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Abstract

In this paper we discuss how to achieve a more efficient sample design of the *Tankan* (Short-Term Economic Survey of Enterprises in Japan), making use of the *Economic Census* of Japan. The Bank of Japan currently forms strata for population estimation using three bases -- industry, capital size, and the number of employees -- and extracts sample enterprises from each stratum. Employing the *Economic Census* newly available as population information allows the Bank to have direct access to population data regarding quantitative survey items of the *Tankan* such as sales. This helps to measure the statistical accuracy of the *Tankan* more precisely as well as to improve its accuracy through revisions of the sample design, such as stratification using different bases.

When measuring the statistical accuracy of the *Tankan* based on the *Economic Census* data, the standard error ratios of total sales are generally low, although some industries show somewhat high ratios. By contrast, those of fixed investment are higher than those of sales, particularly for small enterprises. Moreover, while the *Tankan* estimates of sales and fixed investment are somewhat larger in terms of levels than the aggregated population values, their rates of change exhibit only a small bias, which means no difficulties for users.

Based on this quantitative evaluation, we propose revisions to our sampling methods, considering a balance between an improvement in the statistical accuracy and a reduction in the total burden on respondents. On this basis, changing a basis for stratification from the number of employees to sales and eliminating a fraction of sample enterprises lead to further improvements in the statistical accuracy of the *Tankan*.

The Bank will finalize details of the new sampling methodology based on the results of this paper, and implement them in the upcoming revision of sample enterprises around 2018.

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I. Introduction

The *Tankan* (Short-Term Economic Survey of Enterprises in Japan) is a statistical survey conducted by the Bank of Japan with the aim of providing an accurate picture of business trends of enterprises in Japan, thereby contributing to the appropriate implementation of monetary policy. Since it is practically difficult to conduct a survey of all enterprises in Japan on a quarterly basis, the Bank develops a sample survey framework. Specifically, approximately 11,000 sample enterprises are extracted from a population of private enterprises with a capital of 20 million yen or more excluding financial institutions, or approximately 210,000 enterprises.

To grasp actual economic conditions accurately, the *Tankan* has made regular revisions of sample enterprises in line with updates of its population base. Although the *Establishment and Enterprise Census of Japan* -- conducted by the Ministry of Internal Affairs and Communications -- had been used as population information, it was terminated after the 2006 survey and was integrated into the *Economic Census* jointly conducted by the Ministry of Internal Affairs and Communications and by the Ministry of Economy, Trade and Industry. Given this situation, the Bank made the revision of the *Tankan* sample enterprises in March 2015, using the *2012 Economic Census for Business Activity*.[1]

The *Economic Census* consists of two surveys: the *Economic Census for Business Frame* and the *Economic Census for Business Activity.* In particular, the latter provides various accounting information such as sales and fixed investment, which are also included in the survey items of the *Tankan*. In the March 2015 revision of sample enterprises, while the Bank used sales data of the *Economic Census* for calculating standard error ratios[2] of sales, for which the *Tankan* sets statistical targets, sample design followed almost the same method as the previous revision in March 2010. This is because the Bank needed to update the population information as swiftly as possible; five years had passed since the previous revision, and therefore the Bank had insufficient time to review the sample design.

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[1] For more details of this revision, see Research and Statistics Department of the Bank of Japan [2015].

[2] The standard error ratio is a coefficient of variation for sample estimates, calculated by dividing the standard deviation of sample mean by the population mean. It represents a relative size of deviation between estimates obtained from sample surveys and true values (population values). See Chart 1 for details of the calculation method.

Nevertheless, revising the sampling methodology by utilizing detailed accounting information obtained from the *Economic Census* is likely to enable the Bank to compile more accurate statistics with fewer samples. This helps to grasp actual economic conditions in Japan more accurately as well as to reduce the total burden on survey respondents. Therefore, this paper discusses how to achieve a more efficient sample design of the *Tankan*, making use of the *Economic Census*.

The remainder of this paper is organized as follows. In section II, we describe the current sample design of the *Tankan* and its limitations as well as explain the usage of the *Economic Census*. Section III reports on the statistical accuracy of the *Tankan* calculated by using the *Economic Census*. On this basis, section IV proposes specific revisions to the sample design. Section V concludes. The sample design for surveys of financial institutions, conducted with the aim of supplementing the *Tankan*, is described in the Appendix.

II. Current Sample Design of the *Tankan*

This section overviews the current sampling methodology of the *Tankan* and its limitations. We then explain features of the *Economic Census* newly available as population information.

A. Sample Design of the *Tankan*

Sample enterprises of the *Tankan* are selected using the method of stratified sampling, under which we divide a population into strata on the basis of specific bases such as industry and scale, and extract samples efficiently. On this basis, the Bank provides survey forms to sample enterprises on a quarterly basis and collects answers regarding judgment survey items such as business conditions, quantitative survey items of financial statements such as sales and profits, and the inflation outlook of enterprises. Among them, the Bank simply aggregates answers obtained from sample enterprises for judgment survey items and their inflation outlook. On the other hand, as for quantitative survey items including sales, profits, and fixed investment, total values of private enterprises with a capital of 20 million yen or more (population total) are estimated by amplifying answered figures based on sampling ratios. The Bank then computes and publishes amounts of estimates for population total, their year-on-year rates of change, and their revision rates compared to the previous survey.

Since estimates from sample surveys contain sampling errors, it is necessary to set acceptable error ranges as statistical accuracy targets. The *Tankan* includes various survey items and therefore it is difficult to evaluate the overall survey by a single error value. However, the Bank sets the accuracy targets for standard error ratios of total sales, taking into account their importance as a survey item as well as high correlation between sales and other items including fixed investment, which draws a lot of attention in the *Tankan*.[3] Specifically, for the six main categories, i.e., [two industries (manufacturing and nonmanufacturing) times three capital sizes (large, medium-sized, and small enterprises)], the Bank sets the binding targets of less than 3 percent for manufacturing and 5 percent for nonmanufacturing. The Bank also attempts to keep standard error ratios at less than about 10 percent for 93 categories -- [31 industry classifications times three capital sizes] -- to the extent possible (non-binding targets).

To achieve these accuracy targets with fewer samples, the Bank divides population enterprises into multiple strata (currently 391 strata) based on industry, capital size, and the number of employees, and efficiently extracts sample enterprises (Chart 2). The number of employees, which is not compiled for release in the *Tankan*, is adopted as a basis for stratification, paying attention to its high correlation with sales.[4] Moreover, in the March 2015 revision of sample enterprises, the Bank introduced a more flexible method for stratification, thereby improving the statistical accuracy and achieving fewer samples.[5]

B. Limitations of Current Sampling

Since the *Establishment and Enterprise Census of Japan*, the previous population base,

[3] For details on the sample design and the sample maintenance of the *Tankan*, see Research and Statistics Department of the Bank of Japan [2004].

[4] The number of employees is also less volatile in the short term. In addition, it had been the basis for size classification instead of capital until the December 2003 survey. These factors also help the Bank to use the number of employees for stratifying population enterprises.

[5] Specifically, among the three bases of industry, capital size, and the number of employees, strata boundaries of the number of employees used to be placed in a uniform manner across all capital sizes, but are now allowed to move depending on capital size, so that sample variance of each stratum is minimized. This revision enables us to attain accuracy targets with fewer samples. For details on this flexible classification, see Research and Statistics Department of the Bank of Japan [2015].

didn't offer any accounting data such as sales and fixed investment, the Bank has not fully assessed the statistical accuracy of the *Tankan*'s sample design. Without data of population means and variances, standard error ratios of sales -- our accuracy targets for the sample design -- have been estimated using alternative data sources including the *Basic Survey of Japanese Business Structure and Activities* and the *Census of Commerce* conducted by Ministry of Economy, Trade and Industry. However, these statistics have not sufficiently covered the population. We also have not been able to calculate standard error ratios of fixed investment due to a lack of appropriate alternative data. For the same reason, it has been impossible to evaluate to what extent estimates of sales and fixed investment calculated from sample enterprises (hereafter *Tankan* estimates) deviate from true values of the population, which is referred to as a relative error (sample bias)[6].

Moreover, we have not been able to check the appropriateness of using the number of employees for stratification, compared to the other items such as sales. To be a basis for stratification, all data of population enterprises must be available, and such data has been limited to the number of employees in the *Establishment and Enterprise Census of Japan*.

C. The *Economic Census*

The *Economic Census*, launched in 2009, aims to identify the actual situation of business activities of establishments and enterprises and the comprehensive industrial structure in Japan as well as to organize population information useful for conducting various statistical surveys. The *Economic Census* consists of two surveys -- the *Economic Census for Business Frame* to identify the basic structure of establishments and enterprises, and the *Economic Census for Business Activity* to identify the situation of economic activities of establishments and enterprises -- and each survey is conducted about every five years (Chart 3).[7] The *Economic Census* is carried out based on a list of enterprises prepared by using administrative records such as labor insurances and commercial and corporate registrations, in addition to visual checks by enumerators, thereby achieving greater coverage of

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[6] The relative error (sample bias) is calculated as follows. See Chart 1 for more details.
"Relative error (sample bias)" = ("*Tankan* estimate for total" – "Aggregated population value from the *Economic Census*") / "Aggregated population value from the *Economic Census*" * 100

[7] For details of the aim and the survey items of the *Economic Census*, see Shimizu and Suga [2013].

enterprises compared to the *Establishment and Enterprise Census of Japan*.[8] The *Economic Census for Business Activity* is also characterized by its variety of survey items including accounting information such as sales and fixed investment.[9]

Therefore the use of the *Economic Census* as a population base for the *Tankan* leads to (1) greater coverage of enterprises, and (2) direct access to population information of sales and fixed investment. This allows a quantitative evaluation of standard error ratios and relative errors (sample biases), and provides more options for selecting bases used for forming strata, creating room for reviewing our sample design. This point is discussed below.

III. Statistical Accuracy of the *Tankan* Measured by Using the *Economic Census*

This section measures the statistical accuracy of sales and fixed investment, major quantitative survey items of the *Tankan*, using the *2012 Economic Census for Business Activity*.

A. Features of the *Economic Census*: Changes in the Number of Population Enterprises

Chart 4 denotes the number of population enterprises for the March 2015 revision of sample enterprises and that for the March 2010 revision. As population information, the March 2010 revision employed the *2006 Establishment and Enterprise Census of Japan* surveyed as of October 2006, and the March 2015 revision used the *2012 Economic Census for Business Activity* surveyed as of February 2012, respectively.

The number of private enterprises with a capital of 20 million yen or more excluding financial institutions -- the survey coverage of the *Tankan* -- was 212,277 at the time of the March 2015 revision, and was more or less unchanged (a decrease of 0.4 percent) compared to the March 2010 revision. The number of large and medium-sized enterprises decreased particularly for nonmanufacturing, reflecting mergers and corporate restructuring (by 8.9

[8] Statistics Commission of the Cabinet Office [2016], however, pointed out that the *Economic Census* covers a smaller number of enterprises than the number of population enterprises of the *Financial Statements Statistics of Corporations by Industry*, conducted by the Ministry of Finance, and that of enterprises obtained from tax data, and underlined the need to deliberate this difference in the coverage of population.

[9] The *Economic Census for Business Frame* has added sales to its survey items since the 2014 survey.

percent for large enterprises and by 6.5 percent for medium-sized ones). On the other hand, that of small enterprises slightly increased by 0.5 percent and especially the real estate industry showed a pronounced increase of 32.5 percent. This is deemed to be attributable to the greater coverage of enterprises that enumerators have had difficulty in finding by their visual checks, caused by the use of administrative records. The coverage of small enterprises was notably enhanced, particularly in the real estate industry, including property management companies apparently unobserved because they have neither an office nor employees.

B. Standard Error Ratios of Sales and Fixed Investment

Standard Error Ratios of Sales

The standard error ratios of total sales in the March 2015 revision -- calculated by using the *2012 Economic Census for Business Activity* -- meet the accuracy targets for all six main categories, i.e., less than 3 percent for manufacturing and 5 percent for nonmanufacturing (Chart 5).[10] However, by industry and size, some of the nonmanufacturing industries show somewhat high ratios. For example the standard error ratios exceed 10 percent for real estate and services for individuals (medium-sized and small enterprises), goods rental & leasing (large and medium-sized), and communications (medium-sized). In the manufacturing sector, the standard error ratios of medium-sized enterprises also exceed 10 percent for business oriented machinery, shipbuilding, heavy machinery & other transportation machinery, and other manufacturing.

As for the industries showing high standard error ratios, comparing the ratios of sales in the March 2015 revision with those in the March 2010 revision, real estate exhibits a substantial increase (Chart 6). This would be attributable to the fact that enterprises, newly added to the population of the real estate industry in the *Economic Census*, have a large variance of sales,

[10] The standard error ratios by industry and size (for example, large manufacturing enterprises) shown here are estimated in the following way. First, population enterprises are divided into strata based on industry, capital size, and the number of employees. Next, with respect to each stratum, the standard deviation of sample mean and the population mean are calculated using (1) the number of population enterprises, (2) the population mean and the population variance, (3) the number of sample enterprises, and (4) the share in the population classified by industry and size. See Chart 1 for more details.

and thereby contribute to an increase in standard error ratios.

While the current sample design of the *Tankan* uses the number of employees as a basis for stratified sampling, it sets the statistical accuracy targets for standard error ratios of sales. When there is a strong correlation between the number of employees and sales, stratification based on the number of employees results in a reduction in standard error ratios of sales (Chart 7 [1]). However, when the number of employees is weakly correlated with sales, for example, there is large variance of sales among enterprises having the similar number of employees, stratified sampling based on the number of employees cannot decrease standard error ratios of sales (Chart 7 [2]). Particularly, the real estate industry is more likely to contain enterprises with large sales but few employees, such as property management companies, indicating a weak correlation between the number of employees and sales. For this reason, the current stratified sampling based on the number of employees is less effective in reducing the standard error ratios of sales for the real estate industry.

Standard Error Ratios of Fixed Investment

Since the *Economic Census for Business Activity* provides population information of fixed investment, we can calculate standard error ratios of total fixed investment (excluding land purchasing expenses, and the same hereafter unless otherwise noted), which draws a lot of attention in the *Tankan*. The standard error ratios of fixed investment in the March 2015 revision by industry and size, calculated by using the *2012 Economic Census for Business Activity*, are higher than those of sales (Charts 5 and 8). Looking at the six main categories, the standard error ratios for large manufacturing and nonmanufacturing enterprises stay around 3 percent, but those ratios increase as capital size becomes smaller, reaching fairly high levels of 10 percent for small manufacturing enterprises and 28 percent for small nonmanufacturing enterprises. By industry, the standard error ratios are high for real estate, information services, and services for businesses.

Fixed investment is characterized by its substantial fluctuation every year and large dispersion among enterprises with a sizable proportion of small nonmanufacturing enterprises making no investment. Although minimizing standard error ratios of fixed investment is deemed desirable to improve the convenience of users, it is unavoidable to some extent that standard error ratios of fixed investment exceed those of sales, taking these characteristics into account.

The *Tankan* sets its accuracy targets for standard error ratios of sales rather than those of fixed investment. Since population information of fixed investment is now available from the *Economic Census for Business Activity*, it might be worth considering setting targets for fixed investment. However, since the other survey items, including current profits and judgment of business conditions, have a lower correlation with fixed investment compared to sales, it would be of small benefit to the *Tankan*. In addition, fixed investment is surveyed only by the *Economic Census for Business Activity* -- conducted every five years -- and is not surveyed by the *Economic Census for Business Frame*. Therefore, even if we set accuracy targets for standard error ratios of fixed investment, we can only check them and only revise sample enterprises reflecting that check once every five years. Judging from these points, it is appropriate that the *Tankan* sets its accuracy targets not for fixed investment but for sales.

C. Relative Errors (Sample Biases) of Sales and Fixed Investment

Calculated Results

The use of population data based on the *Economic Census* enables us to calculate the relative error (sample bias) of the *Tankan* estimates regarding sales and fixed investment, i.e., a deviation between the *Tankan* estimate of total and the sum of population data obtained from the *Economic Census* (hereafter aggregated population value). Since the aggregated population values are close to the true values, the peculiarities of the *Tankan* estimates can be analyzed. In the following, we will compute the *Tankan* estimates and the aggregated population values -- both of which are based on the *Economic Census* data -- and assess the relative error (sample bias) of the *Tankan* estimates.[11]

Chart 9 shows the relative errors (sample biases) of the *Tankan* estimates at the time of the March 2015 revision, computed by using sales and fixed investment data of the *2012 Economic Census for Business Activity* (surveying actual results in 2011). The relative

[11] The *Economic Census* takes a survey on accounting information on a calendar year basis while the *Tankan* does it on a fiscal year basis. As a reflection of this discrepancy in data, we use data of individual enterprises taken from the *Economic Census* for calculating not only the aggregated population values but also the *Tankan* estimates. Consequently, the relative errors (sample biases) calculated here exclude a deviation caused by different responses between the *Tankan* and the *Economic Census*, and therefore only result from the sampling methodology of the *Tankan*.

errors (sample biases) of sales and fixed investment are positive for the six main categories, indicating that the *Tankan* estimates have an upward bias compared to the aggregated population values. By industry and size, this upward bias of sales and fixed investment is larger for nonmanufacturing than manufacturing, and also larger for small enterprises than large ones.[12]

Effects of the Upward Bias on Rates of Change

The *Tankan* aims to grasp changes in economic conditions in a timely manner, and the year-on-year rates of change in sales and fixed investment attract most of the attention. Therefore the relative error (sample bias) in terms of the rate of change is of importance. In other words, even if the *Tankan* estimates have an upward bias in terms of levels, the rates of change have no bias as long as the extent of deviation is almost unchanged every year.

To verify this point, using two data sources, the *2012 Economic Census for Business Activity* (surveying actual results in 2011) and the *2014 Economic Census for Business Frame* (surveying actual results in 2013), we calculated the *Tankan* estimates and the aggregated population values of sales in both 2011 and 2013, and estimated each rate of change (Chart 10 [1]). To remove the effect of change in population in two years, the population enterprises of the *2012 Economic Census for Business Activity* were applied to calculations for both 2011 and 2013.[13]

Chart 10 [2] presents the year-on-year rates of change between 2011 and 2013 in the *Tankan* estimates of sales and in the aggregated population values of sales, and the difference between these rates.[14] For the six main categories, the difference (0.1 to 1.1

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[12] In assessing the relative error (sample bias), it should be noted that calculated relative errors (sample biases) have variation in themselves. Since the standard error ratios of sales are low, we can consider the *Tankan* estimates of sales to have an upward bias, even taking its standard error ratios into account (Chart 5). To the contrary, because the standard error ratios of fixed investment are relatively high, it is worth noting that the calculated relative errors (sample biases) have large variation and are subject to a margin of error (Chart 8).

[13] Data of individual enterprises taken from the *Economic Census* were applied to calculations of the aggregated population values as well as the *Tankan* estimates. For the *Tankan* estimates of sales, sample enterprises at the time of the March 2015 revision were applied to calculations for both 2011 and 2013. As a result, the survival bias caused by terminated samples in this period was not taken into consideration. This will be analyzed later in this section.

[14] The difference is calculated as "the year-on-year rate of change of the *Tankan* estimate minus that

percentage points) is small compared to the year-on-year rate of change (3 to 6 percent) in sales and its standard deviation computed from the actual results of the *Tankan*. The rates of change show only limited relative errors (sample biases), suggesting that the *Tankan* has no considerable difficulty in assessing economic conditions.

Mechanism for Causing Overestimation: Variation in the Rate of Acceptance of Survey Request and a Bias Appeared in Terminated Samples

The upward bias of the *Tankan* estimates is attributable to the fact that sample enterprises in each stratum classified by the number of employees tend to be biased toward enterprises with a large number of employees (Chart 11). Since the number of employees is positively correlated with sales and fixed investment, a bias toward sample enterprises with a large number of employees in each stratum leads to overestimation of sales and fixed investment. This overrepresentation reflects the fact that the Bank can more easily elicit cooperation to the survey from enterprises with a large number of employees than those with a small number of employees. In revisions of sample enterprises of the *Tankan*, the rate of acceptance of our survey request to enterprises with a small number of employees tends to be lower, due to a shortage of human resources for responding to the survey. In comparison with large enterprises or manufacturing, this overestimation is particularly large for small nonmanufacturing enterprises. This is because they include more enterprises with a small number of employees in the population, whose rate of acceptance is usually low, likely creating a greater bias in each stratum.

When assessing economic conditions using the *Tankan*, the relative error (sample bias) in terms of the rate of change -- such as in sales and fixed investment -- is of importance. In that case, attention needs to be paid to whether the relative error (sample bias) of the rate of change will be created by enterprises that accept our survey request once but thereafter drop out from samples (survival bias). If enterprises with a small number of employees tend to drop out from samples and those with a large number of employees are likely to continue answering, the survival bias will arise.

To analyze this, we compared the sample enterprises for the March 2010 survey, just after the revision, with those for the December 2014 survey, just before the next revision, and

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of the aggregated population value."

estimated the effect of a decrease in the number of sample enterprises on the *Tankan* estimates during about five years (Chart 12 [1]). Specifically, extracting the sample enterprises that continued answering from the March 2010 to the December 2014 survey (surviving samples), we calculated a deviation on a yearly basis between the estimates of sales and fixed investment based on all samples and those based on surviving samples in the March 2010 survey (Chart 12 [2]).[15] Looking at the estimated results for the six main categories, the *Tankan* estimates, calculated based on the surviving samples, are larger for both sales and fixed investment than those calculated based on all samples, and an upward bias is seen.[16] This indicates the existence of a bias that enterprises with a relatively small number of employees tend to drop out from samples and those with a large number of employees are likely to continue answering. Nonetheless, the estimated effect of the survival bias is small compared to the year-on-year rate of change and its standard deviation, suggesting that the *Tankan* has no considerable difficulty in evaluating changes in economic conditions. This is mainly because the *Tankan* maintains its much higher response rate than other surveys, supported by the cooperation of sample enterprises.[17]

IV. Improving the Sampling Method of the *Tankan*

This section proposes revisions of the sample design of the *Tankan*, in response to measurement of its statistical accuracy in the previous section.[18] In addition, we estimate to what extent statistical accuracy improves by employing proposed revisions. We establish the following two goals for the revision.

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[15] In this analysis the *Tankan* data is used and fixed investment includes land purchasing expenses. The deviation is calculated as follows.

"Deviation" = ("*Tankan* estimate based on surviving samples" – "*Tankan* estimate based on all samples") / "*Tankan* estimate based on all samples" * 100

Strictly speaking, we should compute the effect of a decrease in the number of sample enterprises on the *Tankan* estimates during about five years as of December 2014. However, since data of terminated enterprises is unavailable as of December 2014, the impact of surviving samples at the beginning (as of March 2010) is calculated here.

[16] A downward bias is partly seen, for example in large enterprises. This reflects that they tend to be largely affected by individual factors such as mergers of sample enterprises.

[17] The response rates for the recent surveys have remained more than 99 percent (99.4 percent for the March 2016 survey and 99.7 percent for the June 2016 survey).

[18] See the Appendix for the revision of the sample design for the survey of financial institutions.

(1) Decreasing the standard error ratios of sales, particularly for some of the nonmanufacturing industries showing high ratios, as well as decreasing those of fixed investment as much as possible. Making use of this improvement in standard error ratios to decrease the number of sample enterprises and reduce their burden.

(2) Correcting the relative error (sample bias) of the *Tankan* estimates as much as possible.

A. Proposed Revisions

Changing a Basis for Stratified Sampling from the Number of Employees to Sales

The *Tankan* sets its accuracy targets for standard error ratios of sales, and therefore stratifying the population based on sales is considered to be natural and the most efficient. Since the *Economic Census* provides sales data of population enterprises, it is worth considering a change from the number of employees to sales among the current three bases for stratification -- industry, capital size, and the number of employees. At the same time, an effective way to achieve a decline in standard error ratios of fixed investment is to choose a basis for stratified sampling more highly correlated with fixed investment than the number of employees. Looking at the correlation coefficients between fixed investment and other survey items using data of the *Tankan*, those between fixed investment and sales are larger for most industries, particularly nonmanufacturing, than those between fixed investment and the number of employees. This also suggests that stratified sampling based on sales is likely to lead to a decline in standard error ratios of fixed investment (Chart 13). The weaker correlation between fixed investment and the number of employees -- compared to that between fixed investment and sales -- is attributed to the fact that the number of employees and fixed investment do not always move together, a reflection of the existence of enterprises such as real-estate leasing and goods rental companies that make an investment in commercial buildings for rent or leased machineries without any change in personnel.[19]

Fixed investment could be another option for a basis for stratification, but it is deemed

[19] The solid line in Chart 13 shows that fixed investment is relatively weakly correlated with capital size. This is partly because some subsidiaries of large enterprises have a small amount of capital relative to their firm size, and therefore capital size does not work well as an indicator representing the amount of assets and its changes (including fixed investment).

inappropriate for the following reasons. First, since fixed investment considerably fluctuates through time, sample enterprises often move to different population strata every time, which makes it difficult to ensure the stability of sample design. For example there is a possibility that enterprises with no fixed investment in a certain year will make much investment in the following year. Second, fixed investment data is only available from the *Economic Census for Business Activity* conducted every five years, and the sample design is less frequently reviewed.

Eliminating a Fraction of Sample Enterprises

If the change of a basis for stratification to sales results in more efficient sample design and a decrease in standard error ratios of such as sales, the statistical accuracy targets can be attained with fewer samples. With this improvement in the sampling methodology, we try to reduce the number of sample enterprises. In this regard, it should be noted that eliminating a significant number of sample enterprises could reduce the convenience of users, even though the accuracy targets are achieved. For example, results of the judgment survey items including business conditions could show considerable discontinuity. Therefore, we plan to eliminate a few hundred enterprises in the next sample revision.[20]

Reducing Relative Errors (Sample Biases)

When decreasing the number of sample enterprises, we also try to correct the relative error (sample bias) of *Tankan* estimates. With the aim of grasping changes in economic conditions, the current *Tankan* estimates are likely to have no considerable difficulty, as analyzed in the previous section. However, from the viewpoint of statistical accuracy, it is preferable to decrease a relative error (sample bias) in terms of levels. Therefore we recalculate the relative errors (sample biases) of sales and fixed investment after employing stratified sampling based on sales, and attempt to correct them by eliminating a fraction of sample enterprises with the large number of employees in strata that create large errors.

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[20] To reduce the number of sample enterprises, the Bank also plans to decrease the target sampling ratio of each stratum from more than about 1 percent (non-binding) to more than 0.5 percent (binding). The *Tankan* currently sets this non-binding target sampling ratio of more than about 1 percent, considering a risk that some irregular movements in values reported from sample enterprises are amplified, yielding biased estimates for population total. However, the *Tankan* has introduced the treatment of outliers since the December 2010 survey and has removed effects of outliers. Therefore easing the standard of sampling ratio will not cause any problem. For details of the treatment of outliers, see Ishikawa, Endo, and Shiratori [2010].

B. Standard Error Ratios under the Revised Sample Design

Downward Effects of Sales Stratification on Standard Error Ratios

Chart 14 compares the standard error ratios of sales under stratified sampling based on the number of employees (hereafter employee stratification) with those under stratified sampling based on sales (hereafter sales stratification).[21] For all six main categories by industry and scale, the standard error ratios significantly decrease by changing from the employee stratification to the sales stratification. By industry, a remarkable decline is seen in industries where sales seem to be weakly correlated with the number of employees, such as business oriented machinery, real estate, services for businesses, and services for individuals.

Next, Chart 15 exhibits the standard error ratios of fixed investment based on the two stratification methods. The standard error ratios for all six main categories also decrease under the sales stratification. In particular, a significant decline is seen in small nonmanufacturing enterprises, which have shown the high standard error ratios under the employee stratification (from 28.0 percent for the employee stratification to 11.8 percent for the sales stratification). This is because the sales stratification is effective in controlling standard error ratios of fixed investment, with fixed investment more highly correlated with sales than the number of employees.

Stability of Downward Effects of Sales Stratification on Standard Error Ratios

In Chart 14, using the *2012 Economic Census for Business Activity* as population information, we compare the standard error ratios of sales under the employee stratification with those under the sales stratification, and show a decline in standard error ratios. However, we compute the standard error ratios of sales at the same point in time as sales data -- which is used for stratified sampling -- is compiled, and therefore this effect might

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[21] When employing the sales stratification, we conducted missing value imputation to include enterprises that did not answer their sales in the *Economic Census for Business Activity* as our population. Specifically, we estimated the following equation by industry, using answered data, and used estimated results to stratifying enterprises that unanswered their sales.

$\ln(\text{sales}) = \alpha + \beta * \ln(\text{the number of employees}) + \varepsilon$.

In case of no employees, the average value of sales of enterprises with no employees in the same industry was substituted. These data were not applied to calculations of standard error ratios.

be temporary. Since sales fluctuate more widely through time than does the number of employees, variation in sales within each stratum expands a few years later, likely resulting in a greater increase in standard error ratios under the sales stratification compared to the current employee stratification.

To evaluate the stability of standard error ratios under the sales stratification, we examined whether stratified sampling based on sales has a sustained effect of lowering standard error ratios over time. Specifically, on the basis of the employee stratification and the sales stratification using the *2012 Economic Census for Business Activity* (surveying actual results in 2011), we replaced data of individual enterprises for calculating standard error ratios with that obtained from the *2014 Economic Census for Business Frame* (surveying actual results in 2013), and computed the standard error ratios of sales in 2013 respectively (Chart 16). To remove the effect of change in population, the population enterprises of the *2012 Economic Census for Business Activity* were applied to calculations for both 2011 and 2013.

The estimated results show that the standard error ratios under the sales stratification in 2013 remain lower than those under the employee stratification for all six main categories (Chart 17). Although the degree of increase in the standard error ratios of sales between 2011 and 2013 is greater under the sales stratification than under the employee stratification, reflecting that sales fluctuate more widely through time than does the number of employees, stratified sampling based on sales sustains the effect of decreasing standard error ratios of sales in a generally stable manner, even after two years (Chart 18).

This analysis demonstrates that employing the sales stratification instead of the employee stratification substantially improves the standard error ratios of both sales and fixed investment, and its effect continues after two years. Taking into account our policy of reviewing sample enterprises of the *Tankan* generally twice in five years, sales are a more appropriate basis for stratified sampling.

Eliminating a Fraction of Sample Enterprises

Employing the sales stratification enables us to decrease the number of sample enterprises with the statistical accuracy maintained. In regular revisions of sample enterprises, the Bank continues using current sample enterprises, in principle, to ensure continuity of time-series data. At the same time, to satisfy established criteria such as of the statistical accuracy, the

Bank also randomly extracts new enterprises for each stratum and adds them to samples. In the March 2015 revision, the Bank eliminated 254 sample enterprises as well as added 1,068 new enterprises. Using the sales stratification in the March 2015 revision, the Bank would only have needed to add approximately three to four hundred new sample enterprises to achieve the accuracy targets of standard error ratios for detailed classification. In that case, sample enterprises could have been reduced by approximately seven to eight hundred (i.e., 1,068 enterprises minus three to four hundred enterprises). The sales stratification is useful with a view to easing the total burden on survey respondents.

C. Relative Errors (Sample Biases) under the Revised Sample Design

A Decrease in Relative Errors (Sample Biases) Achieved by Employing Sales Stratification

We next check the relative error (sample bias) of sales and fixed investment after employing stratified sampling based on sales. Chart 19 compares the relative errors (sample biases) of sales and fixed investment under the sales stratification with those under the employee stratification for the six main categories. The sales stratification reduces variation of enterprises within each stratum and decreases an upward bias for most categories. The relative errors (sample biases) of sales of nonmanufacturing, which had large upward biases, particularly show a significant decrease.

A Decrease in Relative Errors (Sample Biases) Caused by Eliminating Sample Enterprises

Finally, on the basis of the relative errors (sample biases) measured above, we choose 300 sample enterprises that contribute the most to overestimation, and simulate changes in the relative error (sample bias) caused by eliminating these enterprises. Looking at the simulated results, the relative errors (sample biases) of sales and fixed investment generally decrease for the six main categories, and in particular sales of large and medium-sized enterprises become almost unbiased for both manufacturing and nonmanufacturing (Chart 20).

This degree of sample reduction presented in the above simulation (300 enterprises) is unlikely to undermine the continuity of the time-series data. Therefore, in future revisions of sample enterprises, we plan to correct the relative error (sample bias) as long as the data continuity is not interrupted.

V. Conclusion

In this paper, we have discussed ways to create more efficient sample design of the *Tankan*, with the use of the *Economic Census* of Japan. When measuring the statistical accuracy of the *Tankan* by using population information newly available from the *Economic Census*, the standard error ratios of total sales, for which the Bank sets the statistical accuracy targets, are generally low, although some industries show somewhat high ratios. By contrast, those of fixed investment are higher, particularly for small enterprises, than those of sales. Moreover, while the *Tankan* estimates of total sales and fixed investment are somewhat larger in terms of levels than the aggregated population values, especially for nonmanufacturing, it becomes clear that their rates of change show only a small bias, demonstrating that the *Tankan* has no significant difficulties in assessing changes in economic conditions and direction of the economy.

Based on this quantitative evaluation, we propose some revisions to our sampling methods, considering a balance between an improvement in the statistical accuracy and a reduction in the total burden on survey respondents. Using sales data of population enterprises newly available from the *Economic Census*, we introduce stratified sampling based on sales rather than on the number of employees, and thereby classify the population more efficiently. On this basis, we attempt to eliminate a fraction of sample enterprises. By employing the revisions proposed in this paper, the standard error ratios and the relative errors (sample biases) of sales and fixed investment show a significant improvement. In addition, making use of data of the *Economic Census* surveyed at different points in time, we present that the sales stratification -- compared to the employee stratification -- sustains the effect of decreasing standard error ratios of sales in a generally stable manner over time. The Bank will finalize details of the new sampling methodology of the *Tankan* based on the results of this paper, and implement them in the upcoming revision of sample enterprises around 2018.

As we mentioned at the outset, since the *Tankan* takes a sample survey framework, appropriate sample design is of great importance to compile highly accurate statistics and provide them to users. For selecting sample enterprises, our basic policy is to maintain and further improve the statistical accuracy as well as reduce the burden on survey respondents. We believe that the approach proposed in this paper strikes an appropriate balance between

the statistical accuracy and survey costs, thereby contributing to a further improvement in the survey methodology of the *Tankan*. Going forward, the Bank would like to continue its persistent efforts to improve the sample design of the *Tankan* from a wide range of viewpoints so that the Bank can ensure this balance as well as provide an accurate picture of business trends of enterprises in Japan.

Appendix: Sample Design for Financial Institutions

Since the March 2004 survey, the Bank has conducted a sample survey of financial institutions to supplement the *Tankan*. Population enterprises of financial institutions are comprised of the following seven sectors: (1) city banks and trust banks; (2) member banks of the Regional Banks Association of Japan and the Second Association of Regional Banks; (3) *shinkin* banks; (4) other financial institutions for small businesses; (5) financial products transaction dealers; (6) insurance companies; and (7) non-deposit money corporations. Sample enterprises are extracted from strata for population estimation classified based on the sector and the amount of total assets.[22] Since sales are not surveyed for financial institutions, the Bank sets a statistical accuracy target of less than 10 percent for the standard error ratio of fixed investment, including land purchasing expenses, for overall financial institutions.

Using available information such as the list of licensed financial institutions, published by the Financial Services Agency, the Bank has formed the population of financial institutions on its own and has extracted samples. The use of the *Economic Census*, which covers financial institutions, as population information leads to greater coverage, as is the case with nonfinancial enterprises, and a reduction in costs associated with forming the population.[23] In the following, we will explain the new sample design of financial institutions, making use of the *Economic Census*.

The use of the *Economic Census* as a population base allows us to have direct access to population information on fixed investment, which is necessary to calculate standard error ratios of financial institutions, thereby improving the accuracy of standard error ratios. As a survey item regarding investment, the *Economic Census* holds a survey on fixed investment

[22] Financial institutions have no size classifications such as large, medium-sized, and small enterprises.

[23] If we include all financial institutions covered by the *Economic Census* as the population of our survey, the number of population enterprises increases from approximately 700 to 20,000 enterprises, and we need to consider substantial addition of sample enterprises. However, taking into account the fact that most financial institutions make almost no investment, we exclude sectors and enterprises from the population which have little impact on estimates of total fixed investment, with the use of the *Economic Census* as a population base. As a result of this, we can grasp overall business trends without any additional survey costs.

(excluding land purchasing expenses) and software investment rather than fixed investment (including land purchasing expenses), of which the *Tankan* has set the statistical accuracy target for the standard error ratio. We set the target for the standard error ratio of fixed and software investment, excluding land purchasing expenses, taking into consideration the higher software investment share in total investment for financial institutions compared to other industries (Appendix Chart [1]). Since the standard error ratio of fixed and software investment -- calculated by using actual results of our survey -- moves at the almost same level as that of fixed investment including land purchasing expenses, which have been used as a target, we continue to set the target ratio of less than 10 percent for overall financial institutions (Appendix Chart [2]).

Next, we discuss revision of a basis used for stratified sampling. The population of financial institutions has been divided into strata by the amount of total assets, taking into consideration its high correlation with fixed investment for which the Bank sets the statistical accuracy target. However, we need to change this basis for stratification because the *Economic Census* does not hold a survey on total assets. Judging from correlation with fixed and software investment excluding land purchasing expenses, the number of employees and sales are possible options of the survey items of the *Economic Census*. Considering that sales of financial institutions are less stable through time, depending on fluctuations in interest rates and asset management, we employ the number of employees as a basis for stratification.

To ensure randomness of sampling, the Bank conducts chi-square goodness-of-fit tests for the *Tankan* so that the distribution of sample enterprises does not deviate from that of population enterprises. We however plan to discontinue this test for financial institutions from the following revision. Since the *Tankan* continues to use current sample enterprises, the distribution of sample enterprises could be biased. On the other hand, it is deemed possible to ensure the randomness of samples for financial institutions by employing an appropriate sampling method for the following reasons: (1) there is a low turnover of population; and (2) a survival bias is unlikely to arise against the background of very few samples that drop out from a survey due to refusal to answer.

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Measures of Statistical Accuracy

(1) Standard Error Ratios

Standard error ratios represent the variation of sample means obtained from sample surveys relative to the population mean. Using sales as an example, the formula is shown below.

$$\text{(Standard Error Ratio)} := \frac{\text{(Standard Deviation of Sample Mean)}}{\text{(Population Mean)}}$$

$$\text{(Standard Deviation of Sample Mean)} := \sqrt{\sum_{i=1}^{L} W_i^{\,2} \frac{N_i - n_i}{N_i - 1} \frac{\sigma_i^2}{n_i}}$$

$$\text{(Population Mean)} := \sum_{i=1}^{L} W_i \, \overline{Y_i}$$

N_i : Number of Population Enterprises in Stratum i
n_i : Number of Sample Enterprises in Stratum i
$\overline{Y_i}$: Population Mean of Sales in Stratum i
σ_i^2 : Population Variance of Sales in Stratum i
W_i : Share of Stratum i in Population Enterprises Classified by Industry and Size
L : Number of Strata in Population Enterprises Classified by Industry and Size

(2) Relative Errors (Sample Biases)

Relative errors (sample biases) show the degree to which the sample mean -- obtained from responses of a particular survey -- deviates from the population mean. Using sales as an example, the formula is shown below.

$$\text{(Relative Error [Sample Bias])} := \frac{\text{(Sample Mean)}}{\text{(Population Mean)}} - 1$$

$$\text{(Sample Mean)} := \sum_{i=1}^{L} W_i \, \hat{Y}_i$$

$\hat{Y}_i$: Sample Mean of Sales in Stratum i

Note: The formula shown in (1) is derived as follows: when extracting a sample of size n without replacements from a population of size N (population mean: μ, population variance: σ^2), the sample mean and the sample variance are given by μ and $\frac{N-n}{N-1}\frac{\sigma^2}{n}$, respectively.

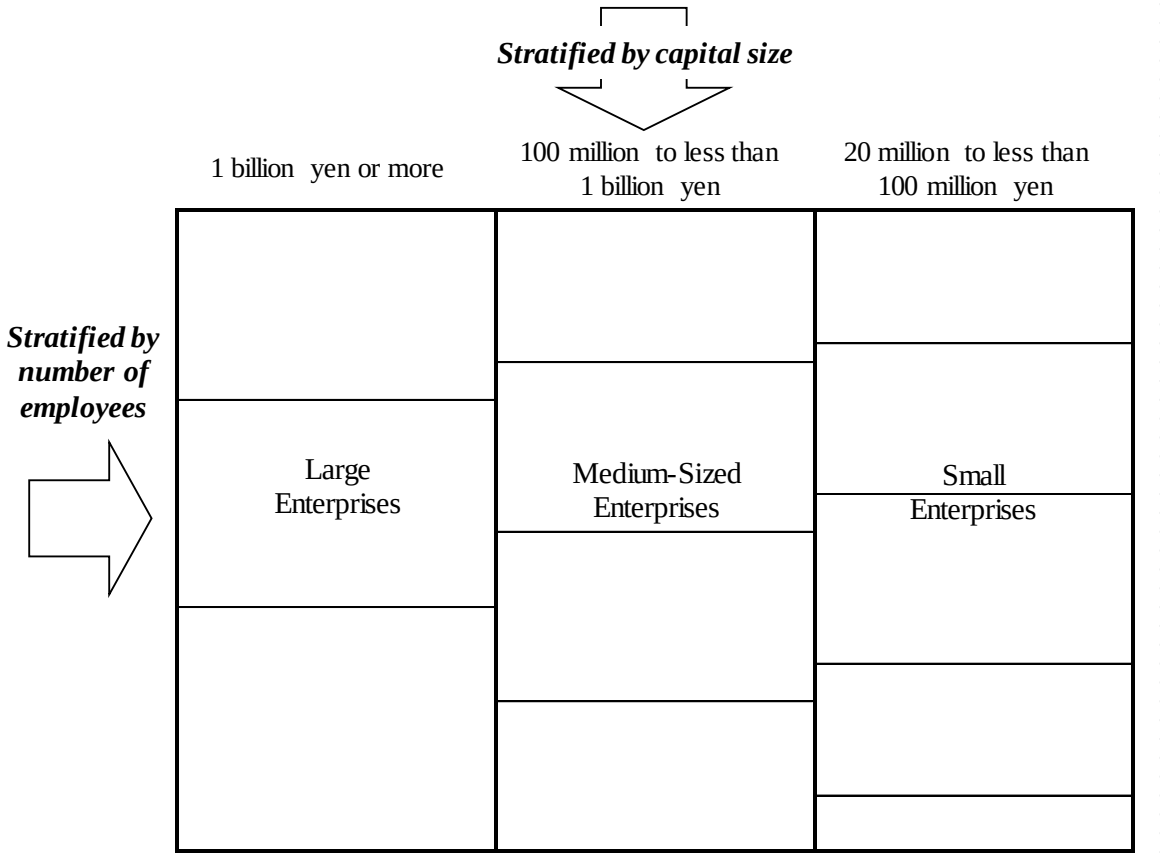
Chart 2

Strata Design for Population Estimation

Population enterprises are subdivided into groups (strata) based on the following three classifications. Sample enterprises are extracted from each stratum.

(a) "Industry" (31 categories)
(b) "Capital Size" (3 categories)
(c) "Number of Employees" (2-5 categories)

For instance, population enterprises of a certain industry are assigned to three size groups (large, medium-sized, and small enterprises) based on their capital size, and further subdivided into multiple strata based on the number of employees.



Note: Each small rectangle -- segmented by both thick and thin lines in the above chart -- represents a stratum for population estimation.

Chart 3

Economic Census of Japan

(1) Key Features of the *Economic Census*

The *Economic Census* provides sales, fixed investment, and other data of individual enterprises, which are not available in the *Establishment and Enterprise Census*.

	Economic Census	*Establishment and Enterprise Census*
Frequency	2 times in 5 years *Economic Census for Business Frame* (2009, 2014…) *Economic Census for Business Activity* (2012, 2016…)	2 times in 5 years
Survey Items	Capital, presence or absence of parent company/subsidiary, number of employees, etc. *plus* **accounting information** *Economic Census for Business Frame*: sales *Economic Census for Business Activity*: sales, expense, and fixed investment	Capital, presence or absence of parent company/subsidiary, number of employees, etc.
Others	Administrative records (commercial and corporate registration, labor insurance, etc.) are used to obtain information on enterprises. Head offices are also required to fill out questionnaires of all branch offices.	N/A

(2) How to Use the *Economic Census*

The *Economic Census* -- which includes data of all population enterprises -- enables to gauge (a) standard error ratios and (b) relative errors (sample biases) to the aggregated population values of the *Tankan*, and provides (c) more options for selecting bases used for stratifying samples.

	Current Methodology	Using the *Economic Census*
(a) Standard Error Ratio	Estimated based on a subset of population data	Calculated precisely
(b) Relative Error (Sample Bias)	Not available	Available
(c) Basis for Stratified Sampling	No options	More options

Chart 4

Number of Population Enterprises by Industry and Size

Industry	All Enterprises			Large Enterprises			Medium-Sized Enterprises			Small Enterprises		
	Mar. 2010 Revision	Mar. 2015 Revision	% chg.	Mar. 2010 Revision	Mar. 2015 Revision	% chg.	Mar. 2010 Revision	Mar. 2015 Revision	% chg.	Mar. 2010 Revision	Mar. 2015 Revision	% chg.
All Industries	**213,210**	**212,277**	**-0.4%**	**5,387**	**4,907**	**-8.9%**	**21,554**	**20,156**	**-6.5%**	**186,269**	**187,214**	**0.5%**
Manufacturing	**44,525**	**46,759**	**5.0%**	**2,137**	**2,099**	**-1.8%**	**5,674**	**5,779**	**1.9%**	**36,714**	**38,881**	**5.9%**
Textiles	2,921	2,714	-7.1%	58	58	0.0%	235	223	-5.1%	2,628	2,433	-7.4%
Lumber & Wood products	1,874	1,810	-3.4%	30	24	-20.0%	130	121	-6.9%	1,714	1,665	-2.9%
Pulp & Paper	1,297	1,360	4.9%	49	42	-14.3%	150	156	4.0%	1,098	1,162	5.8%
Chemicals	2,085	2,397	15.0%	311	317	1.9%	506	564	11.5%	1,268	1,516	19.6%
Petroleum & Coal products	217	246	13.4%	26	21	-19.2%	30	28	-6.7%	161	197	22.4%
Ceramics, Stone & Clay	2,922	2,927	0.2%	87	91	4.6%	285	308	8.1%	2,550	2,528	-0.9%
Iron & Steel	1,160	1,307	12.7%	83	76	-8.4%	219	233	6.4%	858	998	16.3%
Nonferrous metals	727	835	14.9%	61	71	16.4%	156	172	10.3%	510	592	16.1%
Food & Beverages	6,025	6,488	7.7%	221	214	-3.2%	720	747	3.8%	5,084	5,527	8.7%
Processed metals	4,074	4,669	14.6%	102	80	-21.6%	337	379	12.5%	3,635	4,210	15.8%
General-purpose machinery	2,270	1,973	-13.1%	99	87	-12.1%	262	253	-3.4%	1,909	1,633	-14.5%
Production machinery	3,374	4,296	27.3%	154	172	11.7%	392	419	6.9%	2,828	3,705	31.0%
Business oriented machinery	1,509	1,402	-7.1%	95	85	-10.5%	220	218	-0.9%	1,194	1,099	-8.0%
Electrical machinery	5,012	4,845	-3.3%	407	372	-8.6%	929	857	-7.8%	3,676	3,616	-1.6%
Shipbuilding, Heavy machinery & Other transportation machinery	592	637	7.6%	37	37	0.0%	77	72	-6.5%	478	528	10.5%
Motor vehicles	1,717	1,652	-3.8%	158	171	8.2%	303	288	-5.0%	1,256	1,193	-5.0%
Other manufacturing	6,749	7,201	6.7%	159	181	13.8%	723	741	2.5%	5,867	6,279	7.0%
Nonmanufacturing	**168,685**	**165,518**	**-1.9%**	**3,250**	**2,808**	**-13.6%**	**15,880**	**14,377**	**-9.5%**	**149,555**	**148,333**	**-0.8%**
Construction	54,221	50,797	-6.3%	275	252	-8.4%	1,448	1,414	-2.3%	52,498	49,131	-6.4%
Real estate	13,462	17,041	26.6%	377	342	-9.3%	1,874	1,848	-1.4%	11,211	14,851	32.5%
Goods rental & Leasing	1,812	1,845	1.8%	62	66	6.5%	249	219	-12.0%	1,501	1,560	3.9%
Wholesaling	33,642	30,053	-10.7%	684	585	-14.5%	3,968	3,261	-17.8%	28,990	26,207	-9.6%
Retailing	16,993	15,302	-10.0%	368	307	-16.6%	1,485	1,276	-14.1%	15,140	13,719	-9.4%
Transport & Postal activities	11,514	11,993	4.2%	304	291	-4.3%	1,183	1,161	-1.9%	10,027	10,541	5.1%
Communications	444	343	-22.7%	59	50	-15.3%	119	64	-46.2%	266	229	-13.9%
Information services	5,978	5,699	-4.7%	234	196	-16.2%	1,419	1,204	-15.2%	4,325	4,299	-0.6%
Other information communication	3,096	3,110	0.5%	283	234	-17.3%	882	780	-11.6%	1,931	2,096	8.5%
Electric & Gas utilities	359	371	3.3%	79	81	2.5%	159	182	14.5%	121	108	-10.7%
Services for businesses	12,236	13,295	8.7%	166	127	-23.5%	1,237	1,210	-2.2%	10,833	11,958	10.4%
Services for individuals	8,005	8,579	7.2%	153	123	-19.6%	1,045	1,055	1.0%	6,807	7,401	8.7%
Accommodations, Eating & Drinking services	6,460	6,717	4.0%	175	141	-19.4%	775	669	-13.7%	5,510	5,907	7.2%
Mining & Quarrying of stone and gravel	463	373	-19.4%	31	13	-58.1%	37	34	-8.1%	395	326	-17.5%

Note: Based on capital size, enterprises are categorized into large enterprises with a capital of 1 billion yen or more, medium-sized enterprises with a capital of 100 million yen to less than 1 billion yen, and small enterprises with a capital of 20 million yen to less than 100 million yen.

Chart 5

Standard Error Ratios of Sales

Industry		Large Enterprises	Medium-Sized Enterprises	Small Enterprises
Manufacturing		**1.0%**	**2.7%**	**2.5%**
	Textiles	2.2%	9.5%	8.9%
	Lumber & Wood products	4.9%	9.4%	9.3%
	Pulp & Paper	5.8%	9.1%	9.6%
	Chemicals	4.4%	8.7%	8.4%
	Petroleum & Coal products	3.1%	8.8%	8.7%
	Ceramics, Stone & Clay	5.4%	8.3%	9.0%
	Iron & Steel	2.3%	9.3%	8.9%
	Nonferrous metals	8.4%	9.6%	9.0%
	Food & Beverages	5.1%	7.7%	7.9%
	Processed metals	3.2%	9.7%	8.3%
	General-purpose machinery	2.4%	7.7%	7.3%
	Production machinery	4.4%	9.2%	9.2%
	Business oriented machinery	2.8%	10.5%	9.2%
	Electrical machinery	2.0%	8.1%	9.4%
	Shipbuilding, Heavy machinery & Other transportation machinery	1.7%	10.2%	9.2%
	Motor vehicles	1.4%	6.9%	7.1%
	Other manufacturing	3.5%	10.1%	7.6%
Nonmanufacturing		**3.0%**	**4.6%**	**3.9%**
	Construction	2.6%	5.0%	4.1%
	Real estate	9.5%	13.4%	14.4%
	Goods rental & Leasing	11.1%	11.1%	9.7%
	Wholesaling	7.1%	9.5%	9.5%
	Retailing	4.4%	9.3%	6.7%
	Transport & Postal activities	6.3%	7.2%	8.3%
	Communications	7.9%	10.2%	9.2%
	Information services	5.3%	8.4%	9.4%
	Other information communication	9.1%	7.1%	9.3%
	Electric & Gas utilities	1.5%	7.5%	8.2%
	Services for businesses	7.2%	9.0%	9.0%
	Services for individuals	9.3%	10.3%	10.9%
	Accommodations, Eating & Drinking services	8.1%	9.0%	8.8%
	Mining & Quarrying of stone and gravel	24.0%	22.5%	18.2%

Note: Standard error ratios -- the coefficient of variation for sample estimates -- are calculated by dividing the standard deviation of sample mean by the population mean. See Chart 1 for more information.

Chart 6

A Cross-Comparison of Standard Error Ratios of Sales (2010 and 2015)

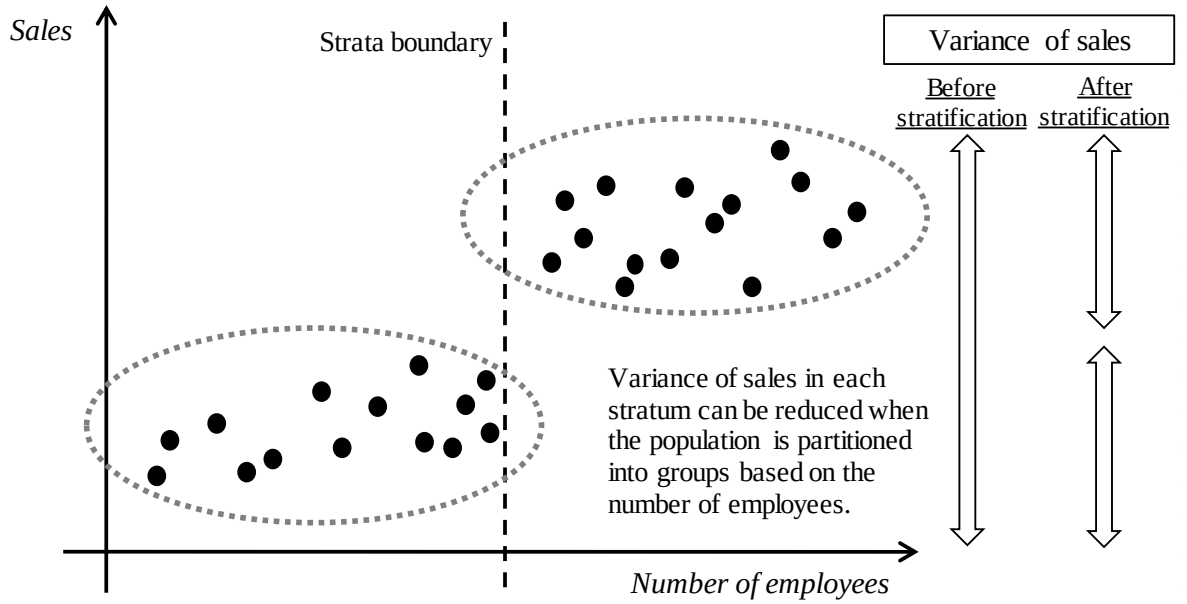
Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Mar. 2010	Mar. 2015	Mar. 2010	Mar. 2015	Mar. 2010	Mar. 2015
Manufacturing	**1.5%**	**1.0%**	**2.6%**	**2.7%**	**2.3%**	**2.5%**
Business oriented machinery	8.4%	2.8%	9.9%	10.5%	9.4%	9.2%
Shipbuilding, Heavy machinery & Other transportation machinery	8.4%	1.7%	9.4%	10.2%	11.2%	9.2%
Other manufacturing	8.1%	3.5%	7.7%	10.1%	6.8%	7.6%
Nonmanufacturing	**3.1%**	**3.0%**	**4.3%**	**4.6%**	**3.8%**	**3.9%**
Real estate	8.8%	9.5%	8.3%	13.4%	9.2%	14.4%
Goods rental & Leasing	11.0%	11.1%	9.2%	11.1%	9.1%	9.7%
Communications	8.2%	7.9%	8.5%	10.2%	12.0%	9.2%
Services for individuals	11.2%	9.3%	8.9%	10.3%	11.3%	10.9%

Note: Standard error ratios are calculated using the method described in the footnote of Chart 5.

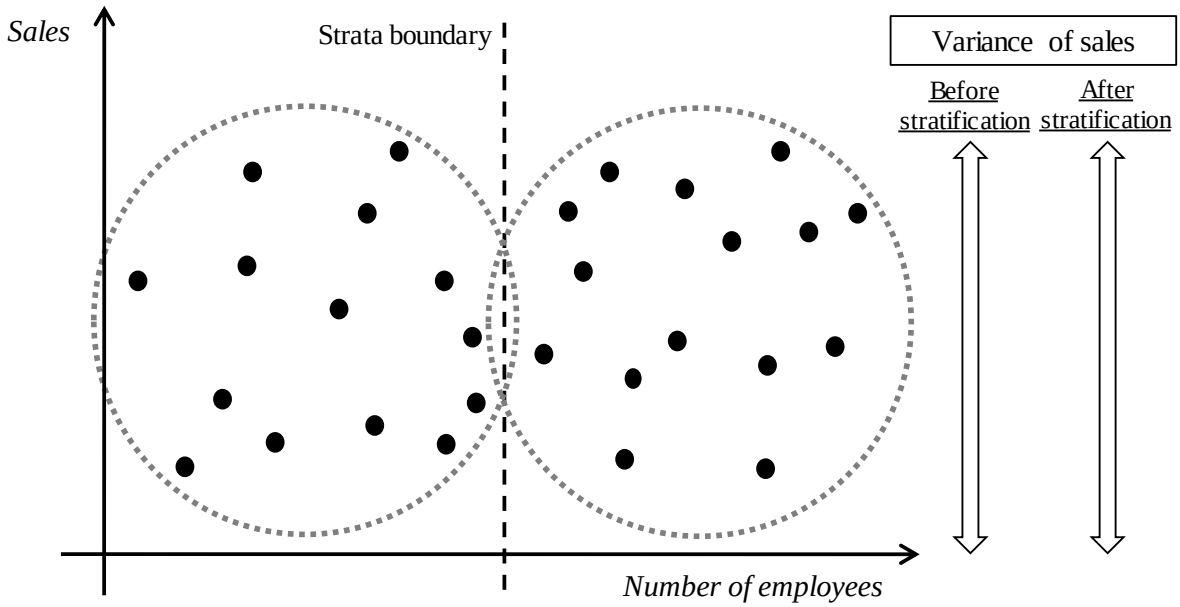
Chart 7

Stratification by Number of Employees

(1) Strong Correlation between the Number of Employees and Sales



(2) Weak Correlation between the Number of Employees and Sales



Variance of sales in each stratum does not change even when the population is partitioned into groups based on the number of employees.

Chart 8

Standard Error Ratios of Fixed Investment

Industry		Large Enterprises	Medium-Sized Enterprises	Small Enterprises
Manufacturing		**3.0%**	**6.5%**	**10.1%**
	Textiles	4.4%	24.9%	39.2%
	Lumber & Wood products	18.0%	19.1%	41.0%
	Pulp & Paper	6.3%	21.0%	30.8%
	Chemicals	6.1%	24.0%	22.2%
	Petroleum & Coal products	0.7%	17.4%	36.2%
	Ceramics, Stone & Clay	10.9%	22.2%	33.1%
	Iron & Steel	4.2%	25.4%	41.3%
	Nonferrous metals	13.8%	16.9%	15.0%
	Food & Beverages	7.5%	18.2%	28.1%
	Processed metals	15.1%	27.2%	25.3%
	General-purpose machinery	10.8%	16.4%	28.1%
	Production machinery	9.3%	36.8%	73.1%
	Business oriented machinery	12.4%	34.5%	15.1%
	Electrical machinery	10.2%	16.3%	43.3%
	Shipbuilding, Heavy machinery & Other transportation machinery	2.5%	11.4%	25.2%
	Motor vehicles	2.7%	10.2%	16.6%
	Other manufacturing	7.8%	21.4%	21.6%
Nonmanufacturing		**3.6%**	**8.3%**	**28.0%**
	Construction	7.5%	29.8%	29.1%
	Real estate	23.6%	31.0%	67.4%
	Goods rental & Leasing	35.7%	24.2%	25.8%
	Wholesaling	14.0%	23.8%	20.8%
	Retailing	11.6%	19.0%	16.3%
	Transport & Postal activities	11.1%	21.5%	156.3%
	Communications	5.1%	26.6%	39.8%
	Information services	18.4%	31.2%	242.0%
	Other information communication	21.1%	14.9%	39.1%
	Electric & Gas utilities	0.8%	15.1%	14.8%
	Services for businesses	26.7%	29.8%	42.4%
	Services for individuals	13.5%	36.3%	21.2%
	Accommodations, Eating & Drinking services	31.7%	41.1%	37.8%
	Mining & Quarrying of stone and gravel	34.3%	31.2%	40.8%

Note: Standard error ratios are calculated using the method described in the footnote of Chart 5.

Chart 9

Relative Errors (Sample Biases) of Sales and Fixed Investment

(1) Sales

Industry	Large Enterprises	Medium-Sized Enterprises	Small Enterprises
Manufacturing	**2.3%**	**3.3%**	**11.4%**
Nonmanufacturing	**11.3%**	**19.8%**	**26.4%**

(2) Fixed Investment

Industry	Large Enterprises	Medium-Sized Enterprises	Small Enterprises
Manufacturing	**3.5%**	**6.2%**	**9.0%**
Nonmanufacturing	**9.8%**	**20.2%**	**13.7%**

Note: Relative errors (sample biases) are calculated as follows (see Chart 1 for details):

"Relative error (sample bais)" = ("*Tankan* estimate for total" – "Aggregated population value from the *Economic Census*") / "Aggregated population value from the *Economic Census*" * 100

Effects of Overestimation on the Rates of Change in Sales

(1) Estimation Method

(i) *Tankan* Estimate of Total Sales

	As of 2011	As of 2013
Population Enterprises	*2012 Economic Census for Business Activity*	*2012 Economic Census for Business Activity*
Sample Enterprises of the *Tankan*	Based on the regular revision in Mar. 2015	Based on the regular revision in Mar. 2015
Individual Data of Enterprises Used for Population Estimation	*2012 Economic Census for Business Activity*	*2014 Economic Census for Business Frame*

[A] Calculating year-on-year rates of change

(ii) Aggregated Population Value

	As of 2011	As of 2013
Population Enterprises	*2012 Economic Census for Business Activity*	*2012 Economic Census for Business Activity*
Individual Data of Enterprises Used for Calculating Aggregates for the *Economic Census*	*2012 Economic Census for Business Activity*	*2014 Economic Census for Business Frame*

[B] Calculating year-on-year rates of change

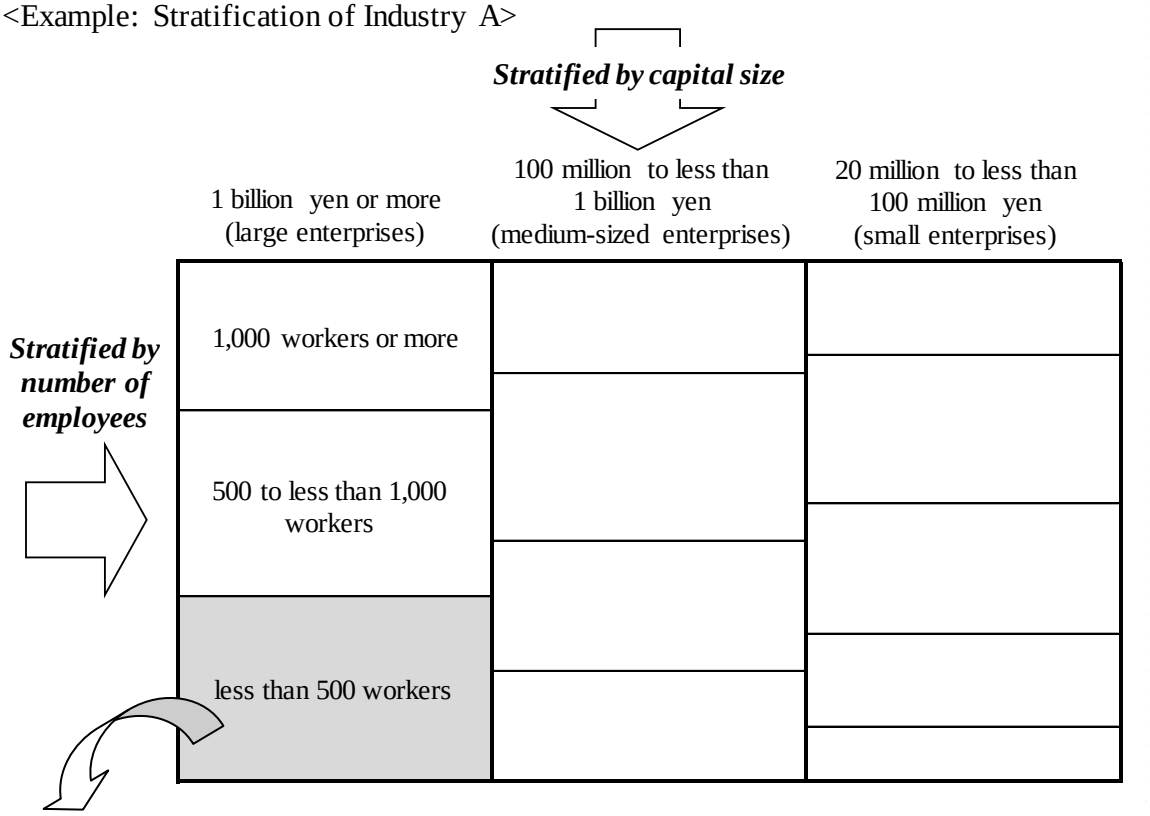
(2) Rates of Change in Sales

Industry	Large Enterprises			Medium-Sized Enterprises			Small Enterprises		
	[A]	[B]	Difference [A-B]	[A]	[B]	Difference [A-B]	[A]	[B]	Difference [A-B]
Manufacturing	**6.4%**	**6.2%**	**+0.1% pt** (5.0%)	**3.5%**	**3.0%**	**+0.6% pt** (4.4%)	**4.0%**	**3.4%**	**+0.6% pt** (3.7%)
Nonmanufacturing	**5.0%**	**5.9%**	**-0.9% pt** (3.1%)	**5.1%**	**6.1%**	**-1.1% pt** (2.6%)	**4.9%**	**5.2%**	**-0.3% pt** (2.8%)

Note: The chart in (2) shows the estimated results of [A] and [B] shown in the above charts. Figures in parentheses are standard deviations of year-on-year rates of change for FYs 2000 through 2014 (excluding FY 2009) obtained from *Tankan* data.

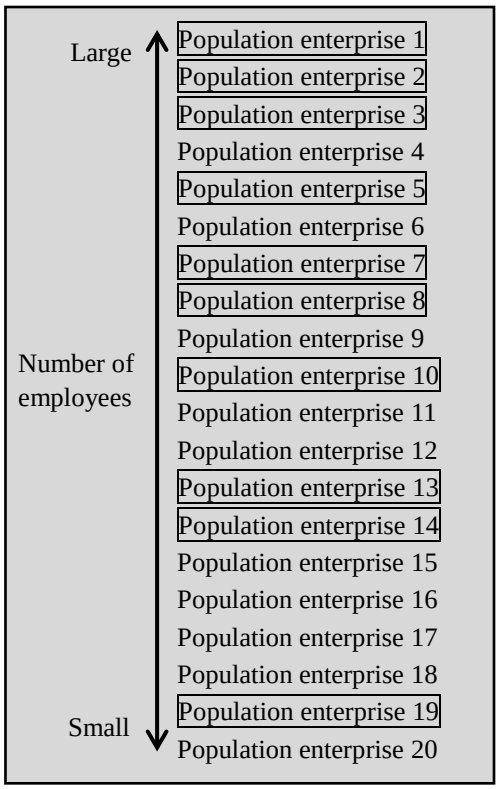
Mechanism of Overestimation

<Example: Stratification of Industry A>



<Stratum for Population Estimation>

Sample enterprises of the *Tankan* are enclosed in squares.



When arranging population enterprises that are included in the "large enterprises with less than 500 workers in industry A" stratum in descending order based on the number of employees, sample enterprises of the *Tankan* are relatively biased toward enterprises with a large number of employees.

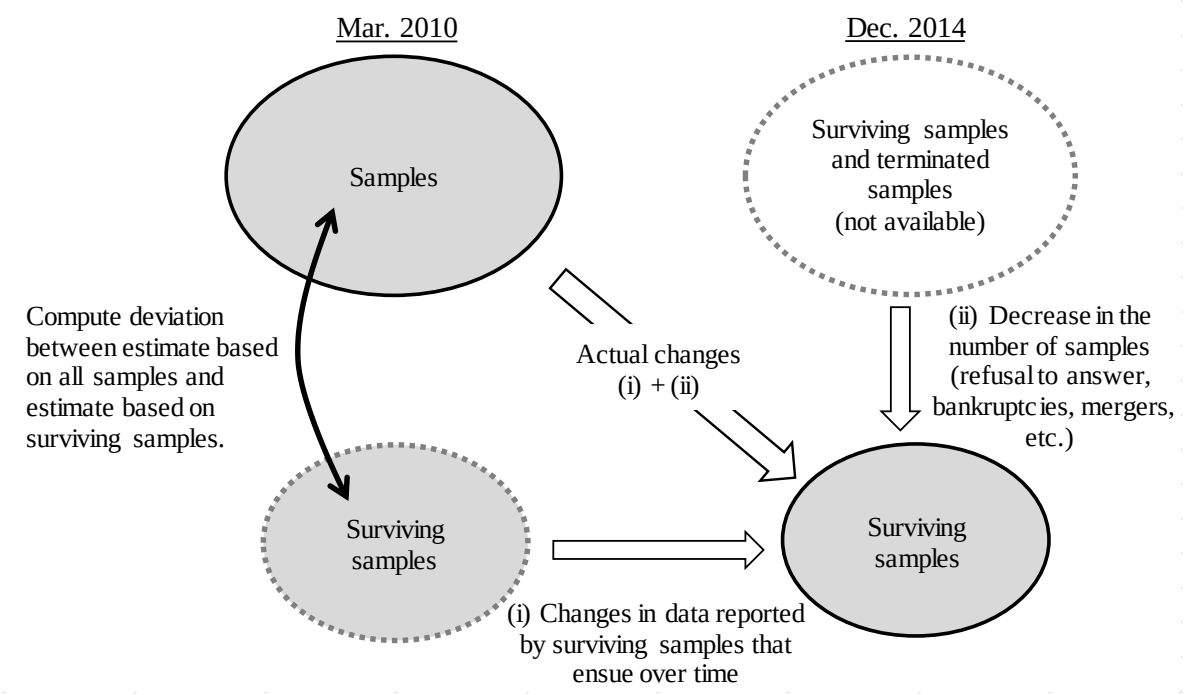
In the case where the number of employees is positively correlated with sales and fixed investment, this leads to an overestimation of the *Tankan* estimate, creating a situation in which the *Tankan* estimate is larger than the true value of the population.

Survival Bias

(1) Estimation Method

In order to analyze the effects of the survival bias caused by a decrease in the number of sample enterprises, we use sample enterprises data of the March 2010 survey and compute the deviation between the estimate based on all samples in the March 2010 survey and the estimate based on surviving samples up until the December 2014 survey.

"Deviation" = ("*Tankan* estimate based on surviving samples" – "*Tankan* estimate based on all samples") / "*Tankan* estimate based on all samples" * 100



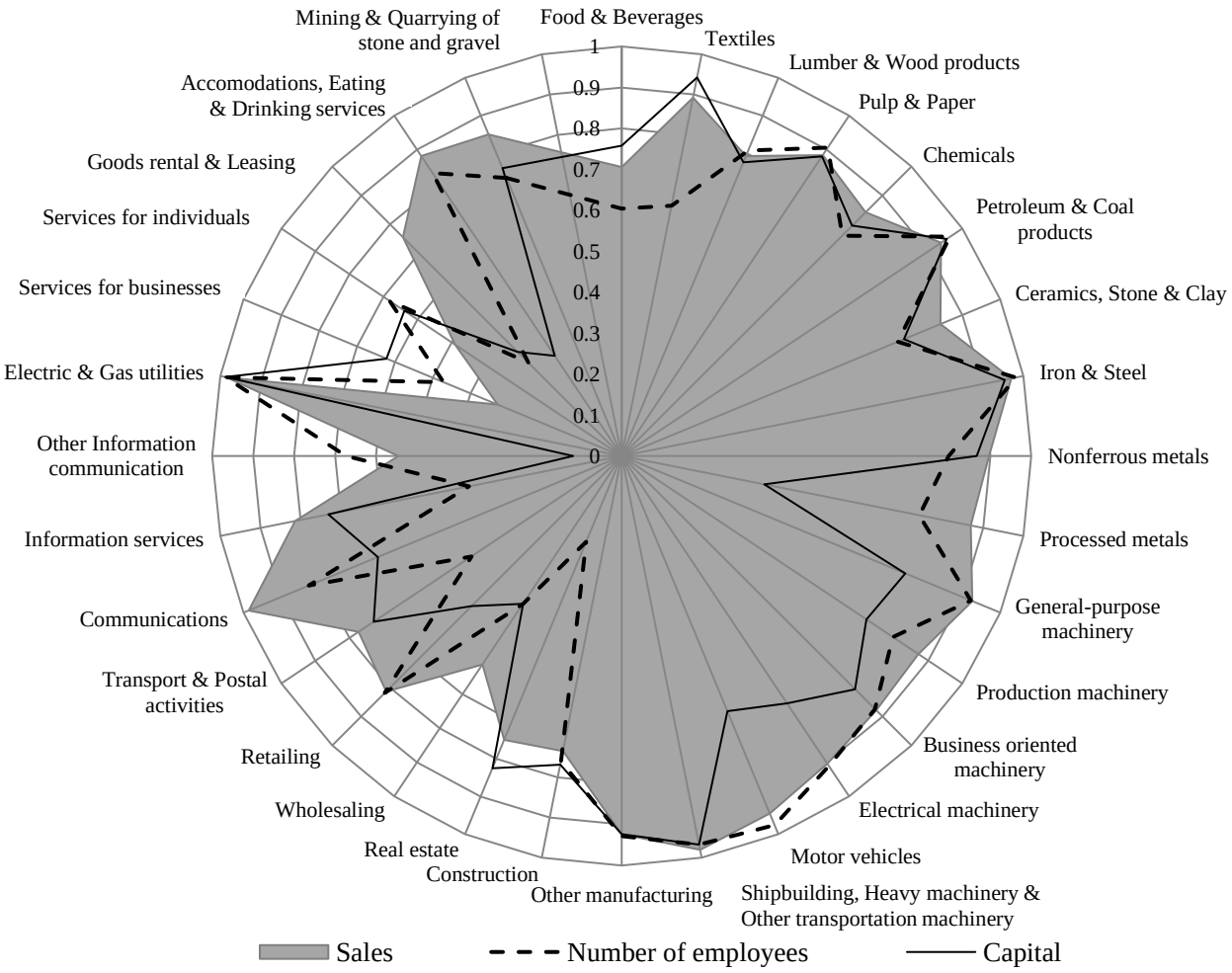
(2) Estimated Yearly Deviation

Industry	Sales			Fixed Investment		
	Large Enterprises	Medium-Sized Enterprises	Small Enterprises	Large Enterprises	Medium-Sized Enterprises	Small Enterprises
Manufacturing	**0.2%** (5.0%)	**0.0%** (4.4%)	**0.4%** (3.7%)	**0.2%** (9.6%)	**-0.1%** (10.4%)	**0.4%** (12.1%)
Nonmanufacturing	**-0.5%** (3.1%)	**0.3%** (2.6%)	**0.5%** (2.8%)	**-0.1%** (5.8%)	**1.7%** (6.4%)	**1.9%** (11.5%)

Notes: 1. Enterprises that were newly added as samples in the March 2010-December 2014 survey period are excluded from the estimation.
2. Figures for fixed investment include land purchasing expenses.
3. Figures in parentheses in (2) are standard deviations of year-on-year rates of change for FYs 2000 through 2014 (excluding FY 2009) obtained from *Tankan* data.

Chart 13

Correlation Coefficient in Relation to Fixed Investment



Note: Correlation coefficients are calculated using the actual results of FY 2011 *Tankan* data.

Chart 14

Standard Error Ratios of Sales: Sales Stratification

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification
Manufacturing	**1.0%**	**0.5%**	**2.7%**	**1.8%**	**2.5%**	**1.8%**
Textiles	2.2%	9.8%	9.5%	6.1%	8.9%	4.5%
Lumber & Wood products	4.9%	4.2%	9.4%	8.3%	9.3%	4.8%
Pulp & Paper	5.8%	4.0%	9.1%	7.8%	9.6%	5.7%
Chemicals	4.4%	1.5%	8.7%	3.9%	8.4%	9.0%
Petroleum & Coal products	3.1%	1.3%	8.8%	11.5%	8.7%	4.7%
Ceramics, Stone & Clay	5.4%	1.8%	8.3%	4.6%	9.0%	4.7%
Iron & Steel	2.3%	1.5%	9.3%	4.0%	8.9%	5.3%
Nonferrous metals	8.4%	8.7%	9.6%	5.8%	9.0%	4.1%
Food & Beverages	5.1%	2.0%	7.7%	4.0%	7.9%	3.0%
Processed metals	3.2%	1.7%	9.7%	6.4%	8.3%	5.4%
General-purpose machinery	2.4%	1.6%	7.7%	4.5%	7.3%	5.0%
Production machinery	4.4%	3.3%	9.2%	8.2%	9.2%	5.7%
Business oriented machinery	2.8%	1.4%	10.5%	4.7%	9.2%	5.5%
Electrical machinery	2.0%	0.7%	8.1%	3.2%	9.4%	11.0%
Shipbuilding, Heavy machinery & Other transportation machinery	1.7%	0.8%	10.2%	9.7%	9.2%	5.1%
Motor vehicles	1.4%	0.8%	6.9%	3.3%	7.1%	3.6%
Other manufacturing	3.5%	1.4%	10.1%	10.4%	7.6%	4.3%
Nonmanufacturing	**3.0%**	**0.8%**	**4.6%**	**3.1%**	**3.9%**	**1.6%**
Construction	2.6%	1.2%	5.0%	2.2%	4.1%	2.6%
Real estate	9.5%	4.3%	13.4%	6.8%	14.4%	4.1%
Goods rental & Leasing	11.1%	3.3%	11.1%	11.6%	9.7%	2.6%
Wholesaling	7.1%	1.2%	9.5%	6.6%	9.5%	3.4%
Retailing	4.4%	1.6%	9.3%	3.4%	6.7%	4.3%
Transport & Postal activities	6.3%	4.5%	7.2%	11.4%	8.3%	2.8%
Communications	7.9%	6.9%	10.2%	37.1%	9.2%	13.5%
Information services	5.3%	3.1%	8.4%	3.4%	9.4%	6.6%
Other information communication	9.1%	5.1%	7.1%	3.6%	9.3%	3.3%
Electric & Gas utilities	1.5%	0.9%	7.5%	4.2%	8.2%	7.0%
Services for businesses	7.2%	2.1%	9.0%	3.7%	9.0%	3.0%
Services for individuals	9.3%	1.1%	10.3%	6.0%	10.9%	4.2%
Accommodations, Eating & Drinking services	8.1%	7.2%	9.0%	9.0%	8.8%	4.2%
Mining & Quarrying of stone and gravel	24.0%	28.9%	22.5%	8.2%	18.2%	9.6%

Note: Standard error ratios are calculated using the method described in the footnote of Chart 5.

Chart 15

Standard Error Ratios of Fixed Investment: Sales Stratification

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification
Manufacturing	**3.0%**	**2.4%**	**6.5%**	**6.3%**	**10.1%**	**9.1%**
Textiles	4.4%	14.7%	24.9%	26.3%	39.2%	34.6%
Lumber & Wood products	18.0%	17.6%	19.1%	24.1%	41.0%	35.6%
Pulp & Paper	6.3%	8.7%	21.0%	20.5%	30.8%	26.9%
Chemicals	6.1%	5.5%	24.0%	18.8%	22.2%	23.1%
Petroleum & Coal products	0.7%	2.9%	17.4%	24.9%	36.2%	36.1%
Ceramics, Stone & Clay	10.9%	5.7%	22.2%	19.8%	33.1%	30.9%
Iron & Steel	4.2%	7.6%	25.4%	26.6%	41.3%	36.3%
Nonferrous metals	13.8%	17.6%	16.9%	18.8%	15.0%	16.6%
Food & Beverages	7.5%	6.4%	18.2%	17.1%	28.1%	34.3%
Processed metals	15.1%	11.1%	27.2%	32.6%	25.3%	25.2%
General-purpose machinery	10.8%	8.5%	16.4%	17.7%	28.1%	31.6%
Production machinery	9.3%	7.8%	36.8%	57.1%	73.1%	44.5%
Business oriented machinery	12.4%	6.9%	34.5%	37.6%	15.1%	14.1%
Electrical machinery	10.2%	7.1%	16.3%	14.5%	43.3%	27.8%
Shipbuilding, Heavy machinery & Other transportation machinery	2.5%	2.4%	11.4%	9.8%	25.2%	20.0%
Motor vehicles	2.7%	3.8%	10.2%	9.8%	16.6%	16.4%
Other manufacturing	7.8%	6.0%	21.4%	20.0%	21.6%	22.5%
Nonmanufacturing	**3.6%**	**3.1%**	**8.3%**	**8.2%**	**28.0%**	**11.8%**
Construction	7.5%	9.9%	29.8%	28.9%	29.1%	24.2%
Real estate	23.6%	20.6%	31.0%	26.6%	67.4%	38.2%
Goods rental & Leasing	35.7%	14.3%	24.2%	33.0%	25.8%	16.9%
Wholesaling	14.0%	13.7%	23.8%	24.8%	20.8%	21.4%
Retailing	11.6%	8.0%	19.0%	13.9%	16.3%	14.6%
Transport & Postal activities	11.1%	11.0%	21.5%	22.2%	156.3%	53.4%
Communications	5.1%	4.5%	26.6%	33.3%	39.8%	46.8%
Information services	18.4%	13.8%	31.2%	29.5%	242.0%	157.2%
Other information communication	21.1%	19.2%	14.9%	14.1%	39.1%	39.3%
Electric & Gas utilities	0.8%	1.9%	15.1%	16.0%	14.8%	10.1%
Services for businesses	26.7%	22.8%	29.8%	31.0%	42.4%	37.2%
Services for individuals	13.5%	7.0%	36.3%	30.7%	21.2%	23.3%
Accommodations, Eating & Drinking services	31.7%	31.1%	41.1%	37.1%	37.8%	33.1%
Mining & Quarrying of stone and gravel	34.3%	33.2%	31.2%	32.5%	40.8%	32.3%

Note: Standard error ratios are calculated using the method described in the footnote of Chart 5.

Stability of Sales Stratification (1)
-- Estimation Method --

(i) Standard error ratios of total sales are calculated for both employee stratification and sales stratification using the *2012 Economic Census for Business Activity* as population information.

⇨ [A] and [B] in the chart below (see Chart 14 for the estimated results)

(ii) Based on the two strata in (i), standard error ratios of total sales are calculated by replacing sales data of individual enterprises with those obtained from the *2014 Economic Census for Business Frame*.

⇨ [C] and [D] in the chart below

(i) and (ii) use the same population enterprises (derived from the *2012 Economic Census for Business Activity*) and sample enterprises of the *Tankan* (based on information at the time of the regular revision in March 2015).

		Sales Data Used for Calculating Standard Error Ratios	
		2012 Economic Census for Business Activity (as of 2011)	*2014 Economic Census for Business Frame* (as of 2013)
		Changes in reporting data	
Basis for Stratification in *2012 Economic Census for Business Activity*	Employee	Standard error ratio [A] (Based on employee stratification and sales data for 2011)	Standard error ratio [C] (Based on employee stratification and sales data for 2013)
	Change	**Decrease (as shown in Chart 14)**	**Verify the ongoing effects of decline in ratios**
	Sales	Standard error ratio [B] (Based on sales stratification and sales data for 2011)	Standard error ratio [D] (Based on sales stratification and sales data for 2013)

Stability of Sales Stratification (2)
-- Standard Error Ratios of Sales after Two Years (in 2013) --

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification
Manufacturing	**1.1%**	**0.8%**	**2.6%**	**2.0%**	**2.7%**	**2.6%**
Textiles	3.3%	9.7%	11.4%	9.4%	11.6%	8.8%
Lumber & Wood products	4.8%	5.2%	9.6%	7.5%	11.4%	9.2%
Pulp & Paper	4.9%	6.0%	11.4%	11.0%	11.8%	13.7%
Chemicals	4.9%	3.4%	8.2%	4.8%	8.9%	9.9%
Petroleum & Coal products	3.2%	0.9%	8.6%	10.4%	7.3%	5.2%
Ceramics, Stone & Clay	5.9%	2.0%	9.0%	6.2%	9.7%	6.7%
Iron & Steel	2.1%	1.8%	11.1%	7.2%	8.8%	5.9%
Nonferrous metals	8.9%	8.8%	10.4%	5.8%	9.3%	4.7%
Food & Beverages	5.3%	2.4%	7.5%	4.3%	8.3%	7.2%
Processed metals	3.7%	2.1%	9.5%	8.6%	8.5%	10.7%
General-purpose machinery	2.5%	2.4%	9.2%	10.9%	8.3%	10.9%
Production machinery	4.6%	4.1%	9.9%	12.5%	9.8%	9.8%
Business oriented machinery	3.2%	6.5%	10.0%	5.4%	10.1%	8.5%
Electrical machinery	2.2%	2.4%	8.0%	6.5%	9.9%	12.8%
Shipbuilding, Heavy machinery & Other transportation machinery	2.3%	2.1%	6.2%	6.8%	8.9%	4.8%
Motor vehicles	2.0%	1.1%	7.3%	5.1%	10.3%	8.7%
Other manufacturing	3.7%	1.8%	8.7%	6.9%	7.8%	5.5%
Nonmanufacturing	**3.0%**	**1.3%**	**4.3%**	**3.8%**	**3.3%**	**2.3%**
Construction	2.7%	1.5%	4.7%	3.5%	4.5%	4.8%
Real estate	10.0%	10.1%	14.8%	7.6%	12.4%	8.4%
Goods rental & Leasing	11.0%	6.4%	9.8%	11.0%	9.2%	4.6%
Wholesaling	6.8%	2.7%	9.0%	8.1%	7.6%	4.9%
Retailing	5.2%	2.8%	7.5%	4.7%	7.0%	5.1%
Transport & Postal activities	7.2%	5.0%	7.6%	11.2%	8.8%	5.5%
Communications	2.8%	4.7%	13.2%	34.6%	9.7%	13.1%
Information services	5.0%	3.1%	11.2%	8.5%	9.9%	8.9%
Other information communication	8.3%	5.4%	7.1%	5.9%	9.7%	10.3%
Electric & Gas utilities	1.9%	1.0%	7.3%	4.2%	7.1%	6.0%
Services for businesses	7.4%	3.2%	9.3%	6.6%	9.7%	5.9%
Services for individuals	9.4%	3.8%	9.7%	16.9%	9.9%	6.5%
Accommodations, Eating & Drinking services	7.6%	4.8%	8.8%	9.1%	10.5%	8.6%
Mining & Quarrying of stone and gravel	21.8%	24.3%	15.2%	7.0%	18.3%	11.3%

Note: Figures are estimated results of [C] and [D] shown in Chart 16 and are calculated using the method described in the footnote of Chart 5.

Stability of Sales Stratification (3)
-- Degree of Change in Standard Error Ratios of Sales during the Two-Year Window (2011-2013 Period) --

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification
Manufacturing	**+0.1% pt**	**+0.3% pt**	**-0.1% pt**	**+0.2% pt**	**+0.2% pt**	**+0.8% pt**
Textiles	+1.1%pt	+0.0%pt	+1.9%pt	+3.3%pt	+2.7%pt	+4.3%pt
Lumber & Wood products	-0.1%pt	+1.1%pt	+0.2%pt	-0.8%pt	+2.1%pt	+4.4%pt
Pulp & Paper	-0.9%pt	+2.1%pt	+2.3%pt	+3.2%pt	+2.2%pt	+8.0%pt
Chemicals	+0.5%pt	+1.9%pt	-0.5%pt	+0.9%pt	+0.5%pt	+0.7%pt
Petroleum & Coal products	+0.1%pt	-0.5%pt	-0.2%pt	-1.1%pt	-1.4%pt	+0.5%pt
Ceramics, Stone & Clay	+0.5%pt	+0.1%pt	+0.7%pt	+1.7%pt	+0.7%pt	+1.9%pt
Iron & Steel	-0.2%pt	+0.4%pt	+1.8%pt	+3.2%pt	-0.1%pt	+0.5%pt
Nonferrous metals	+0.5%pt	+0.1%pt	+0.8%pt	+0.0%pt	+0.3%pt	+0.5%pt
Food & Beverages	+0.2%pt	+0.4%pt	-0.2%pt	+0.2%pt	+0.4%pt	+4.1%pt
Processed metals	+0.5%pt	+0.4%pt	-0.2%pt	+2.1%pt	+0.2%pt	+5.3%pt
General-purpose machinery	+0.1%pt	+0.8%pt	+1.5%pt	+6.4%pt	+1.0%pt	+5.9%pt
Production machinery	+0.2%pt	+0.8%pt	+0.7%pt	+4.0%pt	+0.6%pt	+4.0%pt
Business oriented machinery	+0.4%pt	+5.0%pt	-0.5%pt	+0.2%pt	+0.9%pt	+2.8%pt
Electrical machinery	+0.2%pt	+1.7%pt	-0.1%pt	+3.3%pt	+0.5%pt	+1.8%pt
Shipbuilding, Heavy machinery & Other transportation machinery	+0.6%pt	+1.3%pt	-4.0%pt	-3.0%pt	-0.3%pt	-0.3%pt
Motor vehicles	+0.6%pt	+0.3%pt	+0.4%pt	+1.8%pt	+3.2%pt	+5.0%pt
Other manufacturing	+0.2%pt	+0.4%pt	-1.4%pt	-3.5%pt	+0.2%pt	+1.2%pt
Nonmanufacturing	**+0.0% pt**	**+0.5% pt**	**-0.3% pt**	**+0.7% pt**	**-0.6% pt**	**+0.7% pt**
Construction	+0.1%pt	+0.3%pt	-0.3%pt	+1.3%pt	+0.4%pt	+2.1%pt
Real estate	+0.5%pt	+5.8%pt	+1.4%pt	+0.7%pt	-2.0%pt	+4.3%pt
Goods rental & Leasing	-0.1%pt	+2.9%pt	-1.3%pt	-0.9%pt	-0.5%pt	+1.9%pt
Wholesaling	-0.3%pt	+1.5%pt	-0.5%pt	+1.5%pt	-1.9%pt	+1.5%pt
Retailing	+0.8%pt	+1.2%pt	-1.8%pt	+1.3%pt	+0.3%pt	+0.8%pt
Transport & Postal activities	+0.9%pt	+0.6%pt	+0.4%pt	-0.2%pt	+0.5%pt	+2.8%pt
Communications	-5.1%pt	-2.3%pt	+3.0%pt	-2.5%pt	+0.5%pt	-0.4%pt
Information services	-0.3%pt	+0.0%pt	+2.8%pt	+5.1%pt	+0.5%pt	+2.3%pt
Other information communication	-0.8%pt	+0.2%pt	+0.0%pt	+2.2%pt	+0.4%pt	+6.9%pt
Electric & Gas utilities	+0.4%pt	+0.2%pt	-0.2%pt	+0.0%pt	-1.1%pt	-1.0%pt
Services for businesses	+0.2%pt	+1.1%pt	+0.3%pt	+2.8%pt	+0.7%pt	+2.8%pt
Services for individuals	+0.1%pt	+2.7%pt	-0.6%pt	+10.8%pt	-1.0%pt	+2.3%pt
Accommodations, Eating & Drinking services	-0.5%pt	-2.3%pt	-0.2%pt	+0.0%pt	+1.7%pt	+4.5%pt
Mining & Quarrying of stone and gravel	-2.2%pt	-4.5%pt	-7.3%pt	-1.2%pt	+0.1%pt	+1.8%pt

Note: Figures represent the shift in standard error ratios from [A] to [C] shown in Chart 16 for employee stratification as well as from [B] to [D] for sales stratification. Standard error ratios are calculated using the method described in the footnote of Chart 5.

Chart 19

Relative Errors (Sample Biases): Sales Stratification

(1) Sales

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification
Manufacturing	**2.3%**	**1.8%**	**3.3%**	**1.2%**	**11.4%**	**10.0%**
Nonmanufacturing	**11.3%**	**1.6%**	**19.8%**	**2.5%**	**26.4%**	**9.6%**

(2) Fixed Investment

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification	Employee Stratification	Sales Stratification
Manufacturing	**3.5%**	**3.4%**	**6.2%**	**10.9%**	**9.0%**	**6.6%**
Nonmanufacturing	**9.8%**	**8.4%**	**20.2%**	**10.8%**	**13.7%**	**9.0%**

Note: Relative errors (sample biases) are calculated using the method described in the footnote of Chart 9.

Simulation: Relative Errors (Sample Biases) by Sample Reduction

(1) Sales

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Before Reduction	After Reduction	Before Reduction	After Reduction	Before Reduction	After Reduction
Manufacturing	**1.8%**	**0.4%**	**1.2%**	**0.3%**	**10.0%**	**8.2%**
Nonmanufacturing	**1.6%**	**0.6%**	**2.5%**	**1.6%**	**9.6%**	**8.7%**

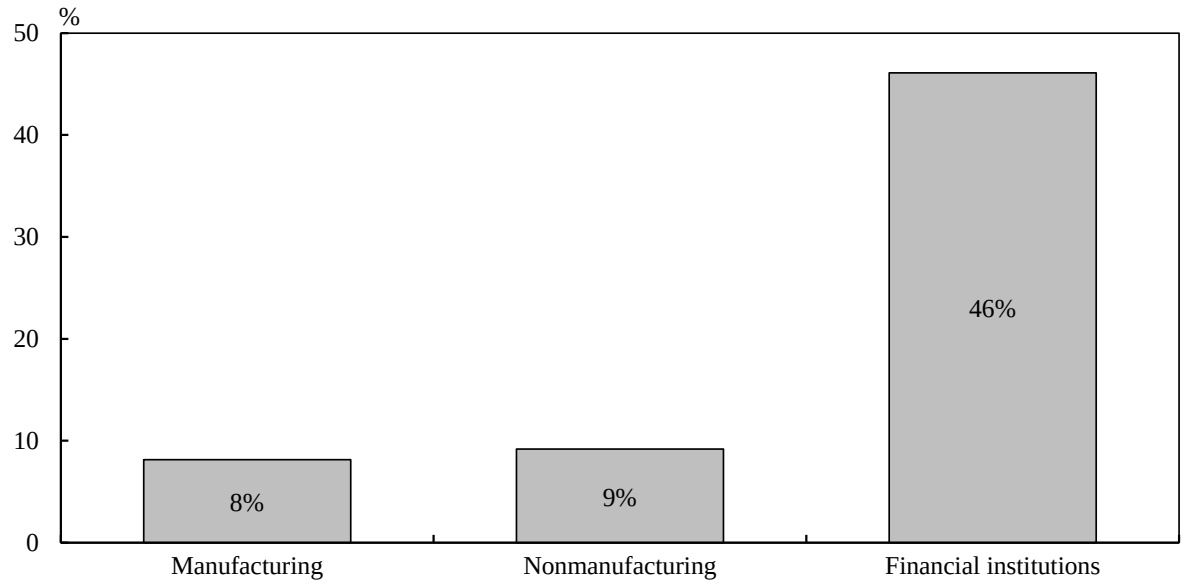
(2) Fixed Investment

Industry	Large Enterprises		Medium-Sized Enterprises		Small Enterprises	
	Before Reduction	After Reduction	Before Reduction	After Reduction	Before Reduction	After Reduction
Manufacturing	**3.4%**	**3.2%**	**10.9%**	**9.1%**	**6.6%**	**3.9%**
Nonmanufacturing	**8.4%**	**5.1%**	**10.8%**	**11.2%**	**9.0%**	**8.4%**

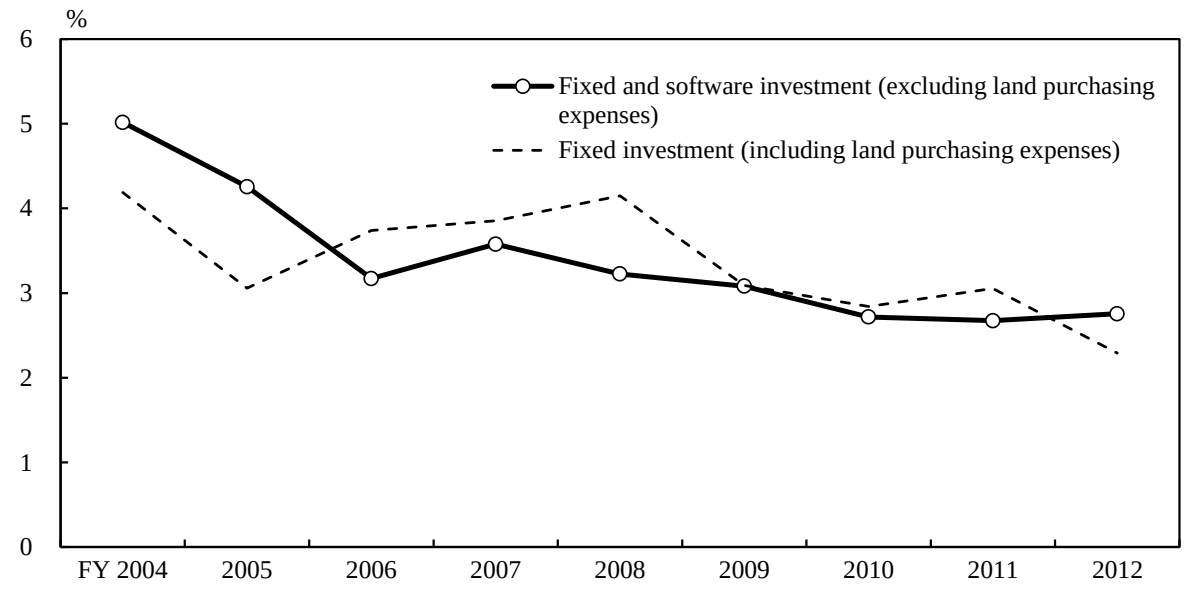
Note: In this simulation, we first recalculate relative errors (sample biases) of sales and fixed investment after employing the sales stratification. On this basis, we choose 300 sample enterprises that are expected to make large contributions to the overestimation from strata with a large relative error (sample bias), and then estimate relative errors (sample biases) in the case where these enterprises are eliminated from our sample. Relative errors (sample biases) are calculated using the method described in the footnote of Chart 9.

Sample Design for Financial Institutions

(1) Share of Software Investment in Total Investment for FY 2014



(2) Standard Error Ratios of Financial Institutions



Notes: 1. Figures used here are those of the *Tankan*. The share of software investment in total investment is calculated as follows:

"Share of software investment in total investment" = "Software investment" / ("Fixed investment excluding land purchasing expenses" + "Software investment") * 100

2. Figures for standard error ratios are based on the population and strata used for the regular revision of *Tankan* sample enterprises in March 2015 and are calculated using the method described in the footnote of Chart 5.