The impact of international competition on executive compensation: Evidence from Japanese firms during the global trade collapse

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Abstract

We examine the causal effect of intensified international competition by exploiting a quasi-natural experiment: the export decline triggered by the global financial crisis in the late 2000s. We find that executive compensation rises significantly relative to wages for workers of the same firm especially among exporters after the global trade collapse in the sample of all listed firms in Japan. Worker wages tend to decline more in exporting firms after the crisis, while executives are insulated from the negative shock. We confirm the robustness of our results by excluding sporadic exporters and service exporters.

Keywords: executive compensation; inequality; export; natural experiment; global financial crisis

JEL classifications: F16; F14; F66; M12; J31

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1. Introduction

Widening income inequality, especially driven by a drastic rise of executive compensation in contrast to stagnant or even declining wages to workers, has stimulated debates in many countries around the world. While globalization is often perceived to be linked with unequal income distribution, we need to identify the causal effect of international competition on compensation paid to executives and on wages paid to workers by appropriately taking account of endogeneity. The historic trade collapse triggered by the global financial crisis in the late 2000s is a valuable quasi-natural experiment in this context. This paper compares exporters with non-exporters in their executive compensation relative to worker wage in Japanese firms before and after the global trade collapse.

Although the level is still modest compared with the remarkable escalation in the U.S., we observe rising executive compensation and widening income inequality even in Japan, a country once notable for its equal income distribution. Income distribution is currently unequal in Japan compared with many other developed countries in Western Europe and North America, with Gini coefficient high almost next to the U.S. and U.K. and comparable with Italy and Greece.[1] Katz and Autor (1999) categorize Japan as a country with rising wage differentials since the 1980s, while France and Germany experienced modest fall or no change during the same period. Yamada and Kawaguchi (2015) emphasize the rise of wage inequality in Japan amid declining average real wages since the turn of the century. High rewards to Chief Executive Officers (COEs) in some large globalized firms attract media attention in Japan with controversial corporate scandal episodes. Hence, the investigation of Japanese inequality deserves attention on its own right but will contribute to our understanding of inequality in globalized economies

[1] Gini coefficient in Japan is 0.330, which is lower than that in U.S. (0.390) and U.K. (0.360) but comparable with that in Spain (0.345), Greece (0.340), Portugal (0.336), and Italy (0.333), and higher than that in Ireland (0.298), France (0.295) and Germany (0.293) at 2015, according to OECD Income Distribution Database.

in general.

Investigating how international competition affects compensations is important in a broad context of the impact of competition on incentives. As offsetting effects of intensified competition, such as higher bankruptcy risks and reduced gains, make theoretical predictions ambiguous,[2] the investigation of this relation is an empirical question but requires us to handle the endogeneity problem for identifying the causal effect. For this purpose, this paper focuses on the case of global trade collapse during the Great Recession in the late 2000s. The world exports experienced the largest fall since World War II, and the declining speed steeper than that during the Great Depression in the 1930s. Japanese exporters were among the most seriously hit by the trade collapse with around one-third of their exports suddenly lost. The investigation of this quasi-natural experiment is valuable for our research as the U.S.-originated global financial crisis is obviously exogenous to individual Japanese firms and its impact is likely to vary with the firm's globalization before the crisis.

To preview our principal results, this paper finds that executive compensation relative to worker wage tends to rise after the global trade collapse significantly more in exporters compared with non-exporters in our sample of all listed firms in Japan. This finding is consistent with the interpretation that firms provide stronger incentives to executives due to higher risks after the global negative shock. We also detect a significant effect only on the level of worker wage, not on the level of executive compensation, suggesting that executives are insulated from the negative shock but workers face downward pressures on their wages. The statistically significant change is confirmed by a difference-in-difference format. Firm-specific shocks are controlled, as we focus on within-firm pay differentials. We confirm the robustness of this finding by excluding switching exporters, service exporters, or outlier firms, or with an

[2] Schmidt (1997) and Raith (2003) are important contributions as theoretical analyses of the impact of competition on incentive provisions.

alternative definition of crisis timing, in our sample of all listed firms in all industries in Japan.

Our research is related with previous literature on the rise of executive compensation, and the impact of globalization on inequality. As these two topics attract wide attention both in academia and popular press, it is certainly beyond the scope of this paper to review all related papers. We briefly and selectively refer to some critical papers to motivate our research.

The increasing executive compensation is a hotly debated issue. Among many studies, Bertrand (2009) documents the long-run trend in the U.S. and discusses a wide range of explanations, including intensified competition among firms for managerial talents. International trade, or globalization more generally, is obviously among the strong factors for intensifying competition in our age.

Along the research line most closely related to this paper, several studies examine the impact of international trade on executive compensation in comparison with wages paid to workers. Based on Standard & Poor's U.S. executive-level data, Cuñat and Guadalupe (2009a) find that import competition, instrumented by exchange rates and tariffs, leads to within-firm pay differentials.[3] Chakraborty and Raveh (2018) examine the India's import liberalization in the 1990s and report that a fall of tariff on inputs raises the compensation share of managers. Although inequality is not their main focus, Cuñat and Guadalupe (2005) analyze the sudden appreciation of British pound in 1996 and discover that intensified competition increases the pay sensitivity to performance for executives in U.K. firms.[4] Our paper on the exports of Japanese firms is not only the first study of Japanese case to the best knowledge of authors, but

[3] Exchange rate is often used as an instrumental variable in this context. For instance, Bertrand (2004) finds that import competition, instrumented by source-weighted exchange rate, raises the sensitivity of workers' wage to the state unemployment rate in the U.S., although she did not analyze executive compensation. While they do not discuss inequality, Bertrand and Mullainathan (2001) discover that CEOs in the U.S. are rewarded for luck, which is instrumented by industry exchange rate.

[4] Cuñat and Guadalupe (2009b) exploit deregulations in the financial sector as a natural experiment and discover a shift of compensation from fixed portion to variable performance-pay, though international competition is outside of their scope of analysis.

also unique in using the global trade collapse as a natural experiment in this context, and complements previous studies of import-side of international competition. While Keller and Olney (2018) on U.S. executives is the most closely related research with ours on Japanese firms, their research mainly based on instrumental variables differ from ours in our use of the historic trade collapse as a quasi-natural experiment and our main focus on within-firm differentials with worker wage.

The remainder of this paper is organized as follows. Section 2 describes the firm-level data used for our research. Section 3 explains the research design for our empirical analysis. Section 4 reports our main estimation results and discusses their implications. Section 5 summarizes several robustness check results. Section 6 concludes.

2. Description of data

This section describes our data. The definitions of main variables included in our analysis are explained in detail to facilitate the understanding of our results reported in the next section. We also report several descriptive findings from our dataset.

We use firm-level data derived from security reports of listed firms.[5] All listed firms in Japan are required to submit annual security reports, which contain standard corporate variables.[6] The government asks each listed firm to report the sum of compensation paid to all executives combined, implying that the disclosure of compensation for each executive is not

[5] We derive firm-level data from NIKKEI NEEDS provided by Nikkei Inc. and eol provided by Pronexus Inc.

[6] Our sample covers all the stock markets in Japan, i.e. the first and the second section and MOTHERS (Market of the high-growth and emerging stocks) of Tokyo stock exchange, the first and second section and Hercules of Osaka stock exchange, the first and second section and Centrex of Nagoya stock exchange, Sapporo securities exchange including Ambitious, and Fukuoka stock exchange including Q-Board. We exclude firms in the bank industry from our sample because their sales data are unavailable.

legally mandatory in Japan.[7]

To investigate the impact of global financial crisis, we focus on the period from 2006 to 2012. As we drop 20% of the firms due to their unbalanced observations and firms with irregular observations,[9] 15,834 observations (2,262 firms for seven years) remain in our sample.

The main variable for our research is the executive compensation relative to the wage payment to workers. The numerator is the average compensation, including bonus and stock option, paid to CEO, board members (*torishimari-yaku* in Japanese) and corporate/executive officers (*shikko-yakuin* in Japanese). The denominator is the average wage, including bonus, to all regular employees (*sei-shain* in Japanese). We exclude irregular workers, such as short-term employees and contract workers dispatched from personnel service companies, as they are not comparable with executives and regular workers in their relations with their employers, and as the payment to some of these workers are merged with outsourcing expenses in corporate reports. The average of each firm is calculated by total compensation or wage payment divided by the number of executives or regular workers. As our data are at the firm level, we are not allowed to identify individual executives or workers.

The other important variable for our analysis is the firm's export. We define exporters if the firm directly sells at least some of their products overseas.[11] While we can calculate the export intensity (the share of exports in sales), this paper focuses on the extensive margin of export (whether the firm exports).

Table 1 displays summary statistics of the variables used for our regressions in the next

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[7] Firms are required to disclose individual compensation only if it exceeds 0.1 billion yen.

[9] We omit firms with executive compensations not higher than worker wage. Section 5.4 discusses outliers by excluding firms with extremely high executive compensation.

[11] This dataset includes exports not only of goods but also services, but exporters are overwhelmingly in manufacturing industries. As is usual in other standard datasets, we exclude sales by offshore affiliates but cannot trace indirect exports handled by intermediaries.

section. Executive compensation, *ExComp*, is on average around four and half times higher than worker wage, *WorkerW*, in our sample. This ratio is low compared with that in many other countries, possibly reflecting a legacy of relatively equal income distribution in the Japanese society and a typically weak incentive scheme in traditional Japanese companies.[12] However, as shown by the standard deviation and the maximal value, firms vary widely in this executive-worker payment ratio.[13] By inspecting executive compensation and worker wage separately, we find that executive compensation tends to differ across firms substantially compared with worker wage.

On other variables in Table 1, we note the following characteristics. First, around one-third of firms are exporters (*Export*).[14] This export participation ratio is higher than that in the whole population of firms in many countries, including Japan. However, the observation of high exporter ratio is plausible in our sample of listed firms, which tend to be older, larger in size and more capital-intensive. Second, R&D-intensity (*R&D/Sales*) is on average slightly less than two percent, no so high as our sample include non-manufacturing firms. Third, we observe wide inter-firm variations in Total Factor Productivity (TFP). Finally, a non-negligible share of firms have labor unions and introduce stock options (both defined as binary dummies), again with wide variations across firms.

Figure 1 displays how executive compensations relative to average worker wage evolve over years during our sample period. We note that the payment gap between executives and employees tends to become wider. This trend is consistent with observations of increasing

[12] As the other end of spectrum in international comparison, a similarly defined ratio exceeds 100 in the U.S. around the same period, according to Figure 1 in Bertrand (2009).
[13] Although the wide inter-firm variability improves the precision of our estimation, we also reports the results from the limited sample excluding outlier firms with extremely high executive compensations as a robustness check.
[14] We define exporters as firms consecutively exporting their products every year in our sample period and non-exporters as all other firms. We will later consider an alternative definition of non-exporters.

inequality in many countries including Japan, as documented by Yamada and Kawaguchi (2015). However, if we compare exporters with non-exporters, the speed of gap expansion appears to be higher for exporters than for non-exporters in later years. While this visual inspection suggests the possible impact of global shock on inequality, we will investigate this interpretation in the difference-in-difference regression format in the next section.

3. Empirical specification

This section is devoted for the explanation of the model and the identification strategy of our analysis. As the baseline model, we estimate the following.

$$ln\frac{ExComp}{WorkerW_{ijrt}}$$
$$= \alpha + \beta_1 Export_j + \beta_2 Crisis_t + \beta_3 Export_j \cdot Crisis_t + Z_{jt}\gamma + \mu_i + \rho_r + \lambda_t + \varepsilon_{jt} \qquad (1)$$

We index firm, industry, region, and year by *j, i*, *r*, and *t*, respectively. The dependent variable is the executive compensation relative to the wage payment to workers in logarithm, which we derive from security reports explained in the previous section. By normalizing by the wage level of workers in the same firm, our regression is regarded as after purging out the firm-specific effect, such as brand image or market power of the firm. Within-firm investigation is important, as skills of executives and of workers are complementary in positive sorting (high-skill executives matched with high-skill workers in exporting firms). On the right-hand side of the regression, we include two binary variables *Export* and *Crisis*. We define *Export* to take the value one for exporters and zero for non-exporters, while *Crisis* indicates the year after the global financial crisis. The definitions of these dummy variables will be explained in detail later. We also include the interactive term of these two dummies to capture the differential impact of global shock on exporters compared with non-exporters. Other firm-level controls, which will be explained below, are summarized by a vector *Z*. The error term is denoted by ε. We also

control for year-, region- and industry-fixed effects.[16]

In the baseline case, we define the exporter dummy *Export* to take the value one for firms exporting their products consecutively every year in our sample period and zero otherwise. This strict definition concentrating on always exporters is to avoid possible contaminations by switching exporters (exporting sporadically or intermittently). To check the robustness of our results, however, the next section will consider alternative definitions of exporter dummy. Our analysis of export complements previous studies of the impact of import on compensation (e.g. Cuñat and Guadalupe 2009a, and Chakraborty and Raveh 2018).

We identify the effect of globalization on executive compensation by estimating (1). Our identification strategy is built on the premise that the global financial crisis is an exogenous event for individual firms in Japan. No single Japanese firm influenced or triggered the global financial crisis, which originated in the finance-related sector in the U.S. We define *Crisis*=1 for years from 2010 to avoid turmoil amid the global crisis, as total exports by our sampled firms stopped declining at that year. We will later discuss an alternative threshold year demarcating pre- and post-crisis period for checking the robustness of our main results.

The negative impact of the U.S.-originated crisis on Japanese firms is mainly through declined exports. Japan's total exports dropped to two-thirds in 2009 as a part of global trade collapse, and returned to the pre-crisis level only after a decade in 2018.[17] While the exports to U.S. was particularly hit by the crisis (decreased to nearly half from pre-crisis peak 2007 to 2009), Japan's exports to other destinations also fell as well possibly linked by global value chains. In contrast, the changes in domestic demand during the period were by far modest (Japan's real domestic demand decreased by 4% in 2009). Consequently, we focus on this

[16] We classify industries into 29, comparable with the two-digit level. We divide Japan into seven regional blocs (Hokkaido-Tohoku, Kanto, Chubu, Kansai, Chugoku, Shikoku, and Kyushu-Okinawa). See Table 1 for summary statistics.

[17] These numbers are in yen values according to trade statistics by the Japan's Ministry of Finance.

export channel and compare the impact of the crisis on exporters relative to that on non-exporters.

As firm-level controls *Z*, we include the following variables: Total Factor Productivity (TFP), R&D intensity (R&D-sales ratio), firm age (years since the establishment of the firm), the dummy for firms introducing stock option, and the dummy for firms with labor union. TFP is estimated by the method of Levinsohn and Petrin (2003).[18] We take logarithm for all variables, except dummies and R&D-sales ratio.[19]

4. Estimation results

4.1. Baseline results

Our baseline estimation results are reported in Table 2. Robust standard errors clustered at the firm level are shown in parentheses. We investigate the result in each column of this table, as they contain important information for our research.

The first column includes only the exporter dummy and the crisis year dummy on the right-hand side of the regression, except for the constant term. Both dummies are significantly positive, indicating that executive compensation relative to worker wage of a firm tends to be higher in exporting firms than in non-exporters or after the global trade collapse than before the crisis. Our finding of significantly positive effect of exporting is consistent with the result from U.S. data by Keller and Olney (2018).[20] On the impact of an exogenous shock, the significant relation with a crisis reported in this table is in line with the finding of Chakraborty and Raveh (2018) from the reform liberalizing imports in India. This basic result appears to be in line with

[18] We estimate the production function linking revenue with labor (the number of employees) and capital (tangible fixed assets) and use materials as the proxy variable. TFP is defined as the residual from this regression.

[19] We do not take logarithm for R&D/sales, as this variable itself is the ratio. However, all of our main results on compensations are intact even with R&D intensity in logarithm.

[20] Kuwahata (2018) also detects a positive relation with exporting based on a propensity-score matching from the same Japanese dataset as ours, though not considering the crisis.

the interpretation that executives are highly rewarded for managing complex and/or risky international business and also in line with our observation of wider inequality after the global crisis as confirmed by Yamada and Kawaguchi (2015).

Next, we inspect the following two cases. The second column of Table 2 adds the interactive term *Export*Crisis*, while the third column additionally includes industry, region, and year dummies. While the exporter dummy and the crisis year dummy remain significantly positive as in previous cases, the interactive term is significantly positive. As we have detailed firm-level data, we control for relevant firm attributes in the last column of this table.

The column (4) of Table 2 reports the results with firm-level controls in addition to dummies for industry-, region-, and year-fixed effects. We confirm the finding from the columns (2) and (3) even after controlling for firm-level characteristics, i.e. executive compensation normalized by wages of workers tends to be significantly higher in exporters especially after the crisis. In other words, the gap between exporters and non-exporters has become noticeably wider after the global trade collapse. The significant interactive term is also consistent with theoretical predictions, such as those by Schmidt (1997) and Raith (2003), in that intensified competition induces firms (owners) to provide relatively stronger incentives to executives in order to make them work harder to avoid liquidation. Prendergast (2002) also formalizes the effect of risk on incentives as a delegation and surveys previous empirical results as strong evidence for the positive effect of risks on incentives.

On other variables in the column (4), several informative points should be noted. Among them, we should first note that TFP is significantly positive. This result on TFP is consistent with previous findings, as Keller and Olney (2018) report that technology increases the pay gap between executives and workers in U.S. firms.[21] As TFP is highly correlated with firm size, this

[21] Keller and Olney (2018) use capital expenditure as a proxy for skill-biased technology.

observation is also in line with Gabaix and Landier (2008), as they claim that the increase in CEO pay in the U.S. during 1980-2003 can be attributable to the expansion of firm size. If we control for TFP, the significance of firm's exporter status (*Export* without interaction) is absorbed as predicted by the established stylized fact on productivity premium of exporters in international trade literature. R&D intensity is also estimated to be significantly positive.

We also find that the payment differential between executives and workers tends to be more moderate in older firms in Japan, possibly reflecting the traditional Japanese style. In contrast, even among Japanese firms, executives are more likely to be highly rewarded if the firms introduce stock option, while they are less rewarded in comparison with workers of the same firms if labor union are organized in the firms. All these results on firm-level variables are consistent with our prior predictions.

4.2. Different responses of executive compensation and worker wage

While our analysis in the previous section discovers that the global negative shock widens the inequality between executives and workers, it will be informative if we can identify whether executive compensation or worker pay dictates this rising inequality. To answer this inquiry, this section reports the regression results separately for executive compensation and worker wage.

First, we estimate the following specification:

$$lnExComp_{ijrt}$$
$$= \alpha^E + \beta_1^E Export_j + \beta_2^E Crisis_t + \beta_3^E Export_j \cdot Crisis_t + Z_{jt}\gamma^E + \mu_i^E + \rho_r^E + \lambda_t^E + \varepsilon_{jt}^E \quad (2)$$

The dependent variable in (2) is the absolute level of executive compensation, not divided by average worker wage, in logarithm. Variables on the right-hand side of the regression are kept exactly the same as in the baseline case (1) to facilitate comparisons. Parameters, fixed effects and the error term in (2) are expressed with superscript *E* for executives.

The estimation results of executive compensation are shown in Table 3. The exporter dummy without interaction is significant positive, implying that executive compensation tends to be higher in exporters. As the crisis dummy without interaction is also significantly positive, executive compensation becomes higher on average after the crisis. However, the interactive term *Export*Crisis* turns out to be statistically insignificant, suggesting that the gap between exporters versus non-exporters in executive compensations tend to be determined basically in the same way before and after the great trade collapse.[23] In other words, exporters are likely to maintain executive compensation significantly higher than non-exporters even after the substantial decline of their exports. This finding of no significant impact of negative shock on executive compensation is consistent with the result from U.S. firms by Keller and Olney (2018). Our finding also suggests that executives are insulated from the global negative shock, in line with the claim by Bertrand and Mullainathan (2001) that "while CEOs are always rewarded for good luck, they may not always be punished for bad luck" (p.908) based on a case study of oil companies in the U.S. Garvey and Milbourn (2006) also confirm this asymmetry in Standard and Poor's compensation data.

On other variables in the last column of Table 3, we confirm basically the same results as in Table 2, except for the firm's age turned into being statistically insignificant. Our finding of negative relation between executive compensation and labor union is consistent with Huang et al. (2017) based on U.S. data.[24]

Second, we estimate the same model for the average wage of workers. The estimation results for workers are reported in Table 4. The dependent variable in this case is replaced by the absolute level of average wage payment to workers in logarithm. In contrast to the previous

[23] As our measure of executive compensation is the average for each firm, the widening payment gap between CEO and other executives within each firm could be consistent with this observation.
[24] Huang et al. (2017) further find that firms with strong unions tend to pay their CEOs less especially when they have union elections and contract negotiations.

table, we find a significantly negative coefficient on the interaction term. This indicates that exporters tend to decrease the average wage of their workers noticeably more than non-exporters after the great trade collapse. This finding is consistent with the stylized fact (wider wage premium of exporters during expanding exports), such as Baumgarten (2013) based on German manufacturing employer-employee matched data.[25] We also emphasize that our worker wage is the average paid to regular employees, thus not affected by expanding use of outsourcing and/or low-wage contract workers.

In addition to the statistical significance of the interactive term, we note its magnitude. While it ranges between 13 to 15% in the first three columns without firm-level controls, the coefficient on *Export* without interaction shrinks to less than four percent after controlling for firm attributes. The estimated coefficient on the interactive term is almost in the same magnitude. This indicates that the exporters' premium in worker wage nearly vanishes after the great trade collapse if we control for TFP and other firm-level characteristics. Consequently, the change due to the negative shock should be substantial.

On other variables in the column (4) of Table 4, we confirm the significantly positive relationship with TFP, R&D intensity and the firm's age. As expected, we find no significant effect of stock option but positive effect of labor union on wages of workers.

By combining these two tables, we conclude that our finding of wider inequality reported in Table 2 is driven by the shrinkage of exporter premium in average worker wage, not by the higher speed of executive compensation rise of exporters relative to non-exporters, after the crisis. The response of executive compensation to the global negative shock was not discernibly different between exporters and non-exporters, while firms adjust the exporter premium in worker wage. Swift downward adjustment of wages of workers in contrast with insensitive

[25] He also finds that most of the increase in wage inequality occurred between establishments and within workers with the same educational attainment.

response of executive compensation appears consistent with the report by Yamada and Kawaguchi (2015) of rising wage inequality mainly due to relatively smaller wage decline among high-wage groups during around the same period in Japan. While one cannot pin down the exact underlying mechanism behind such different responses, our regressions are informative for discussing our wider inequality in globalized economies.

5. Robustness checks

5.1. Exit from exporting

This paper defines exporters to be the firms exporting consecutively in all years during the sample period. This strict definition implies that firms are categorized as non-exporters even if they export in some years but do not export in other years. Therefore, our baseline case merges these sporadic or intermittent exporters with firms that never export. As a robustness check, this sub-section concentrates on "never exporters" in defining non-exporters by excluding firms switching their exporter status from our analysis. As a result, the sample size shrinks from 15,834 to 13,104 observations.

The first column of Table 5 reports the estimation results from this limited sample. All firm-level attributes, and industry, region, and year dummies are included as in the baseline regressions.[26] The variable of our interest *Export*Crisis* is positive and statistically significant at 1% level. Thus, our principal finding on the interactive term remains robust even if we concentrate on the comparison between always exporters versus never exporters. We confirm that firms switching their exporter status do not affect our result.

5.2. Alternative definition of crisis years

[26] Table 5 shows the estimation results with all these controls, but we confirm that our main findings are robust even without them as in the first three columns in Table 2.

We have compared the years before and after 2010 to focus on the post-adjustment period, but this sub-section reports results with an alternative definition of the crisis years for a robustness check purpose. Among various alternative candidates, we choose to define the crisis dummy to take the value one for and after the year 2009, one year earlier than the baseline definition, in order to concentrate on the steep decline of export just after the global financial crisis.

The second column of Table 5 displays the regression results with this alternative definition of the crisis dummy. As in the baseline case, the interaction term *Export*Crisis* is significantly positive. Estimated coefficients on other variables also remain basically the same even after changing the definition of the crisis dummy. Consequently, we confirm that our main results are not dictated by the definition of the crisis year dummy.

5.3. Exporting of goods versus services

While exporters are overwhelmingly observed in manufacturing industries, non-negligible portion of exporters are in non-manufacturing industries. As the global trade collapse in the 2000s is often characterized by a sudden drop of automobile and other machinery exports, it might be useful to distinguish exports of goods from service in our analysis. Our baseline case covers firms in all industries, but this sub-section concentrates on firms exporting goods as a robustness check purpose.

The column (3) of Table 5 reports the regression results from the sample of firms in goods exporting industries. We include not only manufacturing, but also wholesale and retail trade into this category. Although some firms categorized as non-manufacturers may export goods and those categorized as manufacturers may export services, no data on exports disaggregated by product categories are available in standard financial statements. The estimates in the table confirm the robustness of our main finding. Even if we exclude firms in service industries, the

interaction term *Export*Crisis* remains significantly positive. The estimated coefficient of this variable barely differs from that in the baseline case, indicating that the magnitude of the impact of crisis appears to be around the same in goods-exporting firms. As no standard theory predicts different responses of compensation to a crisis between firms exporting goods and services, our confirmation of no difference is also consistent with our prior belief.

5.4. Outliers

As in any standard datasets, we observe substantial variations across firms in the ratio of executive compensation over wage of workers. However, the inter-firm variability is particularly wide in executive compensation. This observation is in line with our daily exposure to the news and episodes of extremely high compensations to some notable CEOs. Therefore, this sub-section omits outlier firms to check the robustness of our main results from the whole sample.

The last column of Table 5 reports the estimation results from a sample excluding outlier firms. We drop firms if their ratio of executive compensation over average worker pay are among the highest 50 in any year. As a result, 32 firms are omitted. In this limited sample, the relative executive compensation divided by worker pay is contained within the ratio 30. The regression results shown in this table confirm the robustness of our main finding from the whole sample. The interaction term *Export*Crisis* remains significantly positive even in this limited sample. Our finding of wider inequality after the crisis is hence not dictated by exceptionally high CEO compensation in outlier firms.

This additional confirmation by excluding outliers is also in line with our other findings. As we have reported in Section 4.2, our finding of wider inequality is almost exclusively by the decline of worker wage, not by the rise of executive compensation, especially among exporters

after the crisis. Since most of the inter-firm variations are in executive compensation, not in worker pay, the observation of extremely high CEO compensation in outlier firms is unlikely to affect our result.

6. Concluding remarks

This paper has analyzed whether and how much executive compensation changes relative to the average wage of workers at the firm level by comparing exporting firms with firms selling all their output in the home country before and after the exogenous and serious trade collapse triggered by the global financial crisis. We detect that the ratio of executive compensation over worker wages tends to be higher among exporters than that among non-exporters and after the crisis than before the crisis, but further find that the change after the crisis is likely to be more substantial among exporters. The robustness of this main finding has been confirmed by omitting firms intermittently exporting their products, firms exporting services, or firms with extremely high executive compensation, and with an alternative definition of the crisis timing.

Although we cannot exactly determine the underlying mechanism behind this observation, our estimation results could be consistent with the interpretation that firms provide relatively strong incentives to executives in order to manage possibly complex and risky export business facing the global negative shock while cutting wages of workers relative to firms concentrating on stable domestic market. Our finding of changes in intra-firm pay differential suggests a piece of evidence on non-negligible impact of globalization on income inequality.

Our finding of different response of executive compensation relative to worker wage in exporters has an informative implication for a broad range of research and policy discussions, but there are several issues left for future independent studies. For example, the control of personal characteristics of executives and/or workers will improve the precision of estimation if

we are able to assemble compensation data at the individual level with employer-employee matched data. On the globalization of firms, it will be useful to expand our scope from exporting toward other equally important channels, such as foreign direct investment.

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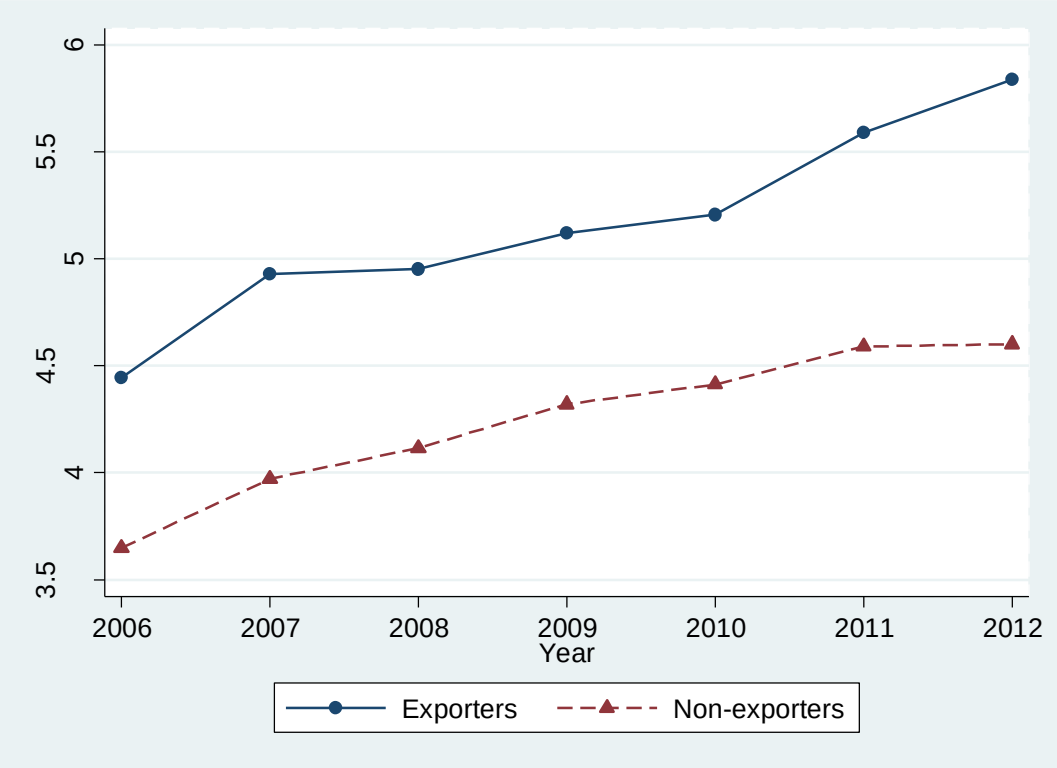
Figure 1 Exporters vs. non-exporters in executive compensation relative to worker wage



Note: The solid line represents the ratio of executive compensation over worker wage of exporters, while the dashed line is for non-exporters.

Table 1 Summary statistics

Variable	Mean	Std. Dev.	Min	Max
ExComp / *WorkerW*	4.541	3.753	1.002	109.699
ExComp	26.527	25.289	4	660.750
WorkerW	5.735	1.309	0.299	16.051
Export	0.331	0.471	0	1
TFP	889.836	1706.114	35.955	54890.740
R&D / *Sales*	0.017	0.034	0	0.917
Age	61.314	22.156	12	137
Labor union	0.400	0.490	0	1
Stock option	0.282	0.450	0	1
Industry dummies				
Agriculture, forestry, and fisheries	0.003	0.056	0	1
Mining	0.001	0.036	0	1
Construction	0.060	0.238	0	1
Food manufacturing	0.043	0.204	0	1
Apparel and textile products	0.017	0.130	0	1
Paper and pulp products	0.010	0.100	0	1
Chemical products	0.075	0.263	0	1
Pharmaceuticals	0.016	0.125	0	1
Petroleum and coal products	0.004	0.059	0	1
Rubber products	0.008	0.086	0	1
Glass and ceramic	0.024	0.154	0	1
Iron and steel	0.018	0.133	0	1
Nonferrous metals	0.012	0.109	0	1
Metal products	0.033	0.178	0	1
General machinery	0.084	0.277	0	1
Electric machinery	0.091	0.287	0	1
Transport equipment	0.038	0.191	0	1
Precision instruments	0.016	0.127	0	1
Miscellaneous manufacturing	0.036	0.186	0	1
Telecommunications	0.069	0.254	0	1
Land transportation	0.013	0.114	0	1

Air transportation	0.001	0.030	0	1
Wholesale trade	0.111	0.314	0	1
Retail trade	0.092	0.289	0	1
Securities dealers	0.002	0.042	0	1
Other finance business	0.004	0.063	0	1
Real estate	0.025	0.157	0	1
Warehousing	0.013	0.113	0	1
Services	0.082	0.274	0	1
Region dummies				
Hokkaido and Tohoku	0.023	0.151	0	1
Kanto	0.572	0.495	0	1
Chubu	0.137	0.344	0	1
Kansai	0.214	0.410	0	1
Chugoku	0.018	0.133	0	1
Shikoku	0.007	0.084	0	1
Kyushu and Okinawa	0.028	0.166	0	1

Note: We include 15,834 observations. *ExComp*, *WorkerW*, and *Sales* are in million yen.

Table 2 Baseline regression results

	Dependent variable: *ln* (*ExComp* / *WorkerW*)			
	(1)	(2)	(3)	(4)
Export	0.1551	0.1429	0.1732	0.0216
	(0.0210)***	(0.0215)***	(0.0256)***	(0.0238)
Crisis	0.1313	0.1219	0.2507	0.2524
	(0.0066)***	(0.0080)***	(0.0118)***	(0.0120)***
*Export*Crisis*		0.0285	0.0285	0.0393
		(0.0139)**	(0.0139)**	(0.0139)***
ln (*TFP*)				0.2338
				(0.0121)***
R&D / sales				0.9290
				(0.3577)***
ln (*Age*)				–0.0952
				(0.0299)***
Stock option				0.0984
				(0.0180)***
Labor union				–0.0534
				(0.0188)***
Constant	1.2365	1.2406	1.208	0.3003
	(0.0112)***	(0.0113)***	(0.0995)***	(0.1574)*
Industry dummy	No	No	Yes	Yes
Region dummy	No	No	Yes	Yes
Year dummy	No	No	Yes	Yes
Adjusted R-squared	0.0326	0.0327	0.0716	0.2089

Notes: We cover 15,834 observations in all cases. Robust standard errors clustered at the firm level are in parentheses. Statistical significance is shown by asterisks: *** 1%, ** 5%, and * 10%.

Table 3 Response of executive compensation

	Dependent variable: *ln* (*ExComp*)			
	(1)	(2)	(3)	(4)
Export	0.2868	0.2907	0.2982	0.0585
	(0.0243)***	(0.0244)***	(0.0288)***	(0.0241)**
Crisis	0.0939	0.0969	0.2465	0.2431
	(0.0067)***	(0.0081)***	(0.0119)***	(0.0120)***
*Export*Crisis*		–0.0091	–0.0091	0.0072
		(0.0144)	(0.0144)	(0.0142)
ln (*TFP*)				0.3486
				(0.0124)***
R&D / sales				1.8282
				(0.3774)***
ln (*Age*)				–0.0457
				(0.0297)
Stock option				0.0968
				(0.0179)***
Labor union				–0.0381
				(0.0194)**
Constant	2.9303	2.9290	2.7753	1.0056
	(0.0123)***	(0.0124)***	(0.0986)***	(0.1578)***
Industry dummy	No	No	Yes	Yes
Region dummy	No	No	Yes	Yes
Year dummy	No	No	Yes	Yes
Adjusted R-squared	0.0562	0.0562	0.1072	0.3503

Notes: We cover 15,834 observations in all cases. Other notes to Table 2 also apply to all the tables in what follow.

Table 4 Response of worker wage

	Dependent variable: *ln* (*WorkerW*)			
	(1)	(2)	(3)	(4)
Export	0.1317	0.1478	0.1250	0.0369
	(0.0085)***	(0.0085)***	(0.0097)***	(0.0082)***
Crisis	–0.0374	–0.0250	–0.0042	–0.0093
	(0.0018)***	(0.0021)***	(0.0026)	(0.0025)***
*Export*Crisis*		–0.0376	–0.0376	–0.0321
		(0.0036)***	(0.0036)***	(0.0034)***
ln (*TFP*)				0.1148
				(0.0043)***
R&D / sales				0.8992
				(0.1304)***
ln (*Age*)				0.0496
				(0.0123)***
Stock option				–0.0016
				(0.0067)
Labor union				0.0153
				(0.0072)**
Constant	1.6938	1.6884	1.5673	0.7052
	(0.0058)***	(0.0058)***	(0.0402)***	(0.0660)***
Industry dummy	No	No	Yes	Yes
Region dummy	No	No	Yes	Yes
Year dummy	No	No	Yes	Yes
Adjusted R-squared	0.0818	0.0832	0.2898	0.5054

Notes: We cover 15,834 observations in all cases.

Table 5 Robustness check results

	Dependent variable: *ln* (*ExComp* / *WorkerW*)			
	(1) switching exporters excluded	(2) alternative definition of the crisis year	(3) service exporters excluded	(4) outlier firms excluded
Export	–0.0087	0.0213	0.0044	0.0295
	(0.0301)	(0.0242)	(0.0257)	(0.0226)
Crisis	0.1984	0.2554	0.2622	0.2495
	(0.0131)***	(0.0120)***	(0.0147)***	(0.0117)***
*Export*Crisis*	0.0428	0.0301	0.0452	0.0393
	(0.0146)***	(0.0141)**	(0.0153)***	(0.0136)***
ln (TFP)	0.2397	0.2338	0.2436	0.2163
	(0.0138)***	(0.0121)***	(0.0143)***	(0.0113)***
R&D / sales	1.1259	0.9272	1.2581	0.6913
	(0.5124)**	(0.3578)***	(0.5015)**	(0.3388)**
ln (Age)	–0.0815	–0.0952	–0.1406	–0.0837
	(0.0331)**	(0.0299)***	(0.0420)***	(0.0285)***
Stock option	0.0949	0.0985	0.1224	0.0941
	(0.0199)***	(0.0180)***	(0.0207)***	(0.0172)***
Labor union	–0.0496	–0.0534	–0.0438	–0.0525
	(0.0211)**	(0.0188)***	(0.0217)**	(0.0181)***
Constant	0.2217	0.3005	0.4838	0.3703
	(0.1764)	(0.1575)*	(0.1945)**	(0.1534)**
Industry dummy	Yes	Yes	Yes	Yes
Region dummy	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes
Adjusted R-squared	0.2165	0.2088	0.2240	0.1990
# observations	13,104	15,834	11,501	15,610

Notes: In the second column, the crisis dummy takes the value one for and after the year 2009 and zero before 2009.