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# Macro Effects of Corporate Restructuring in Japan

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*This paper presents a framework for quantitatively evaluating the macroeconomic effects of corporate restructuring and applies that framework to Japan. Using firm-level financial statement data, this paper estimates total factor productivity of individual Japanese firms. Given the estimated distribution of productivity across firms, this paper simulates the effect of optimal restructuring, that is, reallocation of resources from less-productive firms to more-productive ones, on the dynamic path of aggregate output. In a benchmark case, aggregate output declines by 0.8 percent in the year of restructuring, but converges to a level 1.6 percent above its initial level in the medium term. The present value of net output gains from restructuring over 20 years amounts to 15 percent of the initial output under a 5 percent discount rate, suggesting that the benefits of restructuring may exceed the costs. With different assumptions, the present value of net output gains could range between 13 percent and 31 percent of the initial output.* [JEL G33, G34, E60]

This paper develops a framework for quantitatively assessing the effects of corporate restructuring on aggregate output and applies that framework to Japan. In particular, it explores whether the long-run output gain from corporate restructuring in Japan can be large enough to outweigh its short-run costs. Using firm-level financial statement data, this paper estimates total factor productivity (TFP) of individual Japanese firms. Given the estimated cross-firm distribution of productivity, this paper simulates the effect of an optimal restructuring—reallocation of resources from less-productive firms to more-productive ones—on the dynamic path of

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aggregate output. The results show that the benefits of restructuring may substantially exceed the costs.

Having suffered stagnation for more than a decade since the bursting of the asset bubble, a broad consensus has emerged in Japan that the economy's malaise largely reflects deep-seated structural problems in the corporate and financial sector (e.g., Sakakibara, 2001; Kashyap, 2002; Caballero, Hoshi, and Kashyap, 2003; Dell'Ariccia, 2003; Hamao, Mei, and Xu, 2003; and Peek and Rosengren, 2003). The recognition of serious structural weaknesses prompted the Koizumi cabinet to vow to press strongly ahead with structural reform (see, e.g., Japan Cabinet Office, 2001). However, there is still an ongoing debate about the optimal pace of reform.

Different views on the appropriate pace of reform could be attributed partly to insufficient information on the macroeconomic consequences of restructuring. With large uncertainty about the end result, policymakers can easily become hesitant or reluctant to push hard for reforms, and public support for reform can easily wane. This underlines the importance of knowledge about the macroeffects of corporate restructuring.

There are some existing studies estimating possible effects of restructuring in Japan, but most of these focus on the short-run costs, particularly the adverse short-run effect on employment (e.g., Atkinson and others, 2001; Japan Cabinet Office, 2001; and Young and others, 2002). Atkinson and others (2001) examine the impact on the economy of eliminating potential problem loans (which they estimate at ¥237 trillion, as of fiscal year 2000). Assuming that 43 percent of the job losers get new jobs, the study concludes that restructuring could generate two million unemployed, representing a 3.2 percentage point rise in the unemployment rate. Young and others (2002) study the disposal of ¥40 trillion of nonperforming loans. Based on the assumptions that the ratio of employment to corporate liabilities is constant and that 60 percent of the firms with bad loans are liquidated, they suggest that restructuring would increase the jobless rate by 2 percentage points. Despite the growing literature on the cost effects, however, there have been few studies quantitatively evaluating the benefits of restructuring.

To fill this gap, this paper conducts a quantitative assessment of macroeconomic effects, including both benefits and costs, of restructuring in Japan. A key idea is that structural reform or, more specifically, corporate restructuring can raise aggregate output by raising the average productivity of the corporate sector. Restructuring in the corporate sector induces the reallocation of physical capital and labor across firms. Such restructuring, if optimally carried out, can facilitate the reallocation of resources from *less-productive* firms to *more-productive* firms, which raises average productivity of capital and labor in the economy and, consequently, the aggregate output (see Kim and Izvorski, 2002; and Kim, 2004).

Based on this idea, this paper presents a simple empirical framework to quantitatively evaluate dynamic output gains from restructuring in any country.[1] Using

[1] In Asian countries hit by recent financial crises as well, structural weaknesses were blamed as a key culprit of the crises, and consequently structural reform in the corporate and financial sectors was considered as a key element of the IMF rescue program for those countries (see, e.g., Fischer, 1998; Mody, 1999; Chopra and others, 2002; and Krueger and Yoo, 2002). However, the effect of structural reform on aggregate output has not been formally incorporated in the macro model of the IMF programs for the crisis countries.

Cobb-Douglas production functions, together with firm-level financial statement data, it derives the TFP of individual firms and the distribution of productivity across those firms. The productivities of individual firms are then used to simulate the effect of an optimal restructuring (or reallocation of resources from less-productive firms to more-productive ones) on aggregate output.

The framework also incorporates the cost of restructuring. Restructuring entails loss of firm- or industry-specific capital and skills when resources are redeployed to other firms. Based on the result of previous studies on this subject, I assume that the value of capital, after restructuring, drops by 72 percent of its replacement cost, and that laid-off workers permanently lose their earning abilities by 13–30 percent (see, e.g., Ruhm, 1991; and Ramey and Shapiro, 2001). Costs also arise because output is lost during the time it takes to reallocate resources. Particularly when aggregate demand is weak, a large portion of laid-off workers and released capital could remain unemployed for more than a year (Ramey and Shapiro, 2001; and OECD, 2002). The framework incorporating both the benefits and the costs of reallocation, together with plausible values for key parameters, allows us to trace the dynamic response of aggregate output to a restructuring shock.

From the simulation, based on the financial statement data of 1,555 Japanese firms from the *Worldscope* database, the paper derives several important findings in the case of Japan. First, restructuring could reduce the country's aggregate output to below its initial level in the very short run, but raise it above its initial level in the medium term. In a benchmark case where the least-productive firms representing 5 percent of total labor are liquidated and the freed-up resources are reallocated to more-productive firms, aggregate output declines by 0.8 percent below the initial level in the year of restructuring, largely reflecting the short-run output loss due to the closure of the least-productive firms.[2] But aggregate output exceeds its initial level starting from the third year after restructuring, and converges to a level 1.6 percent above its initial level, as a larger portion of labor and capital released from the least-productive firms are reemployed by more-productive firms over time.

Second, the medium-term output gain from restructuring in Japan could exceed the short-term output loss. Under a 5 percent discount rate, the present value of net output gains over 20 years after restructuring amounts to 15 percent of the initial output in the benchmark case. The large net gain reflects a large productivity gap between less-productive firms and more-productive firms.

Third, the main results of this paper—that the medium-term gain of restructuring exceeds the short-run cost—are robust against various changes in proxies, parameters, and key assumptions. The effect of restructuring slightly increases in a vast majority of cases compared to the benchmark case. Under the assumption of variant TFP, however, the effect of restructuring could be reduced. In addition,

[2]This paper focuses on corporate liquidation as a key measure of corporate restructuring, although there are other measures of corporate restructuring, such as asset sales and employee layoffs (see, e.g., Kang and Shivdasani, 1995). A reason I focus on liquidation is that variation in productivity across firms in the Japanese corporate sector appears so large (as shown in the second part of Section I) that liquidation of the least-productive firms may be more effective in generating output gains than just downsizing of those firms. Of course, within the current framework we could easily analyze the macroeffect of downsizing (nonliquidation) measures of corporate restructuring.

the effect of restructuring could be much larger under less-severe loss of labor and more-aggressive restructuring than the benchmark case. As a result, restructuring could raise aggregate output to a range between 1.4 percent and 3.8 percent above the initial level in the medium term. The present value of net output gains over 20 years after restructuring could range between 13 percent and 31 percent of the initial output under a 5 percent discount rate.

The framework used in this study can be adapted to accommodate four slightly varied situations: (1) a case of more-gradual restructuring, (2) a case in which resources are reallocated only within the same industry, (3) a case in which accurate identification of the least-productive firms is not possible, and (4) a case in which restructuring is limited to heavy borrowers from banks. However, these variations do not alter the main results of this study.

This paper relates to previous work on restructuring activities of Japanese firms (e.g., Hoshi, Kashyap, and Scharfstein, 1990; Kaplan, 1994; Kaplan and Minton, 1994; and Kang and Shivdasani, 1995 and 1997). Kang and Shivdasani (1997) find that Japanese corporations that experience a substantial decline in operating performance implement various downsizing measures—including asset sales, plant closures, and employee layoffs—but to a lesser extent than do U.S. firms with a similar decline in performance. Kaplan (1994) finds that poor firm performance raises the probability of top management turnover in Japan as in the United States, although the fortunes of Japanese executives are more sensitive to low income than those of the U.S. executives. Hoshi, Kashyap, and Scharfstein (1990) also find that main banks play a crucial role in restructuring Japanese firms in financial distress. All of these studies focus on microeconomic features of Japanese corporate restructuring. The current paper extends this literature by examining the effect of firm-level restructuring on macro variables, particularly aggregate output in Japan.

This paper is also related to recent studies investigating the relationship between institutions and macroeconomic performance (for example, Rajan and Zingales, 1998a and 1998b; Acemoglu and others, 2002; Friedman, Johnson, and Mitton, 2002; Johnson, McMillan, and Woodruff, 2002; and Fisman and Love, 2004). Johnson, McMillan, and Woodruff (2002) find that in postcommunist countries, weak institutions for property rights discourage firms from reinvesting their profits. Acemoglu and others (2002) find that countries that inherited more extractive institutions from their colonial past tend to have higher volatility in macroeconomic activity during the postwar period. Fisman and Love (2004) find that countries with better-functioning financial markets have more efficient reallocation of resources across different industries. Most of these studies focus on empirically establishing evidence of a positive relationship between institutions and aggregate economic activity. This paper can be viewed as contributing to the literature by developing a framework within which one can simulate macroeffects of institutional changes (or structural reform).

## I. Productivity Distribution

This section estimates the distribution of productivity across Japanese firms, which is crucial to simulating the macroeffect of restructuring (or reallocation of resources to more-productive firms).

## Estimation Method and Data

To estimate the distribution of productivity across corporations, I use standard Cobb-Douglas production functions, which have been widely used in the economic growth literature to measure the rate of technology progress (e.g., Solow, 1957). There is also evidence that the Cobb-Douglas production function fits Japan well (e.g., Kamada and Masuda, 2001).[3]

Assume that the production technology of each firm is represented by

$$y_i = A_i l_i^{(1-\alpha)} k_i^{\alpha}, \tag{1}$$

where $y_i$ is output, $A_i$ is total factor productivity (TFP), $l_i$ is labor, $k_i$ is capital, and $\alpha$ is the capital income share of the $i$-th firm.

Then a firm's TFP is

$$A_i = \frac{y_i}{l_i^{(1-\alpha)} k_i^{\alpha}}, \tag{2}$$

which suggests that information on output, labor, capital, and capital's share of income from the firm are needed to derive its TFP.

To estimate total factor productivity at the firm level, I use *Worldscope* financial statement data of Japanese firms for the period 2000–2002. *Worldscope* originally provides data for 3,918 Japanese firms, but the number of firms that have the information amounts to 1,555 (representing roughly 20 percent of total corporate liabilities in the economy).

*Worldscope* data do not provide information that exactly matches the concept of output and physical capital. As a proxy for output of individual firms, $y_i$, I use *gross income*, which is the difference between total sales and the cost of goods sold. Existing studies often use *total sales* as a proxy for output (e.g., Khatri, Leruth, and Piesse, 2002). Nevertheless, gross income approximates "value-added," a standard concept of output in economics, better than does total sales. As a proxy for physical capital, $k_i$, I use *fixed assets.* Some existing studies use *total assets* (e.g., Khatri, Leruth, and Piesse, 2002), but fixed assets is conceptually closer to physical capital such as machinery, plant, and equipment. Regarding labor input of each firm, $l_i$, I use the number of employees reported by *Worldscope.*

*Worldscope* does not provide information on the capital and labor income shares of individual firms. I use the labor income share of the industry to which a company belongs as a proxy for that of the firm. Based on 2002 data reported by the Japan Department of Statistics of the Ministry of Finance, I assign 0.78 to the parameter of labor income share for manufacturing, 0.77 for retail and wholesale trade, 0.76 for services, 0.85 for construction, 0.73 for transportation, 0.53 for mining, 0.39 for real estate, and 0.85 for agriculture.

[3]Kamada and Masuda (2001) estimate the constant elasticity of substitution (CES) production function based on time series data for Japanese aggregate output, labor, and capital stock. They find that both parameters for returns to scale and elasticity of substitution in CES function are close to one (0.988–1.003 for returns to scale, and 1.17–1.24 for elasticity of substitution). In Section III, "Sensitivity to Assumptions," I also check the sensitivity of the main results of the paper against assuming CES rather than Cobb-Douglas production function.

Using equation (2) and the yearly data on $y_i$, $l_i$, $k_i$, and $\alpha$, I calculate the TFP of each firm for each of the three years, 2000, 2001, and 2002. To reduce potential measurement errors generated by year-specific idiosyncratic shocks, I use a three-year-average productivity for each firm, that is, $A_i = \frac{\sum_{s=2000}^{2002} A_{i,s}}{3}$, where $A_{i,s}$ represents productivity of the *i*-th firm in year *s*.

I assume that the three-year-average productivity ($A_i$) will remain invariant so that it can well represent the underlying long-run productivity of each firm, given that there is a strong persistence in productivity of each individual Japanese firm over time. According to *Worldscope*, the three-year-average productivity of each firm is highly correlated to its long-run average productivity.[4] For the 1,212 firms whose financial data are available for 1993–2002, the three-year-average productivity for 1993–1995 is a good predictor of the 10-year-average productivity for 1993–2002: for example, the regression of the latter on the former yields 0.9 for $R^2$. This suggests that the three-year-average productivity for 2000–2002 that I use in this study could be a good predictor of the long-run productivity of each firm for the next 10–20 years. Furthermore, I also check the sensitivity of the main results of the paper against the assumption of variant productivity in “Sensitivity to Assumptions” in Section III.

### Estimated Productivity Distribution

By ranking the firms in order of the calculated TFP, I derive the distribution of $A_i$ across 1,555 firms. Figure 1 illustrates the estimated productivity distribution among the 1,555 firms.[5] It suggests that there is a large dispersion in productivity across the 1,555 firms. While the average productivity $\left(\mu(A_i) = \frac{\sum_{i=1}^{N} A_i}{N}\right)$ is 6.9, the standard deviation is 8.5.

In the rest of this paper, we interpret the result in Figure 1 as representing the distribution of productivity for the Japanese corporate sector as a whole. Given

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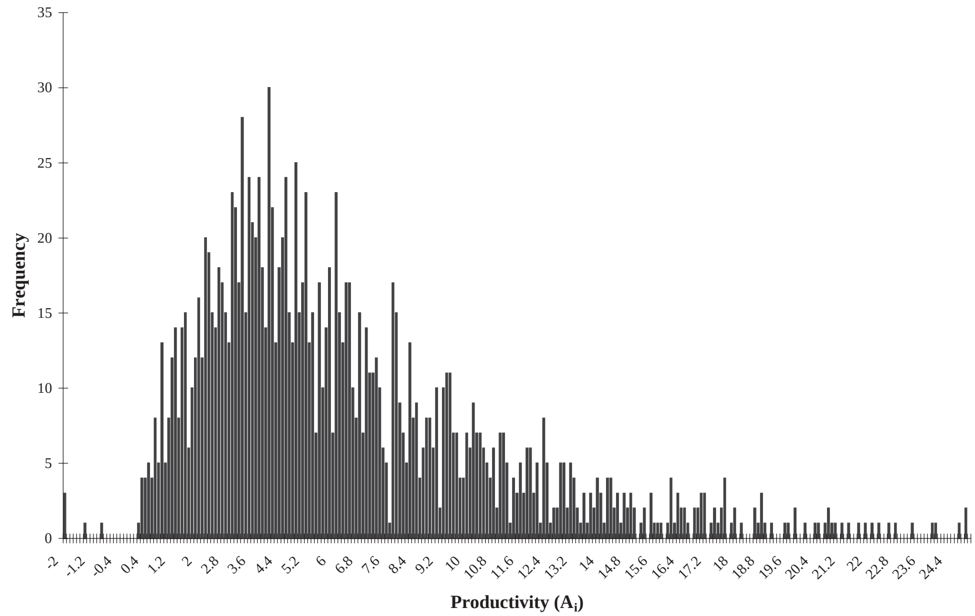
[4] I may instead use the 10-year-average productivity for 1993–2002. However, it would reduce the number of sample firms substantially (by about 20 percent). Moreover, it may create substantial survivorship bias, given that firms that closed because of low productivity during the 10-year period are excluded when deriving productivity distribution in the corporate sector.

[5] The unit of productivity ($A_i$) in our benchmark case is derived as follows. The unit of gross income, which proxies output ($y_i$), is *yen*, and that of fixed assets, which proxies capital ($k_i$), is *yen* as well. Meanwhile, the unit of the number of employees, which proxies labor input ($l_i$) in the benchmark case, is *person*. Therefore, given $A_i = \frac{y_i}{l_i^{(1-\alpha)} k_i^{\alpha}}$, the unit of productivity here is: $\frac{yen}{person^{(1-\alpha)} yen^{\alpha}} = \frac{yen^{(1-\alpha)}}{person^{(1-\alpha)}}$. The unit of productivity would change if quality-adjusted labor is used as a proxy for labor input. Given that wages reflect workers’ quality of labor, quality-adjusted labor employed by a firm can be represented by the number of its employees multiplied by per-worker wages. So the unit of quality-adjusted labor is: *person* $\times$ (*yen/person*) = *yen*. The unit of productivity then becomes: $\frac{yen}{yen^{(1-\alpha)} yen^{\alpha}} = 1$, which is a pure number. It can be shown that such a modification of the unit would not substantially alter the effect of restructuring on aggregate output (see “Sensitivity to Proxies” in Section III).

Figure 1. Productivity Distribution




that the 1,555 firms analyzed here constitute about 20 percent of total corporate liabilities in the economy, we may well assume that the 1,555 firms stand for the Japanese corporate sector. Of course, *Worldscope* covers most large firms but not many small and medium-sized firms, which could generate a bias. Inclusion of data on more small and medium-sized enterprises (SMEs), however, would not alter the main result of this paper (i.e., the positive net effect of structural reforms in Japan). It would make even larger the positive net effect of restructuring, given that SMEs in Japan are considered to be less productive than larger firms.

## Institution and Productivity Distribution

Note that the extent of persistence in productivity of individual firms or cross-firm difference in productivity could be crucial to determining the benefit of structural reform. The more persistent the productivity of individual firms or the greater the cross-firm productivity difference is, the larger the benefit of restructuring would be. In the extreme case of uncorrelated productivity across years or identical productivity across firms, the reallocation of resources would not generate any benefits, only costs.

The extent of persistence in productivity or cross-firm difference may crucially depend on institutions. In general, the market plays a key role in reallocating resources to more-productive firms, particularly by facilitating the exit of less-productive firms, which would reduce the number of firms that show persistently low productivity. However, restructuring driven by markets may be impeded or slowed in the presence of institutional obstacles, such as weak financial disclosure and corporate transparency, existence of business groups characterized by cross-debt-payment guarantees or cross-shareholdings, coordination failures among creditors on debt restructuring, perverse incentives of banks to provide credit to weak firms, underdeveloped markets for mergers and acquisitions and used capital, and labor market rigidities. Which obstacles are more important among those mentioned here may differ across countries. For Korea during a few years before the 1997 financial crisis, for example, business groups were often considered a key obstacle to efficient allocation of resources (Krueger and Yoo, 2002; and Kim, 2004). For Japan, banks' perverse incentive to evergreen weak firms were viewed as important (Kashyap, 2002; and Peek and Rosengren, 2003).[6] Accordingly, the degree of weakness of institutions may also differ across countries.

Two recent papers provide cross-country evidence of the role of market development in facilitating resource allocation across industries (Rajan and Zingales, 1998b; and Fisman and Love, 2004). Fisman and Love (2004), using data on value-added estimated for 37 industries in 42 countries, find that countries with more developed financial markets tend to have better intersectoral resource allocation. Given the evidence, an economy with weaker institutions (or less-developed markets) would likely show higher persistence in productivity of firms, particularly less-productive firms.[7]

Then institutional reforms that help markets better facilitate reallocation of resources from less-productive to more-productive firms (e.g., disposal of nonperforming loans, banking sector recapitalization, and development of more active mergers and acquisitions markets) would reduce persistence in productivity and cross-firm difference in productivity. In the next section, I examine the macro-effects of such reforms in Japan.

## II. Simulation: Benchmark Case

This section quantifies the effect of reallocation of resources from less-productive firms to more-productive firms based on the productivity distribution derived in the previous section.

### Basic Simulation Framework

To simulate the effect of reform on aggregate output, I consider the case of restructuring the least-productive firms that represent fraction $\gamma$ of the total number of

[6]Peek and Rosengren (2003), using Japanese firm-level data for 1993–1999, find that Japanese firms in poor financial condition are far more likely to receive additional credit from banks, which try to avoid the realization of losses on their own balance sheets.

[7]There have been few cross-country studies on the relationship between institutions and interfirm reallocation of resources. But the author's preliminary work suggests that U.S. firms show weaker persistence in productivity than Japanese firms, while the two countries have similar cross-firm differences in the 3-year-average productivity. The regression of the 10-year-average productivity for 1993–2002 on the 3-year-average productivity for 1993–1995 yields an $R^2$ of 0.79 for the United States, lower than 0.90 for Japan. The portion of the firms whose data are still available for 2000–2002 among those having data for 1993–1995 in *Worldscope* is 40 percent for the United States and 71 percent in Japan. The coefficient of variation for the average productivity for 2000–2002 is 1.3 for the United States and close to 1.25 for Japan.

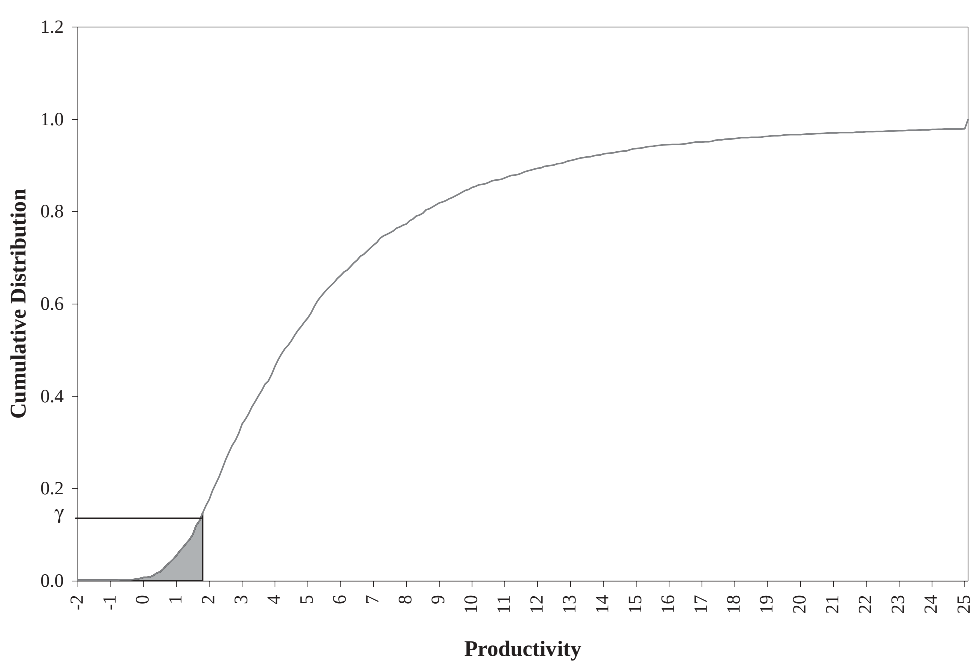
workers—that is, those with the lowest values of $A_i$, starting with the least productive and adding firms until those representing $\gamma$ fraction of total workers are cumulated (regardless of what type of institutional reform facilitates the restructuring). Based on the calculation of productivity of individual firms, we can identify the least-productive firms representing fraction $\gamma$ of the total number of workers, as illustrated in Figure 2.

Assume that restructuring occurs in the beginning of the year $t = 1$. Therefore, the least-productive firms cannot produce from the first year of restructuring ($t = 1$) on. Let $i^B$ and $i^G$ denote the set of the least-productive firms and the rest of the firms (i.e., more-productive firms), respectively.

Restructuring reduces the amount of capital and labor employed by the least-productive firms. Let $K_t^B$ and $L_t^B$ be the total amount of capital and labor of those firms at $t$, respectively. Then capital and labor employment by those firms is positive before restructuring ($K_0^B$, $L_0^B > 0$), but zero after restructuring ($K_t^B = L_t^B = 0$ for $t = 1, 2, \ldots$).

Capital and labor released from closed firms create new supply in factor markets. The amounts of new supply in effective terms, however, are lower than $K_0^B$ and $L_0^B$ because of some restructuring costs. As discussed earlier, restructuring may entail a permanent reduction in the value of capital and labor, caused by the loss of firm- or industry-specific capital and skills. Let $\theta_k$ and $\theta_l$ denote the discount in the value of capital and labor after reallocation as fractions of their original values, respectively. Restructuring may also keep some laid-off workers out of jobs permanently. Let $\psi_l$ be the portion of laid-off workers who become per-

Figure 2. Cumulative Distribution Function of Productivity



manently unemployed. In the presence of such costs, restructuring raises the new supply of effective capital and labor by $K_0^B(1-\theta_k)$ and $L_0^B(1-\theta_l)(1-\psi_l)$, respectively.

The supply of capital and labor released from closed firms needs to be met by demand from more-productive firms, whose measure is $(1-\gamma)$.[8] The demand for capital and labor critically depends on aggregate demand conditions. Particularly when aggregate demand is weak, the freed-up capital and labor would not be reemployed rapidly by more-productive firms. The dynamic path of demand for capital and labor also depends on adjustment costs that increase rapidly with the pace of adjusting capital and labor (e.g., Lucas, 1967; and Ogawa, 2003). Under convex adjustment cost functions for capital and labor, firms gradually raise their factor demand over time rather than achieve a jump at a moment. As capital and labor released from closed firms cannot be met immediately by an equal amount of demand increase from other firms, restructuring entails time costs: output is lost during the time it takes to reallocate resources.

Let $\omega_k$ and $\omega_l$ denote the portion of capital and labor that is demanded (and consequently reemployed) by more-productive firms within the first year of restructuring ($t = 1$). I assume that fraction $\omega_k$ of capital and fraction $\omega_l$ of labor are reemployed evenly from the beginning to the end of the year, so that more-productive firms use fraction $\frac{\omega_k}{2}$ of capital and fraction $\frac{\omega_l}{2}$ of labor on average in the year of the restructuring. From the second year on, the fraction $\omega_k$ of capital and the fraction $\omega_l$ of labor that were reemployed in the first year will be fully used for production through the whole year.

Let $\acute{\omega}_k$ and $\acute{\omega}_l$ be the fraction of the remaining capital and labor that is reemployed in each year ($t = 2, 3, \ldots$). Similar to the case of capital and labor reemployed in the first year, I assume that fraction $\frac{\acute{\omega}_k}{2}$ of capital and fraction $\frac{\acute{\omega}_l}{2}$ of labor, on average, are used in the year when they are reemployed, while the fraction $\acute{\omega}_k$ of capital and the fraction $\acute{\omega}_l$ of labor are fully used from the second year of their reemployment.

For simplicity, assume that capital and labor of the least-productive firms ($K_0^B$ and $L_0^B$) are reallocated to more-productive firms in proportion to their initial amount of capital and labor.[9] Therefore, the increase in capital and labor of more-productive firms are proportional to $k_0^i/K_0^G$ and $l_0^i/L_0^G$, respectively, where $k_0^i$ and $l_0^i$ are the amount of capital and labor of a more-productive firm before restructuring

[8]Though for simplicity I do not explicitly introduce the mechanism for reallocating resources, it must be a standard market mechanism. Consequently, price variables in the markets (i.e., wages and costs of capital) play a key role in reallocating resources. In particular, new supply of labor and capital freed up from closed firms would reduce wages and costs of capital, which encourages more-productive firms to raise their demand for them (and consequently the supply of their products). Of course, how effectively such a market mechanism functions is affected by various factors, including labor market rigidities and underdevelopment of markets for mergers and acquisitions (M&A) and used capital.

[9]I may instead assume that among the more-productive firms, the most-productive reemploy a higher proportion than $k_0^i/K_0^G$ and $l_0^i/L_0^G$. In this case, the net output gains from restructuring would be larger than the benchmark case, which further strengthens the main result of the paper (i.e., positive net output gains from restructuring).

($t = 0$), respectively, and $K_0^G$ and $L_0^G$ are total amount of capital and labor employed by more-productive firms in the initial period $t = 0$, respectively.

After restructuring, the amount of capital and labor used by each more-productive firm ($i \in i^G$) at year $t$, denoted by $k_t^i$ and $l_i^t$, then increase as described in Appendix I. Using the dynamic path of capital and labor employed by more-productive firms, together with their productivity derived earlier, I derive the dynamic path of output for each of those firms from the production function $y_{i,t} = A_i\,(l_t^i)^{1-\alpha}\,(k_t^i)^{\alpha}$.

Given that the least-productive firms produce nothing after restructuring ($Y_t^B = 0$, for $t = 1, 2, \ldots$), aggregate output of the economy is given by

$$Y_t = Y_t^G = \sum_{i \in i^G} y_{i,t}. \tag{3}$$

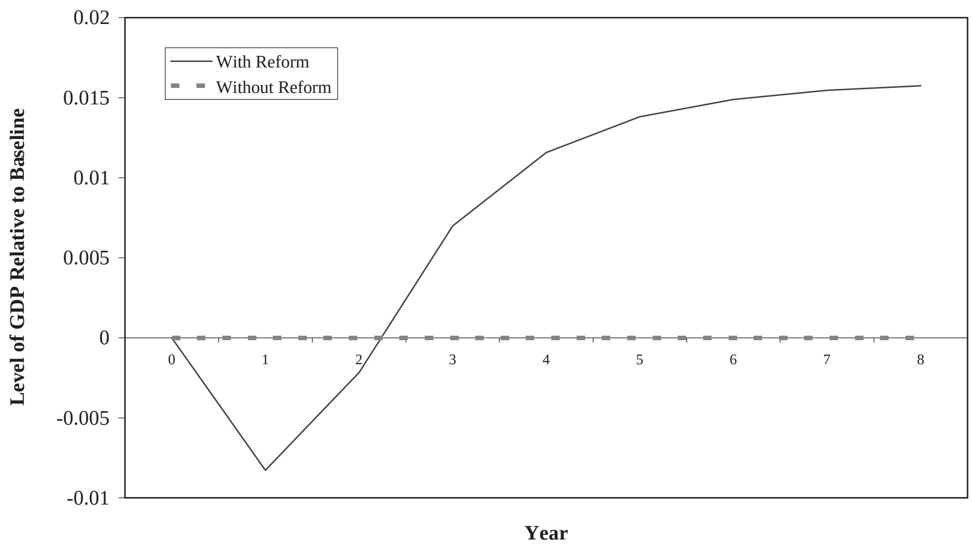
## Benchmark Case

To quantify the effect of restructuring on aggregate output, I assign plausible but rather conservative values to each of the key parameters of the basic framework. Therefore the estimate obtained in this benchmark case can be viewed as close to a lower bound on the level of aggregate output after restructuring.

For the discount of capital due to redeployment, I choose $\theta_k = 0.72$, so that capital loses 72 percent of its value after reallocation, following the estimate suggested by Ramey and Shapiro (2001). Ramey and Shapiro obtain this estimate using equipment-level data from U.S. aerospace plants that closed during the 1990s, and suggest that given the low demand for aerospace equipment, their estimate could be an upper bound on the discount. In light of this, adopting their estimate is a conservative assumption. For the parameter of loss in labor skills of a laid-off worker, I choose $\theta_l = 0.3$, so that displaced workers lose 30 percent of their skills. The chosen value is also conservative, as Ruhm (1991) obtains 0.13 for the parameter, based on U.S. household panel data for 1962–1982 (although the longer tenure of average Japanese workers could imply higher firm-specific human capital and therefore larger skill losses in the event of labor reallocation). I also make a very conservative assumption that $\psi_l = 0.25$, indicating that 25 percent of laid-off workers cannot get a new job permanently. (See “Potential Size of the Macroeffect” in Section III for further discussion on these parameters.)

For the rate of the first-year reallocation of capital and labor that reflects aggregate demand conditions, I choose $\omega_k = 0$ and $\omega_l = 0$, indicating that factors of production are not redeployed within a year. In addition, the reallocation rates of capital and labor in the second year and subsequent years ($t = 2, 3, \ldots$) are assumed to be $\acute{\omega}_k = \acute{\omega}_l = \frac{1}{2}$. The assumption that no laid-off workers are reemployed and no capital is bought by other firms for a year after restructuring is also conservative. It implies that during the first year of restructuring there would be no demand for workers and capital released from closed firms. One may expect *weak* demand for labor and capital in Japan, which currently suffers from prolonged stagnation, continuing excess capacity, and weak aggregate demand. Nevertheless, assuming *no* demand is rather extreme. Indeed, high-productivity firms in Japan actively hire

Figure 3. Effect of Restructuring on the Level of GDP: Benchmark Case




new workers, invest in capital, and therefore absorb a large percentage of laid-off workers and capital, even in a time of very weak aggregate demand.[10] The data on 1,555 firms in our sample show that the 200 most-productive firms have raised their employment and fixed assets by 35 percent and 16 percent, respectively, during the period 2000–2002. This suggests that reallocation of resources to more-productive firms could proceed faster than assumed here.

For the size of the restructuring shock in the benchmark case, I choose $\gamma = 0.05$. That is, I consider the case of restructuring the least-productive firms that represent 5 percent of total workers. These firms also represent 5 percent of total debt outstanding and 5.5 percent of total capital.[11] However, these firms produce only 0.8 percent of the aggregate output, reflecting their low productivity.

## Results

Figure 3 shows the simulation result in the benchmark case. To simplify the exposition, I here normalize the initial level of aggregate output (the level of aggregate output before restructuring) at unity ($Y_0 = 1$). In a baseline scenario without restructuring, aggregate output would then remain constant at the initial level: $Y_t = 1$ for $t = 1, 2, \ldots$. With restructuring, however, output deviates from the baseline over time, as shown in Figure 3, where I express the effect of restructuring as a deviation of aggregate output from the baseline.

[10] The analysis of sensitivity against different parameters (in "Sensitivity to Parameters" in Section III) shows to what extent the main result is affected by different assumptions on aggregate demand.

[11] In the benchmark case, I choose $\gamma = 0.05$ because restructuring of 5 percent of the corporate sector could generate a substantial output effect while perhaps still within a politically feasible range. Of course, I can simulate the effect of any $\gamma$, that is, any size of restructuring. (See Section III, "Potential Size of the Macroeffect," for the case of $\gamma = 0.15$.)

The simulation in the benchmark case provides interesting results on both short-term and medium-term effects of restructuring. First, aggregate output in the first year of restructuring falls to $Y_1 = 0.992$ (or 0.8 percent below the baseline). In the second year the level of the aggregate output rises compared to that of the first year, but still 0.2 percent below the baseline. The negative short-run effect largely reflects the output decline due to the closing of the least-productive firms.[12]

From the third year on, however, aggregate output exceeds its baseline level (for example, by 0.7 percent and 1.2 percent in the third and fourth years, respectively). The positive medium-term effect reflects that the increase in output of more-productive firms outweighs the output loss from the closure of the least-productive firms as the former reemploys labor and capital released from the latter.

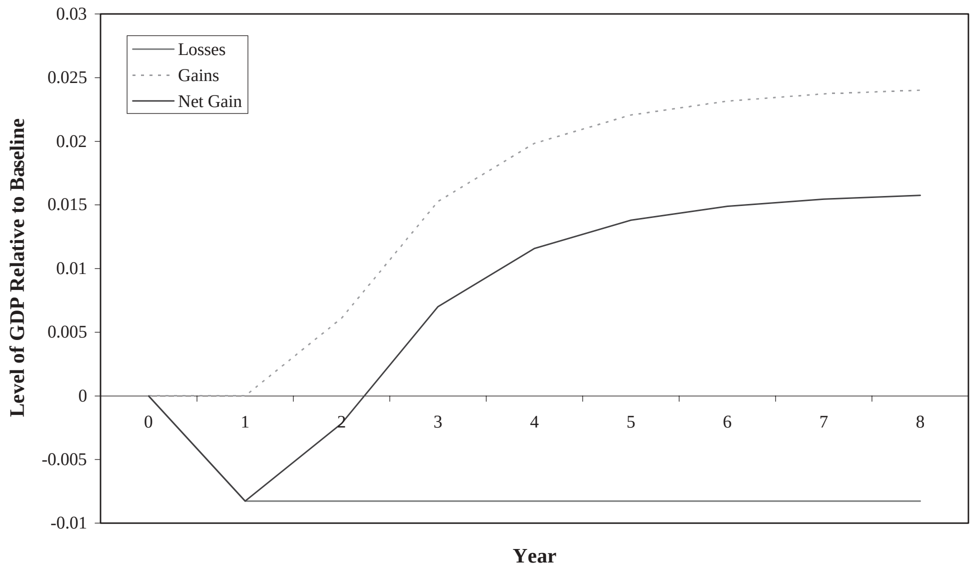
Finally and most importantly, the medium-term output gain from restructuring exceeds the output loss in the first and second year. Aggregate output converges to a level 1.6 percent above the baseline, double its initial decline. As a result, the present value of net output gain is always positive, as long as the rate of discount is below 65 percent. Under a 5 percent discount rate, the present value of net output gains over 20 years after restructuring amounts to 15 percent of the initial output. The larger medium-term gain reflects a large productivity gap between the least-productive firms and more-productive firms.

To examine the factors contributing to the above results, we can decompose aggregate output, denoted by $Y_t$, into the output by the least-productive firms, $Y_t^B$, and by more-productive firms, $Y_t^G$, that is, $Y_t = Y_t^B + Y_t^G$. Restructuring has a negative effect on aggregate output because it reduces output of the least-productive firms ($Y_t^B$). As the least-productive firms close, their employment of capital and labor drops to zero, and so does their output from the first year on ($Y_t^B = 0$, for $t = 1, 2, \ldots$). Therefore, the cost of restructuring in each period ($t = 1, 2, \ldots$) can be measured by $Y_0^B - Y_t^B$. Restructuring has also a positive output effect because it raises output of more-productive firms ($Y_t^G$). Therefore, the benefit of restructuring in each period is $Y_t^G - Y_0^G$. Then the net gain from restructuring in terms of the aggregate output is $Y_t - Y_0 = (Y_t^G - Y_0^G) + (Y_t^B - Y_0^B)$.

Figure 4 illustrates the decomposition of $(Y_t - Y_0)$ into $(Y_t^G - Y_0^G)$ and $(Y_t^B - Y_0^B)$. The figure shows that the restructuring cost in terms of decline in the output of the

[12] The 0.8 percent output decline at $t = 1$ in the benchmark case implies equivalent declines in both aggregate supply and demand. Closing of the least-productive firms, which used to produce 0.8 percent of aggregate output, would reduce aggregate supply by 0.8 percent. It would also affect aggregate consumption demand by reducing aggregate wage income, as workers lose their jobs (although it would little affect aggregate investment, given that investment by the least-productive firms has been negligible according to *Worldscope* data). Under a strong assumption that workers in the least-productive firms used to receive double their marginal product (for 2000–2002), closure of the least-productive firms, whose labor income shares were around 75 percent on average, would reduce aggregate wage income by 1.2 percent of the initial aggregate output. Under another conservative assumption that workers reduce their consumption by two-thirds after being laid off, aggregate demand would then decline by 0.8 percent of the initial aggregate output, the same as aggregate supply. This indicates that under less conservative assumptions, decline in aggregate demand could be smaller than the benchmark case. For example, suppose that laid-off workers reduce their consumption by one-third, which could be more realistic given consumption theories such as the permanent income hypothesis. In this case, aggregate demand would decline by 0.4 percent of the initial aggregate output, leading to an output decline lower than the benchmark case.

Figure 4. Decomposition of the Effect of Restructuring



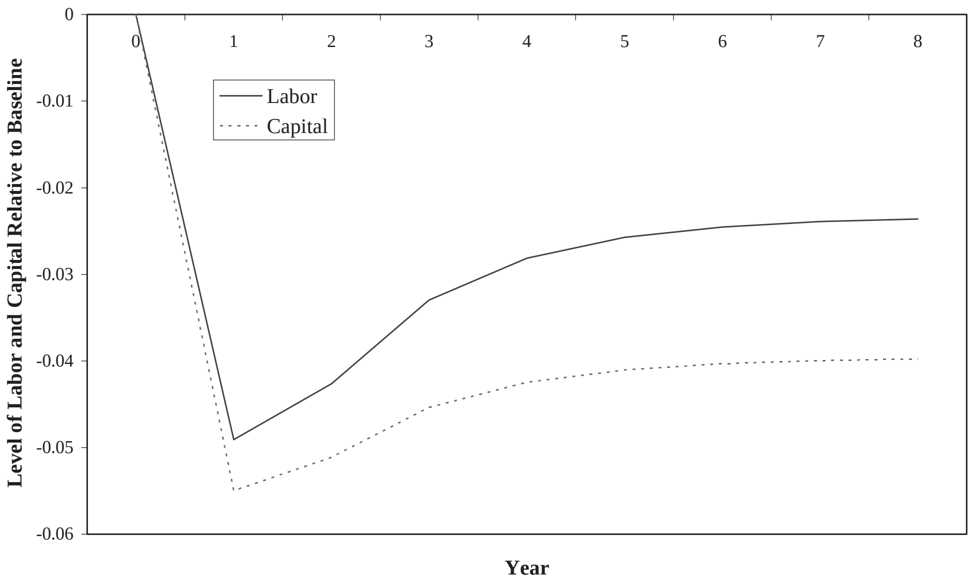

least-productive firms is modest. The initial output of the least-productive firms ($Y_0^B$) amounts to 0.8 percent of aggregate output, and therefore the loss of output by closing those unproductive firms is 0.8 percent of aggregate output. The figure also indicates that the effect of restructuring on more-productive firms' production can be substantial. When more-productive firms reemploy almost all the labor and capital released from less-productive firms, their output rises to a level 2.4 percent above their initial level. Furthermore, the figure shows the net effect of restructuring that adds up the costs and the payoffs. For example, the sum of –0.8 percent (for output loss due to closures of the least-productive firms) and 2.4 percent (for output gain of more-productive firms) generates net medium-term output gain of 1.6 percent above the baseline.

The large medium-term output gain and moderate short-term output loss reflect a large difference in productivity between less-productive and more-productive firms. The displaced capital and labor, despite value losses generated by reallocation, can be used by more-productive firms three times (= 2.4/0.8) more efficiently than by less-productive firms. In particular, the productivities of the least-productive firms are very low. (Several firms in this group even have negative productivity.)[13]

The short-term output loss is modest, despite the assumption of a substantial drop in capital and labor employed (Figure 5). Particularly in the first year of restructuring, aggregate use of labor and capital drop by 5 percent and 5.5 percent, respectively. From the second year, more-productive firms employ an increasing

[13]During the period 2000–2002, real estate and transportation were the least-productive sectors. Among the least-productive firms representing 5 percent of labor, about two-thirds are from these two sectors, while one-third are from manufacturing, construction, services, and wholesale and retail trade. Section IV, "Intra-Industry Resource Allocation," shows that no matter which sectors are the least productive, the main results of the paper would not be altered because of wide cross-firm difference in productivity within each sector.

Figure 5. Effect of Restructuring on Capital and Labor




amount of resources released from less-productive firms, but new steady-state levels of aggregate labor and capital remain below their initial levels, reflecting the assumption of substantial loss of firm- or industry-specific capital and skills, together with large permanent unemployment. This suggests that restructuring can improve the average productivity of the corporate sector substantially enough to outweigh the decline in inputs.

## III. Sensitivity Analysis and Potential Size of Macroeffects

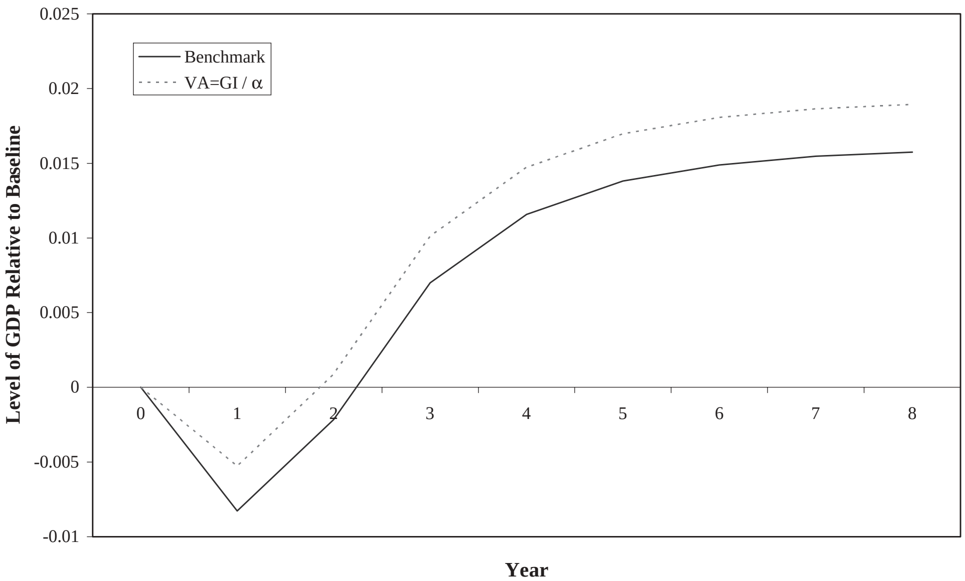
This section checks the robustness of the results obtained in the previous section against different proxy variables for output, capital, and labor, and then tests the sensitivity to the choice of parameters and assumptions of the model. I also discuss potential size of macroeffects of restructuring.

### Sensitivity to Proxies

To check the sensitivity to the choice of proxies for key variables such as output, capital, and labor, I use different proxy variables. First, I use *(gross income)/capital income share* as an alternative proxy for output. This variable could be a better proxy if most labor costs are included in the cost of goods sold (rather than other operating expenses) in the financial statement data. The rationale for using this proxy is that in this case, under the assumption of a Cobb-Douglas production function, we have $y = gross\ income/\alpha$, where $y$ is output or value-added and $\alpha$ is the capital income share.[14] Figure 6 illustrates the effect of restructuring on

[14]It is derived from $gross\ income = y - w = y - (1 - \alpha)\, y = \alpha\, y$, where $w$ is wage cost.

Figure 6. Sensitivity (I)




aggregate output when *(gross income)/capital income share* is used as a proxy for output. The dynamic path of aggregate output in this case is similar to that in the benchmark case, with a slight increase in the output gain from restructuring. Aggregate output declines to 0.5 percent below its initial level in the first year, and it converges to a level 1.9 percent above its initial level.

I also use *operating income* as a proxy for output, though it is a poor proxy for value-added. Figure 7 shows that the positive effect of restructuring in this case is substantially larger than the benchmark case. Aggregate output rises to 1.0 percent above its initial level even in the first year, and converges to a level 2.9 percent above its initial level. The reason for the large effect is that about 8 percent of the firms in the data had negative operating profits on average for 2000–2002. Therefore, just closing those firms with negative operating income would substantially raise aggregate output (measured by aggregate operating income), even without reallocating released resources to more-productive firms.

As a proxy for capital, I use *total assets* instead of fixed assets. As illustrated in Figure 8, the effect of restructuring on the aggregate output in this case is also similar to that in the benchmark case, with a slightly larger gain. Note that the simulation generates a similar result, even with a poorer proxy for physical capital (given that total assets, which includes liquid assets unrelated to production, is likely to be a poorer proxy than fixed assets).[15]

[15]This suggests that the main result of this paper can be robust against various types of measurement errors arising at individual-firm level. As long as measurement errors are independent across individual firms, they will offset each other in the aggregate level and therefore only marginally affect the result on output gains of restructuring.

Figure 7. Sensitivity (II)

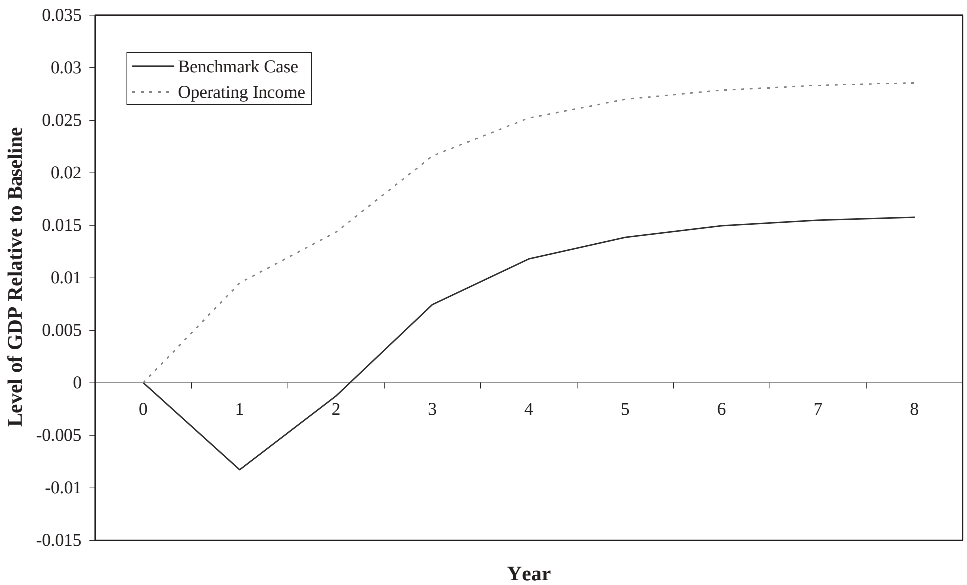
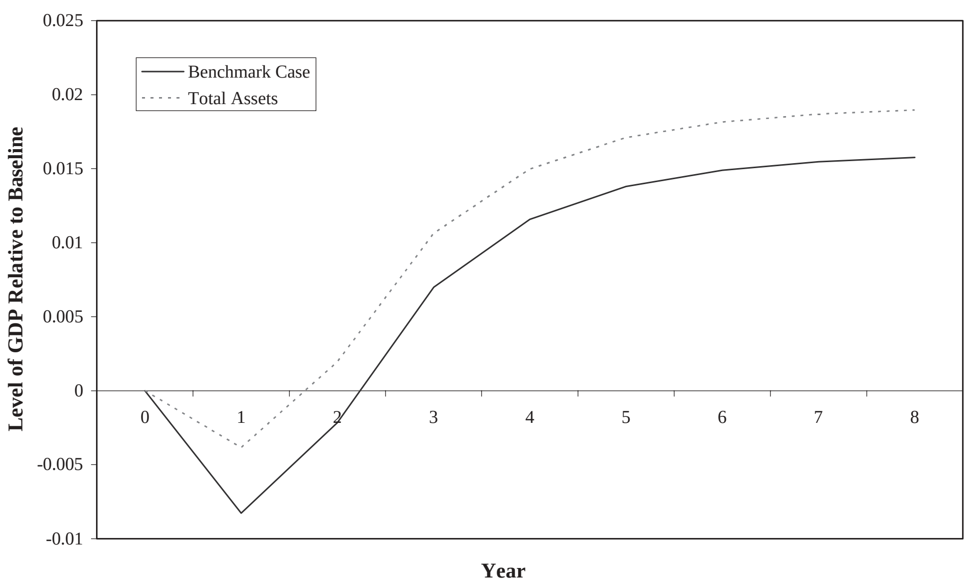



Figure 8. Sensitivity (III)



I also use *the number of employees multiplied by per-employee wage* as a proxy variable for labor input. In this case, labor input is measured by a monetary unit, and therefore the unit of TFP becomes a pure number. Figure 9 shows that the dynamic path of aggregate output in this case is also similar to that in the benchmark case. The restructuring reduces aggregate output to the level 0.6 percent below its initial level in the first year, but raises it thereafter to a level 1.8 percent above its initial level.

### Sensitivity to Parameters

I assess the sensitivity of our results to changes in some key parameter values. The benchmark values taken for some parameters may be biased to some degree, particularly given conservative assumptions, and therefore an examination to see how changes in parameter values affect the results is required.

First, I use $\omega_l = 0.25$ for the rate of labor reemployment, reflecting aggregate demand conditions in the first year, instead of $\omega_l = 0$ as in the benchmark case. The assumption $\omega_l = 0$ can be considered a conservative assumption, as discussed in Section II. Furthermore, in Korea, 40 percent of newly unemployed workers found new jobs within a year, even at the peak of the recent financial crisis. Figure 10 shows that under a less conservative assumption ($\omega_l = 0.25$), the medium-term output gain from restructuring is unaltered. But the initial output loss shrinks from 0.8 percent to 0.6 percent. This suggests that with less conservative assumptions on aggregate demand conditions, the accumulated net output is slightly higher than the benchmark case.

Figure 9. Sensitivity (IV)

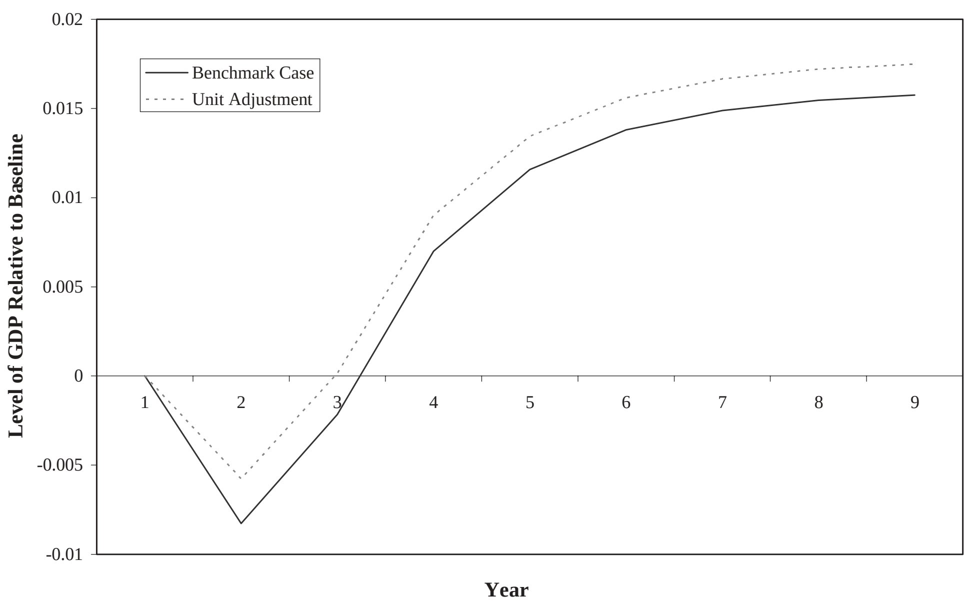
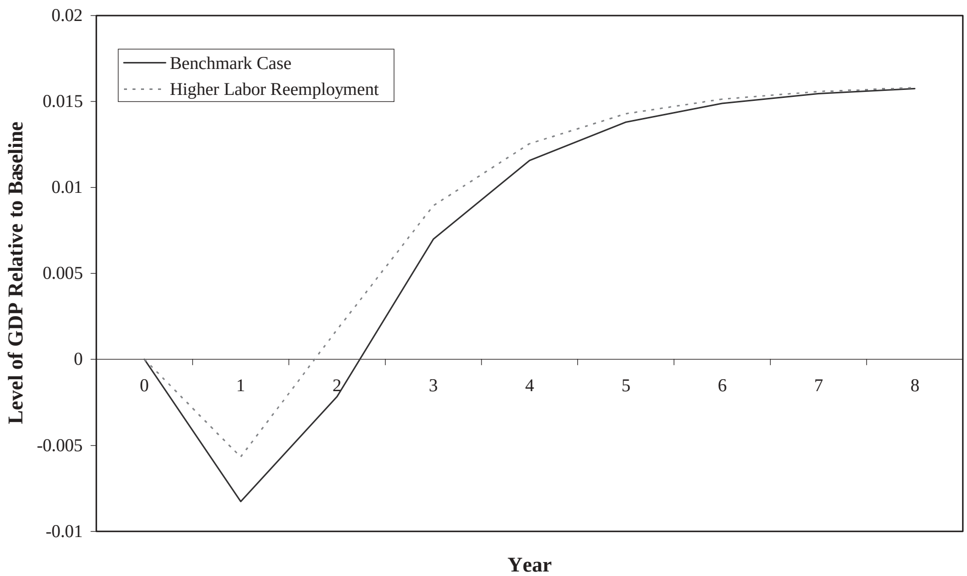


Figure 10. Sensitivity (V)




Next, I check the sensitivity of the results to the choice of labor income share parameters. The estimates of labor income shares used in the benchmark case are calculated based on data for 2002, when the rate of interest was close to zero, and therefore the estimates may be systematically biased upward. To check the robustness against possible systemic measurement errors on the parameters, I assume that labor income shares of all industries are overestimated by 20 percent. From the experiment, I find that the aggregate output path in this case is similar to that in the benchmark case (Figure 11).[16]

Unlike the parameters discussed above, the parameters on the loss of labor may have major impacts on the size of the effect of restructuring. I will discuss the parameters on labor loss in "Potential Size of the Macroeffect."

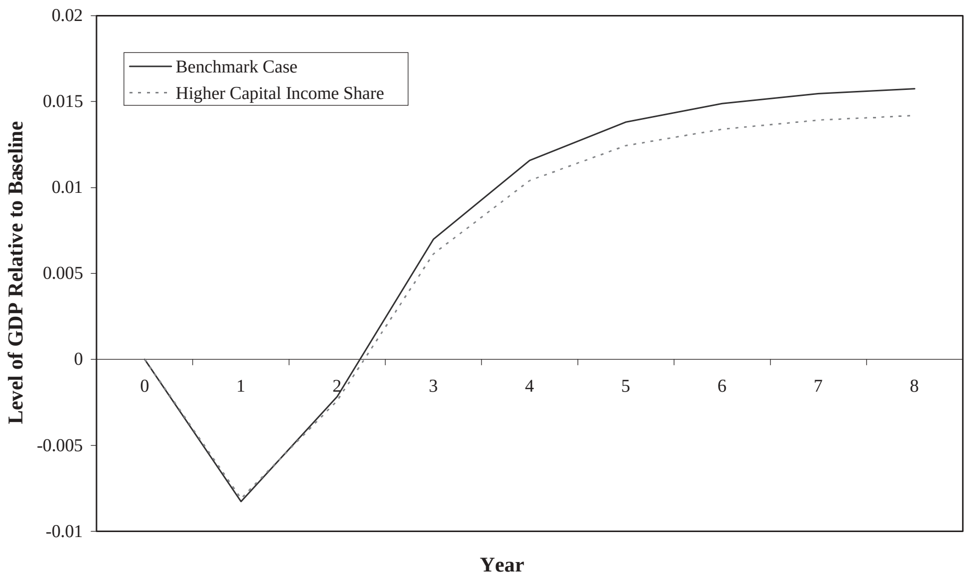
## Sensitivity to Assumptions

I assess the sensitivity of our results to the assumptions of productivity invariance and Cobb-Douglas production function. The benchmark case assumes that the three-year-average productivity ($A_i$) is invariant, so that it can perfectly represent the long-run productivity of each firm. It also assumes a unit elasticity of substitution between capital and labor by adopting Cobb-Douglas function. These assumptions may perhaps generate a substantial bias in our results.

To check the sensitivity to the productivity invariance assumption, I calculate transition probabilities of TFP for the least-productive firms representing 5 percent

[16]This suggests that even in the presence of systemic measurement errors, the main result of the paper would not be affected substantially.

Figure 11. Sensitivity (VI)

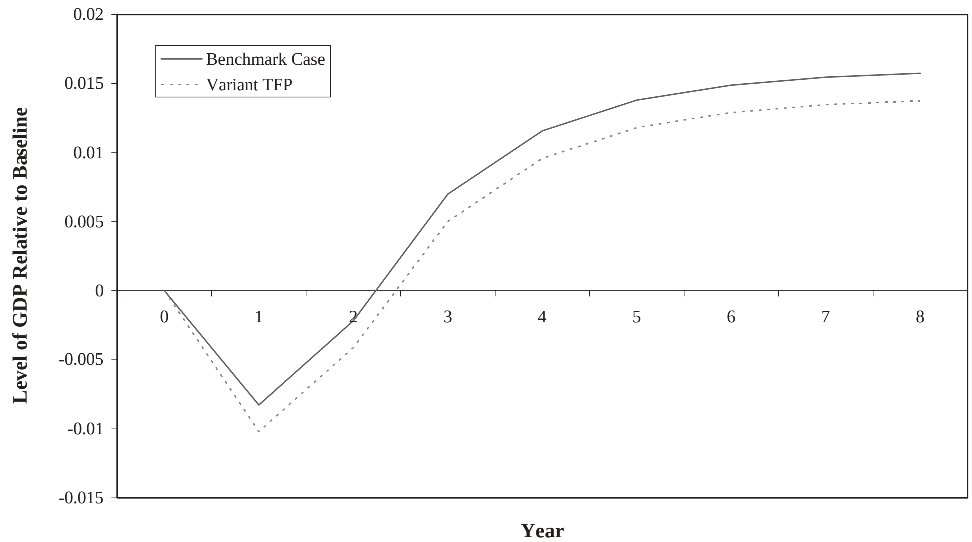



of total number of workers, using 1,212 Japanese firms whose data are available for 10 years (1993–2002). I find that the firms that belonged to the least productive 5 percent during 1993–1995 had a 57 percent chance of remaining in the same group, 41 percent chance of moving up to the least-productive 5–10 percent, and only 2 percent chance of moving up further (beyond the least-productive 10 percent) during the next seven years (1996–2003).

When I use the transition probabilities, the medium-term output gain from restructuring is lower than that in the benchmark case (Figure 12). This suggests that the size of the effect of restructuring in the benchmark case could be a high-end estimate. Given strong persistence in productivity of Japanese firms, however, aggregate output converges to a level 1.4 percent above its initial level, which is slightly lower than the level in the benchmark case. Therefore, the relaxation of the invariance assumption would not substantially reduce the medium-term output gain of restructuring in Japan (although it would in an economy with weaker persistence in productivity).

I also examine the sensitivity of the results against different assumptions on production function. Instead of Cobb-Douglas production function, I assume constant elasticity of substitution (CES) production function with constant returns to scale. For the elasticity of substitution between capital and labor, I use 1.5 (instead of 1.0 in the Cobb-Douglas case), given that a recent study suggests 1.17–1.24 for the elasticity of substitution parameter in Japan (Kamada and Masuda, 2001). In this case, aggregate output converges to a level 1.8 percent above its initial level (Figure 13). This suggests that the introduction of CES production function would not alter the medium-term output gain substantially.

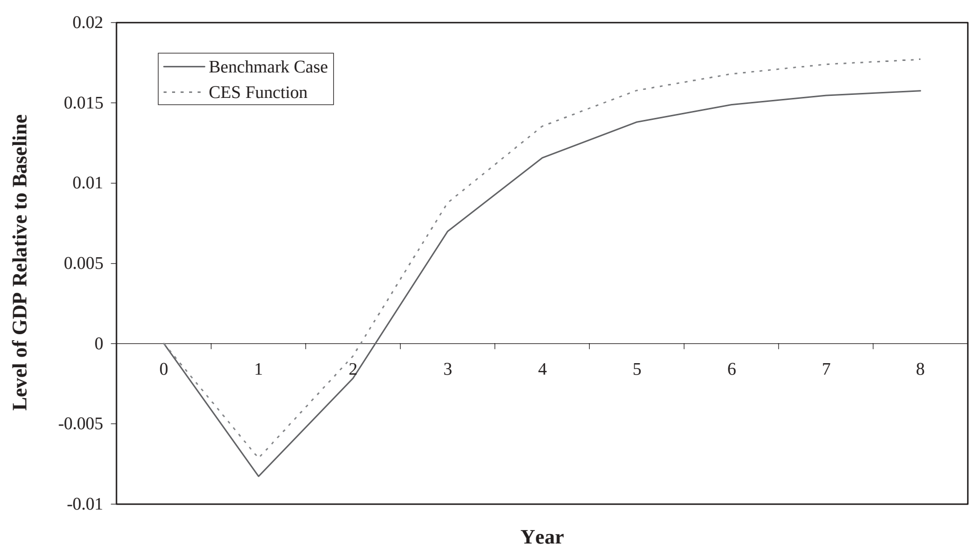
Figure 12. Sensitivity (VII)




## Potential Size of the Macroeffect

The above sensitivity analyses suggest that the main result of this paper—that the medium-term gain of restructuring exceeds the short-run cost—is robust against various changes in proxies, parameters, and assumptions. In addition, the size of the effect of restructuring is altered marginally in a vast majority of the above cases. The

Figure 13. Sensitivity (VIII)



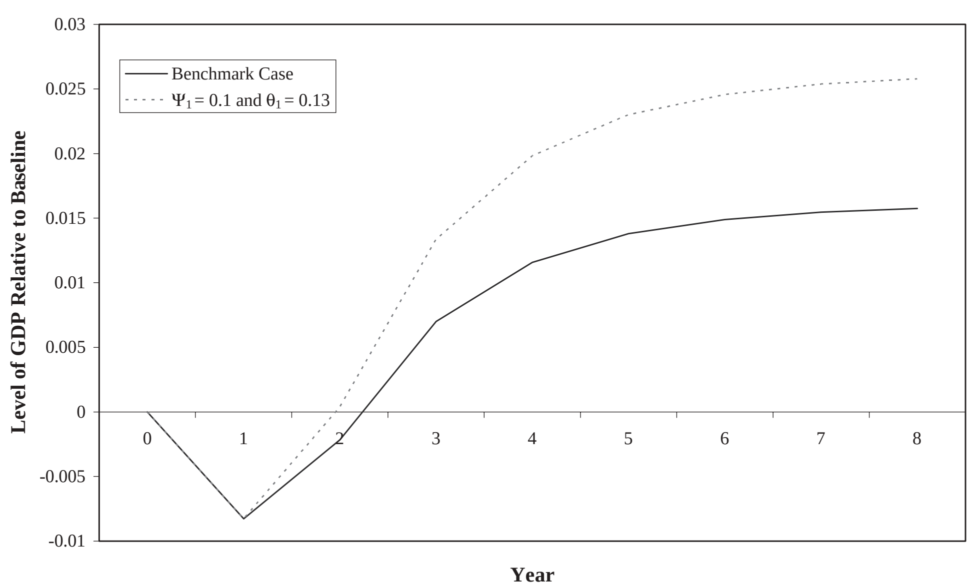
effect of restructuring is slightly lower than the benchmark case with variant productivity and slightly higher in most of the other cases discussed above. I now examine two important situations where the effect of restructuring could be much larger than the benchmark case: less-severe loss of labor and more-aggressive restructuring.

The benchmark case makes a very conservative assumption on the loss of labor. It assumes that 25 percent of laid-off Japanese workers are permanently unemployed. In Korea, however, all displaced workers traced by a study were reemployed within 35 months after the observation started, suggesting zero permanent unemployment (Chung, Chun, and Lim, 2003). In the United States, about 95 percent of the unemployed workers who had been displaced during 1995–1996 were reemployed by February 1998 (Hipple, 1999).

I simulate less conservative assumptions on the loss of labor. For the ratio of permanent unemployment among laid-off workers, I use 0.1 instead of the benchmark case's 0.25. For the parameter representing loss of laid-off workers' skills, I use $\theta_l$ = 0.13 (instead of $\theta_l = 0.3$ in the benchmark case), based on Ruhm's (1991) estimate. When using these two new parameter values, the restructuring reduces aggregate output to the level 0.8 percent below its initial level in the first year, but raises it thereafter to a level 2.6 percent above its initial level (Figure 14). This suggests that in this case, the medium-term output gain is substantially larger than in the benchmark case. Under a 5 percent discount rate, the present value of net output gains over 20 years after restructuring amounts to 26 percent of the initial output.

Recall that the benchmark case simulates the restructuring of the least-productive firms representing 5 percent of total labor. But the portion of zombie or low-productivity firms in Japan could be much higher than 5 percent of the cor-

Figure 14. Sensitivity (IX)



porate sector. Caballero, Hoshi, and Kashyap (2003) suggest that zombies could be around 15 percent of Japanese firms during 2000–2002.

Using their estimate, I conduct a simulation of restructuring of all the zombie firms in Japan. Figure 15 shows the effect of restructuring the least-productive firms representing 15 percent of labor ($\gamma = 0.15$). In this case, aggregate output falls by 4.4 percent in the first year. But it rises above the initial level from the third year, converging to a level 3.8 percent above its initial level. This suggests that the restructuring that eliminates all the zombie firms would amplify both short-term output losses and medium-term output gains, resulting in larger net gains. The present value of net output gains over 20 years after restructuring reaches 31 percent of the initial output under a 5 percent discount rate.

Table 1 summarizes the above discussion on the potential range of the effect of restructuring. Restructuring could raise aggregate output between 1.4 percent and 3.8 percent above the initial level in the medium term. The present value of net output gains over 20 years after restructuring could range between 13 percent and 31 percent of the initial output under a 5 percent discount rate.

## IV. Further Discussions

This section explores how the path of output is affected by the pace of restructuring and by assuming that restructuring involves resource reallocation only within industries. It also discusses macroeffects of restructuring based on inaccurate identification of the least-productive firms and output effects of bank-led restructuring through nonperforming loan (NPL) disposal.

Figure 15. Sensitivity (X)

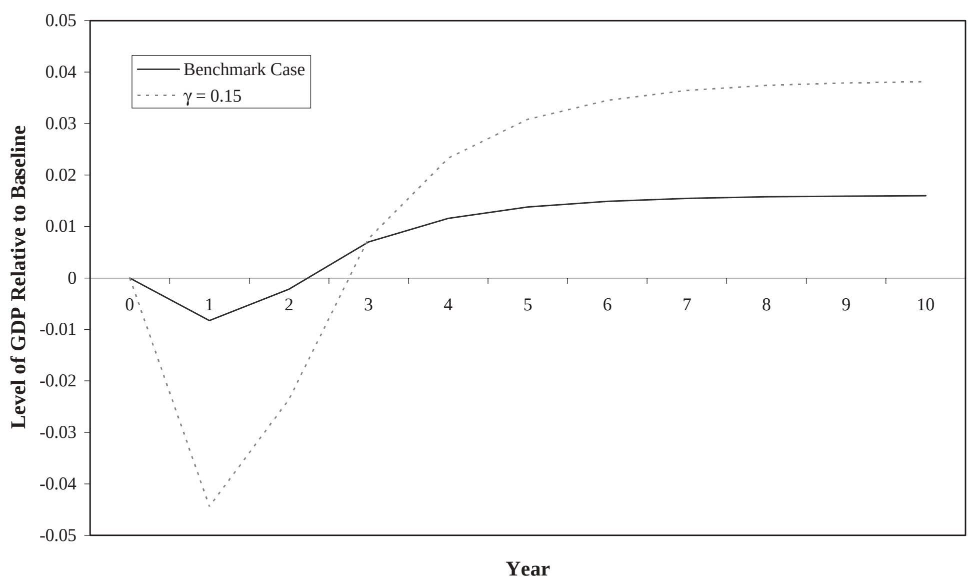


Table 1. The Size of the Macroeffect of Restructuring
(*As percentage of the initial output*)

| | Medium-Term Level of Aggregate Output Above Its Initial Level | Present Value of Net Output Gains Over 20 Years |
|---|---|---|
| Benchmark case | 1.6 | 15 |
| Variant productivity | 1.4 | 13 |
| 10 percent permanent unemployment | 2.6 | 26 |
| Restructuring of all the zombie firms | 3.8 | 31 |

## Pace of Reform

I examine the effect of the pace of reform on the dynamic path of aggregate output.[17] For the purpose of comparison, I first simulate the effect of restructuring the least-productive firms representing 10 percent of labor in a year ($t = 1$). In this case of swift restructuring, aggregate output falls by 1.9 percent in the first year, but eventually converges to a level 2.9 percent above its initial level (Figure 16).

I then evaluate the effect of more-gradual restructuring. For this experiment, I assume that restructuring of the least-productive 10 percent of firms ($\gamma = 0.1$) is carried out over two years: restructuring of the least-productive 5 percent of firms in a year ($t = 1$) and the least-productive 5–10 percent of firms in the next year ($t = 2$). In this case, aggregate output declines to 0.8 percent below its initial level (the same as in the benchmark case of swiftly restructuring the least-productive 5 percent of firms), but converges to a level 2.9 percent above its initial level (as in the case of swift restructuring of the least-productive 10 percent of firms). The results suggest that more gradual restructuring spreads out short-run output losses but also delays the pickup in aggregate output.

## Intra-Industry Resource Reallocation

It is also useful to examine the effect of restructuring a fraction $\gamma$ of firms in each industry, under the assumption that resources released from those firms are reallocated only to other firms in the same industry. For this exercise, I assume that for each industry, the least-productive firms representing 5 percent of the industry's labor are restructured. Note that if we add up the restructured firms across industries in this case, total restructured firms represent 5 percent of the economy's labor, the same as in the benchmark case ($\gamma = 0.05$), where the resources released from closed firms can be reallocated to firms in different industries.

[17]Whether big-bang policies are better than gradualism was hotly debated in the transition economies of Eastern Europe (e.g., Aghion and Blanchard, 1994; and Blanchard, 1997). Blanchard (1997) suggests that gradual reforms might be better under certain circumstances—for example, where a commitment to maintaining state firms for some time may avoid some adverse disorganization effects. The framework developed in this paper could be used to quantitatively compare different paces of reform and determine the optimal pace in such transition economies.

Figure 16. Effect of More-Gradual Restructuring

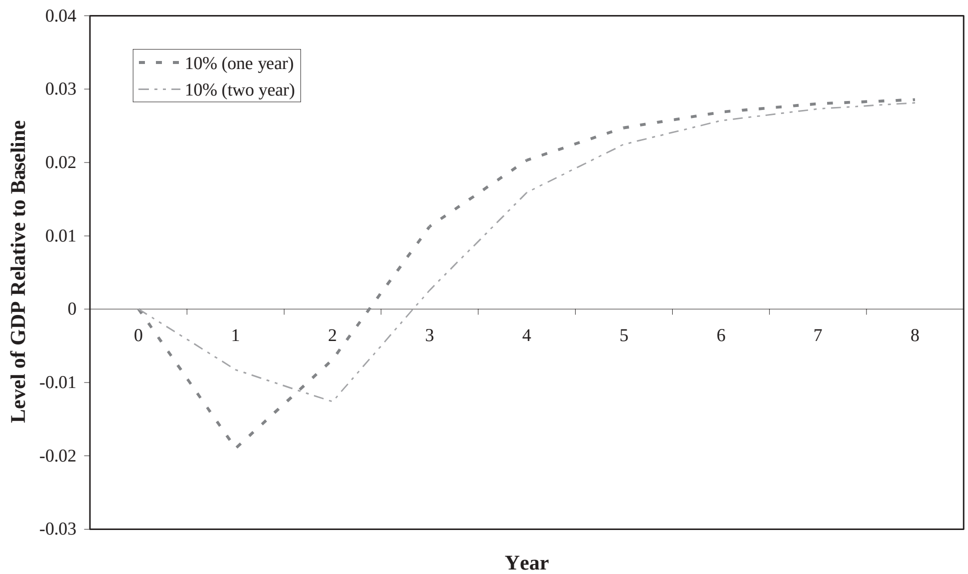
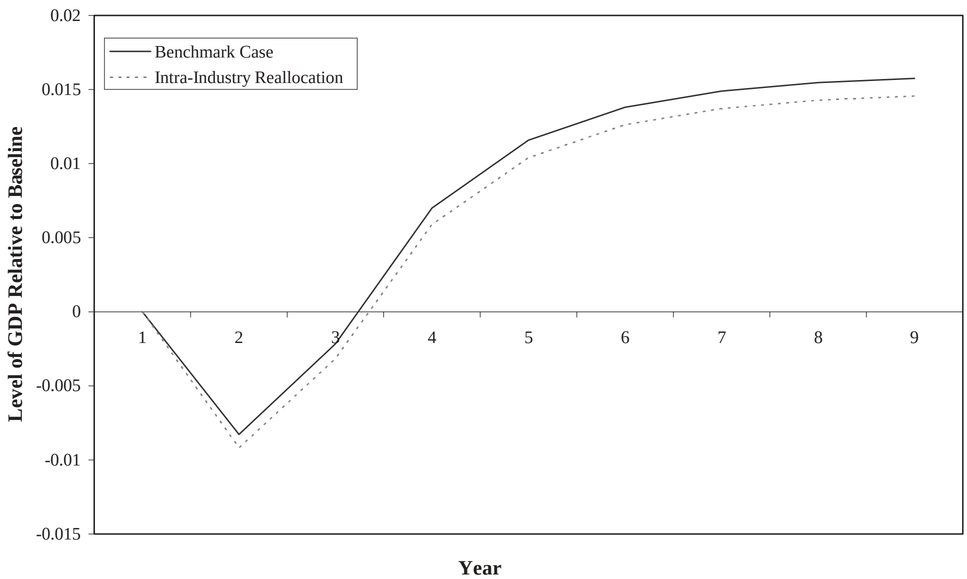



Figure 17 shows that the dynamic response of aggregate output is very similar to that of the benchmark case. In this case, aggregate output drops to a level 0.9 percent below its initial level in the first year, while it converges to a level 1.5 percent above its initial level in later years. Therefore, restructuring in this case generates a short-run output loss and medium-term output gain that are almost the same as in the benchmark case.[18]

This result indicates that distributions of productivity within major industries may be as dispersive as the distribution of the corporate sector. In a hypothetical situation where each industry consists of only one firm and capital income shares differ across industries, reallocation of resources from a firm with lower $A_i$ to others with higher $A_i$ would not always raise the aggregate output; therefore, we would not have the result shown in Figure 17. However, if each industry has a number of firms whose productivities are not concentrated in a specific area (say, left tail or right tail) of the productivity distribution of the economy, resource reallocation to more-productive firms within the same industry can substantially increase aggregate output, as in the

[18]Note that the benchmark assumptions of very high discount for reemployed capital and labor (72 percent for capital and 30 percent for labor) are based on the case where displaced capital and labor are reemployed largely by different industries. If we instead assume that freed-up capital and workers are reemployed by the same industry, the loss of industry-specific capital or skills could be much lower than the benchmark case. For example, if a worker displaced from a company in the information technology industry is reemployed by another company in the same industry, he or she may fully use skills acquired from the previous job. But if the worker is reemployed by a construction firm, he or she may not. Therefore, if this is taken into account, the net output gain could be even larger. For example, suppose that the rate of reemployment-related skill loss is 20 percent instead of the benchmark case's 30 percent and the rate of redeployment-related capital loss is 60 percent instead of 72 percent. It can be shown that in this case, aggregate output would converge to a level 1.9 percent above its initial level, higher than that of the benchmark case.

Figure 17. Effect of Intra-Industry Reallocation




benchmark case. Indeed, *Worldscope* data show a large dispersion in productivity within each of the major Japanese industries—manufacturing, construction, services, and wholesale and retail trade—as in the economy as a whole (as can be seen in the figures in Appendix II). Therefore, each of the major industries has some low-productivity firms but also many high-productivity firms.

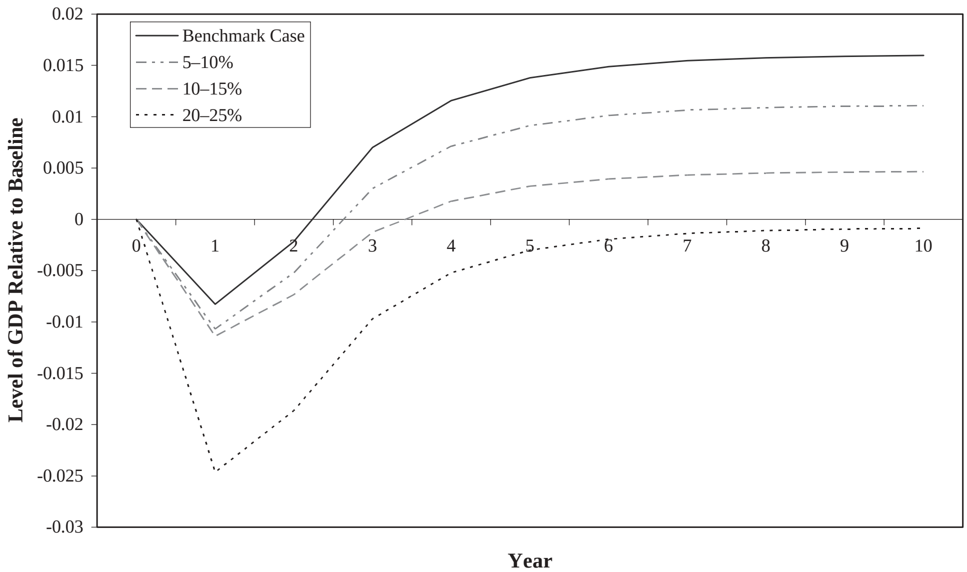
The result also suggests that even when the least-productive sectors change over time, the main results would not be substantially altered, given the wide dispersion of productivity distribution within each sector. According to our calculation based on *Worldscope* data for 2000–2002, real estate and transportation are the least-productive sectors. But even if manufacturing were to have the lowest average productivity, the macroeffect of restructuring would be almost the same as the benchmark case.

## Accuracy in Identification

The above simulations illustrate the size of the potential gain from the most advantageous restructuring, that is, reallocation of resources from the least-productive firms to more-productive firms. However, such ideal restructuring may be impeded or slowed in the presence of various institutional obstacles (as discussed in "Institution and Productivity Distribution" in Section I). Particularly under weak financial disclosure and corporate accounting practices, it may be hard even to accurately identify the lowest-productivity firms, let alone to smoothly reallocate resources. As a result, restructuring carried out under such a situation would not generate as much gain as does the ideal restructuring based on accurate identification of the weakest firms.

Figure 18 illustrates the consequence of a restructuring that is carried out based on inaccurate identification of the least-productive firms. First consider the

Figure 18. Effect of Inaccurate Selection

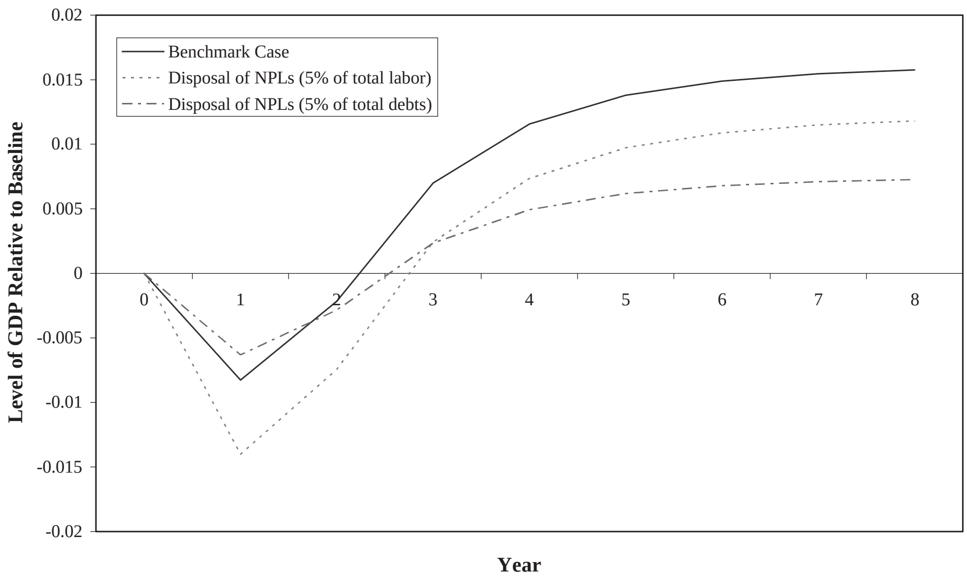



case where, because of weak information disclosure, firms whose productivities rank between the least-productive 5 percent and 10 percent are mistakenly selected for restructuring (instead of the bottom 0–5 percent of firms, as in the benchmark case). Figure 18 shows that output gains from restructuring are still large enough to outweigh the cost, but the net gain is lower than the optimum restructuring in the benchmark case. Now consider the case where the least productive 10–15 percent of firms are restructured. In this case, the net output gain of restructuring becomes marginal. Finally, if the least productive 20–25 percent of firms are liquidated with their capital and labor being reallocated to others (including the least-productive 0–20 percent of firms), restructuring generates output losses, in both the short term and medium term. These results suggest that strong financial disclosure and corporate transparency is a prerequisite for successful corporate restructuring. Furthermore, corporate restructuring would generate a better outcome when carried out by institutions that have expertise in gathering and processing accurate information on individual firms, even under weak financial disclosure by the firms, most probably banks (Fama, 1985).

## Bank-Led Restructuring

The impact of corporate restructuring carried out by banks (including through banks' disposal of nonperforming loans and refusal of "evergreening") also can be analyzed. Based on their expertise in distinguishing between the more productive and the less productive among borrower firms, banks may liquidate (or foster the reorganization of ) less-productive firms and reduce debt burdens of more-productive firms (e.g., through debt-equity swaps). As long as banks perform such

Figure 19. Effect of Nonperforming Loan (NPL) Disposal




a monitoring/allocation function properly, corporate restructuring led by banks can facilitate the reallocation of resources from less-productive firms to more-productive firms and induce a subsequent rise in aggregate output.

Figure 19 illustrates how banks' disposal of problem loans can affect the dynamic path of aggregate output. For this experiment, I assume that bank loans to firms whose ratios of operating profits to debts are less than 5 percent (on average for 2000–2002) have the potential to become bad loans.[19] I also assume that banks have capabilities to accurately measure the productivity of those firms. Further, suppose that the banks liquidate loans to the least productive among those firms (representing 5 percent of total corporate liabilities or total labor). Then the resources freed up from closed firms are demanded by and reallocated to more-productive firms, as described in Section II, "Basic Simulation Framework." Among all the 1,555 firms of our benchmark case, the least-productive firms accounting for 5 percent of total labor represent the same 5 percent of total debt outstanding. Among the firms with less than 5 percent profit/debt ratios, however, the least-productive firms accounting for 5 percent of total labor represent 7.1 percent of total debts.

So I distinguish between restructuring the least productive representing 5 percent of total corporate liabilities and 5 percent of total labor. In the first case, aggregate output declines by 0.6 percent in the first year, but converges thereafter to a level 0.7 percent above its initial level. In the second case, aggregate output

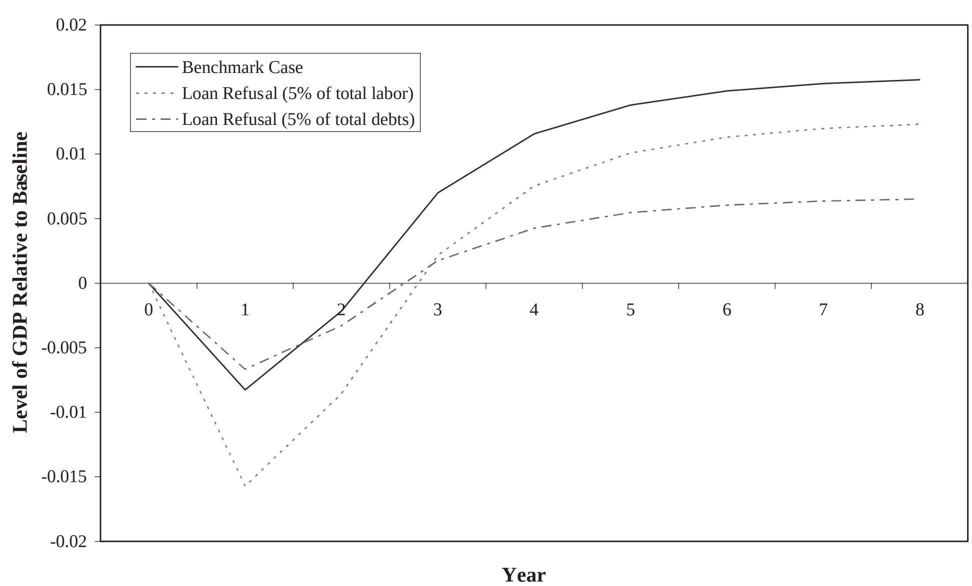
[19]This assumption is consistent with a study by Atkinson and others (2001). They classify potential bad loans into three types, depending on the ratio of operating profits to debt: *effectively bankrupt* loans, for those with a ratio of less than 1 percent; *bankruptcy risk* loans, with a ratio of more than 1 percent but less than 3.5 percent; and *watch list* loans, with a ratio of more than 3.5 percent but less than 5 percent.

declines by 1.4 percent in the first year but converges to a level 1.2 percent above its initial level. The output effect differs because 2.6 percent of total labor is redeployed in the first case, but 5 percent is in the second case. Whichever case is chosen, however, banks' disposal of NPLs can generate substantial net output gain.

Figure 20 illustrates the effect on aggregate output of banks' corporate restructuring through loan refusals to highly indebted firms. Banks may promote corporate restructuring by refusing to roll over existing loans or provide new loans to highly indebted firms (even those with higher than 5 percent profit/debt ratios). If a bank does not "evergreen" loans, firms with heavy debt burdens would likely fall in default. I assume that banks have capabilities to restructure the most highly indebted firms that rank among the top 20 percent in terms of debt/asset ratio. Suppose that banks restructure the least productive (representing 5 percent of total debts or total labor) among the most highly indebted firms.

From the simulation, I find that bank-led restructuring through loan refusals to highly indebted firms also can create substantial net output gain. In the case of restructuring 5 percent of total debts (total labor), aggregate output declines by 0.7 percent (1.6 percent) in the first year and then converges to a level 0.7 percent (1.3 percent) above its initial level. Note that the scope of banks' corporate restructuring in this experiment is limited to firms with heavy bank debt. As a result, the size of the net gain from restructuring is lower in this case than the benchmark case, where the least productive among all the firms (not only among the highly indebted firms) are restructured. However, the above discussion suggests that bank-led restructuring through sorting out the least productive among the top 20 percent most highly indebted firms alone could generate substantial output gain.

Figure 20. Effect of Loan Refusal



Such a simulation result could be obtained only when a certain fraction of the least-productive firms are highly indebted.[20] Indeed, half of the least-productive firms representing 5 percent of total labor rank in the top 20 percent of most highly indebted firms (in terms of debt/asset ratio).

This finding—that many of the least-productive firms can keep borrowing more heavily than the more-productive firms—is consistent with recent studies that ascribe Japan's decade-long stagnation primarily to banks' perverse incentives to evergreen weak firms (Kashyap, 2002; Caballero, Hoshi, and Kashyap, 2003; and Peek and Rosengren, 2003). These studies suggest that Japanese firms in poor financial condition are far more likely to receive additional credit from banks, which try to avoid the realization of losses on their own balance sheets. In particular, corporate affiliations, in the form of main bank or keiretsu ties, make it even likely that a lender will evergreen loans to a weak firm (Peek and Rosengren, 2003).

## V. Conclusion

This paper presented a framework for quantitatively evaluating both potential benefits and costs of corporate restructuring and applied it to Japan. Based on Cobb-Douglas production functions, together with financial statement data of 1,555 Japanese firms and industry-specific labor income share parameters, it calculated TFP of individual firms and derived the distribution of productivity across those firms. Given the productivity distribution and law of motion for the reallocation of capital and labor, the paper traced the dynamic response of aggregate output to restructuring. It showed that well-designed restructuring in Japan could provide a medium-term output gain that outweighs the short-run cost.[21]

These results provide important policy implications. First of all, corporate restructuring in Japan may need to be pushed forward, given that its medium-term output gain substantially outweighs its short-run cost. In addition, corporate restructuring would most likely yield significant gains if accompanied by broader reform measures to achieve the most beneficial restructuring (e.g., strengthening financial disclosure, accounting practices, and corporate transparency, and developing more active mergers and acquisitions markets).

The empirical framework of this paper suggests some useful avenues for further research on measuring the macroeffect of corporate restructuring and, more

[20] The more firms with low productivity and high debt burdens, the larger gain from bank-led restructuring. Based on data from the U.S. trucking industry, Zingales (1998) finds that firms with higher debt and lower efficiency are less likely to survive adverse shocks.

[21] Note that the benefits of restructuring in this paper are generated by the exit of less-productive firms and the resulting resource reallocation to more-productive firms. Caballero, Hoshi, and Kashyap (2003) suggest that the presence of zombie or low-productivity firms generates a dynamic distortion by keeping higher-productivity firms from entering the market. If we incorporate the entrance of new firms in the current model, the benefits of restructuring (or closing the least-productive firms) would be even larger.

generally, institutional changes in any country, including Japan. It would be particularly interesting to apply the same simulation exercise to many countries and to examine cross-country variations in the size of the macroeffect of corporate restructuring and the factors that affect the variations. While the current framework works nicely to generate plausible estimates of the effect of restructuring in various situations, it might not be the sole empirical approach. Therefore, further studies that adopt a different methodology would provide a useful complement to this paper.

## APPENDIX I

The amount of capital reallocated from the least-productive firms to a more-productive firm through year $t$, denoted by $\delta_t^{k,i}$, is

$$\delta_t^{k,i} = \begin{cases} \left(\frac{k_0^i}{K_0^G}\right) K_0^B (1-\theta_k)\left(\frac{\omega_k}{2}\right) & \text{for t=1} \\ \left(\frac{k_0^i}{K_0^G}\right) K_0^B (1-\theta_k)\left[\omega_k + (1-\omega_k)\left(\frac{\acute{\omega}_k}{2}\right)\right] & \text{for t=2} \\ \left(\frac{k_0^i}{K_0^G}\right) K_0^B (1-\theta_k)\left[\omega_k + (1-\omega_k)\,\acute{\omega}_k \sum_{s=0}^{t-3}(1-\acute{\omega}_k)^s + (1-\omega_k)(1-\acute{\omega}_k)^{t-2}\left(\frac{\acute{\omega}_k}{2}\right)\right] & \text{for t=3, 4, . . .} \end{cases} \tag{A1}$$

and the amount of labor reallocated to a more-productive firm through year $t$, denoted by $\delta_t^{l,i}$, is[22]

$$\delta_t^{l,i} = \begin{cases} \left(\frac{l_0^i}{L_0^G}\right) L_0^B (1-\theta_l)(1-\psi_l)\left(\frac{\omega_l}{2}\right) & \text{for t=1} \\ \left(\frac{l_0^i}{L_0^G}\right) L_0^B (1-\theta_l)(1-\psi_l)\left[\omega_l + (1-\omega_l)\left(\frac{\acute{\omega}_l}{2}\right)\right] & \text{for t=2} \\ \left(\frac{l_0^i}{L_0^G}\right) L_0^B (1-\theta_l)(1-\psi_l)\left[\omega_l + (1-\omega_l)\,\acute{\omega}_l \sum_{s=0}^{t-3}(1-\acute{\omega}_l)^s + (1-\omega_l)(1-\acute{\omega}_l)^{t-2}\left(\frac{\acute{\omega}_l}{2}\right)\right] & \text{for t=3, 4, . . .} \end{cases} \tag{A2}$$

After restructuring, the amount of capital used by each more-productive firm ($i \in i^G$) at year $t$, denoted by $k_t^i$, then increases as

$$k_t^i = k_0^i + \delta_t^{k,i}. \tag{A3}$$

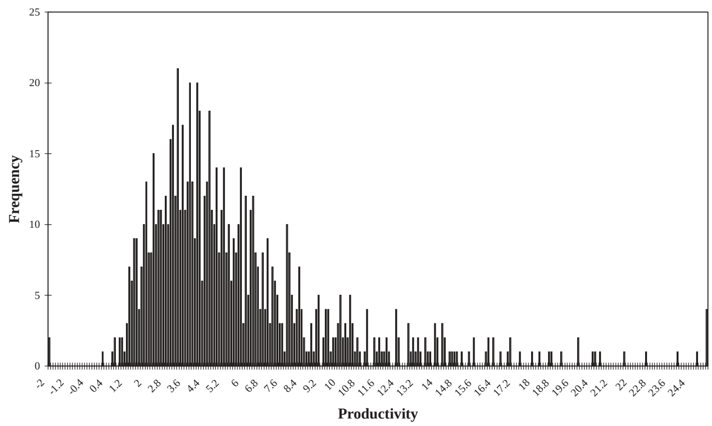
Similarly, the amount of capital used by a more-productive firm at year $t$, denoted by $l_t^i$, increases as

$$l_t^i = l_0^i + \delta_t^{l,i}. \tag{A4}$$

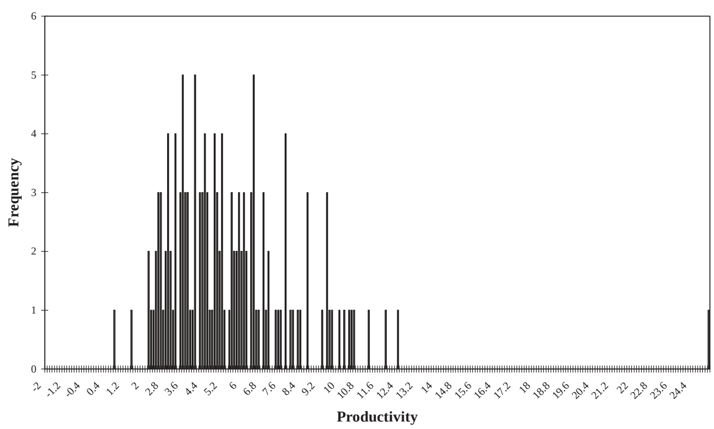
[22]In the case of Japan, Ogawa (2003) derives and estimates a dynamic path of labor based on quadratic adjustment cost of hiring/firing.

## APPENDIX II Productivity Distribution by Sector

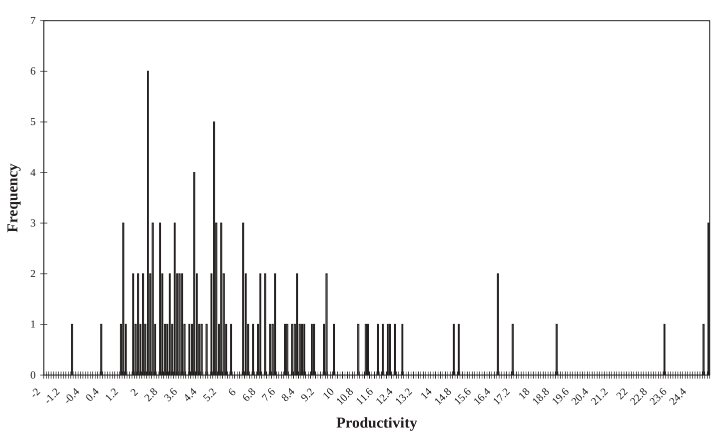
**Manufacturing**



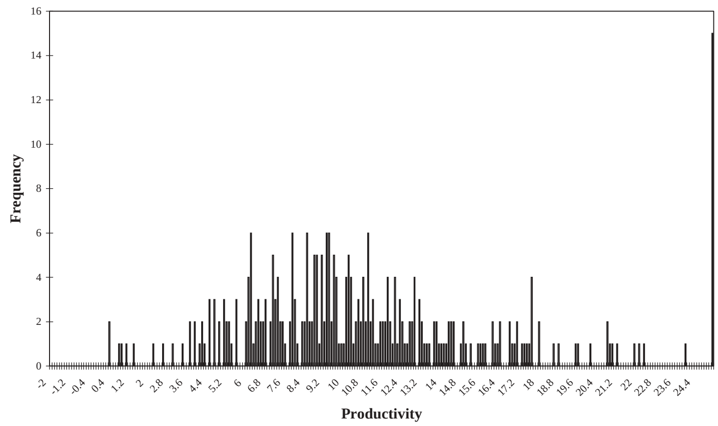

**Construction**



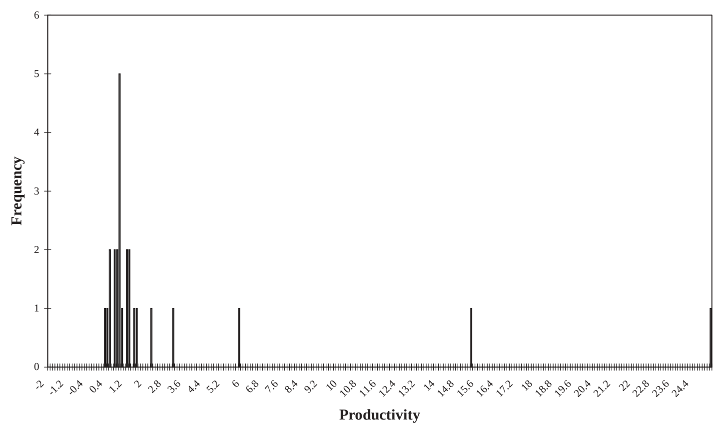

**Services**



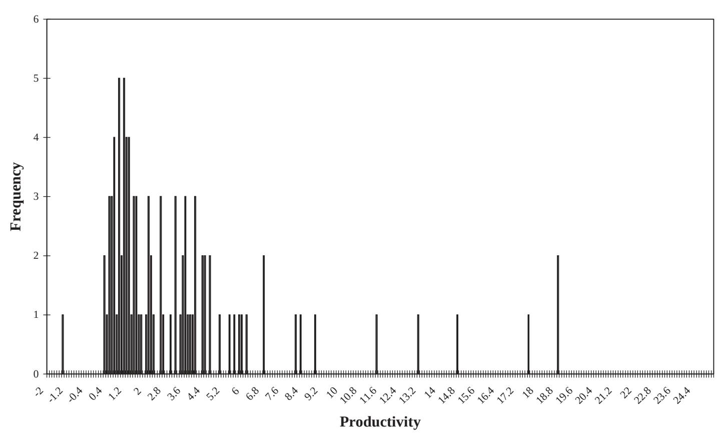
**Wholesale and Retail Trade**




**Real Estate**




**Transportation**



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