Does Tobin's q Matter for Firm Choice of Globalization Mode?*

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Abstract

We draw from Japanese firm-level data to estimate whether and to what extent Tobin's q and total factor productivity (TFP) influence the choice of globalization mode. We employ quantile regression to accommodate a strong negatively skewed distribution of our sample and deal with endogeneity using the endogenous quantile regression technique. Our main findings are that firms with a higher Tobin's q tend to favor foreign direct investment (FDI) over foreign outsourcing and that firms with a higher TFP tend to devote a greater proportion of FDI to exports, conditional on a higher degree of engagement in exports relative to FDI.

Keywords: foreign direct investment; foreign outsourcing; exports; Tobin's q; total factor productivity; quantile regression.

JEL classification: F10; F23; D22; L22.

1 Introduction

The relationship between firm productivity and the manner in which firms access foreign markets has been investigated theoretically and empirically.[1] Melitz (2003) presents a model in which the most productive firms export goods to foreign markets, whereas less productive firms supply goods only to their domestic market. Helpman, Melitz, and Yeaple (2004, HMY hereafter) extend the framework in Melitz (2003) to incorporate the possibility that firms serve foreign markets through foreign direct investment (FDI). They predict that only the most productive firms find it profitable to serve foreign markets via FDI and that medium-productivity firms serve foreign markets through exports.

The superior performance of exporters relative to domestic producers and the productivity advantage of multinationals have been well documented in numerous empirical studies (e.g., Bernard and Jensen, 1995, 1999; HMY; Mayer and Ottaviano, 2007). In addition, multinationals that also engage in exports are more productive than those that do not (Head and Ries, 2003; Kimura and Kiyota, 2006; Tomiura, 2007).

When a firm has at least a part of its production offshore, it effectively makes a choice between FDI and foreign outsourcing. In such a situation, Antràs and Helpman (2004) demonstrate that relatively higher-productivity firms conduct FDI, whereas relatively lower-productivity firms choose foreign outsourcing. With regard to the empirical investigation on this issue, only a few studies have reported firm-level evidence on FDI and foreign outsourcing, primarily because of data limitations (Tomiura, 2007; Defever and Toubal, 2007; Federico, 2010; Kohler and Smolka, 2012). For example, using Japanese firm-level data, Tomiura (2007) observes that firms engaging only in foreign outsourcing tend to be less productive than those engaging in FDI. Federico (2010) and Kohler and Smolka (2012) also find empirical support for the predictions of Antràs and Helpman (2004) for Italian and Spanish firms, respectively. In contrast, Defever and Toubal (2007) report a reverse ordering of firm productivity due to the higher fixed costs for foreign outsourcing in the case of French firms.

Antràs and Helpman's (2004) model is based on a property rights approach (Grossman and Hart, 1986; Hart and Moore, 1990), which emphasizes the ownership of physical assets. In this setting, the

[1] Helpman (2006), Greenaway and Kneller (2007), and Wagner (2007, 2012) provide useful surveys of the literature.

owners of residual rights in the asset retain full control of the asset in the event of a failed relationship or negotiation. An alternative approach focuses on knowledge-based assets (e.g., Markusen, 1984, 2002; Horstmann and Markusen, 1987). This approach emphasizes the jointness property of knowledge-based assets. In turn, the jointness property leads to the problem of non-excludability if relationships or negotiations fail. That is, the local manager or licensee easily absorbs the knowledge capital.

Chen, Horstmann, and Markusen (2012, CHM hereafter) have proposed a model that combines both approaches to explain how the relative importance of knowledge capital over physical capital affects the firm's choice between FDI and foreign outsourcing. They show that firms with a higher physical capital intensity tend to choose foreign outsourcing, whereas firms with a higher knowledge capital intensity tend to conduct FDI. Based on the theoretical analysis, CHM provide an interesting testable hypothesis that firms with a higher Tobin's q (i.e., the ratio of firm's market value to the replacement value of book equity) are more likely to establish foreign subsidiaries. Because the firm's market value reflects both knowledge-based and physical assets, and given that the book value of capital reflects only physical assets, a firm with a higher knowledge capital intensity will have a higher Tobin's q. Consequently, their hypothesis implies that firms with a high Tobin's q tend to conduct FDI, whereas those with a low Tobin's q tend to choose foreign outsourcing.

Despite its potential importance, existing empirical studies have not paid enough attention to the relationship between Tobin's q and firm choice of globalization mode. Thus, this paper empirically investigates whether and to what extent Tobin's q and firm productivity influence a firm's choice of globalization modes. We employ detailed Japanese firm-level data covering the period 1994–99. Our dataset includes information on sales, employment, capital, R&D expenditure, direct exports, the costs of domestic and foreign outsourcing of the companies headquartered in Japan, and the sales of their foreign affiliates. Corporate balance sheet data are also included. The advantage of our dataset over previous studies is that it allows us to recognize not only whether a firm engages in a particular globalization activity (i.e., exports, FDI, and foreign outsourcing) but also the extent to which it is involved in that activity. Thus, we can employ estimation techniques that are more informative than categorizing globalization activities by binary variables that equal one if a firm engages in a particular activity and zero if otherwise.[2] Utilizing this feature of our dataset, we construct indexes to measure the relative choice of globalization mode by calculating the ratio of the volume of direct exports by the headquarters company to *horizontal* FDI (i.e., sales of foreign affiliates, excluding exports to Japan) and the ratio of the costs of foreign outsourcing to the total FDI (i.e., total sales of foreign affiliates). To estimate Tobin's q, we employ the simple approximation proposed by DaDalt, Donaldson, and Garner (2003). Finally, using the method developed in Olley and Pakes (1996), we compute the total factor productivity (TFP) to measure the firm's productivity. We then regress the indexes of globalization activity on these explanatory variables. Our analysis mainly focuses on firms that engage in multiple globalization modes and attempts to reveal whether a difference in Tobin's q or TFP motivates those firms to select more or less FDI relative to exports or foreign outsourcing.[3] No previous study has investigated this issue, although some studies (e.g., Tomiura, 2007) have documented superior performance of firms that engage in multiple modes relative to those with a single mode.

In our estimation, we must seriously consider and address the distributional characteristics of our globalization indexes, which exhibit strong negative skewness and include outliers. Traditional estimation techniques, such as the linear regression model, may not be appropriate because they provide information only about the effects of the regressors at the conditional mean of the dependent variable. Given the nature of our sample, it is important to estimate the effects of the regressors at different points in the conditional distribution of the dependent variable. To address this issue, we employ *quantile regression* (QR), which provides estimates of the parameters at different quantiles of the dependent variable.[4] Moreover, given the need to handle possible endogeneity in our explanatory

[2] In the empirical literature, it is a popular approach to categorize globalization activities by binary variables. Studies on outsourcing, such as Defever and Toubal (2007), Federico (2010), and Kohler and Smolka (2012), also take this approach.

[3] We also estimate the effects of Tobin's q and TFP on each globalization activity by constructing indexes to measure the degree of engagement in each globalization mode.

[4] Koenker and Bassett (1978) first introduced QR. Koenker and Hallock (2001) give a non-technical introduction to QR. For technical details, see Koenker (2005). Wagner (2006) applies QR to the analysis of the export behavior of German manufacturing plants and shows that the effects of plant characteristics, such as size, branch status, and R&D intensity, on export activity vary with the conditional size distribution of the export/sales ratio. Trofimenko (2008)

variables, we employ endogenous quantile regression (QRIV) using two sets of instrumental variables (IVs) to check the robustness of our estimation results.

The main findings of the paper are as follows. The QRIV results indicate that Tobin's q has a significantly negative effect on the ratio of foreign outsourcing to the total FDI at all quantiles but no definite effect on the ratio of exports to horizontal FDI. Thus, firms with a higher Tobin's q tend to choose a greater FDI and less foreign outsourcing, whereas the difference in Tobin's q has few implications for the choice between FDI and exports. The former supports the prediction of CHM. In contrast, a higher TFP favors horizontal FDI over exports, with statistical significance occurring at higher quantiles. However, TFP does not have a significant effect on the ratio of foreign outsourcing to the total FDI. These results suggest that an increase in TFP motivates a firm to increase its engagement in horizontal FDI relative to exports and that the difference in TFP does not significantly affect the choice between FDI and outsourcing. The former supports the prediction of HMY and concurs with existing empirical findings (e.g., HMY). On the other hand, the latter is different from findings in a limited number of existing studies (Tomiura, 2007; Federico, 2010; Kohler and Smolka, 2012).

To our knowledge, this is the first paper that reports evidence for the relationship between Tobin's q and the firm's choice of globalization mode. Another important contribution of this paper is to provide new evidence that multinationals with a higher TFP tend to devote a greater proportion of horizontal FDI to exports, whereas they do not necessarily devote a greater proportion of FDI to foreign outsourcing. Moreover, we contribute to the literature by proposing a new estimation strategy for investigating the effects of firm performance on the choice of globalization mode.

The remainder of the paper proceeds as follows. Section 2 describes the data and variables employed in the analysis. Section 3 explains our estimation strategy. Estimation results are reported in section 4. Section 5 concludes the paper.

applies QR to a related issue.

2 Data and Variables

2.1 Data

We collect data primarily from three datasets for Japanese companies: The Basic Survey of Japanese Business Structure and Activities (*Kigyo Katsudo Kihon Chosa*, hereafter KKKC), the Survey on Overseas Business Activities (*Kaigai Jigyo Katsudo Kihon Chosa*, hereafter KJKKC), and the Nikkei Economic Electronic Database Systems (NEEDS) Company Financial Reports.

KKKC and KJKKC are annual surveys by the Ministry of Economy, Trade, and Industry (METI).[5] The KKKC is a mandatory survey for all firms with 50 or more employees and paid-up capital or investment funds exceeding 30 million yen. It covers the mining, manufacturing, wholesale/retail trade, and service industries, and approximately 26,000 firms responded to the survey in 1999. On the other hand, the KJKKC is an approved-type survey for Japanese corporations which, as of the end of March, own or previously have owned overseas affiliates. The KJKKC lists two types of overseas affiliates: (i) those with at least 10% of their capital held by a Japanese parent company and (ii) those with at least 50% of their capital held by a foreign subsidiary that in turn has at least 50% of its capital held by a Japanese parent company. The KJKKC excludes foreign affiliates in the financial, insurance, and real estate industries. Approximately 2,200 Japanese parent companies and 14,000 overseas affiliates responded to the survey in 1999. Data from KKKC and KJKKC include sales, employment, capital, R&D expenditures, and direct exports of the headquarters, and the sales of their foreign affiliates. The KKKC for the period 1994–99 also includes information on outsourcing, i.e., the number of domestic and foreign firms to which a headquarters company has contracted manufacturing and/or processing tasks and the costs of contracting out business activities. Unfortunately, detailed data for outsourcing are not available after 2000. Because of this data limitation, our sample period is restricted to 1994–99.

Corporate balance sheet data, which we use to calculate Tobin's q and TFP, are from NEEDS,

[5] See the websites of METI for details of these surveys (KKKC: `http: //www.meti.go.jp /english/statistics/tyo/kikatu/index.html`; and KJKKC: `http://www.meti.go.jp/english/statistics/tyo /kaigaizi/index.html`).

which covers approximately 4,000 publicly traded firms on the Japanese stock market. NEEDS data cover the period from 1975 to the present. All Japanese publicly traded firms are identifiable using two codes—a Nikkei company code defined by Nikkei, Inc., and a security code defined by the Japanese Securities Identification Code Committee. Given that firm codes in the KKKC and KJKKC surveys differ from those in NEEDS, we use the Nikkei company code to link the three datasets. By matching full names and addresses of companies in the three datasets, we identify approximately 1,000 to 1,300 headquarters companies for each year during the period 1994–99.[6] In our sample, each headquarters company engages in at least one globalization activity (exports, FDI, or foreign outsourcing).[7]

2.2 Indexes of Globalization Activity

Table 1 shows the globalization activity of our sampled firms by providing the number of firms engaging in each globalization mode. It is clear that many firms engage in multiple globalization modes rather than a single mode. For example, more than 550 firms engaged in both exports and FDI in 1999. This is more than double the number of firms engaged only in exports in 1999. This evidence is important when selecting our preferred empirical framework.

(Insert Table 1 around here.)

Moreover, our dataset contains unique information about other dimensions of firms' globalization activities, including sales of foreign affiliates, the value of exports from the headquarters in Japan, and costs of foreign outsourcing. By exploiting information available in our dataset, we are able to measure the extent of engagement in each globalization mode by taking the ratio of the size of a particular activity (exports, FDI, or foreign outsourcing) to the domestic sales of headquarters companies. We can also measure the firm's relative choice of globalization mode by calculating the ratio of two variables representing its globalization activity. To start with, we denote domestic sales by headquarters companies in Japan as D, the total sales of foreign affiliates as I, the value of exports

[6]Note that, even among those identified companies, many do not answer every item in the surveys each year during the sample period.

[7]In the sample of headquarters companies in the KJKKC and KKKC surveys, approximately two-thirds report implementing at least one globalization activity during 1994–99.

from the headquarters companies as X, and the costs of foreign outsourcing as O. I measures the size of the total FDI. We then construct an additional measure of FDI (denoted as I^h, where the superscript h refers to the horizontal type) by excluding exports to Japan from the sales of foreign affiliates, which measures the size of *horizontal* FDI. Using these variables, we calculate the ratio of each globalization activity (i.e., X, I, I^h, and O) to D, denoted as RXD, RID, RI^hD, and ROD. Moreover, we also calculate the ratio of X to I^h, denoted as RXI^h, to capture the relative choice between exports and horizontal FDI, and the ratio of O to I, denoted as ROI, to capture the relative choice between foreign outsourcing and FDI.

In the index for the relative choice of exports over FDI, we use I^h as the measure of FDI. This is because, as HMY show, in the choice between export and FDI, what matters to firms is horizontal FDI. Conversely, ROI measures the relative choice of foreign outsourcing over FDI. In this index, we consider that the total sales of foreign affiliates, including exports to the source country, are an appropriate measure of FDI. The reason is that in the choice between FDI and foreign outsourcing, foreign partners may sell outputs on the local market, ship them to third-party countries, or return them to the source country. Note that by specifying the total sales of foreign affiliates as a measure of FDI, our analysis is consistent with that of CHM, who consider only the case where production occurs in the foreign country and a domestic firm chooses either FDI or outsourcing. In their model, FDI can be horizontal or vertical.

Table 2 provides descriptive statistics for these indexes. As shown, the percentiles and means suggest that the distributions of these indexes are extremely negatively skewed.

(Insert Table 2 around here.)

2.3 Tobin's q and TFP

We measure Tobin's q using the ratio of the firm's market value to its tangible assets. We follow DaDalt, Donaldson, and Garner (2003) and specify the following simple approximation of Tobin's q:[8]

$$\text{Tobin's } q = \frac{MVE + PS + LTDEBT + CL + BVINV - NCA}{TA}, \tag{1}$$

where MVE is the year-end value of a common stock, PS is the liquidation value of a preferred stock, and $LTDEBT$, CL, $BVINV$, CA, NCA, and TA denote the book values of long-term debt, current liabilities, inventory, current assets, net current assets, and total assets, respectively. We exclude PS in our measure of Tobin's q because the requisite data are unavailable.

We estimate TFP following Olley and Pakes (1996) and Keller and Yeaple (2009). Let y_{it} be the logarithm of the value added of firm i at time t and k_{it} and l_{it} be the logarithm of the firm's capital and labor, respectively. TFP is then given by

$$TFP_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}, \tag{2}$$

where $\hat{\beta}_l$ and $\hat{\beta}_k$ are consistent estimates of the labor and capital elasticities. A detailed derivation of Eq. (2) is provided in Appendix B.

In our data, it turns out that the correlation between Tobin's q and TFP is positive but weak. The correlation coefficient is 0.121 (see Table A.1).[9]

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[8] Several studies significantly incorporate more complex estimations of Tobin's q, which rely on the estimated market value of the firm (Abel and Blanchard, 1986; Perfect and Wiles, 1994). However, as argued by DaDalt, Donaldson, and Garner (2003), although these approaches to Tobin's q produce more precise estimations, they are computationally costly. Moreover, these approaches may be subject to greater selection bias. DaDalt, Donaldson, and Garner (2003) suggest that a simple approach is then preferable unless the extreme precision of the q estimates is paramount and sample selection bias is not likely to be significant.

[9] The relationship between firm productivity and Tobin's q is not as obvious. In theory, there may or may not be a positive relationship between productivity and Tobin's q (Dwyer, 2001). In the presence of ex ante uncertainty with respect to the outcome of investment, and given that firms with successful investments will have high productivity and market value relative to the replacement cost of assets, a positive relationship exists between productivity and Tobin's q (Jovanovic, 1982; Hopenhayn, 1992: Melitz, 2003). In contrast, if physical capital embodies any productivity differential, the relationship between them is not necessarily positive (Cooley, Greenwood, and Yorukoglu, 1997). Some

3 Estimation Strategy

Our primary estimation strategy is to employ *quantile regression* (QR). As discussed in the previous section, the globalization indexes in our sample have a strong negatively skewed distribution, indicating that heterogeneity across firms may be substantial. Thus, relationships between the globalization indexes and firm characteristics also may differ across firms. The major advantage of quantile regression is that it can provide information about the relationship at different points in the conditional distribution of the globalization indexes. In contrast, traditional regression techniques, such as ordinary least squares (OLS), can only summarize the average relationship between the globalization indexes and the set of regressors. A key underlying assumption of such traditional techniques is that the effects of the regressors on the dependent variable are best represented at the conditional mean of the dependent variable. This is not the case in the presence of a skewed distribution.

In our analysis, we first use an algorithm known as least absolute deviations (LAD) to provide quantile estimates, where the estimation is implemented by solving linear programming problems.[10] We then address endogeneity. Endogeneity potentially arises because factors that simultaneously influence the choice of globalization mode and Tobin's q or TFP may exist. The problems of omitted variables or sample selection also may involve endogeneity. To control for possible endogeneity, we employ the endogenous quantile regression (QRIV) technique proposed by Lee (2007). The estimation procedure consists of two steps. The first step is to estimate the residuals of the reduced-form equation for the endogenous explanatory variables, i.e., Tobin's q or TFP. The second step is to estimate the primary equation, which describes the relation between the choice of globalization mode and Tobin's q or TFP, using the reduced-form residual as an additional explanatory variable.

In general, it is not easy to find appropriate instrumental variables (IVs). We employ IVs that are assumed to be correlated with factors that determine the firm performance, suggested by Griliches (1981) and others. We use two sets of IVs to check the robustness of our estimation results. The first set includes the logarithm of sales LnS, the ratio of profits to the equipment capital PK, and

studies in the corporate finance literature find a positive relationship between firm productivity and Tobin's q even after controlling other factors that affect the firm's market value (Palia and Lichtenberg, 1999; Dwyer, 2001).

[10] See Cameron and Trivedi (2009) for the detailed Stata command for the QR.

the logarithm of the years in business of the headquarters company LnT^B. LnS and LnT^B are used as proxy variables for firm size and business experience, respectively. We denote the QRIV with the first set of IVs as QRIV(1). The second set of IVs consists of $LnKL$ and $LnRL$, which respectively denote the ratio of the equipment capital to labor input and the ratio of R&D stock to labor input (in logs) for the headquarters company, such that $LnKL = \ln(K/L)$ and $LnRL = \ln(RD/L)$. $LnKL$ and $LnRL$ measure the physical capital intensity and the R&D intensity of the headquarters company, respectively. Appendix A provides details on the calculation of the equipment capital (K) and the R&D stock (RD). We measure labor input (L) using the number of full-time employees. We denote the QRIV with the second set of IVs as QRIV(2). We assume that if changes in these IVs are not controlled, they will be part of the error, accounting for inconsistent estimates as long as they are correlated with the performance of the headquarters companies, such as Tobin's q and TFP.[11]

4 Empirical Results

In this section, we report our estimation results. We first analyze the effects of Tobin's q and TFP on the degree of firm engagement in a particular globalization mode by regressing each of RXD, RID, RI^hD, and ROD on Tobin's q and TFP. As reported in the supplementary appendix, our estimation results indicate that the coefficients are generally significantly positive at high quantiles for both Tobin's q and TFP, which suggests that Tobin's q and TFP are both positively related to engagement in globalization activity. Thus, our results concur with existing theoretical and empirical findings. See the supplement for details of these results.

We next regress the indexes of the relative choice of globalization mode on Tobin's q and TFP. As we calculate the ratios of the two globalization modes (i.e., exports to horizontal FDI for RXI^h and foreign outsourcing to the total FDI for ROI), we exclude the observations that have zero values for at least one of the two modes. We report our regression results for Tobin's q and TFP separately in the following subsections.

[11]Table A.1 reports the correlations of the variables. As shown in this table, our IVs are fairly correlated with either or both of Tobin's q and TFP, while they have no evident correlation with the indexes of globalization activity.

4.1 The effects of Tobin's q

We first report our estimation results regarding the effects of Tobin's q on the relative choice of globalization modes. The upper panel of Table 3 summarizes the results from the OLS, robust OLS (ROLS), and QR estimations of RXI^h and ROI on the logarithm of Tobin's q, denoted LnQ.[12] The OLS estimates shown in the first column yield an insignificant coefficient of LnQ for both RXI^h and ROI, and the magnitude of the estimated coefficients is relatively large, suggesting that the presence of outliers seriously affects the regression coefficients. ROLS is an estimation technique that can address the issue of outliers. We employ ROLS with two types of weights—Huber weighting and biweighting.[13] As reported in the second column, the magnitude of the estimated coefficients becomes modest by employing ROLS. Although negatively significant estimates are obtained for both RXI^h and ROI, they are highly sensitive to the choice of the biweight tuning constant.

Columns 3–7 report the results from the QR estimations. As shown in the table, we apply QR at five quantiles: 0.10, 0.25, 0.50, 0.75, and 0.90. The results indicate that the point estimates and the statistical significance of the estimated coefficients from QR differ substantially across the quantiles and from the OLS or ROLS estimates. The estimated coefficient of LnQ in the regression of RXI^h is statistically insignificant, except for the point estimate at the 0.90 quantile, which is significantly positive. In the regression of ROI, in contrast, the coefficient of LnQ is significantly negative at the 0.10, 0.50, 0.75, and 0.90 quantiles, and its significance level reaches 10.5% at the 0.25 quantile. Thus, an increase in Tobin's q tends to motivate a firm toward more FDI and away from foreign outsourcing.

(Insert Table 3 around here.)

To check the robustness of the QR findings, and to account for the possible endogeneity of both TFP and Tobin's q, we employ a QRIV technique using two sets of IVs, as explained in the previous section. Table 4 reports the estimated coefficients of LnQ from QRIV.[14] Similar to the estimations in

[12] The estimations of QR are implemented using Stata's command `sqreg` with 500 bootstrapping replications.

[13] The ROLS estimations are implemented using Stata's command `rreg`. It first runs the OLS and obtains the Cook's distance for each observation. Then, after dropping observations with Cook's distance greater than one, the iteration process begins with calculating weights based on absolute residuals. See Huber (1981) for details on robust regressions.

[14] The estimation is implemented using Stata's command `cqiv`. The Stata code for `cqiv` is released and introduced

Table 3, we apply QRIV at 0.10, 0.25, 0.50, 0.75, and 0.90 quantiles. In this table, the values in square brackets indicate the lower and upper bounds of a 95% confidence interval. QRIV(1) and QRIV(2) indicate the estimated results from QRIV with the first and the second sets of IVs, respectively. The upper panel of Table 4 summarizes the regression of RXI^h on LnQ. The coefficients of LnQ are positively significant at the 0.10 and 0.25 quantiles in QRIV(1) and at the 0.10 quantile in QRIV(2), and they are insignificant at all other quantiles. The lower panel of Table 4 shows the results of QRIV estimations for ROI. The estimated coefficients of LnQ are significantly negative at all quantiles in QRIV(1). In QRIV(2), the coefficients of LnQ are significantly negative at the 0.50 and 0.75 quantiles. Although the significance level at the 0.25 quantile is greater than 12%, the pointwise confidence interval at the 0.25 quantile does not include zero. These results indicate that the findings from QR estimation are robust even after controlling for endogeneity and that the two sets of IVs yield consistent estimates for the most part. That is, LnQ has a significantly negative effect on ROI, whereas it has no definite effect on RXI^h. The former strongly supports the hypothesis of CHM that firms producing goods with a higher knowledge capital intensity tend to choose FDI over foreign outsourcing.

(Insert Table 4 around here.)

4.2 The effects of TFP

We turn to the analysis of the effects of TFP. The lower panel of Table 3 summarizes the results from the OLS, ROLS, and QR estimations of RXI^h and ROI on TFP.[15] First, the OLS estimate of TFP shown in the first column is subject to the same problem as that of LnQ. It seems to be seriously affected by the presence of outliers. Second, as shown in the second column, the ROLS estimates of TFP indicate the modest magnitude but still insignificant. As in the analysis of Tobin's q, the

by Chernozhukov, Fernández-Val, and Kowalski (2011). We employ an endogenous quantile estimation involved in `cqiv` without censoring, which is developed on the basis of Lee (2007). The information required to build pointwise confidence intervals is obtained by 500 bootstrap replications. The value of t-statistics is measured using the bootstrap mean and the lower and upper bounds of a 95% confidence interval.

[15]See footnotes 12 and 13 for an explanation of QR and ROLS estimations.

estimated results from ROLS are highly sensitive to the choice of the biweight tuning constant. Third, the QR estimates are shown in columns 3–7. The estimated coefficients of TFP in the regression of RXI^h are insignificant at the 0.10 and 0.25 quantiles, and it turns significantly negative with the 11% significance level at the 0.50 quantile. The estimates become significantly negative at the 0.75 and 0.90 quantiles. This result implies that a higher TFP favors horizontal FDI over exports at high quantiles. In the regression of ROI, on the other hand, the estimated coefficient is insignificant at all quantiles.

Table 5 reports the estimated coefficients from QRIV.[16] As in the analysis of Tobin's q, we estimate QRIV with two sets of IVs. These results are indicated as QRIV(1) and QRIV(2) in Table 5. The upper panel of Table 5 summarizes the regression of RXI^h on TFP. In both QRIV(1) and QRIV(2), the estimated coefficients of TFP are now significantly negative at the 0.50, 0.75, and 0.90 quantiles. These results indicates that controlling for endogeneity strengthens the estimated results. TFP has a significantly negative effect on RXI^h at higher quantiles. It implies that an increase in firm productivity tends to motivate a firm to choose a greater horizontal FDI and less export, conditional on the firm engaging in a higher rate of exports relative to horizontal FDI. This result supports the hypothesis of HMY. The lower panel reports the results from QRIV for ROI. In QRIV(1), we obtain negative but insignificant estimates for the coefficient of TFP at all quantiles other than the 0.10 quantile. On the other hand, in QRIV(2), TFP yields positive but again insignificant estimates at all quantiles. Thus, we cannot find any significant effect of TFP on the choice between FDI and foreign outsourcing.

(Insert Table 5 around here.)

4.3 Graphical presentation of the estimated results

Finally, we plot point and interval estimates from QR in Figure 1 and those from QRIV with two different sets of IVs in Figures 2 and 3. In each panel in these figures, the horizontal axis measures the quantile, and the vertical axis measures the value of estimates. Moreover, the thick black lines

[16] See footnote 14 for an explanation of QRIV estimation.

depict the point estimates at various quantiles and dashed lines indicate the lower and upper bounds of a 95% confidence interval. These figures report the estimated results for all quantiles rather than at particularly selected quantiles. Figure 1 depicts the estimates for LnQ in panels (a) and (b) and those for TFP in panels (c) and (d). Panel (a) shows that the 95% confidence interval for the estimate of RXI^h on LnQ crosses zero at most quantiles and lies above zero at the quantiles higher than 0.80. In the regression of ROI on LnQ (panel (b)), the confidence interval does not include zero at most quantiles, while there are some disturbances at the quantiles higher than 0.90, which may be due to the endogeneity problem. In the estimations of RXI^h on TFP (panel (c)), the confidence interval for the estimate crosses zero at lower quantiles and is below zero at higher quantiles. Panel (d) shows that the confidence interval for the estimate of ROI on TFP includes zero throughout the quantiles.

(Insert Figure 1 around here.)

Figures 2 and 3 indicate that the importance of controlling for the endogeneity is apparent and that the two sets of IVs yield consistent results for the QRIV regressions. Figure 2 reports point and interval estimates from QRIV for LnQ. Panels (a) and (b) in it show that the 95% confidence interval in the regression of RXI^h on LnQ includes zero at quantiles higher than 0.40 in QRIV(1) and higher than 0.20 in QRIV(2). In contrast, panels (c) and (d) show that the confidence interval for the estimated coefficient of LnQ in the regression of ROI lies below zero at all quantiles in QRIV(1) and at quantiles higher than 0.20 in QRIV(2). Figure 3 reports the QRIV estimates for TFP. Panels (a) and (b) in it show that the confidence interval in the regression of RXI^h is below zero at quantiles higher than 0.50 in both QRIV(1) and QRIV(2). In panels (c) and (d), on the other hand, the estimates of ROI on TFP are insignificant at most quantiles.

(Insert Figures 2 and 3 around here.)

5 Conclusion

Using Japanese firm-level data, we empirically investigated how the firm choice of globalization mode differs according to Tobin's q and TFP. We found that firms with a higher Tobin's q tend to choose a greater FDI and less foreign outsourcing, which supports the prediction of CHM. However, we could not find any definite effect of Tobin's q on the choice between FDI and exports. On the other hand, firms with a higher TFP tend to choose a greater FDI and less exports, which supports the prediction by HMY. However, the choice between FDI and foreign outsourcing is not affected by any difference in TFP. Controlling for endogeneity with IVs in QR strengthened our estimation results for the most part. This is the first empirical study that analyzes the relationship between Tobin's q and the choice of globalization mode. Moreover, although many previous empirical studies have investigated the relationship between firm productivity and the choice of exports versus FDI, this paper provided new evidence that multinationals with a higher TFP favor FDI over exports.

According to our empirical analysis of the links between Tobin's q and the choice of globalization mode, the knowledge capital intensity *does* affect the choice between FDI and foreign outsourcing, as CHM demonstrate. However, the knowledge capital intensity is not so important when a firm makes a choice between exports and FDI. This may be because domestic production for exports and the offshore production under FDI are both undertaken within the boundary of the firm. On the other hand, our analysis also demonstrates that the ordering of firm productivity may not be monotonically related to the choice between FDI and foreign outsourcing. This finding may appear to be inconsistent with the prediction of Antràs and Helpman (2004). However, as Grossman, Helpman, and Szeidel (2005) and Defever and Toubal (2007) show, the productivity ordering in the Antràs and Helpman's (2004) model depends crucially on the relative size of fixed costs associated to FDI and foreign outsourcing. Thus, their prediction concerning the productivity ordering is not robust. Our estimates reveal that there is actually no robust relationship between TFP and the choice of FDI versus foreign outsourcing.

Finally, our results suggest that QR is an appropriate estimation technique when analyzing the relationship between the globalization mode and firm characteristics because the distributions of the indexes of globalization activities have strong negative skewness and include outliers. Results obtained from employing traditional estimation techniques that yield information only at the conditional mean of the dependent variable may be unsatisfactory. QR provides more valuable information on the effects of the regressors than such traditional techniques. Actually, our QR estimations revealed that the effects of Tobin's q or TFP on the choice of the globalization mode could vary among quantiles.

Appendix A Value added, Equipment Stock, and R&D Stock

Value added Y_{it} is measured as follows:

$$Y_{it} = SA_{it} - COGS_{it} - SGA_{it} + OR_{it} + PE_{it} + DE_{it} + ST_{it},$$

where SA, $COGS$, SGA, OR, PE, DE, and ST denote total sales; cost of goods sold; selling, general & administrative expenses; office rents; payroll expenses; depreciation expenses; and sundry taxes of firm i at time t. All values are converted into real measures using the GDP deflator released by METI.

The equipment stock K_{it} is estimated by the perpetual inventory method:

$$K_{it} = I_{it} + (1 - \delta)K_{it-1}, \tag{A.1}$$

where K_{it} is the stock of equipment of firm i at the end of period t, I_{it} is the real investment of equipment of firm i during period t, and δ is the depreciation rate. Real investment I_{it} includes three types of investment involved in firm production: buildings and structures, machinery, and transportation machinery and tools. Following Hayashi and Inoue (1991), we apply depreciation rates of 5.2%, 9.5%, and 8.8% to buildings and structures, machinery, and transportation machinery and tools, respectively. We estimate each type of investment using (A.1) first and then aggregate them into K_{it}.

The R&D stock RD_{it} is computed in a manner similar to that used to compute equipment stock. That is, in Eq. (A.1), K_{it} is replaced by RD_{it}, and I_{it} is interpreted as the firm i's real R&D expenditure in period t. In calculating the R&D stock, we use $\delta = 0.15$, a conventional depreciation rate for building R&D stock. In the analysis, we specify that the stock variables (K and RD) lagged one period.

Appendix B Productivity Estimation

We first consider the following production function:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \eta_{it}, \tag{A.2}$$

where y_{it} is the logarithm of value added $\ln Y$ in firm i at time t, k_{it} is the logarithm of the capital input $\ln K$, l_{it} is the logarithm of the number of full-time employees $\ln L$, ω_{it} is productivity, and η_{it} is either measurement error or a shock to production. Both ω and η are not observed. Olley and Pakes (1996) argue that the endogeneity of input demand and self-selection induced by the exit behavior bias the OLS estimates of (A.2). In general, endogeneity arises because input choices are determined by the firm's beliefs about ω_{it} when these inputs are used.

Following Olley and Pakes (1996), we assume that labor is the only variable factor whose choice can be affected by the current value of ω and that capital k is a fixed factor only affected by the distribution of ω_{it}, conditional on the information available at time $t-1$ and past values of ω. The investment demand function is then $i_{it} = i(\omega_{it}, k_{it})$. Provided $i_{it} > 0$, the equation is strictly increasing in ω for any k. Thus, the investment demand function can be inverted to yield $\omega_{it} = h(i_{it}, k_{it})$. Substituting into (A.2) gives

$$y_{it} = \beta_l l_{it} + \phi(i_{it}, k_{it}) + \eta_{it}, \tag{A.3}$$

where $\phi(i_{it}, k_{it}) = \beta_0 + \beta_k k_{it} + h(i_{it}, k_{it})$. Because $\phi(\cdot)$ contains the productivity term ω, which is the source of the simultaneity bias, we can estimate (A.3) to obtain consistent estimates for β_l.[17] We use a fourth-order polynomial with interaction terms in investment and capital to identify the unknown function $\phi(\cdot)$. As the investment demand function (and hence $\phi(\cdot)$) should differ across industries, we estimate different polynomials for each of ten main sectors: (i) food, textiles/apparel, and wood/paper products; (ii) chemicals, pharmaceuticals, and refined petroleum products; (iii) non-metallic products, basic metals, and fabricated metal products; (iv) machinery and precision instruments; (v) electrical and electronic equipment; (vi) transportation equipment; (vii) construction; (viii) trading; (ix) wholesale trade; and (x) other service activities.

A firm maximizes its expected value of both current and future profits and evolves according to an exogenous Markov process. In every period, the firm decides whether to continue operations along with decisions about its labor input l and investment i, conditional on staying in the market.

[17] Eq. (A.3) is referred to as the "partially linear" model, which identifies β_l but not the production function coefficient of capital β_k.

With consistent estimates of β_l, we use estimates of the survival probabilities to identify β_k. The survival probabilities Pr_{it} are obtained using a probit regression on a fourth-order polynomial with the interaction terms for capital and investment with a one-period lag. The final step to estimate β_k is as follows:

$$y_{it} - \hat{\beta}_l l_{it} = \beta_k k_{it} + g(\hat{\phi}_{it-1} - \beta_k k_{it-1}, \widehat{Pr}_{it}) + \eta_{it}, \tag{A.4}$$

where variables with a hat (^) indicate estimators of these variables. In Eq. (A.4), we also estimate the unknown function $g(\cdot)$ using a fourth-order polynomial with interaction terms for $\hat{\phi}_{it-1} - \beta_k k_{it-1}$ and $\widehat{Pr}_{it}$ with non-linear regression on β_k. Using consistent estimates of β_l and β_k, we estimate TFP as $TFP_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it}$, which is Eq. (2) in the main text.

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Table 1: Globalization Choice of Japanese Companies

Year	No. of firms	Export (X) only	FDI (I) only	Outsource (O) only	$X+I$	$I+O$	$X+O$	All ($X+I+O$)
1994	1006	325	32	13	315	101	131	89
1995	1280	277	51	6	503	141	167	135
1996	1388	234	68	9	555	167	195	160
1997	1323	193	77	5	569	157	173	149
1998	1334	222	67	9	551	153	186	146
1999	1380	248	71	13	552	157	188	151

Source: Author calculations using KKKC and KJKKC for 1994-99.

Table 2: Descriptive Statistics

	No. of obs.	Mean	Std. Dev.	Percentiles 5%	10%	25%	50%	75%	90%	95%
Tobin's q	5221	1.177	0.723	0.441	0.577	0.840	1.106	1.390	1.714	1.986
TFP	5148	1.260	0.587	0.464	0.607	0.863	1.254	1.635	1.963	2.186
RXD	4884	0.132	0.550	0.000	0.000	0.009	0.048	0.154	0.326	0.459
RID	4035	0.469	2.593	0.000	0.000	0.004	0.073	0.303	0.850	1.623
RI^hD	2461	0.359	1.632	0.000	0.001	0.018	0.086	0.280	0.696	1.272
ROD	4792	0.014	0.082	0.000	0.000	0.000	0.000	0.000	0.016	0.057
RXI^h	2122	24.116	492.620	0.025	0.057	0.168	0.533	1.730	6.105	15.444
ROI	876	33.872	575.101	0.001	0.005	0.018	0.075	0.362	1.000	3.047
$LnKL$	5214	3.906	0.864	2.429	2.910	3.461	3.932	4.397	4.928	5.322
$LnRL$	3951	0.555	2.041	−2.964	−1.728	−0.343	0.906	1.930	2.678	3.024
LnS	5217	6.905	1.221	5.170	5.451	6.059	6.775	7.603	8.481	9.159
LnT^B	5187	3.927	0.324	3.258	3.555	3.829	3.932	4.111	4.344	4.382
PK	5218	0.091	0.351	−0.021	−0.002	0.010	0.028	0.073	0.182	0.315

Source: Author calculations using KKKC, KJKKC, and NEEDS for 1994-99.

Table 3: OLS and QR Estimates

Dependent variable	OLS	ROLS	Quantile regression estimates 0.10	0.25	0.50	0.75	0.90	No. of obs.
	Independent variable: LnQ							
RXI^h	11.444	-0.068^{**}	0.014	-0.008	-0.043	0.130	1.209^{***}	2117
	(1.19)	(-2.24)	(1.24)	(-0.44)	(-1.57)	(1.10)	(3.15)	
ROI	38.287	-0.020^{**}	-0.003^{**}	-0.008	-0.054^{***}	-0.159^{**}	-0.216^{*}	876
	(1.29)	(-2.04)	(-2.22)	(-1.62)	(-3.02)	(-2.44)	(-1.73)	
	Independent variable: TFP							
RXI^h	20.376	0.027	0.0004	-0.002	-0.110	-0.690^{***}	-1.914^{**}	2104
	(1.28)	(0.77)	(0.05)	(-0.09)	(-1.60)	(-3.21)	(-2.46)	
ROI	139.478	0.012	-0.001	-0.007	0.007	-0.018	0.098	862
	(1.37)	(1.37)	(-0.40)	(-1.26)	(0.34)	(-0.20)	(0.27)	

Notes: (1) QR estimations are implemented in Stata's command `sqreg` with 500 bootstrap replications.

(2) Constant terms and time and sector dummies are included in the estimations.

(3) Values in parentheses are t-statistics.

(4) Robust variance calculation is used in the variance estimator for OLS regression.

(5) "***","**", and "*" indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: QRIV Estimates for the Effects of LnQ

	Dep. var.	Quantiles 0.10	0.25	0.50	0.75	0.90	No. of obs.
		Independent variable: LnQ					
QRIV(1)	RXI^h	0.119^{**}	0.181^{**}	0.049	−1.267	−4.990	2039
		(2.35)	(2.01)	(0.53)	(−0.01)	(−0.62)	
		[0.027, 0.201]	[0.029, 0.393]	[−0.263, 0.496]	[−1.270, 1.626]	[−7.562, 4.461]	
QRIV(2)	RXI^h	0.225^{*}	0.109	0.492	3.617	19.557	1793
		(1.89)	(0.78)	(0.92)	(1.15)	(1.40)	
		[0.019, 0.403]	[−0.207, 0.521]	[−0.385, 1.614]	[−1.163, 5.135]	[−4.051, 20.258]	
		Independent variable: LnQ					
QRIV(1)	ROI	-0.024^{**}	-0.071^{***}	-0.387^{***}	-1.363^{***}	-2.404^{***}	844
		(−2.50)	(−2.66)	(−3.47)	(−3.95)	(−3.51)	
		[−0.045, −0.005]	[−0.167, −0.035]	[−0.545, −0.157]	[−1.696, −0.624]	[−2.825, −0.876]	
QRIV(2)	ROI	−0.019	−0.106	-0.422^{**}	-1.205^{*}	−3.217	756
		(−0.97)	(−1.54)	(−2.17)	(−1.77)	(−0.98)	
		[−0.120, 0.015]	[−0.315, −0.016]	[−1.127, −0.183]	[−3.040, −0.101]	[−9.131, 0.988]	

Notes: (1) Estimations are implemented using Stata's command `cqiv` with 500 bootstrap replications.

(2) Constant terms and time and sector dummies are included in the estimations.

(3) Values in square brackets are the lower and upper bounds of a 95% confidence interval.

(4) Values in parentheses are t-statistics measured by bootstrap mean and confidence intervals.

(5) An endogenous variable is LnQ. QRIV(1) includes LnS, LnT^B, and PK as IVs and QRIV(2) includes $LnKL$ and $LnRL$ as IVs.

(6) "***","**", and "*" indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5: QRIV Estimates for the Effects of TFP

	Dep. var.	Quantiles 0.10	0.25	0.50	0.75	0.90	No. of obs.
		Independent variable: TFP					
QRIV(1)	RXI^h	0.020	-0.043	-0.298^{**}	-1.215^{**}	-3.891^{**}	2029
		(0.75)	(-0.33)	(-2.34)	(-2.31)	(-2.21)	
		[-0.033, 0.086]	[-0.172, 0.102]	[-0.778, -0.066]	[-2.927, -0.379]	[-7.687, -0.349]	
QRIV(2)	RXI^h	0.004	-0.033	-0.464^{*}	-2.736^{***}	-11.341^{***}	1785
		(-0.24)	(-0.41)	(-1.65)	(-3.10)	(-2.68)	
		[-0.101, 0.083]	[-0.207, 0.153]	[-1.282, 0.028]	[-5.927, -1.506]	[-16.832, -2.740]	
		Independent variable: TFP					
QRIV(1)	ROI	-0.014^{**}	-0.048	-0.262	-0.296	-0.466	832
		(-2.00)	(-1.04)	(-1.03)	(-0.91)	(-0.41)	
		[-0.043, -0.004]	[-0.129, 0.015]	[-0.344, 0.056]	[-0.460, 0.160]	[-0.859, 0.927]	
QRIV(2)	ROI	0.013	0.051	0.238	0.675	1.371	744
		(1.00)	(1.29)	(0.96)	(0.29)	(-0.06)	
		[-0.009, 0.041]	[-0.025, 0.125]	[-0.155, 0.479]	[-1.059, 1.163]	[-5.823, 3.105]	

Notes: (1) Estimations are implemented using Stata's command `cqiv` with 500 bootstrap replications.

(2) Constant terms and time and sector dummies are included in the estimations.

(3) Values in square brackets are the lower and upper bounds of a 95% confidence interval.

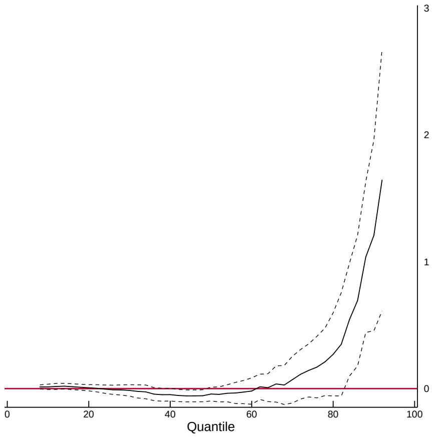
(4) Values in parentheses are t-statistics measured by bootstrap mean and confidence intervals.

(5) An endogenous variable is TFP. QRIV(1) includes LnS, LnT^B, and PK as IVs and QRIV(2) includes $LnKL$ and $LnRL$ as IVs.

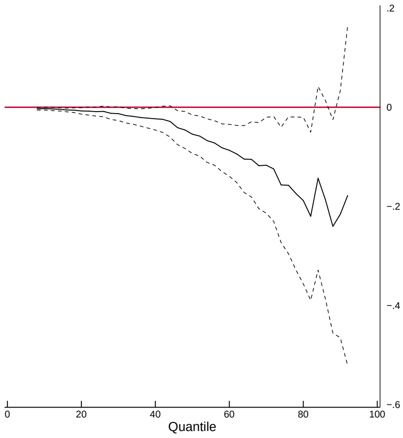
(6) "***","**", and "*" indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A.1: Correlations of Variables

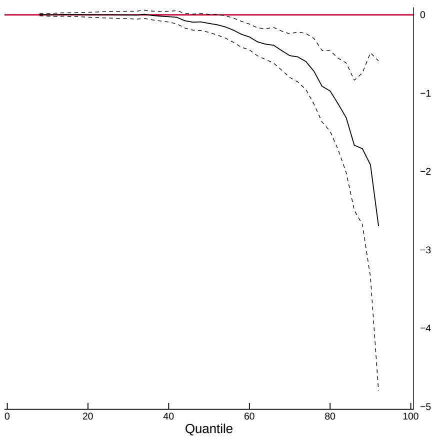
	LnQ	TFP	RXD	RID	RI^hD	ROD	RXI^h	ROI	$LnKL$	$LnRL$	LnS	LnT^B	PK
LnQ	1.000												
TFP	0.121	1.000											
RXD	0.045	0.099	1.000										
RID	0.027	0.022	0.226	1.000									
RI^hD	0.010	0.015	0.129	0.939	1.000								
ROD	−0.007	0.057	0.514	0.296	0.188	1.000							
RXI^h	0.005	0.035	0.044	0.001	−0.008	−0.005	1.000						
ROI	−0.023	0.029	−0.011	−0.014	−0.013	0.103	−0.002	1.000					
$LnKL$	0.017	−0.304	−0.015	0.073	0.069	−0.032	0.011	−0.072	1.000				
$LnRL$	0.118	0.041	0.117	0.089	0.080	0.025	−0.050	−0.021	0.364	1.000			
LnS	0.254	−0.036	0.119	0.014	−0.007	−0.004	0.032	−0.064	0.171	0.239	1.000		
LnT^B	−0.026	−0.184	−0.053	0.008	0.010	0.008	−0.005	−0.093	0.334	0.106	0.197	1.000	
PK	0.108	0.499	0.016	0.015	0.020	−0.020	0.007	−0.001	−0.341	−0.056	−0.120	−0.220	1.000



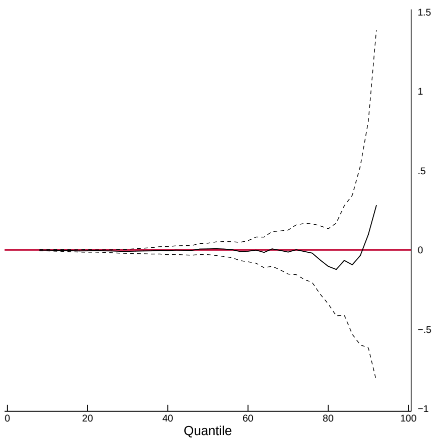
(a) RXI^h on LnQ



(b) ROI on LnQ



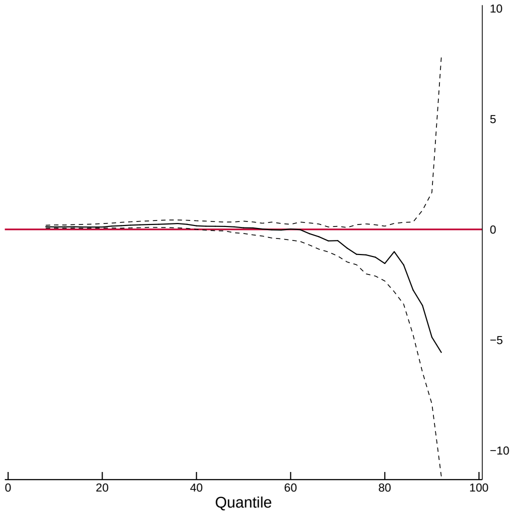
(c) RXI^h on TFP



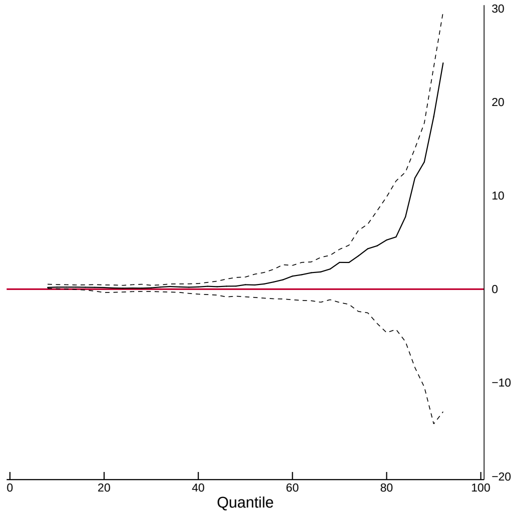
(d) ROI on TFP

Figure 1: QR Estimates and Confidence Intervals

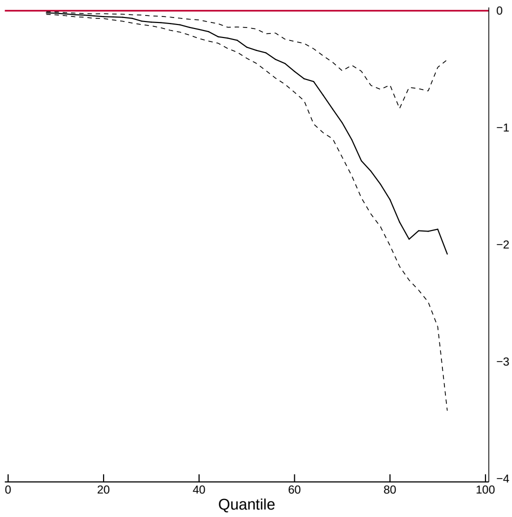
Note: Solid and dashed lines respectively refer to estimates and 95% confidence intervals estimated using Stata's command `sqreg` with 500 bootstrap replications.



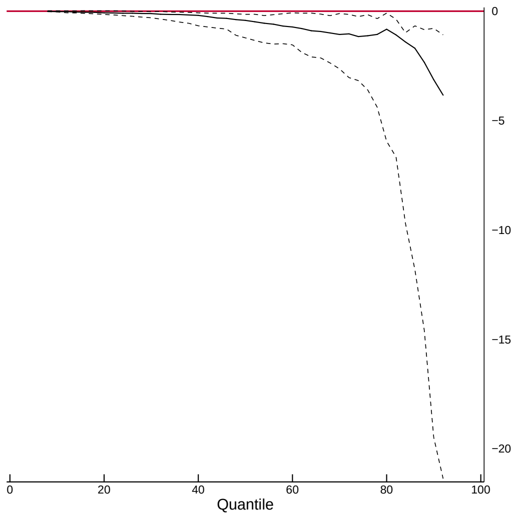
(a) RXI^h in QRIV(1)



(b) RXI^h in QRIV(2)



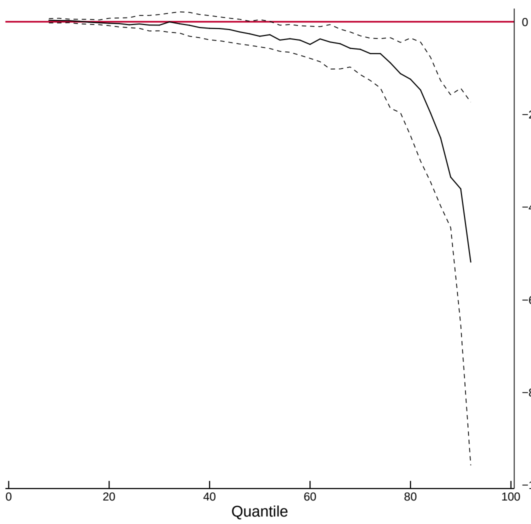
(c) ROI in QRIV(1)



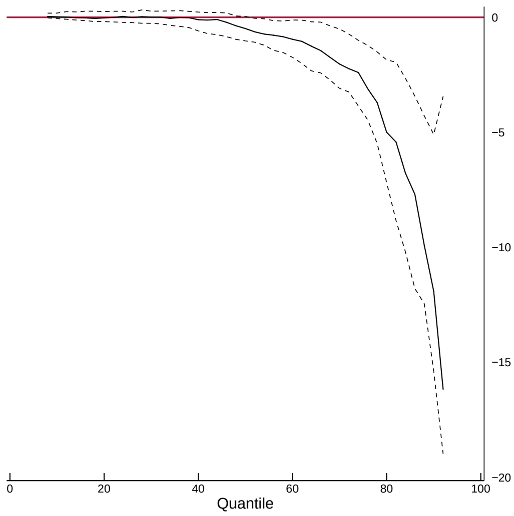
(d) ROI in QRIV(2)

Figure 2: QRIV Estimates and Confidence Intervals for LnQ

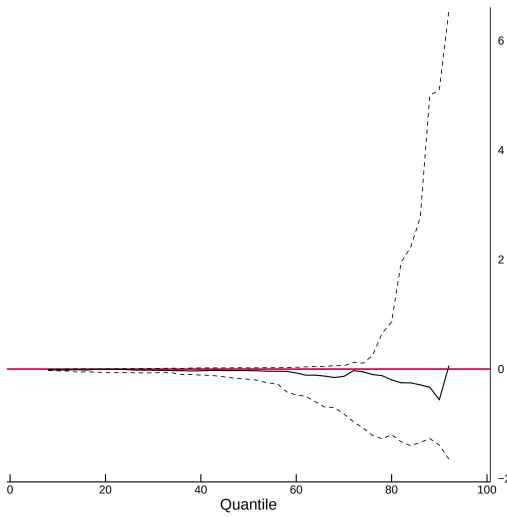
Notes: (a) Solid and dashed lines respectively refer to estimates and 95% confidence intervals estimated using Stata's command `cqiv` with 500 bootstrap replications. (b) QRIV(1) includes LnS, LnT^B, and PK as IVs and QRIV(2) includes $LnKL$ and $LnRL$ as IVs.



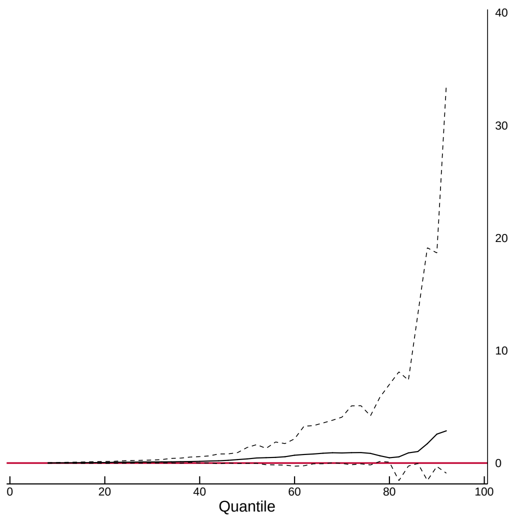
(a) RXI^h in QRIV(1)



(b) RXI^h in QRIV(2)



(c) ROI in QRIV(1)



(d) ROI in QRIV(2)

Figure 3: QRIV Estimates and Confidence Intervals for TFP

Notes: (a) Solid and dashed lines respectively refer to estimates and 95% confidence intervals estimated using Stata's command `cqiv` with 500 bootstrap replications. (b) QRIV(1) includes LnS, LnT^B, and PK as IVs and QRIV(2) includes $LnKL$ and $LnRL$ as IVs.