao et al. (2007).

[24] The concordance between the industry-level EU-KLEMS database and the firm level *EAE* database in presented in Table (to be completed)

[25] Investment data are not available in the *BSJBSA*. We thus uses the difference of nominal tangible assets between two consecutive years as a proxy for the nominal investment.

[26] If firm i's investment was missing in year t, we regard that it did not make any investment: $I_{it} = 0$.

2-digit industrial classification level. They are drawn from the JIP 2009 database for Japan and from INSEE series for France. Investment flows are traced back to 1994 for incumbent firms and back to the entry of the firm into our data set for the firms which have entered our data set after 1994.

The cost of intermediate inputs is defined as nominal intermediate inputs while that of labour is wage payments. To compute the user cost of capital (i.e. the rental price of capital) in country c, we use the familiar cost-of-capital equation given by Jorgenson and Griliches (1967) (industry subscript k and country superscript c are discarded to simplify the notation):[27]

$$P_{Kt} = P_{It-1}\tilde{P}_{Kt} + \delta_t P_{It} - [P_{It} - P_{It-1}]. \tag{A-2}$$

This formula shows that the rental price of capital P_{Kt} is determined by the nominal rate of return ($\tilde{P}_{Kt}$), the rate of economic depreciation and the capital gains. The capital revaluation term can be derived from investment price indices. To minimize the impact of sometime volatile annual changes, three-period annual moving averages are used. The nominal rates of return are the 10 year government bond respectively of France and Japan.

Firm-level data on exports

Exports are also available at the firm level both in the *BSJBSA* and in the *EAE* surveys. However, the export variable has some country specificities.

In Japan, one problem is that the definition of exports in the *BSJBSA* changed in 1997. Before 1997, exports included sales by foreign branches (indirect exports). After 1997, however, exports are defined as exports from the parent firm (direct exports). Total (direct plus indirect) exports are also available between 1997 and 1999. For consistency, this paper focuses on direct exports. Exports before 1997 are adjusted by multiplying the figure by the ratio of direct exports to total exports. The ratio of direct exports is defined as the industry-average ratio of direct exports to total exports between 1997 and 1999.

In France, one problem is that the *EAE* survey does not allow distinguishing exports within Europe from export outside Europe. This leads to the outcome that in some industries we have very few non-exporters.

Concordance tables for different industry classification

- From *EAE* to *BSJBSA*:

  to be completed

- From JIP 2009 to *BSJBSA*: The industry classification of the *BSJBSA* is not the same as that of the JIP 2009 database. If one industry in the *BSJBSA* corresponds to more than one industry in the JIP 2009 database, we aggregate the nominal values and real

[27] Ideally, this equation should be augmented to take into account business income tax. However as taxation regimes differ across France and Japan, we prefer, as Inklaar and Timmer (2009), to rely on a simpler common formula abstracting from taxation

values from the JIP 2009 database and then divide the aggregate nominal values by the aggregate real values to obtain indices. The concordance of the industry classification between the *BSJBSA* and the JIP 2009 database is presented in Table A1.

=== Table A1 (to be added) ===

- From *EUKLEMS* to *EAE*:

  to be completed

Apppendix B: Exporter participation rates and Export intensity by industry

In this Appendix, we complement Table 5 with more details statistics at the industry level. Specifically, Table B1 reports the exporter participation rate (defined as the percentage of exporting firms), the export intensity (defined as the average share of exports in total sales for exporting firms) and the contribution of different groups of exporters to aggregate exports in both France and Japan for the year 1997 and for each of our 18 industries.

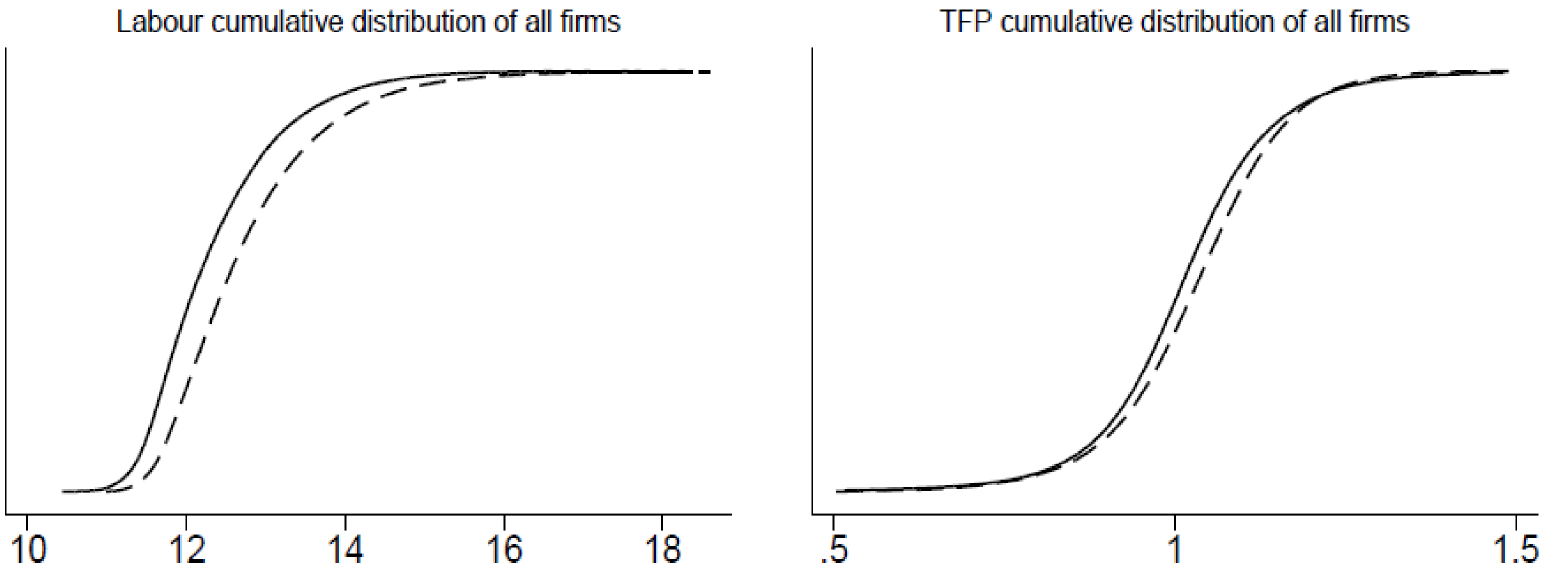
=== Table B1 ===

Apppendix C: Size and TFP cumulative distributions of firms, by industry

In this Appendix, we complement Figure 1 with more details statistics at the industry level. Specifically, Figure C1 reports the size cumulative distributions of Japanese and French firm, by industry while Figure C2 reports the TFP cumulative distributions for both types of firms. Finally, Figures C3 and C4 reports the the TFP cumulative distributions for Japanese and French firms, respectively within the sample of exporters and Non-exporters.

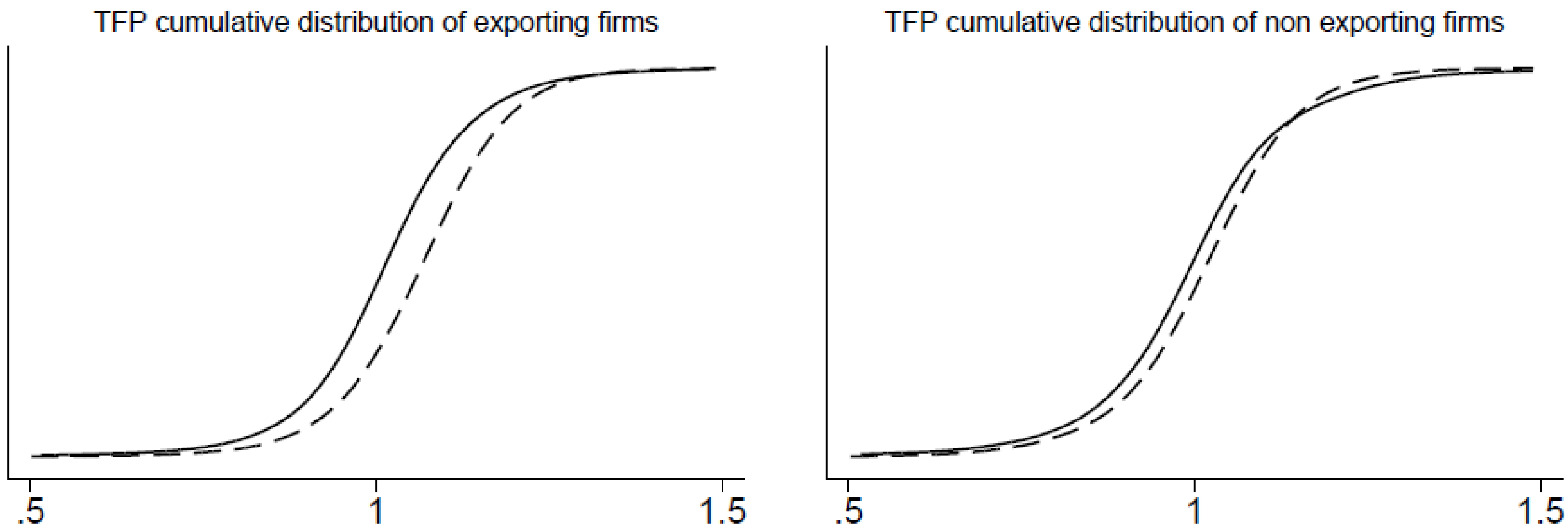
=== Figures C1 to C4 ===

Figure 1. Cumulative Size and TFP Distributions of Manufacturing Firms: France versus Japan



Note: France (solid line) and Japan (dashed line) .

Figure 2. Cumulative TFP Distributions of Manufacturing Firms by Export Status: France versus Japan



Note: France (solid line) and Japan (dashed line).

Table 1. Revealed Comparative Advantage for France and Japan, 2000

OECD industries	France	Japan	JP/FR
Chemicals and allied industries	1.20	1.00	0.83
Plastics / rubbers	1.20	0.90	0.75
Raw hides, skins, leather, and furs	1.10	0.10	0.09
Wood and wood products	1.20	0.20	0.17
Textiles	0.90	0.40	0.44
Footwear / headgear	0.40	0.10	0.25
Stone / glass	1.10	0.90	0.82
Metals	1.10	1.00	0.91
Machinery / electrical	1.00	1.50	1.50
Transportation	1.50	1.40	0.93
Miscellaneous	0.80	1.40	1.75

Source: OECD (2011), Annex Table 3.C3.

Table 2. International Comparisons of Industry-level TFP, Benchmark Year 1997

EU KLEMS industries	*EUK*	France	Germany	Italy	Japan	United Kingdom	United States	JP/FR
TOTAL MANUFACTURING, EXCLUDING ELECTRICAL	MexElec	0.98	1.01	1.01	0.84	0.96	1.00	0.86
Food products, beverages and tobacco	15t16	0.90	0.98	1.08	0.76	0.93	1.00	0.85
Textiles, textile products, leather and footwear	17t19	0.73	0.73	0.82	0.83	0.81	1.00	1.13
Manufacturing nec; recycling	36t37	0.87	1.01	0.92	0.68	1.65	1.00	0.78
Wood and products of wood and cork	20	1.22	1.06	1.00	0.91	0.62	1.00	0.75
Pulp, paper, paper products, printing and publishing	21t22	0.88	0.98	0.68	0.88	1.13	1.00	1.00
Coke, refined petroleum products and nuclear fuel	23	1.18	0.99	0.75	0.86	1.17	1.00	0.73
Chemicals and chemical products	24	1.26	1.05	1.11	1.00	0.94	1.00	0.80
Rubber and plastics products	25	1.63	1.37	1.36	0.81	1.43	1.00	0.50
Other non-metallic mineral products	26	1.16	1.20	1.47	0.87	1.03	1.00	0.75
Basic metals and fabricated metal products	27t28	0.96	1.01	1.10	0.91	0.84	1.00	0.95
Machinery, nec	29	1.08	1.12	1.01	1.06	1.16	1.00	0.99
Transport equipment	34t35	0.74	0.82	1.05	0.96	0.67	1.00	1.28
ELECTRICAL MACHINERY, POST AND COMMUNICATION SERVICES	Elecom	1.00	1.01	0.94	0.93	1.10	1.00	0.92
Electrical and optical equipment	30t33	0.81	0.85	0.92	0.96	0.81	1.00	1.19
Post and telecommunications	64	1.36	1.33	0.94	0.83	1.70	1.00	0.61

Source: Appendix tables to Inklaar and Timmer (2008) available at http://www.ggdc.net/databases/levels.htm

Table 3. International Comparisons of Firm-level TFP, Benchmark Year 1997

	TFP[a] (Unweighted Mean)			TFP (Weighted Mean[b])		
Industry	Japan	France	JP/FR	Japan	France	JP/FR
Textile	1.33	0.58	2.30	1.37	0.60	2.27
Clothing	1.21	0.59	2.04	1.35	0.65	2.06
Manufacture of wood	0.78	1.16	0.67	0.83	1.16	0.71
Pulp and paper	1.08	0.89	1.21	1.16	0.90	1.29
Printing and publishing	0.98	0.97	1.01	1.10	1.06	1.04
Chemical products	0.85	1.14	0.75	0.93	1.18	0.78
Rubber and plastic	0.47	1.52	0.31	0.55	1.55	0.35
Non-metallic mineral products	0.70	1.25	0.55	0.76	1.34	0.56
Basic metal products	1.02	0.93	1.09	1.11	0.97	1.14
Fabricated metal products	0.94	1.03	0.91	1.01	1.05	0.96
Machinery and equipments	0.98	1.01	0.97	1.08	1.04	1.03
Machinery for office and services	1.31	0.85	1.54	1.43	0.90	1.60
Electric machinery and apparatus	1.20	0.86	1.40	1.34	0.91	1.47
Communication equipment and related products	1.20	1.03	1.17	1.35	1.08	1.25
Medical, precision and optical instruments, watches and clocks	1.20	0.86	1.40	1.30	0.93	1.40
Motor vehicles	1.29	0.68	1.90	1.39	0.69	2.03
Other transportation equipments	1.18	0.72	1.65	1.27	0.83	1.53
Furnitures and other manufacturing	0.86	1.13	0.76	0.96	1.16	0.83

Notes: a. TFP is defined as lnTFP.
b. Value Added shares used as weights.

Table 4. France-Japan TFP Comparisons: Industry-level Data *versus* Firm-level Data, Benchmark Year 1997

EU KLEMS industries	*EUKLEMS classification*	*FJ classification*	JP/FR GGDC[a]	JP/FR Our team[b]
Textiles, textile products, leather and footwear	17t19	1t2	1.13	2.16
Wood and products of wood and cork	20	3	0.75	0.71
Pulp, paper, paper products, printing and publishing	21t22	4t5	1.00	1.17
Chemicals and chemical products	24	6	0.80	0.78
Rubber and plastics products	25	7	0.50	0.39
Other non-metallic mineral products	26	9t10	0.75	0.56
Basic metals and fabricated metal products	27t28	8	0.95	1.05
Machinery, nec	29	11	0.99	1.02
Transport equipment	34t35	16t17	1.28	1.78
Electrical and optical equipment	30t33	13+15	1.19	1.43
Manufacturing nec; recycling	36t37	18	0.78	0.92

Notes: a. GGDC series are drawn from the Appendix tables to Inklaar and Timmer (2008) available at http://www.ggdc.net/databases/levels.htm

b. Own computations based on firm-level data for the benchmark year 1997 (weighted TFP mean).

Source: Authors' own calculations.

Table 5. Exporter Participation Rate, Export Intensity and Share of Exports for Top Exporters, All Manufacturing, 1997

	Export participation	Export intensity		Share of export		
			Standard	Top 1	Top 5	Top 10
	Percent	Mean	deviation	percent	percent	percent
France	84.6	26.4	25.1	48.3	71.4	81.5
Japan	27.5	11.5	16.9	83.9	96.8	99.1

Source: Authors' own calculations.

Table 6. Exporters Participation Rate and Export Intensity, by Class Size, 1994 and 2005

Country		Number of firms	Export participation Percent	Export intensity Mean	Export intensity Standard deviation	Share of exports Top 1 percent	Share of exports Top 5 percent	Share of exports Top 10 percent
France								
1994	SME (50-250)	6,238	83.1	21.1	22.8	16.6	39.1	54.6
	Intermediary (250-500)	991	92.6	28.7	24.7	11.8	30.7	44.6
	Large (+500)	785	95.9	33.0	23.4	32.8	55.1	67.0
2005	SME (50-250)	5,406	84.1	27.1	26.8	19.2	40.5	55.6
	Intermediary (250-500)	952	92.4	35.2	28.3	10.6	31.1	46.1
	Large (+500)	794	96.1	40.3	28.6	36.1	56.8	67.2
Japan								
1994	SME (50-250)	5,396	17.9	11.0	14.8	42.9	81.3	95.9
	Intermediary (250-500)	1,177	33.1	9.8	14.2	23.2	64.2	84.7
	Large (+500)	1203	59.7	13.1	16.5	51.5	80.8	90.4
2005	SME (50-250)	5,185	26.4	12.0	16.8	37.0	75.8	91.2
	Intermediary (250-500)	1,042	47.1	12.7	17.4	24.2	58.7	76.2
	Large (+500)	989	66.0	17.3	19.2	47.5	76.9	87.8

Source: Authors' own calculations.

Table 7. TFP Export Premium, by Size Class, Pooled Sample

	France		Japan	
	Number of obs.	Export premium[a]	Number of obs.	Export premium[a]
Size class		β (p value)		β (p value)
All manufacturing firms	99,963	0.0138	100,744	0.056
		0.000		0.000
SME (50-249)	75,850	0.0103	71,452	0.038
		0.000		0.000
Intermediary (250-499)	13,232	-0.0003	14,919	0.031
		0.398		0.000
Large (+500)	10,881	0.0050	14,373	0.026
		0.280		0.000

Note: a. β is the estimated regression coefficient from an OLS-regression of log (TFP) on a dummy variable for exporting firms, controlling for a full set of interaction terms of industry dummies and year dummies. The regression is first computed on the whole set of manufacturing firms in each country, and then, separatly on each of the subset of firms belonging to a specific size class.

Source: Authors' own calculations.

Table 8. Kolmogorov-Smirnov Test for Stochastic Dominance of G(JP) over G(FR)

	All firms		Exporters		Non-exporters	
	Distance	Critical probability	Distance	Critical probability	Distance	Critical probability
All Manufacturing	-0.081	0.000	-0.199	0.000	-0.079	0.000
Textile	-0.981	0.000	-1.000	0.000	-0.960	0.000
Clothing	-0.922	0.000	-0.989	0.000	-0.896	0.000
Manufacture of wood	0.975	0.000	0.989	0.000	0.977	0.000
Pulp and paper	-0.715	0.000	-0.788	0.000	-0.708	0.000
Printing and publishing	0.077	0.000	-0.105	0.000	0.068	0.000
Chemical products	0.749	0.000	0.727	0.000	0.698	0.000
Rubber and plastic	0.999	0.000	0.999	0.000	0.998	0.000
Non-metallic mineral products	0.963	0.000	0.938	0.000	0.981	0.000
Basic metal products	-0.347	0.000	-0.436	0.000	-0.361	0.000
Fabricated metal products	0.309	0.000	0.239	0.000	0.325	0.000
Machinery and equipments	0.137	0.000	0.067	0.000	0.181	0.000
Machinery for office and services	-0.874	0.000	-0.935	0.000	-0.989	0.000
Electric machinery and apparatus	-0.669	0.000	-0.740	0.000	-0.685	0.000
Communication equipment and related products	-0.369	0.000	-0.481	0.000	-0.362	0.000
Medical, precision and optical instruments, watches and clocks	-0.703	0.000	-0.742	0.000	-0.674	0.000
Motor vehicles	-0.986	0.000	-0.996	0.000	-0.972	0.000
Other transportation equipments	-0.931	0.000	-0.968	0.000	-0.920	0.000
Furnitures and other manufacturing	0.718	0.000	0.639	0.000	0.631	0.000

Note: Negative distance implies first order stochastic dominance of G(JP) with respect to G(FR), so that the distribution of Japanese firms lies to the right of the distribution of French firms.

Table 9. Productivity Level Differences between French and Japanese Firms, by Industry, 1994-2006: Hypotheses Test Statistics

	Japan		France		
	Number of obs.	lnTFP	Number of obs.	lnTFP	TFP difference
All manufacturing	100,744	1.04	102,004	1.022	0.02***
Textile	3,148	1.31	5,810	0.59	0.72***
Clothing	3,289	1.23	6,743	0.61	0.62***
Manufacture of wood	1,345	0.78	2,557	1.19	- 0.41**
Pulp and paper	3,728	1.08	3,977	0.90	0.18***
Printing and publishing	6,948	0.96	6,604	1.00	- 0.04***
Chemical products	8,576	0.90	8,904	1.19	- 0.29***
Rubber and plastic	6,339	0.49	8,538	1.58	- 1.09***
Non-metallic mineral products	5,127	0.72	4,565	1.27	- 0.55***
Basic metal products	6,721	1.02	3,652	0.94	0.08***
Fabricated metal products	8,786	0.95	13,083	1.04	- 0.09***
Machinery and equipments	12,349	1.00	13,260	1.04	- 0.04***
Machinery for office and services	1,430	1.38	423	0.88	0.51***
Electric machinery and apparatus	12,186	1.27	6,696	0.94	0.33***
Communication equipment and related products	2,148	1.28	1,394	1.17	0.12***
Medical, precision and optical instruments, watches and clocks	4,716	1.26	4,522	0.93	0.33***
Motor vehicles	8,217	1.32	3,483	0.68	0.64***
Other transportation equipments	1,979	1.23	2,087	0.68	0.55***
Furnitures and other manufacturing	3,712	0.89	5,706	1.17	- 0.27***

Note: *** and ** indicate statistically significant at 1 and 5 percent levels, respectively.

Source: Authors' own calculations.

Table 10. Productivity Level Differences between French and Japanese Firms, by Industry and by Export Status

		Japan		France		
		Number of obs.	lnTFP	Number of obs.	lnTFP	TFP difference
All manufacturing	Exporter	31,399	1.07	87,442	1.02	0.05***
	Non-exporter	69,345	1.02	14,562	1.01	0.01***
Textile	Exporter	567	1.37	5,076	0.59	0.78***
	Non-exporter	2,581	1.30	734	0.57	0.72***
Clothing	Exporter	282	1.34	5,054	0.61	0.73***
	Non-exporter	3,007	1.22	1,689	0.60	0.62***
Manufacture of wood	Exporter	92	0.80	1,889	1.18	- 0.38***
	Non-exporter	1,253	0.77	668	1.20	- 0.42***
Pulp and paper	Exporter	354	1.11	3,622	0.89	0.22***
	Non-exporter	3,374	1.07	355	0.91	0.17***
Printing and publishing	Exporter	486	1.01	4,718	1.00	0.00
	Non-exporter	6,462	0.96	1,886	1.00	- 0.04***
Chemical products	Exporter	4,297	0.93	8,341	1.19	- 0.27***
	Non-exporter	4,279	0.87	563	1.16	- 0.29***
Rubber and plastic	Exporter	1,721	0.52	7,496	1.58	- 1.06***
	Non-exporter	4,618	0.48	1,042	1.56	- 1.09***
Non-metallic mineral products	Exporter	1,065	0.76	3,437	1.27	- 0.51***
	Non-exporter	4,062	0.71	1,128	1.25	- 0.55***
Basic metal products	Exporter	1,866	1.05	3,400	0.94	0.10***
	Non-exporter	4,855	1.01	252	0.93	0.07***
Fabricated metal products	Exporter	1,958	0.97	11,067	1.04	- 0.07***
	Non-exporter	6,828	0.94	2,016	1.03	- 0.09***
Machinery and equipments	Exporter	6,065	1.02	11,703	1.04	- 0.01***
	Non-exporter	6,284	0.97	1,557	1.02	- 0.05***
Machinery for office and services	Exporter	508	1.45	404	0.88	0.57***
	Non-exporter	922	1.35	19	0.85	0.50***
Electric machinery and apparatus	Exporter	4,530	1.31	5,874	0.94	0.37***
	Non-exporter	7,656	1.24	822	0.91	0.33***
Communication equipment and related products	Exporter	764	1.34	1,060	1.17	0.17***
	Non-exporter	1,384	1.25	334	1.15	0.11***
Medical, precision and optical instruments, watches and clocks	Exporter	2,559	1.28	4,110	0.93	0.35***
	Non-exporter	2,157	1.23	412	0.91	0.32***
Motor vehicles	Exporter	2,495	1.35	3,188	0.68	0.67***
	Non-exporter	5,722	1.30	295	0.62	0.68***
Other transportation equipments	Exporter	678	1.28	1,800	0.69	0.59***
	Non-exporter	1,301	1.21	287	0.64	0.57***
Furnitures and other manufacturing	Exporter	1,112	0.95	5,203	1.17	- 0.22***
	Non-exporter	2,600	0.87	503	1.10	- 0.23***

Note: *** and ** indicate statistically significant at 1 and 5 percent levels, respectively.

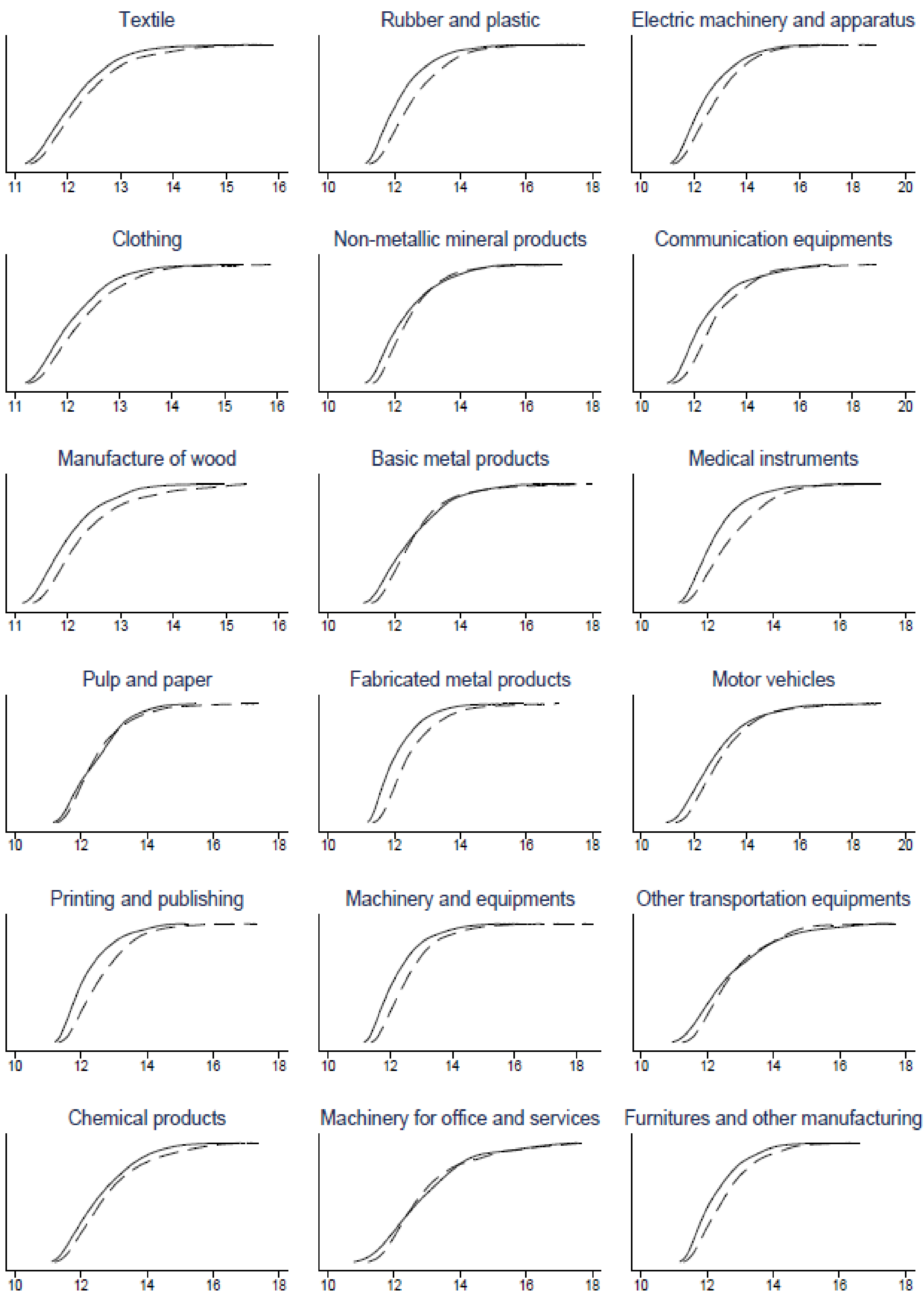
Source: Authors' own calculations.

Table B1. Exporter Participation Rate, Export Intensity and Share of Exports for Top Exporters, by Industry, 1997

	Export participation		Export intensity		Share of export					
	France	Japan	France	Japan	France			Japan		
Industry	Percent	Percent	Mean	Mean	Top 1 percent	Top 5 percent	Top 10 percent	Top 1 percent	Top 5 percent	Top 10 percent
Textile	85.6	13.1	30.6	9.0	17.4	41.8	56.0	32.6	88.1	99.5
Clothing	72.9	6.9	22.4	7.7	27.5	54.1	69.5	68.3	99.6	100.0
Manufacture of wood	71.1	5.7	22.8	0.6	18.7	42.5	58.2	50.7	93.4	100.0
Pulp and paper	89.1	7.3	22.9	13.8	15.7	45.7	65.2	75.7	99.2	100.0
Printing and publishing	71.4	6.4	9.3	5.8	20.6	48.4	64.2	96.8	100.0	100.0
Chemical products	94.0	45.0	32.3	7.3	23.6	49.2	66.4	47.2	80.9	91.8
Rubber and plastic	83.9	22.9	19.2	6.3	50.8	68.1	76.8	79.8	94.6	98.5
Non-metallic mineral products	75.5	18.5	26.1	7.8	29.0	53.3	66.8	70.0	92.8	98.6
Basic metal products	92.5	23.6	35.4	7.3	32.9	61.7	76.9	57.4	94.6	98.5
Fabricated metal products	84.2	18.8	18.5	5.9	23.2	47.0	62.0	78.6	94.8	98.6
Machinery and equipments	86.9	44.8	33.5	13.1	24.8	50.4	66.0	47.1	84.9	92.8
Machinery for office and services	97.3	34.9	47.9	16.4	42.8	67.4	78.5	55.5	91.8	98.8
Electric machinery and apparatus	85.8	34.8	30.4	15.6	36.9	63.9	75.8	68.7	95.1	98.4
Communication equipment and products	73.2	31.1	30.7	18.4	17.5	55.4	75.2	77.4	97.1	98.9
Medical, precision and optical instruments	92.2	51.8	34.6	14.3	38.6	63.4	74.5	31.4	73.8	88.4
Motor vehicles	90.5	24.8	28.6	8.3	76.8	89.3	94.0	86.4	99.0	99.7
Other transportation equipments	87.3	31.7	33.9	23.9	46.6	80.6	87.2	59.1	84.4	93.9
Furnitures and other manufacturing	92.3	27.8	22.2	15.2	25.2	49.7	65.8	79.0	94.6	98.7

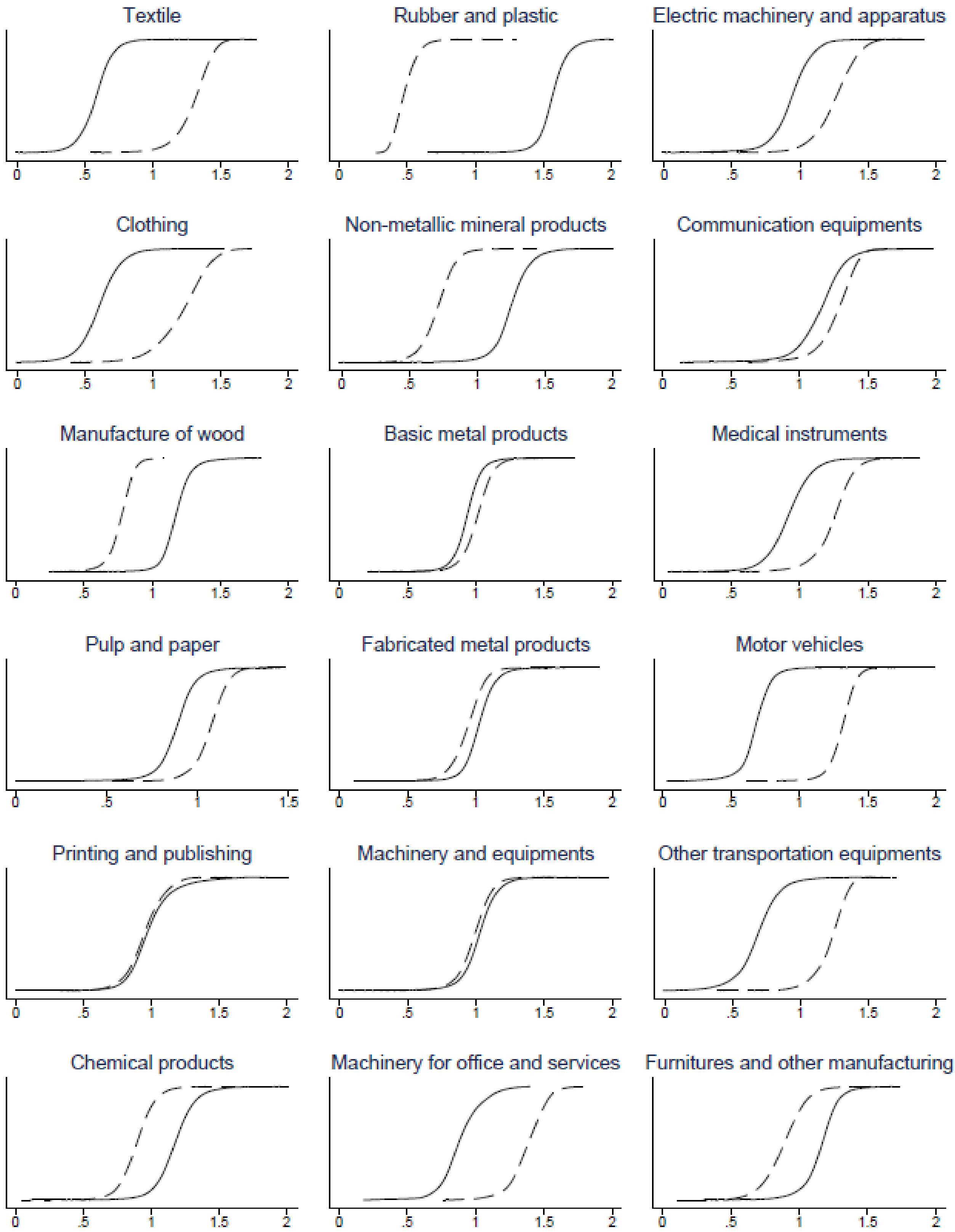
Source: Authors' own calculations.

Figure C1. Size Cumulative Distributions of Manufacturing Firms, by Industry



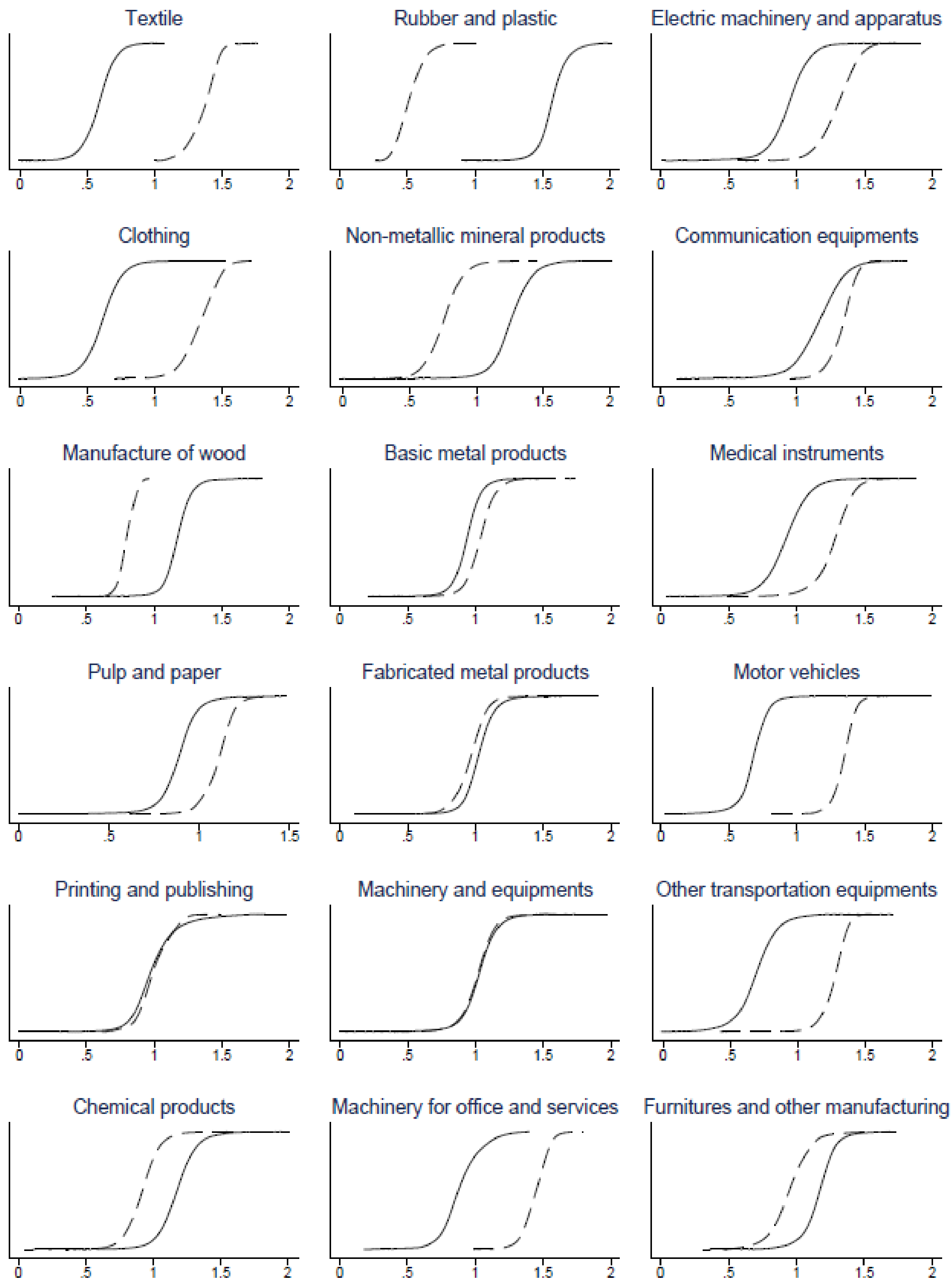
Note: The solid line is for France and the dashed line is for Japan. Size is measured by the number of employees.

Figure C2. Cumulative TFP Distributions, by Industry



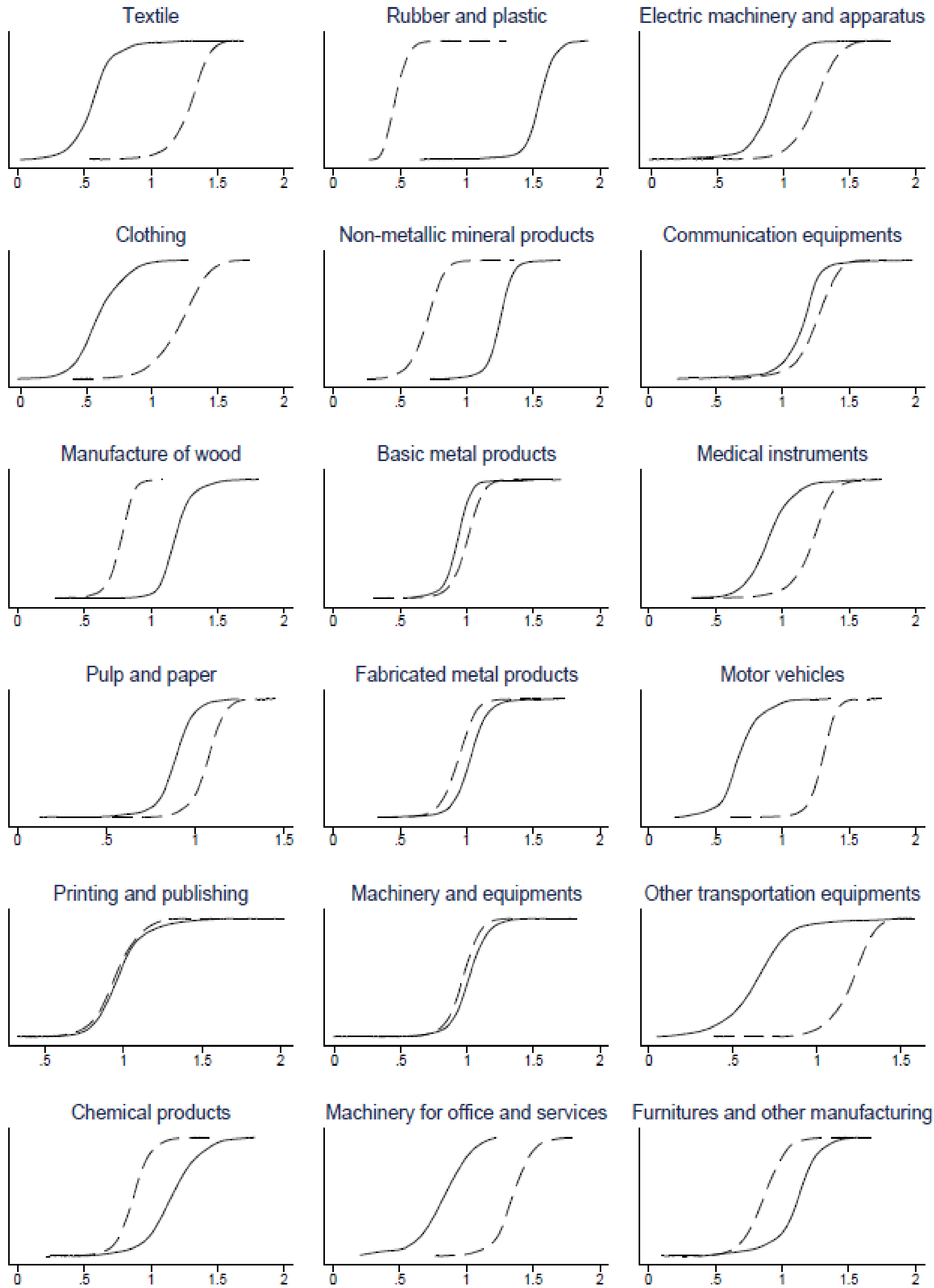
Note: The solid line is for France and the dashed line is for Japan.

Figure C3. Cumulative TFP Distributions for Exporters, by Industry



Note: The solid line is for France and the dashed line is for Japan.

Figure C4. Cumulative TFP Distributions for Non-exporters, by Industry



Note: The solid line is for France and the dashed line is for Japan.