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Abstract

We study the inter-firm reallocation of land and other tangible assets and examine its relationship with productivity. By focusing on the Japanese firms during 1980-2014 including the period of massive asset price fluctuations, we find the following. First, there exists no obvious cyclicality in the extent of land and other tangible asset reallocation. Instead, the reallocation of land has been stagnant for more than 20 years since the burst of the asset price bubble. Second, reallocation of land and non-land tangible assets is efficiency-reducing rather than efficiency-enhancing in that firms with high TFP reduce their holdings of these assets more than low TFP firms do. Third, the relationship between reallocation and productivity changes over time. Even though the reallocation of land was efficiency-enhancing around the end of the 1980s, it turned to efficiency-reducing afterward.

JEL Classifications: E22; G34; R33
Keywords: Land; Total factor productivity; Asset price bubble; Business cycle

1. Introduction

The interfirm allocation of inputs for production, such as labor and capital, plays a role as important as their volume for the performance and efficiency of an economy. This has motivated many economists to construct aggregate measures for input reallocation and to examine its extent and the relationship with the business cycle. They first focused on the reallocation of jobs among firms (Davis and Haltiwanger, 1992; Davis, Haltiwanger, and Schuh, 1996) to find that the gross flow of labor input is substantially more sizable than its net flow and that the extent of reallocation is counter-cyclical. Then, they turned to the reallocation of physical capital (Eisfeldt and Rampini, 2006; Ramey and Shapiro, 1998), even though the extent of examination is still limited relative to the study on the labor reallocation.

The relevance of input reallocation to the overall economy also prompted these economists to study if it is efficiency-improving at the firm level. Theoretical studies including Jovanovic (1982) and Hopenhayn (1992) provide a model of heterogeneous firm dynamics, in which unproductive firms exit while productive ones survive in the market. This mechanism of selection among firms, which is termed as "cleansing," facilitates the flow of resources from low productivity firms to high productivity ones and results in the efficiency-enhancing reallocation. Further, a number of theoretical studies that follow relate the extent of cleansing to the business cycle. Davis and Haltiwanger (1990), Caballero and Hammour (1994), and Mortensen and Pissarides (1994) show a large extent of cleansing during recession periods due to lower marginal costs of creating jobs or filling job vacancies. In contrast, Barlevy (2003) and Osotimehin and Pappada (2017) focus on a severer credit constraint during recessions to add qualifications for the counter-cyclicality of the cleansing effect. However, empirical investigation on the cleansing effect is mostly on the reallocation of labor such as Foster, Haltiwanger, and Krizan (2006) and Foster, Grim, and Haltiwanger (2016) but not on the capital reallocation.

Against this background, this paper focuses on the reallocation of physical capital, which has been less frequently scrutinized than that of labor, and examines the relationship with productivity. Further, it takes into account of the heterogeneity of capital and focuses on the reallocation of land and other tangible assets rather than to focus on the overall capital stock as Eisfeldt and Rampini (2006) did. There are several reasons for distinguishing between land and non-land tangible assets in our analysis.

First, the relevance of reallocation varies across capital stocks with different rates of depreciation and it is worth focusing on the capital stocks whose reallocation is quantitatively more important than new investment. Capital goods with high depreciation rates such as equipment decay so quickly that it is difficult for its owners to sell them to others, in which case reallocation (i.e. purchase and sales of existing capital goods) is smaller in size than new investment (i.e. installment of new capital goods). In contrast, capital goods with low depreciation rates decay slowly and firms have enough time to reallocate these capital goods to others. For this type of capital, its reallocation is larger in size than the new investment. Land seldom depreciates and has a very limited amount of new investment.[2] This makes land a unique class of capital goods whose reallocation should be closely examined.

Second, volatility in the value of capital, which is one of the important determinants of capital acquisitions and sales, differs substantially between land and other tangibles. Davis and Heathcote (2007) evidence that a fluctuation of real estate values is mostly attributable to the fluctuation of land values rather than to that of structure values. Hence, it is important to compare the extent of reallocation between land and other tangible assets whose volatilities in their values are different from each other. This examination is especially relevant during the periods of real

[2] To be precise, there is a small amount of new investment for land due to land reclamation and grading. Also, there is a small amount of land depreciation due to quarrying. However, both of them are very small in size.

estate booms and busts, such as those in the latter half of the 2000s in the US and in the late 1980s and early 1990s in Japan.

This paper has three distinct research questions on the reallocation of land and other tangible asset capital. First, what is the pattern of reallocation of land and non-land tangible assets over the business cycle or over time? Second, is the reallocation productivity enhancing? Third, does the nature of the relationship between productivity and reallocation change over the business cycle or over time?

In order to answer these three questions, our analyses comprise two parts. The first part constructs aggregated variables for the reallocation of two types of capital stocks, namely, land and non-land tangible assets by employing a firm-level panel data set for more than 30 years. Using these variables, we summarize the characteristics of capital reallocation over the business cycle and answer the first question. The second part estimates a production function for each industry to calculate firm-level TFP. After doing so, we examine the role of TFP in the capital reallocation and answer the second and third questions.

For these analyses, we employ the firm-level data from the Quarterly Financial Statement Statistics of Corporations by Industry assembled by the Ministry of Finance, the government of Japan. The statistics is from the first quarter of the fiscal year 1980 to the fourth quarter of 2014. It covers all the large-sized corporations with capital amount of no smaller than 500 or 600 hundred million yen and randomly samples smaller corporations in Japan. The advantages of the QFSSC are two-fold. First, it contains not only the balance sheet information which is necessary to construct firm-level statistics for total factor productivity but also the information on sales and purchases of land and non-land tangible assets. We use them for constructing the reallocation variables. Second, it covers both manufacturing and non-manufacturing industries, while Foster, Grim, and Haltiwanger (2016), which is the closest study to ours, employ data solely on the manufacturing businesses.

As a result of the analysis, we have the following major findings. First, the extent of the capital reallocation both for land and non-land tangibles is not significantly correlated with the business cycle measured by the change in the unemployment rate. This is not consistent with Eisfeldt and Rampini (2006) who evidence for the pro-cyclicality of the capital reallocation. Rather, the extent of land transactions among firms has been stagnant since the bubble burst in the early 1990s. Second, firms with higher TFP tend to reduce the amount of land and non-land tangible asset holdings rather than to increase it. This indicates that the reallocation of capital stocks, be they land or non-land tangibles, is efficiency-reducing rather than efficiency-enhancing. This is in contrast with Foster, Grim, and Haltiwanger (2016) who found efficiency-enhancing job reallocation in the US. Third, the efficiency-reducing reallocation of land is statistically significant in Japan’s early 2000s, while the reallocation of land and non-land tangibles is efficiency-enhancing in the late 1980s when the massive bubble peaked in the Japanese real estate market.

The paper proceeds as follows. We describe the data and the empirical approach employed for the analysis in Section 2. This is followed by the explanation of the results in Sections 3 and 4. Section 3 details the results on the extent of reallocation, while Section 4 shows the estimation results on the relationship between the reallocation and productivity. Section 5 concludes.

2. Data and empirical approach

This section describes the data set we construct and the empirical methodologies we employ for analysis. After giving details about the data sources used for analysis, we explain how we measure reallocations, how we calculate firm-level TFP, and how we examine the relationship between reallocation and TFP in the following subsections.

2.1 Data sources

We employ the Quarterly Financial Statement Statistics of Corporations by Industry (hereafter QFSSC) for the main data source for analysis. In addition, we use the Japan Industrial Productivity (hereafter JIP) database for industry level deflators and average working hours. The QFSSC is a survey of business corporations whose headquarters are located in Japan. It contains firm-level information on balance sheet, employment, industry, geographic location, and transactions of fixed assets. It covers both manufacturing and non-manufacturing industries, although we exclude financial and insurance industries from the analysis. The sample structure of the QFSSC comprise two parts: the part that covers all large-sized corporations and the part that collects smaller-sized samples firms. For firms in the latter category, they receive questionnaires four to eight quarters (one to two years). We explain details about sampling of the survey in the appendix.

2.2 Measuring reallocation

We measure the extent of reallocation of land and non-land tangible assets using transaction information from the QFSSC. For quarter t, we have the following information as shown in Table 1(a). Notably, not only the information on the net change in asset holdings but also the information on the purchase and sales of these asset holdings are available. Note that N_Land_t and D_Land_t are very small since investment for land is limited to reclamation and grading and land depreciation is observed only in case it is used for quarrying. We are also able to see the exact amount of these transactions in Table 1(b). For the fourth quarter of fiscal year 2014, N_Land_t and D_Land_t is only 6 billion and 0.08 billion yen, while that of land purchase and land sales is 1441 billion and 2246 billion yen, respectively. This indicates that reallocation (purchase and sales) is far more important than new investment in case of land asset. In contrast, there is a substantial amount of new investment for non-land tangibles whose size is comparable to the amount of sales and purchases of these assets.

Based on the above information, we define variables for reallocation of these two types of assets and a variable for new investment for non-land tangibles. First, we define the aggregated sales and purchases amount for each asset and the aggregated new investment amount for non-land tangible assets in quarter t:[3]

$$POS\_Land_t = \sum_i \frac{P\_Land_{it}}{0.5(Land_{it-1} + Land_{it})} \frac{Land_{it}}{\sum_i Land_{it}}$$

$$NEG\_Land_t = \sum_i \frac{S\_Land_{it}}{0.5(Land_{it-1} + Land_{it})} \frac{Land_{it}}{\sum_i Land_{it}}$$

$$POS\_Tangible_t = \sum_i \frac{P\_Tangible_{it}}{0.5(Tangible_{it-1} + Tangible_{it})} \frac{Tangible_{it}}{\sum_i Tangible_{it}}$$

$$NEG\_Tangible_t = \sum_i \frac{S\_Tangible_{it}}{0.5(Tangible_{it-} \ \ + Tangible_{it})} \frac{Tangible_{it}}{\sum_i Tangible_{it}}$$

$$NEW\_Tangible_t = \sum_i \frac{N\_Tangible_{it}}{0.5(Tangible_{it-1} + Tangible_{it})} \frac{Tangible_{it}}{\sum_i Tangible_{it}}$$

Note that each of the P_Land_{it} and S_Land_{it} is deflated by the land value deflator and each of the $P\_Tangible_{it}$, $S\_Tangible_{it}$, and $N\_Tangible_{it}$ is deflated by the investment deflator which will be detailed in Section 2.3.2. Then, we define the aggregated sum of reallocation and net of reallocation as follows:

$SUM\_Land_t = POS\_Land_t + NEG\_Land_t$

$NET\_Land_t = POS\_Land_t - NEG\_Land_t$

$SUM\_Tangible_t = POS\_Tangible_t + NEG\_Tangible_t$

$NET\_Tangible_t = POS\_Tangible_t - NEG\_Tangible_t$

[3] In the QFSSC, some of the new investment for non-land tangibles is counted as acquisitions of existing non-land tangible assets after it appears as new investment in the construction in progress. This may result in the overestimation of existing non-land tangible asset acquisitions. We take necessary measures to correct this possible overestimation.

The definitions of these reallocation variables are in line with those in the previous literature and we employ these variables in the following analysis of capital reallocation.

2.3 Calculating total factor productivity

2.3.1 Procedure for estimating the production function

In calculating the firm-level TFP, there are two alternative ways: subtracting the cost share of each input from the output and estimating a production function to calculate TFP based on the estimated parameters. While Foster, Grim, and Haltiwanger (2016) employ the former approach, we adopt the latter since the assumption of perfect competition in the input market, which is necessary for the former approach, may not hold in reality. Note, however, that production function estimation itself has a fundamental difficulty. If unobserved productivity shocks are correlated with the firm's input choices, a simple OLS will yield biased estimates of the production function coefficients. Among the several methods proposed to solve this issue in the literature, we adopt the control function approach. The control function approach originally proposed by Olley and Pakes (1996) considers a firm's observed input demand as a proxy for unobserved productivity shocks and substitutes the inverted demand function for these unobserved shocks in the estimation.

To be more specific, we follow the methodology of Ackerberg, Caves, and Frazer (2015, hereafter ACF), which focus on the demand for intermediate inputs like Levinsohn and Petrin (2003, hereafter LP) did but employ a functional form more flexible than theirs. The only difference in our study from ACF is the number of inputs. We add land stock in addition to labor, capital, and intermediate goods as inputs in the production function and estimate the following equation:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_n n_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it},$$

where y_{it} is the log of value added for firm i in period t, k_{it}, n_{it}, and l_{it} are respectively the logs of non-land capital, land, and the amount of labor for the firm in the period, ω_{it} is the unobservable productivity shocks, and ε_{it} is the transitory shocks. We assume here that land is used as inputs for production like labor or other tangible assets. It is possible to argue that firms hold land for other purposes than production such as assets to be pledged as collateral for loans or as assets to be sold for capital gains in the future. However, we treat land as inputs for production since firms in Japan leave only a very limited portion of their land asset idle.[4] We also have the following assumption that firms' intermediate input demand is given by

$$m_{it} = \widetilde{f_t}(k_{it}, n_{it}, l_{it}, \omega_{it})$$

and that $\widetilde{f_t}(k_{it}, n_{it}, l_{it}, \omega_{it})$ is strictly increasing in ω_{it}. Given these assumptions, we invert intermediate input demand and substitute it into the production function to have

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_n n_{it} + \beta_l l_{it} + \widetilde{f_t}^{-1}(k_{it}, n_{it}, l_{it}, m_{it}) + \varepsilon_{it} = \widetilde{\Phi_t}(k_{it}, n_{it}, l_{it}, m_{it}) + \varepsilon_{it},$$

resulting in the following first stage moment condition:

$$\mathrm{E}[\varepsilon_{it} | I_{it}] = \mathrm{E}\left[y_{it} - \widetilde{\Phi_t}(k_{it}, n_{it}, l_{it}, m_{it}) | I_{it}\right] = 0.$$

[4] According to the Survey on Firms' Land Transactions implemented by the Ministry of Land, Infrastructure, Transport and Tourism, 94.3% of land owned by firms that responded is used for their activities as of the beginning of the year 2012.

In the first stage of the estimation, we produce an estimate $\widehat{\widetilde{\Phi_t}}(k_{it}, n_{it}, l_{it}, m_{it})$ of $\widetilde{\Phi_t}(k_{it}, n_{it}, l_{it}, m_{it})$ but not an estimate $\hat{\beta}_l$ of β_l. The difference of the methodology of ACF from that of LP is that it does not estimate β_l at this stage but do it along with other production function parameters in the second stage. Following ACF, we have the following second stage conditional moment:

$$\mathrm{E}[\xi_{it} + \varepsilon_{it} | I_{it-1}]$$
$$= \mathrm{E}\big[y_{it} - \beta_0 - \beta_k k_{it} - \beta_n n_{it} - \beta_l l_{it} - g\big(\widetilde{\Phi_{t-1}}(k_{it-1}, n_{it-1}, l_{it-1}, m_{it-}\ ) - \beta_0 - \beta_k k_{it-1} -$$
$$\beta_n n_{it-1} - \beta_l l_{it-1}\big) | I_{it-1}\big] = 0,$$

where $\widetilde{\Phi_{t-1}}$ is replaced by the estimate from the first stage. Then we estimate the parameters in the production function for each industry and calculate TFP for each firm within the industry.

2.3.2 Variables

For estimating the above production function and calculating the firm-level TFP, we need to construct the variables. These are variables for output, labor, non-land capital, land, and intermediate inputs.

Output

We calculate real firm-level value-added, Y_{it}, as shown in the following formula:

$$Y_{it} = \frac{Current\ Profit_{it} + Personnel\ Cost_{it} + Interest\ Payment_{it} + Depreciation_{it}}{PVA_{st}},$$

where $Personnel\ Cost_{it}$ is composed of salaries for executives and employees, bonuses for executives and employees, and welfare expenses, all of which are obtained from the QFSSC. PVA_{st} is the industry-level value-added deflator calculated from the industry-level nominal value-added and the real value-added that are obtained from the JIP database.

Labor

For L_{it}, we calculate the total hours as shown in the following formula:

$$L_{it} = Number\ \ of\ \ Employees_{it} * Yearly\ \ working\ \ hours_{st}.$$

We obtain the firm-level number of employees from the QFSSC. We also calculate industry-level yearly working hours per person from the man-hours and the number of employees in the JIP database.

Non-land tangible asset capital

We calculate real non-land tangible assets K_{it} measured in market values from the nominal book value information stored in the QFSSC, KN_{it}. We first calculate the industry-level series of non-land tangible assets measured by market values K_{st} using the following formula:

$$K_{s0} = \frac{KN_{s0}}{PINVEST_{s0}}$$

$$K_{st} = K_{st-1} + (1 - \delta_{st})\frac{INVEST_{st}}{PINVEST_{st}}, \text{ t=1,…, T,}$$

where KN_{st} is the industry-level nominal non-land tangible asset amount outstanding measured at end of t, $PINVEST_{st}$ is the industry-level investment deflator, $INVEST_{st}$ is the nominal investment amount for non-land tangible assets, and δ_{st} is the industry-level depreciation rate. We set the year 1975 as the starting period of t=0. All the information for the above calculation is obtained from the JIP database and the Annual Financial Statement Statistics of Corporations by Industry. Then, we obtain the industry level market-to-book value ratio and obtain the firm-level real non-land tangible asset amount evaluated by market prices using the following formula:

$$Ratio_{st} = \frac{K_{st}}{KN_{st}}$$

$K_{it} = Ratio_{st} * KN_{it}$.

Land

We calculate the firm-level real land asset holdings, N_{it}, as shown in the following formula:

$$N_{it} = \frac{NN_{it}}{PLand_t}$$

$$PLand_t = \frac{Unit\ \ Land\ \ Value_t}{Unit\ \ Land\ \ Value_{2000}} \ ,$$

where NN_{it} is the firm-level nominal land asset holdings from the QFSSC and $Unit\ \ Land\ \ Value_t$ is the nominal land value in Japan in year t from the SNA statistics divided by the total area size of the country in the year.

Intermediate inputs

We calculate the real firm-level input of intermediate goods, M_{it}, as shown in the following formula:

$$M_{it} = \frac{Sales\ \ Cost_{it} + Sal\ \ \ \ Administrative\ \ Expense_{it} - (Personnel\ \ Cost_{it} + Depreciati\ \ \ \ _{it})}{PM_{st}},$$

where PM_{st} is the industry-level intermediate inputs deflator calculated from the industry-level nominal intermediate inputs and the real intermediate inputs that are obtained from the JIP database.

2.3.3 Industries

We also need to specify the industries for which we estimate the production function. In principle, we employ industry classifications set by the QFSSC but we combine some of them to be consistent before and after the revision of the classifications in the QFSSC in 2009. We also do this in order to match with classifications set by the JIP database. The set of industry classifications used for analysis is shown in Table A1.

2.4 Relationship between reallocation and TFP

By employing the TFP calculated by the procedure detailed in the previous subsections, we examine the relationship between the reallocation of land and non-land tangible assets and productivity at the firm level. We employ a simple regression model connecting the growth of capital of each type and productivity. A baseline specification is given by the following equation:

$$Y_{it+} = \alpha_r + \varphi_t + \beta TFP\_dev_{it} + \gamma Cycle_{rt+1} + \delta TFP\_dev_{it} * Cycle_{rt+1} + X_{it}\theta + \varepsilon_{it+1}. \quad (1)$$

Y_{it+1} is the growth of the land and other tangible asset variable whose reallocation we have focused for firm i from quarter t to t+1. There are seven variables, which are sales and purchases of land and non-land tangible assets (P_Land_{it}, S_Land_{it}, $P\_Tangible_{it}$, and $S\_Tangible_{it}$), the net changes in land and non-land tangible asset holdings by these sales and purchases ($P\_Land_{it} - S\_Land_{it}$, $P\_Tangible_{it} - S\_Tangible_{it}$), and the new investment for non-land tangibles ($N\_Tangible_{it}$). Note that these are denominated by the amount of land or non-land tangible asset amount outstanding. TFP_dev_{it} is total factor productivity deviations from industry by quarter averages, and $Cycle_{rt+1}$ is the change in the unemployment rate in the region where the firm i's headquarters are located from t to t+1. X_{it} is the firm's control variable, in which case we employ the number of a firm's employees for firm size.

We estimate this equation for the period from the first quarter of the fiscal year 1980 to the fourth quarter of 2014. We pool all the observations with quarter and region dummies. We have 47 prefecture dummies for region dummies. In case we observe a cleansing effect, by which resources are reallocated from low productivity firms to high productivity ones, the coefficient of β is positive (for equations with the net change in assets or the purchase of assets being employed for the dependent variable) and negative (for equation with the sales of assets being employed for the dependent variable). In case we observe a more sizable cleansing effect during the times of recessions, the coefficient of δ is again positive (for equations with the net change in assets or the purchase of assets being employed for the dependent variable) and negative (for equation with the sales of assets being employed for the dependent variable). By looking at these coefficients, we are able to answer the second and the third research questions we posited in the introduction.

Note, however, that there may be some other time-varying factors that affect the impact of TFP on the capital reallocation than the change in the unemployment. For example, higher volatility in asset prices may discourage firms from acquiring additional amount of capital. Or an institutional change in the way firms disclose the value of their tangible assets in their balance sheets may promote or discourage sales of their assets. In order to capture such time-varying factors other than the one captured by the change in the unemployment, we implement another specification in below:

$$Y_{it+1} = \alpha_r + \varphi_t + \sum_{y=t_0}^{T} \beta_y \, TFP\_dev_{it} + \gamma Cycle_{rt+1} + X_{it}\theta + \varepsilon_{it+1} \tag{2}$$

The difference of this specification from the baseline is that we allow the coefficient on TFP_dev_{it} to be time-varying, while we omit the interaction term between the TFP_dev_{it} and $Cycle_{rt+1}$. Using these two specifications, we examine the relationship between reallocation and productivity and test our second and third research questions in the following sections.

3. Reallocation of land and non-land tangibles

3.1 Reallocation for the entire sample

In this section, we show the extent of reallocation of land and non-land tangible assets over the sample period. Figure 1 shows the pattern of reallocation of these assets. Panels (a) and (b) of the figure present the reallocation of land. The bold line in Panel (a) represents the amount of land acquisitions (POS_Land_t), while the dotted line represents the amount of land sales (NEG_Land_t). Panel (b) shows the sum of these two in the bold line (SUM_Land_t) and the difference between these two in the dotted line (NET_Land_t). Panels (c) and (d) present the reallocation of non-land tangibles in a similar manner. Panel (e) presents the new investment of non-land tangibles ($NEW\_Tangible_t$). A comparison between Panels (c), (d) and (e) shows the relative importance of reallocation of existing tangible assets to investment in the tangible assets that are newly created. Further, Panel (f) presents the change in the unemployment rate which we call as $Cycle_t$. We compare this with the capital reallocation measures to examine the cyclical nature of the reallocation.

There are several notable features in these figures. For the reallocation of land, POS_Land_t was high before 1992 with a spike around the period of the bubble burst in the Japanese real estate market. But it has been low ever since despite a temporary increase at the end of the 1990s. There is no conspicuous impact caused by the global financial crisis that occurred in 2008. NEG_Land_t was stable and lower than POS_Land_t until the late 1990s but increased its size around the mid of 2000s and became larger than POS_Land_t. It actually peaked at the beginning of the fiscal year 2005, which coincided with the introduction of impairment loss accounting for fixed assets to listed companies in Japan.[5] The overall amount of reallocation SUM_Land_t and the net change in the allocation NET_Land_t are mostly driven by POS_Land_t except for a

[5] For the possible impact of the impairment loss accounting on firms' sales of fixed assets, see Uesugi, Nakajima, and Hosono (2017, in Japanese).

brief period in the mid-2000s.

Regarding the cyclical nature of the land reallocation, from the figure there appear to be negative correlations between $Cycle_t$ and POS_Land_t and SUM_Land_t. But it turns out that NEG_Land_t is marginally negatively correlated with $Cycle_t$, while other reallocation variables show no statistically significant cyclicality as shown in Table 2.

For the reallocation of non-land tangible assets, its size measured in terms of $POS\_Tangible_t$, $NEG\_Tangible_t$, and $SUM\_Tangible_t$ has gradually increased over the years. This contrasts with the reallocation of land whose size has become smaller since the burst of the asset price bubble. $POS\_Tangible_t$ was low in the 1980s and 90s except for the fiscal years of 1991 and 92. But it gradually increased in the 2000s to peak in the fiscal years of 2008 and 09. $NEG\_Tangible_t$ shows a similar pattern to that of $POS\_Tangible_t$, but it is in general larger than $POS\_Tangible_t$. The difference between these two indicates a substantial depreciation of these tangible assets which corresponds to the difference between original acquisition prices measured by the book value of sold tangibles ($NEG\_Tangible_t$) and the new acquisition prices measured by the book value of purchased tangibles ($POS\_Tangible_t$). In order to evaluate the economic significance of each of reallocation and new investment, we compare $SUM\_Tangible_t$ and $NEW\_Tangible_t$. $SUM\_Tangible_t$ used to be smaller than $NEW\_Tangible_t$ in size. But it has steadily increased, while $NEW\_Tangible_t$ has declined substantially, making the former being larger than the latter since the latter half of 2000s.

3.2 Reallocation for different industries

Next, we show the extent of the reallocation in different industries in order to examine if there is any heterogeneity among them. For brevity we only show POS_Land_t, NEG_Land_t, $POS\_Tangible_t$, $NEG\_Tangible_t$, and $NEW\_Tangible_t$ for nine out of 26 industries. The results are shown in Figures 2 Panel (a) for land reallocation, Panel (b) for non-land tangibles reallocation, and Panel (c) for new non-land tangible investment.

In Figure 2 Panel (a) in which we observe the land reallocation, there are a few common features across industries on the one hand. First, the amount of acquisitions (POS_Land_t) is larger than that of sales (NEG_Land_t) with the exception of the period in the mid of 2000s. Second, POS_Land_t used to be substantially high until the early 1990s followed by a sharp drop afterward. Third, there is a substantial increase in NEG_Land_t, which coincides with the introduction of the impaired loss accounting to the Japanese listed companies. On the other hand, there exists heterogeneity. The size of reallocation itself differs across industries. Real estate and construction are the industries with the largest average amount of land acquisitions, while chemical and electrical and IT machinery are those with the smallest amount of land acquisitions. Moreover, firms in some industries keep purchasing a large amount of land even after the burst of the bubble. Most of them belong to manufacturing industries such as chemical, automobile and parts, and iron and steel except for the wholesale industry.

In Panel (b) we observe the reallocation of non-land tangibles by industry. There is a common tendency that both acquisitions and sales of non-land tangibles gradually increase over time with the exception of $NEG\_Tangible_t$ for the construction industry. These upward trends contrast with the downward trend of $NEW\_Tangible_t$ that are observed in most industries, which is shown in Panel (c). In sum, we observe more sizable reallocation of tangibles among firms while there is a smaller amount of new investment in most industries.

4. Relationship between reallocation and productivity

In this section, we aim to answer our second and third research questions: if the reallocation is productivity-enhancing and if the nature of the reallocation-TFP relationships changes over the business cycle or change over time.

4.1 Baseline estimation results

We first show the results of the estimation with the baseline specification of (1) in Table 3. The most striking results are the coefficients on TFP_dev_{it} in Columns (1) and (4), which are both negative. Another interesting results are that the coefficients on the interaction term of $TFP\_dev_{it} * Cycle_{rt+1}$ are positive and significant in Column (1). The first result indicates that firms with higher productivity than industry average tend to reduce the amount of land and non-land tangibles through their purchases and sales. The second result suggests that the negative impact of productivity on the land reallocation becomes weaker during economic downturns.

These results indicate the efficiency-reducing reallocation of capital and contrast with the findings in Foster, Grim, and Haltiwanger (2016) that labor reallocation is efficiency-enhancing. In order to see why our results differ from most of the previous studies, we decompose the net change in asset holdings into their sales and purchases and examine how they are related to the firms' productivity.

Columns (2) and (3) show the results of estimations with land purchase (P_Land_{it}) and sales (S_Land_{it}) as dependent variables. In each column we see the coefficients on TFP_dev_{it} and on the interaction of $TFP\_dev_{it} * Cycle_{rt+1}$. In both columns the coefficients on TFP_dev_{it} are positive, indicating that more productive firms not only purchase but also sell larger amount of land than less productive ones. Note that the size of the coefficient is larger in the land sales estimation than in the land purchase estimation. In Column (3), the coefficient on the interaction term is marginally negative, indicating that the extent of the above tendency of more productive firms selling larger amount of land becomes weaker during economic downturns.

We observe similar findings for the reallocation of non-land tangibles in Columns (5) and

(6). These show the estimation results with non-land tangibles purchases ($P\_Tangible_{it}$) and sales ($S\_Tangible_{it}$) employed for dependent variables. In both columns the coefficients on TFP_dev_{it} are positive, indicating that more productive firms not only purchase larger amount of tangible assets but also sell them by a larger amount than firms with lower productivity. Note further that the size of coefficient is larger in the $S\_Tangible_{it}$ estimation than in the $P\_Tangible_{it}$ estimation. In Column (6), the coefficient on the interaction term is marginally negative, indicating that the extent of the above tendency of more productive firms selling larger amount of land becomes weaker during economic downturns.

Note, however, that the difference between land and non-land tangibles lies in the existence of depreciation and new investment. Therefore, in order to evaluate if efficiency-reducing reallocation really matters for non-land tangibles, we also need to examine whether the new investment is efficiency-reducing or not. Column (7) shows the results on the impact of productivity on the amount of new investment for tangibles. The coefficient on TFP_dev_{it} is positive and significant, while that on the interaction term is insignificant. These indicate that the new investment works in the direction of enhancing efficiency.

4.2 Time-varying relationship between reallocation and productivity

In order to detect the sources of the efficiency-reducing reallocation of capital, we implement estimations with the specification (2). Since there is a large number of time-varying coefficients on TFP_dev_{it}, we show them graphically in Figure 3. In every panel, the bold line presents the coefficients that vary over the years with the confidence band of 95%.

By looking at each panel in the figure, we are able to see the varying impact of firms' productivity on the capital reallocation over the years. Panels (a) through (c) show the estimation results for land reallocation. Panel (a) of the figure shows the time-varying coefficients on

TFP_dev_{it} in the estimation with the net change of land reallocation for the dependent variable. We find that the size and the statistical significance of the coefficient on TFP_dev_{it} vary over the years. During the years of 1988 through 1992, we observe positive coefficients, some of which are also statistically significant. However, the size of the coefficient decreases over time to become negative in the latter half of the 1990s and the first half of the 2000s. In years of 2003 through 2005 they are also statistically significant. These results indicate that there exists a gradual but persistent change in the way productivity affects the land reallocation. During the years from the end of 1980s to the early 1990s, more productive firms increase the amount of land holdings while less productive ones reduce it. This tendency reversed in the early 2000s, in which more productive firms decrease rather than increase their land asset outstanding.

Panels (b) and (c) detail which one or both of purchases and sales of land contribute to the results we obtain in Panel (a). Roughly speaking, the size and the statistical significance of the coefficients on TFP_dev_{it} do not vary substantially over the years in the land purchase estimations, while they increase especially during the first half of the 2000s in the land sales estimations. These indicate that the time-varying coefficients in the net change of the land asset holding estimation are mostly driven by the time-varying coefficients in the land sales estimations rather than by those in the land purchase estimations.

Turning to the reallocation of non-land tangibles, we observe the results in Panels (d) through (g). There are similarities and differences from the results for land we observed in Panels (a) through (c). In Panel (d), the coefficient is positive and significant in year 1989 but turn mostly negative and insignificant in most other years. Looking at Panels (e) and (f), there exists a difference even though coefficients are mostly positive in both estimations. In Panel (e), the coefficient is far larger in the year 1999 then those in other years, while the coefficients in Panel (f) do not vary much but gradually increase in size over the years. These indicate that time-varying coefficients in the net change in the reallocation estimation are mainly driven by the large positive and significant coefficients in the late 1980s in the purchase estimation.

Finally, looking at Panel (g), the coefficients on TFP_dev_{it} are positive and significant in most years but gradually decrease in its size and statistical significance.

5. Conclusion

We study the inter-firm reallocation of real estate with a distinction between land and non-land tangible assets and examine its relationship with productivity. By focusing on the Japanese firms in years from 1980 to 2014 including the period of a massive asset price fluctuations, we have found the following empirical regularities. First, there exists no obvious cyclicality in the extent of reallocation but the burst of asset price bubbles has dampened the amount of land transactions for more than 20 years. Second, reallocation of land and non-land tangible assets is efficiency-reducing rather than efficiency-enhancing in that firms with high TFP reduce their holdings of these assets more than low TFP firms. Third, the relationship between reallocation and productivity changes over time. The reallocation of land was efficiency-reducing in the first half of 2000s, while it was efficiency-enhancing around the end of the bubble in the late 1980s.

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Appendix

A. Firm-level data of Quarterly Financial Statement Statistics of Corporations by Industry

The Quarterly Financial Statement Statistics of Corporations by Industry (hereafter QFSSC) is a survey of business corporations whose headquarters are located in Japan. The QFSSC started in the fourth quarter of the fiscal year 1949 and firm-level data in their electronic form are available to researchers (after careful but time-consuming application process!) for the periods after the first quarter of the fiscal year 1980.

The QFSSC contains corporation-level information on balance sheet, employment, industry, geographic location, transactions of fixed assets. It covers both manufacturing and non-manufacturing industries, although we exclude financial and insurance industries from the analysis. The sample structure of the QFSSC comprise two parts: the part that covers all large-sized corporations and the part that collects smaller-sized samples firms.

There is a substantial change in the way the survey chooses sample firms in the fiscal year 2009. Prior to the fourth quarter of fiscal year 2008, the first part covers all the corporations with the capital amount of no smaller than 600 million yen. The second part is further divided into two subparts: the part that covers corporations with the amount of capital ranging between 100 and 600 million yen and the part that covers those with the amount of capital smaller than 100 million yen. The former subpart is more likely to choose corporations with larger capital amount, while the latter subpart randomly chooses them regardless of its capital size. All the smaller sample firms whose capital amount is less than 600 million yen receive questionnaires only for four quarters (from the first to the fourth quarter of one fiscal year), while all the larger corporations always receive survey questionnaires.

After the first quarter of fiscal year 2009, the first part covers all the corporations with the capital amount of no smaller than 500 million yen. There exist no subparts in the second part, which randomly choose corporations from the pool of firms with the capital amount of less than 500 million yen. All the sample corporations whose capital amount is smaller than 500 million yen receive questionnaires for eight quarters (two years). As a result, half of the small firms whose capital amount is smaller than 500 million yen in the sample are replaced in the first quarter of each fiscal year. Note that all the larger corporations keep receiving the questionnaire every period.

Tables and figures

Table 1(a): Information on transactions of fixed tangible assets for quarter t included in the QFSSC

	Outstanding amount at beginning of t	New investment	Purchase of existing assets	Depreciation	Sales of existing assets	Outstanding amount at end of t
Land	$Land_{t-1}$	N_Land_t	P_Land_t	D_Land_t	S_Land_t	$Land_t$
Non-land tangibles	$Tangible_{t-1}$	$N\_Tangible_t$	$P\_Tangible_t$	$D\_Tangible_t$	$S\_Tangible_t$	$Tangible_t$

Table 1(b): The actual amount of transactions of fixed tangible assets for Q4 of FY2014 (billion yen)

	Outstanding amount at beginning	New investment	Purchase of existing assets	Depreciation	Sales of existing assets	Outstanding amount at end
Land	165724	6	1441	0.08	2246	164925
Non-land tangibles	230930	5032	6819	7776	3396	231610

Table 2: Correlation coefficients between reallocation variables and Cycle

	POS_Land	NEG_Land	SUM_Land	NET_Land	POS_Tangible	NEG_Tangible	SUM_Tangible	NET_Tangible	NEW_Tangible
Correlation coefficient with Cycle	0.0396	-0.1507	-0.0101	0.0853	0.0139	0.0648	0.0507	-0.0635	0.0247
P-value	0.646	0.0788	0.9063	0.3217	0.8722	0.4518	0.5566	0.461	0.7747

Table 3: Determinants of capital reallocation: Baseline specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	P_Land-S_Land	P_Land	S_Land	P_Tangible-S_Tangible	P_Tangible	S_Tangible	N_Tangible
TFP_dev	-0.00251***	0.00528***	0.00779***	-0.00172***	0.00441***	0.00590***	0.00845***
	(0.000495)	(0.000477)	(0.000455)	(0.000648)	(0.000477)	(0.000445)	(0.000546)
Cycle	0.000703	0.00113	0.000424	-0.000380	-2.34e-05	0.000317	0.000530
	(0.000752)	(0.000725)	(0.000692)	(0.000990)	(0.000729)	(0.000676)	(0.000829)
TFP_dev*Cycle	0.00614***	0.00251	-0.00363*	0.00147	-0.00166	-0.00345*	-0.000915
	(0.00210)	(0.00202)	(0.00193)	(0.00275)	(0.00202)	(0.00189)	(0.00231)
EMP	2.81e-07***	2.39e-07***	-4.30e-08	5.57e-08	1.74e-07***	6.65e-08	-1.91e-07***
	(4.53e-08)	(4.37e-08)	(4.18e-08)	(7.99e-08)	(5.88e-08)	(4.08e-08)	(5.00e-08)
Constant	0.0128***	0.0184***	0.00554***	-0.00442	0.00279	0.00767***	0.0229***
	(0.00225)	(0.00217)	(0.00207)	(0.00295)	(0.00217)	(0.00202)	(0.00248)
Quarter dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	799,478	799,486	799,479	679,304	679,350	799,538	799,595
R-squared	0.006	0.005	0.003	0.001	0.001	0.002	0.003
F-stat	27.85	24.66	13.36	3.079	2.176	9.919	14.76

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Figure 1: Reallocation of land and non-land tangibles and new investment of non-land tangibles

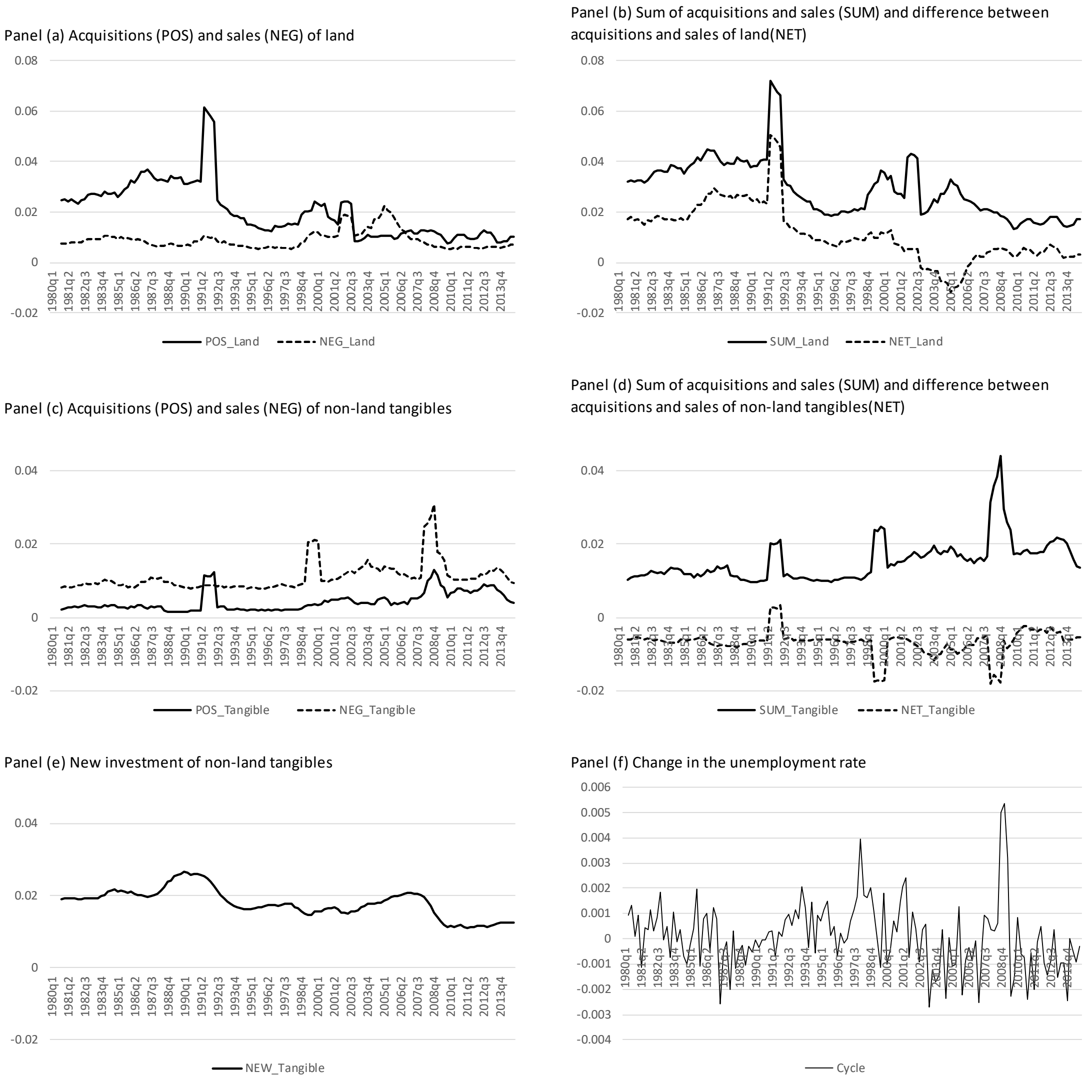


Figure 2 Panel (a) Acquisitions (POS) and sales (NEG) of land by industry

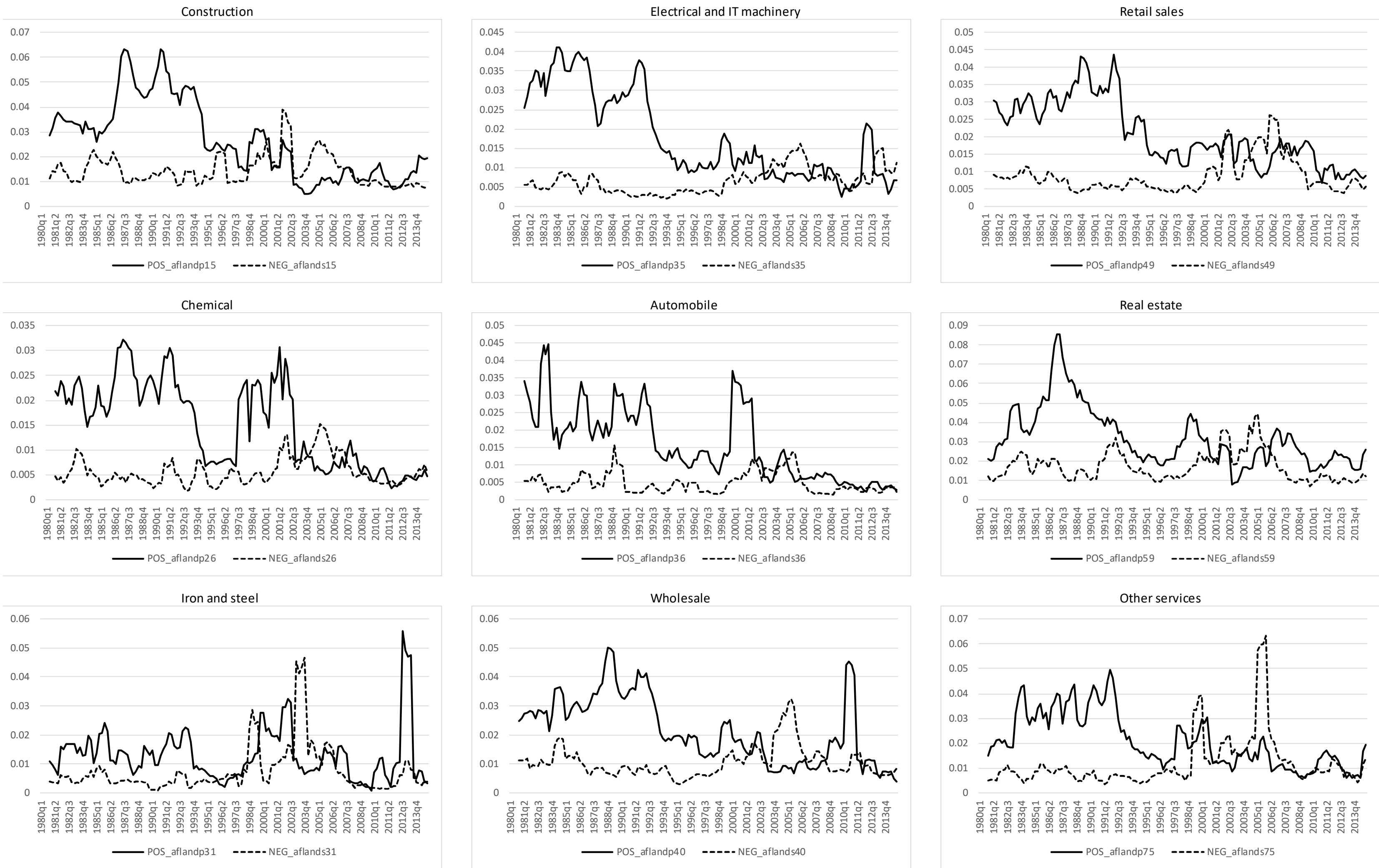


Figure 2 Panel (b) Acquisitions (POS) and sales (NEG) of non-land tangibles by industry

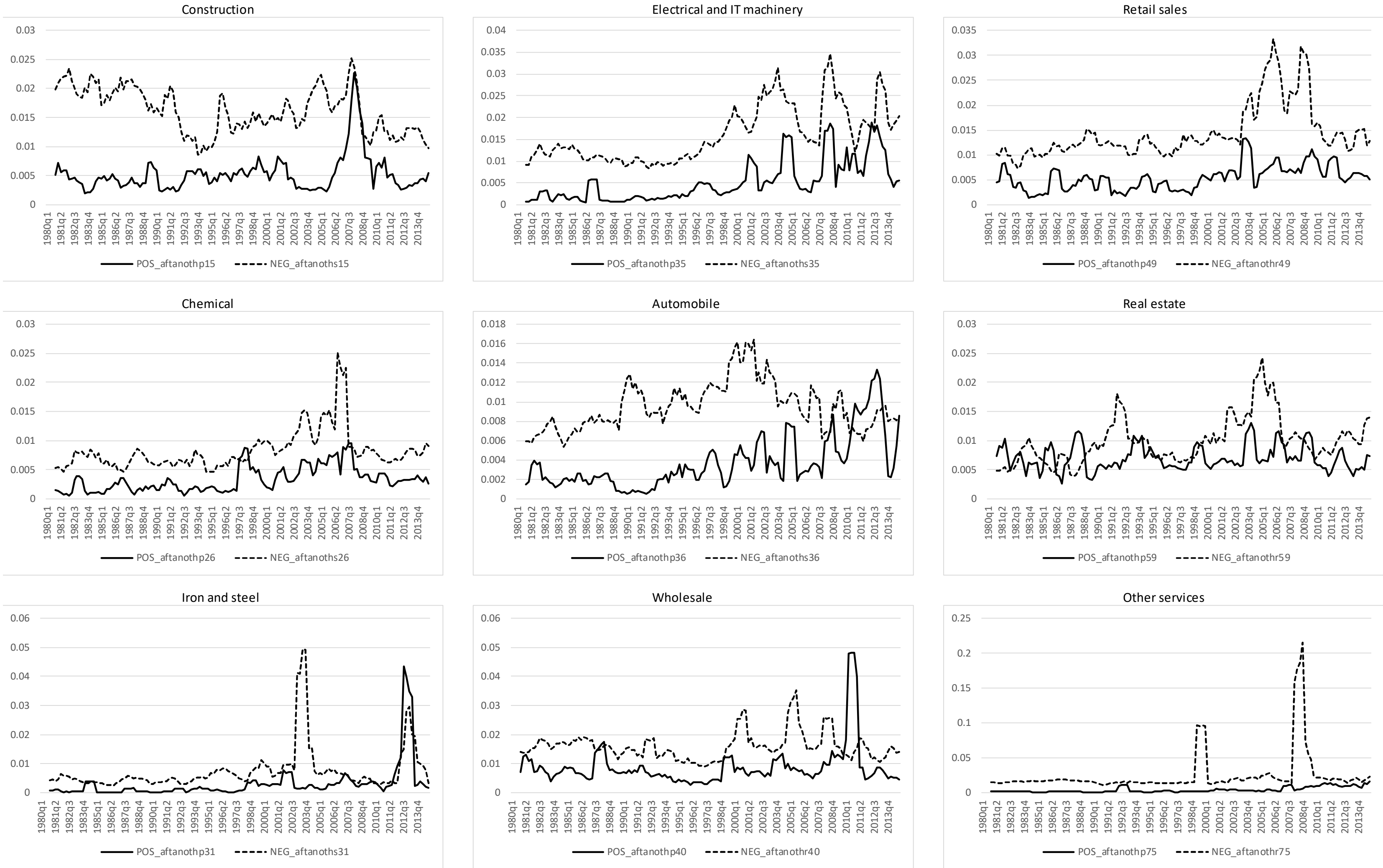


Figure 2 Panel (c) New investment of non-land tangibles (NEW) by industry

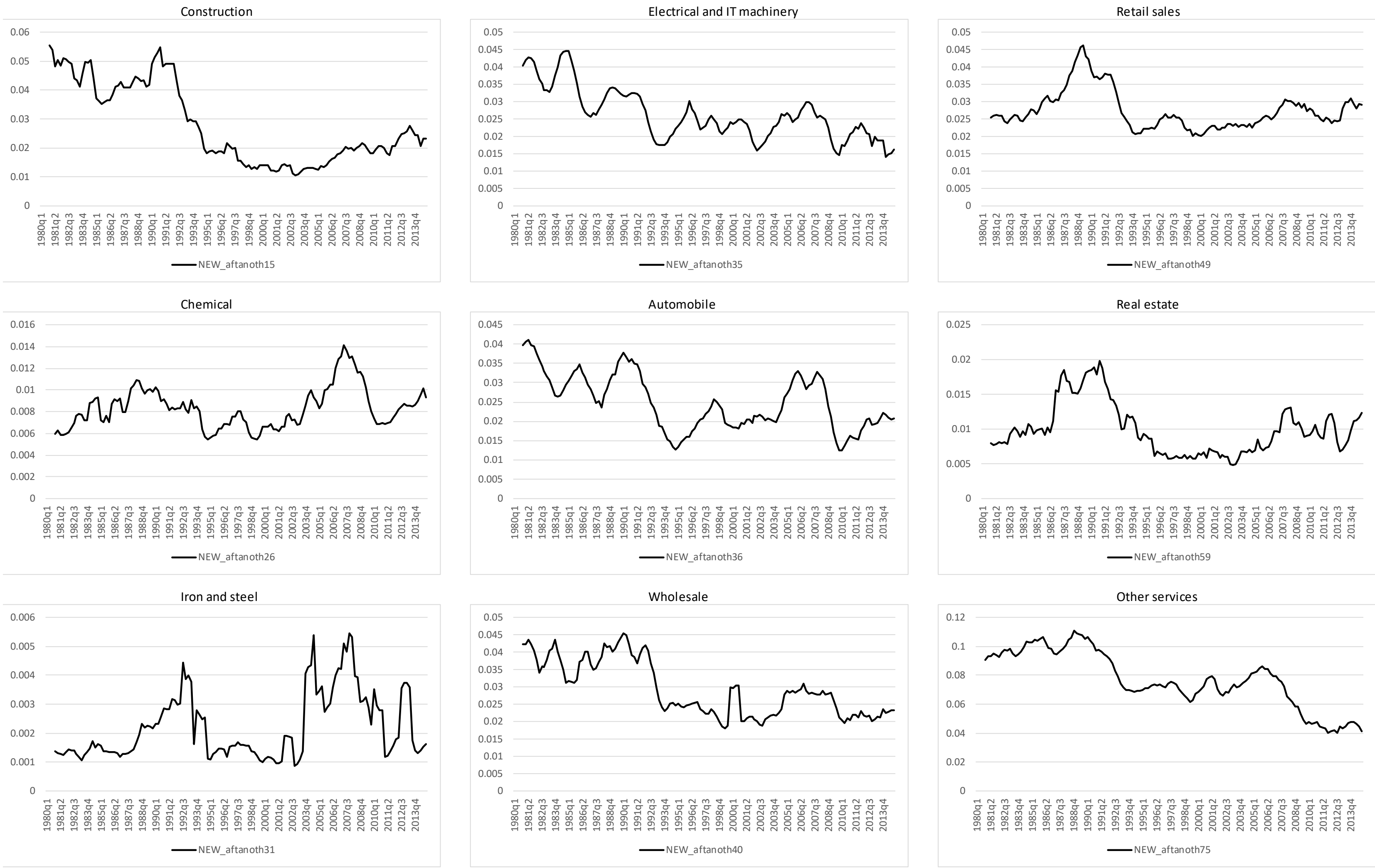
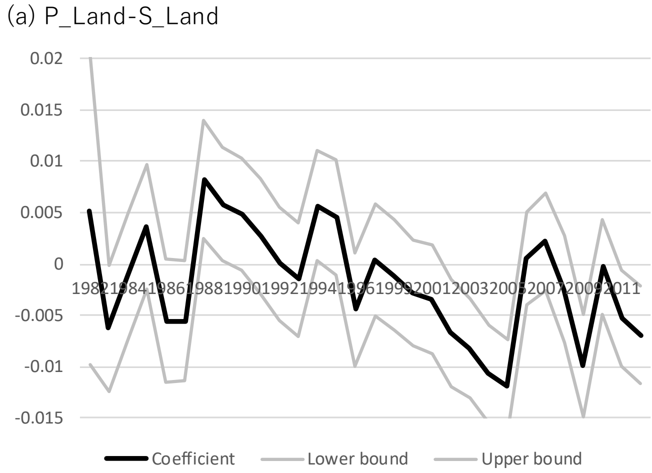
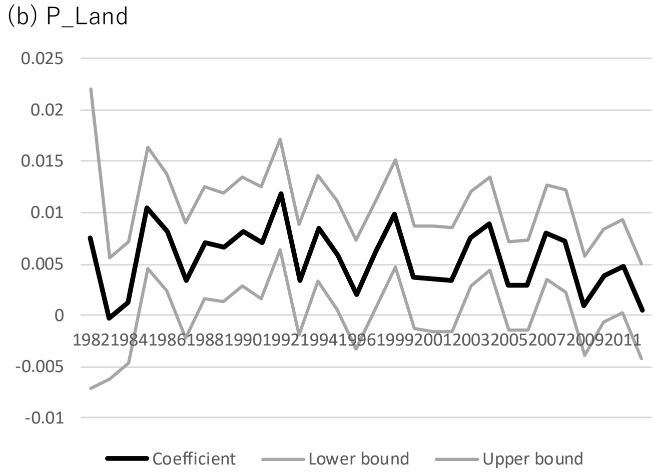


Figure 3: Time-varying coefficients on TFP_dev





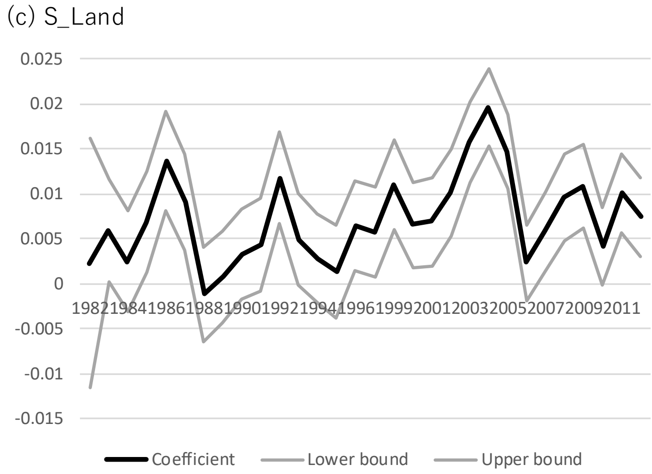
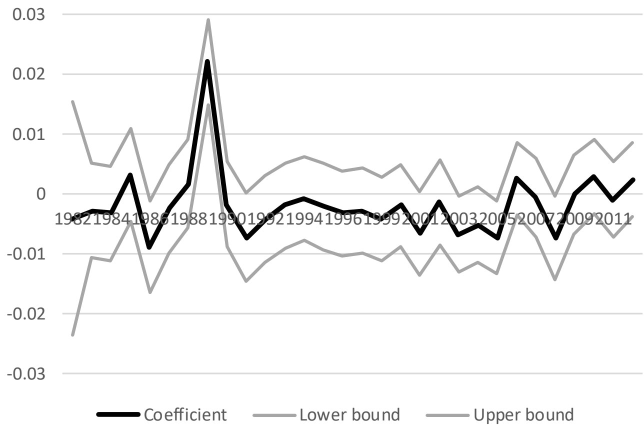
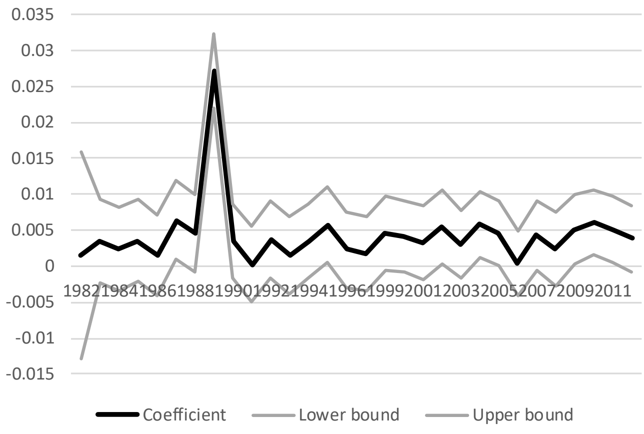


Figure 3: Time-varying coefficients on TFP_dev

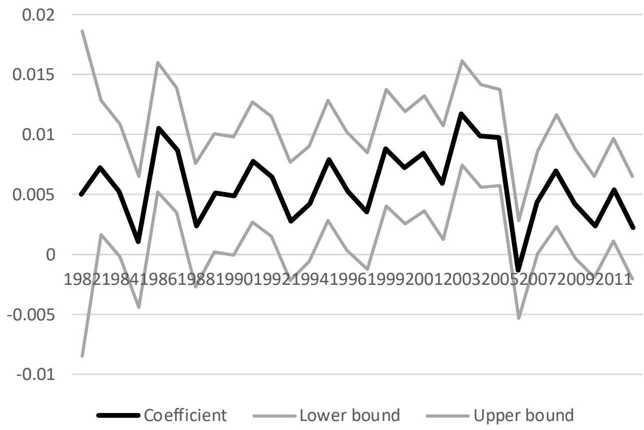
(d) P_Tangible-S_Tangible



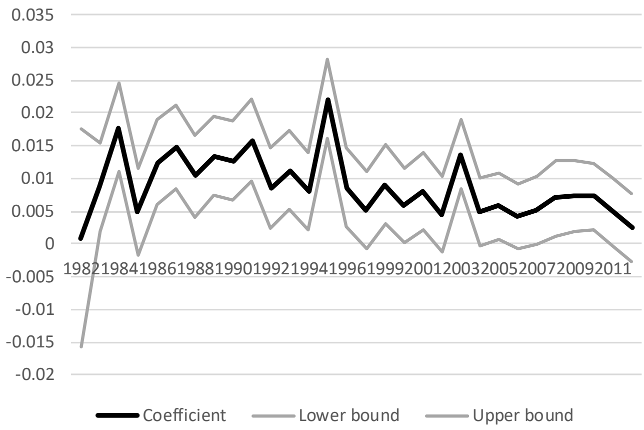
(e) P_Tangible



(f) S_Tangible



(g) N_Tangible



Appendix Table

Table A1: Industry classifications used for analysis

Industry code	Name of industry
1	Agriculture, forestry, and fishery
10	Mining and quarrying of sand and gravel
15	Construction
18	Food processing
20	Textile and clothing
22	Wood and wood products
24	Pulp and paper
25	Printing and related
26	Chemical
27	Petroleum and coal products
30	Ceramic products
31	Iron and steel
32	Non-ferrous metal
33	Metal products
34	General and precision machinery
35	Electrical and IT machinery
36	Automobile and parts
38	Other transportation machinery
39	Other manufacturing
40	Wholesale
49	Retail
59	Real estate
60	Information and telecommunication
61	Land, water, and other transportation
70	Electricity, gas, heat supply, water
75	Other services