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What's Behind the Figures? Quantifying the Cross-Country Exporter Productivity Gap

Kozo Kiyota、Toshiyuki Matsuura、Lionel Nesta

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Institute for Economic Studies, Keio University
2-15-45 Mita, Minato-ku, Tokyo 108-8345, Japan
ies-office@adst.keio.ac.jp
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Kozo Kiyota
Keio Economic Observatory, Keio University
2-15-45, Mita, Minato-ku, Tokyo, Japan
kiyota@sanken.keio.ac.jp

Toshiyuki Matsuura
Keio Economic Observatory, Keio University
2-15-45, Mita, Minato-ku, Tokyo, Japan
matsuura@sanken.keio.ac.jp

Lionel Nesta
1. Université Côte d'Azur, 2. OFCE Sciences Po. Paris, 3. SKEMA Business School
GREDEG, 250 rue Albert Einstein, 06905, France
lionel.nesta@unice.fr

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Kozo Kiyota † Toshiyuki Matsuura ‡ Lionel Nesta §

December 26, 2018

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†Department of Economics, University of Hawai'i, Mānoa, 2424 Maile Way, Saunders 534, Honolulu, HI, 96815, USA, Keio University, and RIETI, Japan. E-mail: kiyota@sanken.keio.ac.jp

‡Keio University, Japan. E-mail: matsuura@sanken.keio.ac.jp

§Université Côte d'Azur, CNRS, Gredeg, OFCE SciencesPo and SKEMA Business School, France. Email: lionel.nesta@unice.fr

1 Introduction

How can one compare the performance of exporters from different countries? This question has gained enormous momentum in the past decade [e.g., 8], first and foremost because exporting firms are regarded as the key actors in economic recovery. Consider the Eurozone countries. Since the financial turmoil of 2008, Eurozone countries have found it difficult to return to their pre-crisis level of economic activity. Austerity policies have depressed internal demand, making it key for the country to recover growth *via* distant markets. A better understanding of the behaviour and performance of exporters is therefore needed for policy makers to implement successful export policies.

Increased awareness of the benefits of exports for economic growth is accompanied by a broadening reliance on firm-level information (International Study Group on Exports and Productivity (ISGEP), 2008). The well-documented productivity premium has made it clear that in many respects, exporters outperform non-exporters within a given country. However, it is difficult to provide an economic interpretation for the magnitude of the productivity premium enjoyed by exporters, and a large export premium does not mechanically imply a productivity advantage of these exporters relative to their foreign competitors. In other words, little can be said about how exporters from one country perform with respect to exporters from other countries.

The main contribution of this paper is to encourage economists to use readily available data to actually assess and compare the performance of exporters from different countries. Our intuition is that readily available figures conceal additional information that allows one to compare exporters from different countries. Our paper is similar in spirit to that of [1]. However, whereas [1] focus on families of theoretical models, our paper concentrates on families of empirical papers analyzing the exporters' premium. In a similar fashion, we come up with the conclusion that, without direct access to firm-level data, three descriptive statistics are sufficient to allow the comparison of exporters' level of productivity across countries.

We advance three propositions. The first proposition is based on a simple identity to show that the productivity gap between exporters can be assessed by using three basic statistics. Proposition 2 states that Proposition 1 holds irrespective of the distribution underlying firm productivity and irrespective of the presence of fixed costs. Proposition 3 raises concerns about the use of aggregated statistics and shows that our framework holds either when the productivity gap between exporters is of significant magnitude or, if this gap is narrow, when market structures are similar across countries. The paper then empirically explores our propositions by using readily available, aggregated data and testing the validity of the framework by accessing confidential firm-level data.

The remainder of the contribution is structured as follows. The next section presents the literature review. Section 3 explains our analytical framework and explores various dimensions such as concerns regarding the use of aggregated data. Section 4 presents empirical results based on the use of readily available data and on confidential, firm-level data from France and Japan. A summary of our findings and their implications is presented in the final section.

2 Literature Review

The international competitiveness of industries has long been a central issue in the business literature [e.g., 28] and in the economics literature [e.g., 9, 8].[1] In measuring the international competitiveness of industries, previous studies have focused primarily on two aspects. One is productivity (e.g., the comparison of industry-average productivity), and the other is exports (e.g., the comparison of export shares in the world market using revealed comparative advantage). After [23] succeeded in developing a model to explain the systematic link between firm productivity and exports, a number of studies have examined the relationship between these two values in various countries.[2] However, the focus of the previous studies is limited to the relationship between firm productivity and exports *within a country*. Although the productivity of exporters certainly reflects the international competitiveness of the firms in a country, little attention has been paid to the comparison of the productivity gap across exporters *between countries*.

Some studies such as that conducted by the [17] and by [7] have examined the cross-country differences in export premia (i.e., the productivity difference between exporters and non-exporters within a country). However, high export premia do not necessarily imply that exporters will be competitive on international markets. To the best of our knowledge, only [4] directly compare the productivity of exporters from two different countries.[3] In other words, although we now know that exporters outperform non-exporters, we do not know much about whether exporters from one country outperform those from another country. The cross-country comparison of exporter performance has not yet been fully explored in the literature.

Focusing on the productivity of exporters is nontrivial. Table 1 presents the ranking of labour productivity for 11 developed countries. One interesting finding is that the

[1] In this paper, we focus on competitiveness as measured by productivity, and do not analyze other competitiveness measures such as unit labour cost. Accordingly, our empirical analysis focuses on advanced countries exclusively. The comparison between advanced and developing countries is beyond the scope of our paper.

[2] See [13, 31, 14] for surveys and [5] and [20] for evidence from France and Japan, respectively.

[3] Using confidential firm-level data from the French and Japanese manufacturing industries, [4] report that the productivity gap across French and Japanese exporters systematically differed from the average industry productivity gap: it is wider in industries in which Japan has a productivity advantage and it is narrower in industries in which France has a productivity advantage. This is due to the differences in the selection effect between Japan and France. As a consequence of the stronger selection of Japanese firms into export markets, the productivity gap between Japanese and French exporters becomes larger than the average productivity gap in industries in which Japan has a productivity advantage.

United States ranks eighth out of these 11 countries. This low rank is puzzling because it is widely believed that US firms represent the productivity frontier and are therefore the most competitive firms in the world. We argue that this puzzle comes from the gap between the productivity of exporters and industry-average productivity (i.e., the productivity of exporters and non-exporters). The average productivity of an industry certainly affects the productivity of exporters. However, as we will show, the productivity of exporters is also the product of the selection of firms into foreign markets and is hence determined by the export participation rate. It follows that high (low) average productivity in an industry does not mechanically imply a high (low) level of productivity for exporting firms.

[Table 1 about here.]

Clarifying the cross-country exporter productivity gap is not an easy task. Some studies have compared the international productivity gap at the firm level.[4] However, most of them have focused on large, listed firms. This choice precludes the ability to address the issue of heterogeneity in the export behaviour of firms, simply because the vast majority of listed companies are exporters. One thus needs access to confidential firm-level data from different countries, which implies that one faces several confidentiality restrictions. For example, Japanese confidential firm-level data are available only within Japan. Similarly, French confidential firm-level data are available only within France. Because of data confidentiality restrictions, one cannot simply merge two or several datasets into one unique dataset.

One additional difficulty remains. To compare productivity levels between different countries, one needs to address the issue of the comparability of inputs and outputs. First, one needs to ensure that the accounting definitions of many firm-level variables stemming from the financial statements are similar, if not identical. Second, the exchange rate between any two currencies does not necessarily yield the proper relative price between countries, due, for example, to short-term capital movements. One needs information on purchasing power parity (PPP) for inputs and outputs [e.g., 18, 16] if one is to address the issue of the cross-country exporter productivity gap.

Our main contribution is to develop a simple framework that allows one to examine the cross-country exporter productivity gap without directly accessing confidential firm-level data. This framework is based on three propositions that are empirically tested. We show that the average international productivity gap between exporters (P_X^b) depends on the following three sufficient statistics:

1. The industry-average productivity gap between two countries (P^b), which is defined as the average productivity of all firms (exporters and non-exporters);

[4] See, for example, [2], [11], and [19].

2. The export participation rate (Ω), which is defined as the ratio of the number of exporters to the number of all firms (exporters and non-exporters);

3. The export premium (P_X^w) within a country, which is defined as the productivity difference between exporters and non-exporters.

The above three variables can be relatively easily obtained from the literature allowing, for example, the implementation of a meta analysis.

Our framework does not depend upon the productivity distribution so long as the distribution has a mean.[5] Many studies on firm heterogeneity and trade assume that the productivity and/or size of firms follow a Pareto distribution.[6] Some recent studies depart from this assumption. For example, [10] and [25] explore the properties of a bounded (or truncated) Pareto distribution, while [15], [32], and [4] examine those of a log-normal distribution. Our study goes one step further without assuming any specific distribution while addressing the issue of firm heterogeneity and trade.[7]

We apply our framework to cross-country comparisons across 11 advanced countries, such as Japan, the United Kingdom, and the United States, obtaining the relevant information from the literature. The major findings of our paper are twofold. First, the average exporter productivity gap between two countries does not necessarily reflect the industry-average productivity gap due to the differences in export participation rates and export premia between countries. Second, higher export premia do not necessarily reflect higher performance in exporter productivity.

3 Statistical Framework

3.1 A simple identity

Consider a population that consists of two groups 1 and 2. Let $\bar{x}_i$ be the mean of group i, with $i = (1,2)$. The mean of the sample $\bar{x}$, as the weighted average of x_1 and x_2, reads as $\bar{x} = sx_1 + (1-s)x_2$, where s is the share of group 1 in the overall population. Subtracting x_1 from both sides and rearranging terms yields:

$$x_1 = \bar{x} + (1-s)dx, \tag{1}$$

[5] Some distributions such as the Cauchy distribution do not have a mean. However, such distributions are rarely used in economic studies.

[6] See, for example, [23].

[7] [4] also present a simple framework to relate cross-country productivity gaps to the export status of firms. However, the scope of their framework is limited in the sense that it relies on the assumption that firms' productivity is distributed log-normal. Therefore, our paper is a generalizatoin of their study.

where $dx = x_1 - x_2$. Identity 1 holds if the overall population and its subgroups admit a mean. Now this very simple, if not tautological, identity provides a useful starting point to analyse the exporter productivity gap.

Let μ_X and μ_D be the average productivity gap for exporters and domestic firms (firms focusing on the domestic market), respectively. Let N, N_X and N_D be the number of all firms, exporters, and non-exporters, respectively, where $N = N_X + N_D$. Similar to the above general example, the overall industry-average productivity μ reads as the weighted average of the levels of productivity of domestic and exporting firms $\mu = \Omega\mu_X + (1-\Omega)\mu_D$, where $\Omega = N_X/N$ is the export participation rate, i.e., the share of firms exporting to foreign markets. Now write the overall level of productivity μ as the weighted average of the levels of productivity of domestic and exporting firms μ=$\Omega\mu_X + (1-\Omega)\mu_D$. Subtracting μ_X from both sides and rearranging terms yields:

$$\mu_X = \mu + (1-\Omega)(\mu_X - \mu_D) = \mu + (1-\Omega)P_X^w, \tag{2}$$

where $P_{X,c}^w$ is the well-documented – generally positive – export premium, that is, the productivity difference between exporters and non-exporters. The superscript w denotes the export premium computed using firms active within the same domestic market. Equation (2) states that the mean level of productivity of exporting firms is a function of the overall level of productivity of active firms μ and the product of the *domestic* participation rate $(1-\Omega)$ and the export premium $P_X^w = \mu_X - \mu_D$. We call the first component (μ) the *competitiveness effect* and the second component $((1-\Omega)\cdot P_X^w)$ the *selection effect*. Although the former effect is pervasive in the literature on cross-country competitiveness, the selection effect provides information about the threshold productivity levels that companies must reach to cope with sunk costs of entering export markets.

The above general framework is useful if one wishes to establish cross-country comparisons in competitiveness with readily available statistics in the empirical literature on the firm export premium. For any pair of countries, we have the following proposition:

Proposition 1: *The average international exporter productivity gap* (P_X^b) *depends on three sufficient statistics: 1) the industry-average productivity gap* (P^b)*; 2) the export participation rate* Ω*; and 3) the export premium in each country* (P_X^w).

Proof: Let $\mu_{X,1}$ and $\mu_{X,2}$, be the mean productivity of exporters in country 1 and country 2, respectively. Using equation (2), the following is immediate:

$$\begin{aligned} P_X^b \equiv \mu_{X,1} - \mu_{X,2} &= \mu_1 + (1-\Omega_1)P_{X,1}^w - \left[\mu_2 + (1-\Omega_2)P_{X,2}^w\right] \\ &= P^b + (1-\Omega_1)P_{X,1}^w - (1-\Omega_2)P_{X,2}^w, \end{aligned} \tag{3}$$

where $(\mu_1 - \mu_2)$ represents the productivity gap between the two countries. ■

Proposition 1 is admittedly very simple. However, conditional upon the availability of information on P^b, Ω and P_X^w, it allows for the comparison of country performance in export markets without accessing confidential firm-level data in countries 1 and 2. A direct implication is that, given the same benchmark, pairwise comparisons involving several countries can be recovered. Hence, we have Lemma 1:

Lemma 1: *Given three countries 1, 2 and 3, if the international exporter productivity gap between countries 1 and 3 ($P^b_{X,13}$) and the international exporter productivity gap between countries 2 and 3 ($P^b_{X,23}$) are known, then the international exporter productivity gap between countries 1 and 2 ($P^b_{X,12}$) can be recovered.*

Proof: Let $P^b_{X,13} \equiv \mu_{X,1} - \mu_{X,3}$ and $P^b_{X,23} \equiv \mu_{X,2} - \mu_{X,3}$; the following is immediate:

$$\begin{aligned} P^b_{X,13} - P^b_{X,23} &= (\mu_{X,1} - \mu_{X,3}) - (\mu_{X,2} - \mu_{X,3}) \\ &= \mu_{X,1} - \mu_{X,2}. \\ &= P^b_{X,12} \end{aligned} \tag{4}$$

Depending on data availability, pairwise comparisons can be performed. ■

The decomposition presented above excludes more sophisticated phenomena such as firm entry into and exit from foreign and domestic markets. In this respect, our analysis is based on a simple static framework rather than a more complex dynamic one. Nonetheless as presented here, a part of the extensive margin effects can be captured by the changes in the export participation rate because firm entry and exit directly affects the share of exporters.[8]

3.2 Heterogeneous firms and trade model

Although useful, the above framework does not assume any distribution of firm-level productivity, nor is it based on any formal international trade model *à la* [23]. In fact, this simple framework is consistent with the heterogeneous firm trade model. To this end, we make the simplifying assumption that firms cope with sunk costs of entering domestic and foreign markets that are common to all firms. Obviously, such costs are firm specific and follow a given distribution, as is the case in [24]. Therefore in our framework, such costs should be viewed as the industry average of a distribution of heterogeneous, firm-specific sunk costs of entering markets, whether domestic or international.

[8] A caveat is that the export participation rate can only capture the net entry effects.

Let ω_i be the logarithm of the productivity of firm i in an industry. Firm productivity is assumed to follow a distribution $\omega \sim g(\omega)$, with $\underline{\omega}$ and $\bar{\omega}$ representing the minimum and maximum values of firm productivity. For the sake of generality, we do not need to assume any specific parametric distribution.

Firms cope with two types of sunk entry costs. We define c_D as the cost associated with entering the domestic market and c_X as sunk costs of entering export markets. To cope with c_D and c_X, firm efficiency must exceed the threshold productivity levels ω_D to enter the domestic market and ω_X to enter foreign markets. Strictly speaking, export costs c_X include not only sunk entry costs into export markets but also period-by-period fixed costs. Moreover, assuming that firms face a common threshold (i.e., c_D and c_X) may seem highly simplistic. In a more realistic fashion, one could think of export thresholds as being composed of four components: a firm-specific component c_i; a sector-specific component c_s, a region-specific component c_r, and a domestic – economy-wide – component c_w, so that $c_X = c_i + c_s + c_r + c_w$. By analyzing the conditions under which cross-country comparisons can be performed, we naturally equate c_X with c_w ($c_X = c_w$). When cross-country comparisons can be performed by industry, our framework equates c_X with both c_s and c_w ($c_X = c_s + c_w$). However, this framework cannot include firm-specific thresholds to perform cross-country comparisons. What is important is that our framework can only address comparisons based on the part of sunk (and fixed) costs which is common to the set of companies to which the comparisons applies.

The literature generally reports that the vast majority of firms focus on domestic markets and fewer export part of their production to foreign markets. Accordingly, we rank the threshold values as follows: $0 < \underline{\omega} < \omega_D < \omega_X < \bar{\omega} < \infty$. Given this setting, the average productivity of firms active in the market reads as follows:

$$\mu = E(\omega|\omega_D < \omega_i < \bar{\omega}) = \frac{\int_{\omega_D}^{\bar{\omega}} \omega g(\omega) d\omega}{\int_{\omega_D}^{\bar{\omega}} g(\omega) d\omega}. \tag{5}$$

Under perfect sorting, all firms exceeding the threshold value export, whereas firms failing to reach the threshold focus on the domestic market. The expected productivity of domestic and exporting firms μ_D and μ_X then read, respectively, as:

$$\mu_D = E(\omega|\omega_D < \omega_i < \omega_X) = \frac{\int_{\omega_D}^{\omega_X} \omega g(\omega) d\omega}{\int_{\omega_D}^{\omega_X} g(\omega) d\omega}, \tag{6}$$

and

$$\mu_X = E(\omega|\omega_X < \omega_i < \bar{\omega}) = \frac{\int_{\omega_X}^{\bar{\omega}} \omega g(\omega) d\omega}{\int_{\omega_X}^{\bar{\omega}} g(\omega) d\omega}. \tag{7}$$

Given this very general framework, we propose the following:

Proposition 2: *Proposition 1 holds irrespective of 1) the truncation of the productivity distribution due to sunk costs of entering the domestic market and 2) the data generating process, that is, the distribution of the productivity distribution so long as the distribution has a mean.*

Proof: Write the overall level of productivity μ as the weighted average productivity of domestic and exporting firms:

$$\mu = \frac{\int_{\omega_X}^{\bar{\omega}} g(\omega)d\omega}{\int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega}\mu_X + \frac{\int_{\omega_D}^{\omega_X} g(\omega)d\omega}{\int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega}\mu_D, \tag{8}$$

where $\int_{\omega_X}^{\bar{\omega}} g(\omega)d\omega / \int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega$ is the share of firms active in export markets (the export participation rate) and $\int_{\omega_D}^{\omega_X} g(\omega)d\omega / \int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega$ is the share of firms focusing on the domestic market (the *domestic* participation rate). Now let Ω be the export participation rate. The domestic participation rate reads as follows:

$$\frac{\int_{\omega_D}^{\omega_X} g(\omega)d\omega}{\int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega} = \frac{\int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega - \int_{\omega_X}^{\bar{\omega}} g(\omega)d\omega}{\int_{\omega_D}^{\bar{\omega}} g(\omega)d\omega} = 1 - \Omega.$$

Inserting Ω and $(1-\Omega)$ into equation (8), subtracting μ_X from both sides and rearranging terms yields

$$\mu_X = \mu + (1-\Omega)(\mu_X - \mu_D) = \mu + (1-\Omega)P_X^w. \tag{9}$$

Whether the data generating process is identical or different across any two countries does not affect equation (9) and, therefore, does not affect equation (3). In the same vein, whether there exist significant differences in fixed costs C_D between countries does not affect the feasibility of the comparison. ■

3.3 Aggregation issues

Thus far, the average productivity is the simple, arithmetic mean of the (log of) the productivity parameter of all firms within an industry $\mu = (1/N)\sum_i \omega_i$. Because we do not weight observations, μ represents the unweighted productivity average. However in the literature, most figures stem from industry-level data, meaning that when computing productivity, one necessarily computes the ratio of two sums:

$$\Psi = \frac{\sum_i Q_i}{f(\sum_i \mathbf{V}_i)}, \tag{10}$$

where Q_i and V_i are output and input for firm i and $f(\sum_i \mathbf{V}_i)$ may represent various combinations of inputs. Because larger firms will account for a larger share of the industry summation for both Q and V, Ψ represents the weighted average of the firm-specific productivity terms. Only under very specific market structures in which all firms have a strictly identical use of inputs and equal market shares will the two productivity averages coincide: $\mu = \Psi$. Because this is very unlikely to hold in practice, one must address the additional issue of aggregate productivity.

By aggregate productivity, we mean the summation of individual, firm-specific measures of some productivity performance ω_i using specific weights, the choice of which is far from univocal. Firms are heterogeneous in their use of inputs and in market shares, and whether one chooses to weight firms using their output shares or their input use does not yield a similar relationship between the unweighted productivity average used in our framework and aggregate productivity [see 30, for a discussion]. In this subsection, we follow [27] and choose to use output weights.

Define the log of weighted average productivity as $\Psi \equiv \sum_i v_i \omega_i$, where $v_i (= Y_i/Y)$ is the market share of firm i; Y_i and $Y (= \sum_i Y_i)$ are the output of firm i and that of all firms, respectively. Let $\bar{v}$ and $\bar{\omega}$ be the simple average of the output share and productivity. As [27] show, the weighted average productivity can be decomposed into the unweighted average productivity and the overall covariance term:

$$\Psi = \bar{\omega} + \sum_i \Delta v_i \Delta \omega_i, \tag{11}$$

where $\bar{\omega} = (1/N) \sum_i \omega_i$, $\Delta v_i = v_i - \bar{v}$ and $\Delta \omega_i = \omega_i - \bar{\omega}$.

Note that $\bar{\omega}$ equates with μ, the unweighted average productivity of all firms. Hence $\bar{\omega}$ is also the weighted average of the productivity of exporters and that of non-exporters:

$$\bar{\omega} = \mu = \Omega \mu_X + (1 - \Omega) \mu_D. \tag{12}$$

The so-called covariance term $\sum_i \Delta v_i \Delta \omega_i$ is an indicator of allocative efficiency. If firms with higher market shares are also the most productive, the covariance term exceeds zero. A negative covariance term indicates that the least-productive firms are also those with the larger market shares, thus indicating a misallocation of resources across firms active in the market. Therefore, allocative efficiency must reflect institutional and regulatory features that may distort the functioning of markets [3]. Note that the covariance term can also be written as follows:

$$\sum_i \Delta v_i \Delta \omega_i = N \frac{\sum_i \Delta v_i \Delta \omega_i}{N} = N cov(\Delta v, \Delta \omega), \tag{13}$$

where $cov(\Delta v, \Delta \omega) \equiv (1/N) \sum_i \Delta v_i \Delta \omega_i$. We thus have

$$\Psi = \mu + N cov(\Delta v, \Delta \omega). \tag{14}$$

The term $N cov(\Delta v, \Delta \omega)$ is economically meaningful. The number of firms N relates to competition or market structure in a given market, and the covariance $cov(\Delta v, \Delta\omega)$ provides information on what could be thought of as *normalized allocative efficiency*. Computing $\partial cov(\Delta v, \Delta\omega)/\partial\Delta\omega$ yields $(1/N)\sum_i \Delta v_i$. This term can be interpreted as the expected gain in market share for domestic firms stemming from a unit increase in the firm's own productivity relative to the market. In turn, knowledge about the size of the market provides information on profit opportunities. This latter component makes the covariance term comparable across countries and/or industries.

If $Ncov(\Delta v, \Delta\omega)$ is large, i.e., $\Psi > \mu$, then competition and normalized allocative efficiency add to the overall productivity of the market. Conversely if $\Psi \leq \mu$, then a lack of competition and misallocation problems presumably harm economic growth. We therefore propose the following:

Proposition 3: *The comparison of exporter performance between any two countries is compatible with the use of aggregated data* if *allocative efficiency is similar between the two countries.*

Proof: Adding a country-specific subscript c to take into account country differences yields $\Psi_c = \mu_c + N_c cov(\Delta v_c, \Delta\omega_c)$. The weighted average productivity gap between two countries ($c = 1, 2$) now reads as follows:

$$\begin{aligned} \Psi_1 - \Psi_2 &= \mu_1 - \mu_2 + N_1 cov(\Delta v_1, \Delta\omega_1) - N_2 cov(\Delta v_2, \Delta\omega_2) \\ &= P^b + N_1 cov(\Delta v_1, \Delta\omega_1) - N_2 cov(\Delta v_2, \Delta\omega_2). \end{aligned} \tag{15}$$

Our framework is consistent with the weighted average productivity gap if the following relationship holds:

$$N_1 cov(\Delta v_1, \Delta\omega_1) = N_2 cov(\Delta v_2, \Delta\omega_2). \tag{16}$$

Differences in allocative efficiency can stem from differences in either competition or profit opportunities. ■

Whether this relationship actually holds is an empirical issue. We will address this issue in Section 4.3.

4 Empirical Analysis

4.1 Baseline analysis: labour productivity

This section examines the empirical validity of Proposition 1. It states that our analytical framework can be applied to cross-country comparisons without directly accessing confidential firm-level data. To estimate the international exporter productivity gap P_X^b, only the industry-average productivity gap P^b, export participation rate Ω_c, and export productivity premium P_X^w of each country are needed. For manufacturing as a whole, it is relatively easy to access these data.

We focus on 11 advanced countries: Belgium, Germany, Sweden, France, Austria, the United Kingdom, Denmark, the United States, Japan, Italy and Spain. We obtain the industry-average labour productivity gap P^b from the Groningen Growth and Development Center (GGDC) Productivity Level Database.[9] The export participation rate Ω_c and export productivity premium P_X^w come from [17] and [4].

Ideally, we would construct these variables using firm-level data across countries to maintain the consistency of the variables. However, firm-level data are confidential in many countries, and thus, it is not easy to apply the same criteria across countries. Therefore, this exercise may be helpful for those who are interested in the international comparison of exporters' productivity but cannot access confidential firm-level data, although the results of this exercise should be interpreted with caution.

Table 2 presents the results using equation (3). The industry-average productivity gaps P^b and the exporter productivity gaps P_X^b are measured relative to the United States. Table 2 indicates, for example, that Belgian firms are, on average, 26.4 percent more productive than their US counterparts (0.264 in Belgian P^b), whereas Spanish firms are, on average, 26.9 percent less productive than US firms (-0.268 in Spanish P^b). Rank P^b and Rank P_X^b are the rankings of the productivity gap for all firms and that for exporters, respectively.

[Table 2 about here.]

Three findings appear immediately. First, the exporter productivity gap (P_X^b) for two countries does not necessarily reflect the industry-average productivity gap (P^b). For example, while French exporters are 8.4 percent less productive than US firms (-0.084 in French P_X^b), the industry-average productivity for France is 7.9 percent greater than that of the US (0.079 in French P^b). As suggested by the fact that the export participation rate is higher in France, French firms presumably face lower trade costs than their US counterparts. This is indeed plausible, first because France is geographically located in the centre of Europe and, second, because it shares its currency with other neighbouring Eurozone countries, thereby decreasing export costs related to the use of foreign currencies.

Second, a higher export premium does not necessarily reflect greater performance in exporter productivity. For example, the export premium for Italy is 9.7 percent, whereas that of the United States is 2.0 percent. Nevertheless, the average productivity of Italian exporters is 32.8 percent lower than that of US exporters. This pattern is due both

[9] We first focus on labour productivity to account for possible measurement error. As was pointed out by [22], the measurement error tends to be most pronounced in capital variable.

to the higher industry-average productivity of US companies and fiercer selection into export markets due to higher trade costs in the US. This result clearly indicates that the international comparison of exporter productivity gaps is different from that of export productivity premia.

Third, use of Lemma 1 allows us to recover various international productivity gaps. For example, the performance of German exporters relative to Belgian exporters amounts to $P^b_{X,GER/US} - P^b_{X,BEL/US} = -.017 - .165 = -.182$, implying that German exporters are 18 percent less productive than their Belgian counterparts. In a similar vein, the performance of French exporters relative to Italian exporters amounts to $P^b_{X,FR/US} - P^b_{X,IT/US} = -.084 - (-.328) = +.244$, implying that French exporters are 24 percent more productive than their Italian counterparts. Through such a procedure, one can recover the relative performance of exporters for any pair of countries.

Our finding raises the issue of policy solutions for advanced countries that face declining and aging population such as Japan, to promote export markets as a possible alternative solution to lack of internal demand. Although little can be done in the short run to overcome the geographic specificity of Japan, solutions can be viewed as twofold. One would be to promote innovation and productivity growth in order to help firms exceed the productivity threshold. This would shift the productivity distribution to the right, holding the threshold ω_X constant. The second policy solution is to promote exports by supporting potential exporters in the search for foreign markets. This would shift the export threshold ω_X to the left, holding the productivity distribution constant.

4.2 Robustness check I: Alternative measures of productivity and of the export participation rate

One may argue that TFP is a more appropriate productivity measure than labour productivity. We focus on France, Japan, the United Kingdom, and the United States, where such information is relatively easy to access. We obtain the industry-average productivity gap P^b from **(author?)** [26, Table I-1-3-2].[10] The export participation rates Ω_c and export productivity premia P^w_X are obtained from [6] for the United States, from [4] for France and Japan, and from [12] for the United Kingdom.

Table 3 presents the results based on TFP. Note that the ranking in the international TFP gap differs from that using the labour productivity gap. For example, while the labour productivity level for France is greater than that of the US, France's TFP is lower. This may reflect differences in working hours regulation and, primarily, differences in the productivity of capital. Turning to the exporters' TFP gap, the results confirm our

[10] We rely on **(author?)** [26] rather than the GGDC Productivity Level Database. The GGDC Productivity Level Database reports manufacturing productivity while excluding electrical machinery. In contrast, **(author?)** [26] computes manufacturing productivity while including electrical machinery based on the GGDC Productivity Level Database.

previous findings with labour productivity: the rankings of exporters' TFP gap P_X^b are not always consistent with the rankings of the industry-average productivity gap P^b, and higher export premia $P_{X,c}^w$ across countries do not reflect greater exporter performance.

[Table 3 about here.]

One may also be concerned about the export participation rate. Our definition of exporters follows the standard definition of the literature [e.g., 6]. This means that exporting firms also sell domestically and thus a firm was included even if 99.9 percent of its sales are domestic. Ultimately, what matters is not so much the number of exporters but the volume of exports. Hence, rather than using the share of exporters, one should use the volume of exports relative to gross output. To address this concern, we use the share of exports to gross output Ω' in total manufacturing in 2005 obtained from the World Input–Output Database [29]. The result for labour productivity is presented in the upper panel of Table 4, and that for TFP is in the lower panel. The results are qualitatively similar to those presented in the upper panel. Even when focusing on the volume of exports, our main message remains unchanged.

[Table 4 about here.]

In sum, our framework seems relevant for a meta-analysis comparing the performance of exporters across countries. Even in the absence of firm-level data, there is indeed enough information in the economic literature to make comparisons. The productivity differences between exporters across any countries can be approximated using readily available figures *out there*, that is, when one obtains the industry-average productivity gap, the export participation rate, and the export productivity premium for both countries.

4.3 Robustness check II: Comparing gaps using aggregate data and firm-level data

This paper claims that one can estimate the exporters' productivity gap between any two countries without accessing firm-level confidential data. Yet in order to assess the relevance of this claim, we need to test whether the estimated gap $\hat{P}_X^b$ is actually *on target*: $\hat{P}_X^b = P_X^b$. To this end, we take advantage of the fact that we can access firm-level information for companies with at least 50 employees in both France and Japan, and compare the firm-level exporter productivity gaps from those obtained using GGDC data for year 1997.[11] Table 5 compares P_X^b obtained from firm-level data and $\hat{P}_X^b$ obtained

[11]Not only are the French and Japanese firm-level data highly comparable with one another, but also both countries exhibit substantial trade cost differences, which enables us to identify large differences in

from GGDC data.[12] Since the gap is defined by subtracting French firms' TFP from that of Japan, a positive productivity gap indicates a productivity advantage in favour of Japan.

[Table 5 about here.]

Two findings are noteworthy. First, both exporter productivity gaps P_X^b and $\hat{P}_X^b$ exhibit the same sign in nine out of 11 industries. Hence aggregate figures provide a reasonably accurate picture of the direction of the exporter productivity advantage. The same holds for the overall productivity gap P^b and $\hat{P}^b$, where a discrepancy in the direction of the productivity advantage is found in only three industries. Second, the correlation coefficient between GGDC and firm-level figures exceeds .9 for the two comparisons concerning P_X^b and P^b. Overall, this exercise corroborates the idea the economic literature conceals valuable information about the productivity gaps across countries, either for the overall manufacturing or by industry.

Nevertheless, the magnitude of the two gaps – P_X^b and $\hat{P}_X^b$ – differs significantly. In fact, the absolute value estimated $\hat{P}_X^b$ is significantly lower than that of P_X^b by an average of .2, which represents an underestimation of the actual gap of around 20 percent. In order to better understand the reasons justifying such a gap, we estimate the following simple regression $P_X^b = \alpha + \beta \hat{P}_X^b + \varepsilon$ over the 11 industries at our disposal. If the GGDC gap $\hat{P}_X^b$ is equal to the firm-level gap P_X^b , one would expect to find $\hat{\alpha} = 0$ and $\hat{\beta} = 1$. If instead $\hat{\alpha} \neq 0$, then there is a constant *bias* between P_X^b and $\hat{P}_X^b$. In the same vein, if $\hat{\beta} \neq 1$, the difference between P_X^b and $\hat{P}_X^b$ increases ($\hat{\beta} > 1$) or decreases ($\hat{\beta} < 1$) with $\hat{P}_X^b$, expressing a deviation in magnitude from P_X^b proportional to $\hat{P}_X^b$. Figure 1 displays the comparison, exhibiting the equality between P_X^b and $\hat{P}_X^b$ by a 45-degree solid line, the dashed line exhibiting the fit where $P_X^b = .148 + 1.708\hat{P}_X^b$. Figure 1 corroborates the idea that using GGDC data produces an exporter productivity gap substantially lower than the one obtained using firm-level data.

[Figure 1 about here.]

the export behaviour of firms from the two countries. More precisely, we use firm-level data from France and Japan developed in [4]. To account for possible measurement errors, we exclude outliers from the data used in [4]. We exclude firms with logs of outputs and inputs in the bottom 1 percent. Appendix in our working paper version ([21]) provides a detailed explanation of the construction of the data, the definition of each variable and the methodology to ensure comparability across the two countries.

[12] In some industries, the export premium P_X^w is negative. A negative export premium questions both our statistical framework and the underlying theory, which stipulates that only the more productive firm can make it to export markets. Our first interpretation is that some market distortions may exist, because of the presence of public subsidies supporting existing exporters essentially. But due to the EU regulation, the role of public support can only be limited in time and in scope, and this conjecture should be further confirmed. Moreover, as discussed above, one cannot rule out the possibility of measurement errors in the data. In all cases if empirically grounded, negative premia question the sustainability of such firms to survive on foreign markets in the long run.

Why do we observe such differences? Our contention is threefold. First, one cannot rule out the possibility of measurement errors in the data, although we have trimmed the outliers located in the top and bottom one percent of the firm-level productivity distribution.[13] Second, there may be differences in the subtleties of the TFP computation which may affect the P_X^b. Indeed, looking at P^b using firm level data and $\hat{P}^b$ using GGDC data, we observe a significant gap. We conjecture that this change in magnitude in the two measures is likely to explain why $\hat{\beta} > 1$, although it is hard to explain the very mechanics at work. One possible explanation is the fact that the use of firm-level data implies a wider spectrum of productivity levels, thereby inflating heterogeneity in the data, as opposed to the use of industry-level data relying on the use of a representative firm undermining heterogeneity in the data. Third, differences in data coverage between GGDC data – with no size truncation – and firm-level data (with a size truncation of 50 employees) produce a upward bias in favour of Japan when using firm level data, thereby explaining the positive $\hat{\alpha}$.

To see this, take equation (3) and apply it to the comparison between France and Japan, yielding $P_X^b = P^b + P_{X,JP}^w(1-\Omega_{JP}) - P_{X,FR}^w(1-\Omega_{FR})$. It is straightforward to show that $\partial P_X^b / \partial \Omega_{JP} = -P_{X,JP}^w < 0$ and $\partial P_X^b / \partial \Omega_{FR} = P_{X,FR}^w > 0$. This tells us that the exporter productivity gap P_X^b decreases when the export participation rate of Japan increases, and P_X^b increases when the export participation rate of France increases. By applying a size-threshold, one may indeed modify the export participation rates. How this influences the exporter productivity gap ultimately depends on the export participation rates Ω of the two countries.

Figure 2 presents the relationship between the log of size and the export participation rate.[14] Figure 2 displays the observed export participation rates gradually increasing the size truncation (i.e., the number of employees).[15] Recall that in our case, we observe companies with at least 50 employees, and discard smaller firms, symbolised in the Figure by the vertical, solid line at ln(50) = 3.91. As Figure 2 clearly shows, the difference between the export participation rates between the two countries is greatest at around 50 employees, where the French participation rate exceeds 85 percent in France and reaches 28 percent in Japan. This implies that P_X^b is likely to be overestimated when applying such a size truncation to firm-level data, and that the difference between P_X^b

[13]Our framework does not need to assume no measurement errors in productivity measures. But it needs to assume that in the presence of measurement error, its underlying magnitude and direction are similar in both countries.

[14]For Japan, we apply linear approximation below 50 workers due to the lack of data.

[15]Figure 2 indicates a generally positive, quasi-monotonic relationship between size truncation and the export participation rate. But for relatively high levels of size truncation, the export participation rate decreases. Although this may seem surprising, our contention is that this is due to changes in the industry composition of the economy as the size truncation increases. By doing so, some industries are being dropped from the sample, thereby affecting the size truncation-export participation rate non-monotonically.

and $\hat{P}_X^b$ is exacerbated by the 50-employee size truncation.

[Figure 2 about here.]

The conclusion of this exercise is that our estimated $\hat{P}_X^b$ is likely to be more reliable that firm level data imposing a size truncation in the measures. It corroborates the use of aggregate data which presumably covers all firms within an economy (or an industry). The caveat is that the proposed premium in the literature relies on the use of arithmetic productivity averages whereas industry-level productivity gaps produced by the GGDC database stem from aggregated output and input with a weight in favour of larger firms. Next Subsection investigates this avenue explicitly.

4.4 Robustness check III: The incidence of the market selection mechanism on the exporter productivity gap

One may be concerned that the aggregate productivity documented in the literature does not compare with the unweighted productivity average μ that we have used thus far. As discussed in Section 3.3, our framework is consistent with the weighted average productivity if equation (16) holds. However, whether this relationship actually holds is an empirical question. The contribution of the gap between the unweighted average productivity P^b and that of the covariance term $Ncov(\Delta v \Delta \omega)$ and the weighted average productivity gap Ψ is computed by dividing equation (15) by $\Psi_J - \Psi_F$:

$$1 = \left(\frac{P^b}{\Psi_J - \Psi_F}\right) + \left(\frac{N_J cov(\Delta v_J, \Delta \omega_J) - N_F cov(\Delta v_F, \Delta \omega_F)}{\Psi_J - \Psi_F}\right). \quad (17)$$

Because of the covariance term, the computation of equation (17) necessitates the use of firm-level data. Thus, we examine this issue by using our firm-level data from France and Japan. Table 6 reports the decomposition of weighted average productivity Ψ into the unweighted average productivity μ and the term $Ncov(\Delta v \Delta \omega)$, what [27] call the covariance term. It also exhibits the number of observations N for both countries, the differences in Ψ and in μ, and the contributions of both μ and the covariance term to the weighted average productivity gap $\Psi_J - \Psi_F$.

[Table 6 about here.]

Five findings are notable. First, the covariance terms $Ncov(\Delta v, \Delta \omega)$ in France and Japan are not negligibly small. Market structures (N) and the size productivity advantage $cov(\Delta v, \Delta \omega)$ account for less than 10 percent of the aggregate productivity. The unreported Student t-tests of equality of the covariance terms between the two countries reveal that the means are significantly different between the two countries for all industries. This suggests that the nature of competition is country-specific.

Second, the difference in the productivity premium in size $cov(\Delta v \Delta \omega)$ between France and Japan is relatively small, and the unreported Student t-test reveals no significant differences in the covariance terms. This implies that the difference in the covariance term comes essentially, if not exclusively, from the difference in the number of firms N, that is, differences in market structures between the two countries.[16] The fact that the size advantage does not appear to be significantly different between the two countries may come as a surprise. The rise and growth of the Japanese economy was initially export driven, based on the capacity of few yet remarkably successful companies in gaining international market shares. This relatively accepted story could produce results whereby Japanese companies should enjoy a larger size advantage. A more detailed observation of the covariance term shows that in 14 industries, the covariance term is larger in Japan. Whether these differences are statistically significant is one issue. Economically, however, they suggest that, indeed, Japanese companies have been more successful at exploiting economies of scale than their French counterparts.

Third, the contribution of the covariance term $Ncov(\Delta v \Delta \omega)$ to the aggregate productivity gap is rather small for most industries when the productivity gap between the two countries is large. This is mainly due to differences in technologies μ. When the gap is small, the role played by differences in the nature of competition mechanically inflates, as is the case for *Fabricated metal prod* and in *Machinery & equip* industries. This is why in *All Manufacturing* the contribution of the covariance term is relatively large, amounting to 72 percent. This is because the performance of countries in manufacturing conceals important sectoral specialization where productivity differentials are more pronounced. It also implies that sector specialization should be taken into account when comparing the productivity performance of countries.

Fourth, although similar in size, allocative efficiency (the covariance term) in France and Japan do not equate. This may be due to differences in market structures, in the nature of the underlying technology and, *inter alia*, in the regulation of the sector by the local authorities. In order to assess the degree of competition per industry across countries, one possibility would be to use the information provided by OECD on Product Market Regulation. Such database provides insightful information on entry barriers, price regulation, competition law and policy, among other dimensions.[17] Although potentially fruitful, this line of inquiry lies beyond the scope of this paper.

[16] Although we take into account the differences in market structures by measuring the number of firms (N), the productivity should also be measured in a consistent manner across countries, which appears as a demanding necessary condition. If the industry average productivity is measured under the assumption of perfect competition (like GGDC Productivity Level Database), the export premium also embodies the same assumptions. In other words, in order to take into account differences in market structures, export productivity premia and industry average productivity levels should be measured assuming away perfect competition.

[17] See the OECD homepage of OECD entitled "Indicators of Product Market Regulation Homepage" at http://www.oecd.org/eco/growth/indicatorsofproductmarketregulationhomepage.htm.

Finally, in all sectors and for both countries, the market selection mechanism seems to operate in conformity with what economic theory tells us: firms with higher productivity levels enjoy larger market shares. Allocative efficiency seems to perform better in Japan for all manufacturing. Yet this overall difference conceals sector-specific differences that are much larger in magnitude. We do not observe any specific link between profit opportunities for domestic firms and a productivity advantage. Again, this corroborates the idea that allocative efficiency reflects more institutional aspects of the functioning of markets that cannot be reflected in a simple productivity term.

5 Conclusion

Social scientists increasingly rely on the use of confidential data on individual companies or employees, and rightly so. For example, in the realm of economics, increased reliance on firm-level information has produced a series of results across countries and industries regarding the export behaviour of companies that are readily available to all economists. However, this information is generally dispersed, difficult to compare and conceals differences in data generating processes that reflect differences in country-specific institutions. These caveats often cast doubt on the comparability of such simple statistics across countries.

This paper stems from the intuition that under specific yet generally satisfied conditions, such comparisons can be performed. Importantly, such statistics can be used to infer additional features, notably that of the cross-country exporter productivity gap. Our simple framework allows for the computation of the cross-country exporter productivity gap without directly accessing confidential firm-level data. We have shown that the average international productivity gap between exporters depends on the following three sufficient statistics: 1) the industry-average productivity gap between any pair of countries, 2) export participation rates, and 3) within-country export premia.

We applied our framework to cross-country comparisons across 11 advanced countries such as Japan, the United Kingdom, and the United States. We found that the average exporter productivity gap between two countries does not necessarily reflect the industry-average productivity gap, due to the differences in export participation rates and export premia across countries. Our simple framework performs well with the use of such readily available information and is robust to various measures of productivity and alternative definitions of the export participation rate. Our methodology relies on the assumption that the differences in allocative efficiency, namely the product of competition and the expected gains in market shares stemming from productivity growth, are small. However, when the productivity gap between two countries is large, differences in allocative efficiency do not matter. Altogether, these results suggest that, while caution is needed, our framework is useful as a first order approximation.

Greater access to detailed information can help social scientists to depict new causalities. However, our experience also tells us that the use of large databases entails important computational costs. One should not ignore the alternative possibility of deriving additional stylized facts from simple, existing information. This paper is a first step towards such a research strategy. We believe that our framework can be extended to various other issues, such as, the analysis of international wage or price differentials that may help to explain the international allocation of resources.

References

[1] Costas Arkolakis, Arnaud Costinot, and Andrés Rodríguez-Clare. New trade models, same old gains? *American Economic Review*, 102(1):94–130, 2012.

[2] Martin Neil Baily and Robert M. Solow. International productivity comparisons built from the firm level. *Journal of Economic Perspectives*, 15(3):151–172, 2001.

[3] Eric Bartelsman, John Haltiwanger, and Stefano Scarpetta. Cross-country differences in productivity: The role of allocation and selection. *American Economic Review*, 103(1):305–334, 2013.

[4] Flora Bellone, Kozo Kiyota, Toshiyuki Matsuura, Patrick Musso, and Lionel Nesta. International productivity gaps and the export status of firms: Evidence from france and japan. *European Economic Review*, 70:56–74, 2014.

[5] Flora Bellone, Patrick Musso, Lionel Nesta, and Michel Quéré. The u-shaped productivity dynamics of french exporters. *Review of World Economics (Weltwirtschaftliches Archiv)*, 144(4):636–659, 2008.

[6] Andrew B. Bernard, J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott. Firms in international trade. *Journal of Economic Perspectives*, 21(3):105–130, 2007.

[7] Antoine Berthou, Emmanuel Dhyne, Matteo Bugamelli, Ana-Maria Cazacu, Calin-Vlad Demian, Peter Harasztosi, Tibor Lalinsky, Jaanika Meriküll, Filippo Oropallo, and Ana Cristina Soares. Assessing european firms' exports and productivity distributions: The compnet trade module. Working Paper Series 1788, European Central Bank, 2015.

[8] Wendy Carlin, Andrew Glyn, and John Van Reenen. Export market performance of oecd countries: An empirical examination of the role of cost competitiveness. *Economic Journal*, 111(468):128–162, 2001.

[9] Jan Fagerberg. International competitiveness. *Economic Journal*, 98(391):355–374, 1988.

[10] Robert C. Feenstra. Restoring the product variety and pro-competitive gains from trade with heterogeneous firms and bounded productivity. NBER Working Papers 19833, National Bureau of Economic Research, 2014.

[11] Kyoji Fukao, Tomohiko Inui, Keiko Ito, Young Gak Kim, and Tangjun Yuan. An international comparison of the tfp levels and the productivity convergence of japanese, korean, taiwanese and chinese listed firms. *Journal of Chinese Economic and Business Studies*, 9(2):127–150, 2011.

[12] David Greenaway and Richard Kneller. Exporting and productivity in the united kingdom. *Oxford Review of Economic Policy*, 20(3):358–371, 2004.

[13] David Greenaway and Richard Kneller. Firm heterogeneity, exporting and foreign direct investment. *Economic Journal*, 117(517):F134–F161, 2007.

[14] Kazunobu Hayakawa, Tomohiro Machikita, and Fukunari Kimura. Globalization and productivity: A survey of firm-level analysis. *Journal of Economic Surveys*, 26(2):332–350, 2012.

[15] Keith Head, Thierry Mayer, and Mathias Thoenig. Welfare and trade without pareto. *American Economic Review: Papers & Proceedings*, 104(5):310–316, 2014.

[16] Robert Inklaar and Marcel P. Timmer. Ggdc productivity level database: International comparisons of output, inputs and productivity at the industry level. Ggdc research memorandum, Groningen Growth and Development Centre, University of Groningen, 2008.

[17] ISGEP. Understanding cross-country differences in exporter premia: Comparable evidence for 14 countries. *Review of World Economics*, 144(4):596–635, 2008.

[18] Dale W. Jorgenson, Masahiro Kuroda, and Mieko Nishimizu. Japan–u.s. industry-level productivity comparisons, 1960–1979. *Journal of the Japanese and International Economies*, 1(1):1–30, 1987.

[19] Moosup Jung and Keun Lee. Sectoral systems of innovation and productivity catch-up: determinants of the productivity gap between korean and japanese firms. *Industrial and Corporate Change*, 19(4):1037–1069, 2010.

[20] Fukunari Kimura and Kozo Kiyota. Exports, fdi, and productivity: Dynamic evidence from japanese firms. *Review of World Economics (Weltwirtschaftliches Archiv)*, 142(4):695–719, 2006.

[21] Kozo Kiyota, Toshiyuki Matsuura, and Lionel Nesta. What's behind the figures? quantifying the cross-country exporter productivity gap. GREDEG Workin Paper No. 2017-33, GREDEG, 2017.

[22] James Levinsohn and Amil Petrin. Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70(2):317–341, 2003.

[23] Marc J. Melitz. The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6):1695–1725, 2003.

[24] Marc J Melitz and Gianmarco IP Ottaviano. Market size, trade, and productivity. *Review of Economic studies*, 75(1):295–316, 2008.

[25] Marc J. Melitz and Stephen J. Redding. New trade models, new welfare implications. *American Economic Review*, 105(3):1105–1146, 2015.

[26] Ministry of Economy, Trade and Industry (METI). *White Paper on International Economy and Trade 2013*. METI (In Japanese), Tokyo, 2013.

[27] G. Steven Olley and Ariel Pakes. The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64(6):1263–1297, 1996.

[28] Michael E. Porter. The competitive advantage of nations. *Harvard Business Review*, 68(2):73–93, 1990.

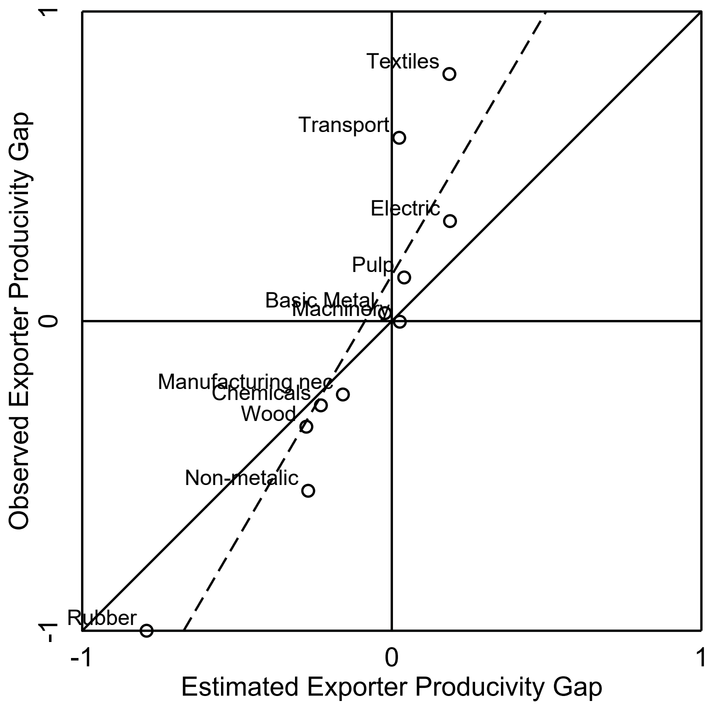
[29] Marcel P. Timmer. The world input-output database (wiod): Contents, sources and methods. WIOD Working Paper Number 10, University of Groningen, 2012.

[30] Johannes van Biesebroeck. Aggregating and decomposing productivity. *Review of Business and Economics*, 53(2):122–146, 2008.

[31] Joachim Wagner. International trade and firm performance: A survey of empirical studies since 2006. *Review of World Economics (Weltwirtschaftliches Archiv)*, 148(2):235–267, 2012.

[32] Mu-Jeung Yang. Firm heterogeneity and trade in a distorted-gravity world. manuscript, University of Washington, Seattle, 2014.

Figure 1: Observed and Estimated Productivity Gaps P_X^b and $\hat{P}_X^b$ between France and Japan



Notes: The dashed line represents predictions from the regression $P_X^b = \alpha + \beta \hat{P}_X^b + \varepsilon$, where $\hat{\alpha} = .148$ and $\hat{\beta} = 1.708$, with respective p-values $p_\alpha = .072$ and $p_\beta = .000$. Adjusted $R^2 = .819$ and $N = 11$ industries.

Figure 2: Export Participation Rates for France (dashed line) and Japan (solid line)

Notes: Based on our appreciative knowledge, we arbitrarily set the export participation rate for all firms to 5% in France and 1% in Japan. Values for France for firms with less than 50 employees are obtained from FICUS data. In the case of Japanese firms with less than 50 employees, we use a log-linear approximation of the relationship between size truncation and export participation rate. The vertical, solid line indicates the size truncation of 50 employees (ln(50) = 3.91) used in the firm-level analysis.
Sources: Firm-level data obtained from national statistical offices for Japan and France.

Table 1: Ranking of Labour Productivity Relative to the US for the year 2005

	P^b	Rank P^b
Belgium	0.264	1
Germany	0.149	2
Sweden	0.139	3
France	0.079	4
Austria	0.073	5
United Kingdom	0.067	6
Denmark	0.066	7
United States	0.000	8
Japan	-0.180	9
Italy	-0.239	10
Spain	-0.268	11

Notes: Labour productivity is measured by value added per hours worked. P^b is the industry-average labour productivity gap, based on year 2005 PPP, relative to the United States.
Source: P^b is obtained from the GGDC Productivity Level Database.

Table 2: Productivity of Exporters: Labour Productivity

	P^b	Ω	P_X^w	P_X^b	Rank P^b	Rank P_X^b
Belgium	0.264	0.803	0.578	0.165	1	1
Germany	0.149	0.693	0.154	-0.017	2	3
Sweden	0.139	0.830	0.067	-0.063	3	5
France	0.079	0.748	0.200	-0.084	4	6
Austria	0.073	0.714	0.175	-0.090	5	7
United Kingdom	0.067	0.695	0.099	-0.116	6	8
Denmark	0.066	0.772	0.385	-0.059	7	4
United States	0.000	0.180	0.260	0.000	8	2
Japan	-0.180	0.275	0.210	-0.241	9	9
Italy	-0.239	0.693	0.403	-0.328	10	10
Spain	-0.268	0.747	0.275	-0.412	11	11

Notes: P^b is the industry-average productivity gap, based on year 2005 PPP, relative to the United States; Ω is the ratio of the number of exporters to the total number of firms; P_X^w is the export productivity premium; and P_X^b is the productivity gap between exporters across countries. P_X^b is obtained from equation (3): $P_X^b = P^b + P_{X,c}^w(1-\Omega_c) - P_{X,US}^w(1-\Omega_{US})$.
Sources: See main text

Table 3: Productivity of Exporters: Total Factor Productivity (TFP)

	P^b	Ω	P_X^w	P_X^b	Rank P^b	Rank P_X^b
United States	0.000	0.180	0.020	0.000	1	1
France	-0.104	0.748	0.014	-0.117	2	4
United Kingdom	-0.110	0.695	0.097	-0.097	3	2
Japan	-0.139	0.275	0.056	-0.115	4	3

Notes: P^b is the industry-average TFP gap, based on year 2005 PPP, relative to the United States; Ω is the ratio of the number of exporters to the total number of firms; P_X^w represents the export productivity premia; and P_X^b is the productivity gap between exporters across countries. P_X^b is obtained from equation (3): $P_X^b = P^b + P_{X,c}^w(1-\Omega_c) - P_{X,US}^w(1-\Omega_{US})$.
Sources: See main text.

Table 4: Alternative measure of export participation rate

	P^b	Ω	P_X^w	P_X^b	Rank P^b	Rank P_X^b
United States	0.000	0.151	0.020	0.000	1	1
France	-0.104	0.422	0.014	-0.113	2	4
United Kingdom	-0.110	0.420	0.097	-0.071	3	2
Japan	-0.139	0.187	0.056	-0.110	4	3

Notes: This table uses an alternative measure of the export participation rate. Ω' is the ratio of exports to gross output.
Sources: See main text.

Table 5: Productivity of Exporters: Firm-level Analysis for France and Japan

	France-Japan firm-level data						GGDC	
	France		Japan		Japan-France			
GGDC industries	Ω	P_X^w	Ω	P_X^w	P^b	P_X^b	$\hat{P}^b$	$\hat{P}_X^b$
Textiles, textile products, leather & footwear	0.797	0.019	0.099	0.103	0.709	0.798	0.097	0.186
Wood & products of wood & cork	0.730	-0.027	0.064	0.030	-0.376	-0.341	-0.311	-0.276
Pulp, paper, paper products, printing & publishing	0.785	-0.024	0.066	0.041	0.100	0.141	-0.003	0.040
Chemicals & chemical products	0.942	0.006	0.458	0.047	-0.297	-0.272	-0.254	-0.229
Rubber & plastics products	0.857	0.045	0.245	0.041	-1.064	-1.039	-0.816	-0.792
Other non-metallic mineral products	0.868	0.007	0.212	0.039	-0.004	0.026	-0.287	-0.270
Basic metals & fabricated metal products	0.760	0.042	0.187	0.033	-0.565	-0.548	-0.052	-0.022
Machinery, nec	0.886	0.007	0.454	0.050	-0.028	-0.002	0.000	0.026
Transport equipment	0.911	0.009	0.271	0.050	0.556	0.592	-0.012	0.024
Electrical & optical equipment	0.873	0.044	0.390	0.070	0.288	0.323	0.152	0.188
Manufacturingnec; recycling	0.927	0.023	0.291	0.048	-0.270	-0.237	-0.190	-0.158

Notes: The comparison pertains to year 1997 only, and covers 11 industries only, due to the adequacy of the industry breakdown between GGDC data and the national statistical offices.

Sources: Firm-level data obtained from national statistical offices for Japan and France.

Table 6: Decomposition of the Weighted Average Productivity Gap Between France and Japan

Industry	Ψ_{FR}	Ψ_{JP}	μ_{FR}	μ_{JP}	OP_{FR}	OP_{JP}	N_{FR}	N_{JP}	cov_{FR}	cov_{JP}	$Diff_{\Psi}$	$Diff_{\mu}$	$Cont_{\mu}$	$Cont_{cov}$
All manufacturing	1.109	1.162	1.034	1.049	0.075	0.113	85,848	87,406	0.9	1.3	0.053	0.015	0.275	0.725
Textile	0.645	1.37	0.599	1.321	0.046	0.049	4,890	2,715	9.4	18.0	0.725	0.721	0.995	0.005
Clothing	0.727	1.375	0.626	1.248	0.101	0.127	5,377	2,695	18.8	47.1	0.648	0.622	0.961	0.039
Manufacture of wood	1.203	0.832	1.190	0.783	0.012	0.049	2,183	1,128	5.5	43.4	-0.371	-0.407	1.098	-0.098
Pulp & paper	0.942	1.161	0.903	1.081	0.039	0.080	3,396	3,294	11.5	24.3	0.220	0.178	0.811	0.189
Printing & publishing	1.128	1.088	1.006	0.959	0.122	0.129	5,565	6,034	21.9	21.4	-0.040	-0.047	1.169	-0.169
Chemical prod	1.317	1.020	1.198	0.910	0.119	0.110	7,516	7,571	15.8	14.5	-0.297	-0.288	0.969	0.031
Rubber & plastic	1.619	0.579	1.580	0.494	0.039	0.085	7,248	5,383	5.4	15.8	-1.040	-1.085	1.044	-0.044
Non-metallic mineral prod	1.399	0.815	1.278	0.732	0.121	0.083	3,891	4,398	31.1	18.9	-0.584	-0.546	0.935	0.065
Basic metal prod	0.998	1.104	0.949	1.025	0.049	0.079	3,151	5,910	15.6	13.4	0.106	0.076	0.717	0.283
Fabricated metal prod	1.062	1.029	1.039	0.956	0.023	0.074	10,960	7,715	2.1	9.6	-0.033	-0.084	2.536	-1.536
Machinery & equip	1.102	1.103	1.047	1.002	0.055	0.100	11,237	10,840	4.9	9.2	0.001	-0.045	$-\infty$	$+\infty$
Machinery for office	1.044	1.537	0.929	1.398	0.116	0.139	340	1,245	341.2	111.6	0.493	0.470	0.953	0.047
Electric machinery	1.030	1.427	0.963	1.288	0.067	0.139	5,653	10,463	11.9	13.3	0.397	0.326	0.819	0.181
Communication equip	1.331	1.500	1.205	1.340	0.126	0.161	1,128	1,798	111.7	89.5	0.169	0.135	0.796	0.204
Medical & precision inst	1.068	1.383	0.950	1.269	0.118	0.114	3,822	4,106	30.9	27.8	0.315	0.319	1.015	-0.015
Motor vehicles	0.716	1.437	0.689	1.324	0.027	0.113	2,945	7,210	9.2	15.7	0.721	0.634	0.881	0.119
Other transport equip	0.812	1.337	0.683	1.242	0.129	0.095	1,765	1,730	73.1	54.9	0.525	0.559	1.065	-0.065
Furnitures & other mfg	1.225	1.076	1.181	0.905	0.043	0.171	4,781	3,171	9.0	53.9	-0.148	-0.276	1.861	-0.861

Notes: the figures are the averages across years. *OP* stands for the Olley and Pakes covariance term measuring allocative efficiency, while *cov* stands for the covariance measuring the expected gains in market share ($\times 10^6$) for a one-unit increase in productive efficiency. Contributions were computed using equation (17). See also the footnote to Table 5 for the computation of sector averages.

Sources: Firm-level data obtained from national statistical offices for Japan and France.