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Mark-up, Productivity and Imperfect Competition: An empirical analysis of the Japanese retail trade industry

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Abstract

This paper examines mark-up and productivity of retail trade industries under imperfect competition. Applying a newly developed approach by Martin (2010) to Japanese retail trade firm data, we estimate the firm-specific mark-up and productivity without price information and discuss their dispersion. Our results reveal that some assumptions largely used in productivity analysis such as constant returns to scale and perfect competition possibly bias estimates of productivity. Higher mark-up do not always mean higher productivity while firms with lower mark-ups are less productive. Relative levels of firm-specific mark-up and productivity are persistent. The performance of mark-up and productivity are heterogeneous across various retail trade industries. Among them, food retailers have both lower market power and lower productivity. Furthermore, regression results indicate that effects of deterministic factors on mark-ups do not coincide with those of productivity. It implies that competition-friendly policies possibly lead to unsuccessful results where firms pursue profit maximisation by pursuing pricing power rather than by raising productivity. Ignoring market power may produce misunderstandings concerning how various factors affect productivity and may thus lead to misleading policy implications.

Key words: Productivity, Mark-up, Imperfect Competition
JEL Classifications: C81, D24, L11, L25

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1. Introduction

Although many economists and policymakers share the recognition that productivity growth in service industries is crucial for further long-lived development, academic knowledge on this issue is insufficient. This is partly because data availability and reliability are poor, and also partly because the theoretical and methodological models remain problematic. As a result, empirical results and their policy implications are somewhat controversial and further research to fill these gaps is necessary. This paper is dedicated to that research. For the Japanese retail trade industries, we estimate firm specific mark-up and productivity between 1995 and 2005, and discuss their dispersion.

Discussions on service productivity address the following three mutually related issues: measurement, cause, and consequence[1]. Among these, the issue of measurement simply means that it is difficult to precisely measure the amount of service production although productivity is defined as output over the weighted sum of inputs[2]. In many empirical papers, the total sales or the value added is used as output. This approach is justifiable if and only if the market is perfectly competitive, and the production function has constant returns to scale (CRS). Under the assumption of perfect competition, the price equals the identical marginal cost for all firms and total sales do not include mark-up effects. The effects of returns to scale are excluded by the CRS assumption as well. However, the validity of these assumptions is really controversial. In fact, firms produce differentiated products and services reflecting consumers' preferences in

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1 Kato (2007)

2 In this paper, we assume that the markets of inputs are perfectly competitive since Eslava et al. (2005) reveals that ignoring input prices gives little effects on TFP estimates using Columbian data.

imperfectly competitive market where mark-ups significantly affect total sales and value added. In addition, the existence of major firms in many service industries suggests that returns to scale is possibly increasing rather than constant even in service industries. Therefore, it is important to apply alternative approaches that relax these assumptions and compare their results from those of the standard approaches. As those alternatives, Melitz (2000), Loecker (2007), and Martin (2008) develop approaches which incorporate the Dixit-Stiglitz model of monopolistic competition into productivity estimation. For service sectors, Kato (2009) applies the Melitz approach to the Japanese large scale retail trade firms, and find positive effects of service differentiation and increasing returns to scale.

As for the second issue, many papers have paid attention to increase in service productivity in the U.S. since the late 1990s. They compare it to stagnation in other advanced economies, particularly Japan, and discuss what account for these different performances, referring to productivity analysis of manufacturing industries. The following factors and conditions are examined: the roles of entry/exit effects, labour market flexibility, regulatory reforms, R&D, and the information and communication technologies (ICTs). Among these, entry/exit effects are sometimes discussed together with financing[3]. Problems of labour market flexibility are associated with issues of the employment structure. Regulatory reforms and ICTs are usually thought of as the main engines for recent service productivity growth while the role of R&D is still controversial. In addition to these, the accumulation of intangible assets is also examined[4]. These papers have contributed significantly to devising economic and industrial policies. On the other hand, the measurement problems still exist even in

3 Caballero et al. (2008)
4 Bloom and van Reenen (2007), and Miyagawa et al. (2010)

these papers. Therefore, it seems to be meaningful to carry out the robustness test for the above results by estimating productivity using alternative approaches.

The third issue covers the macroeconomic effects of service sector expansion. Following the seminal paper by Baumol (1967), many economists have studied if the expansion of the service sector lowers macroeconomic productivity growth. This effect is called Baumal's disease, and Nordhaus (2008) found that the U.S. economy experienced it in the second half of the twentieth century. Recently, Triplett and Bosworth (2003) assert that it was already cured in the U.S. because of the ICT revolution. On the other hand, Hartwig (2006) refutes it because he found that only the wholesale and retail trade industries raised their productivity growth even in that period. These papers indicate that empirical results on this issue are still ambiguous, and we need further development both theoretical and methodological research, in order to obtain more reliable perspective.

In this paper, we focus on the first and the second issues. For the first issue, we use an estimation approach proposed by Martin (2010) as an alternative. Unlike other approaches which assume monopolistic competition or perfect competition, this approach does not rely on the assumption of a constant elasticity of substitution, and simultaneously estimate the firm-specific mark-up and productivity under various forms of imperfect competition[5]. It means that we can examine both market power and the productivity of firms at the same time since the firm- specific mark-up represents the price making power of firm in the market[6]. Comparing the estimates from those of the standard approach, we shed light on the first issue. In addition, dynamics of firm performance and market structure is also examined.

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5 Klette (1999) also allows firm-specific mark-up in productivity estimation.

6 In this paper, the term, market power is equivalent to mark-up.

The second issue is examined by descriptive and regression analysis. Following Morikawa (2007), we examine some variables which represent characteristics and strategies of firms. For foreign capital and outsourcing, we rely on a descriptive analysis rather than regression because they have many zero records and blanks. Through this analysis, we discuss what variables are decisive for firms' market power and productivity. These analyses provide some contributions to further understandings of service productivity dynamics and devising of more reliable industrial policies.

The outline of this paper is as follows. In Section 2, we briefly explain the model and estimation method which we apply. In Section 3, we describe the data used. In Section 4, we discuss the empirical results and their implications. In Section 5, we conclude.

2. Estimation Method

2-1. Definition of Service Production

Before discussing the methodology which we use, we have to make clear the definition of service production and problems in estimating productivity. In existing research on service productivity, the definition of service production is not always explained, and it sometimes confuses us about what we estimate and discuss in those papers. In this work, we define service production as follows. Service production is the activities which experts provide consumers with contentment and convenience by doing something on behalf of consumers themselves. Theoretically, consumers can do what experts do by themselves although consumers' own activities do not always provide a sense of contentedness or are not efficient. In this definition, output is obtained as the sum of consumers' contentment and opportunity costs, and is uncountable. In actual empirics, total sales or value added is usually available. Since these variables are defined as $output \times price$ and $output \times price - intermediate$, we need price information but it is not available, either. It means that it is difficult to directly estimate productivity using available data, and some econometric methods seem to be useful.

For that purpose, Martin (2010) proposed a control function approach. This approach has the following advantages. First, it does not rely on the CRS assumption. Secondly, it does not assume a constant elasticity of substitution. So, it can estimate the firm-specific mark-up as well as productivity. Using these estimates, we examine dynamics of market structure and productivity. Thirdly our estimates are not affected by deflators because this approach uses the deviations from the median for all variables. Since the validity of deflators is somewhat controversial, it seems to be a reasonable idea to obtain the robust estimates. On the other hand, the estimation process is relatively complicated.

2-2. Model and Estimation Method

Following Martin (2010), we briefly explain the mode and the estimation method. First, we assume that a firm follows a simple form of Hicks neutral production function,

$$Q_i = A_i \left[f\left(\mathrm{X}_i \right) \right]^{\gamma} \qquad (1),$$

where Q_i , A_i , X_i are quantity of output, Hicks-Neutral technology, a vector of inputs, respectively. γ is the degree of returns to scale and [7] $\gamma > 0$. Applying the mean

[7] In this paper , the term, product also include service provided by firms.

value theorem, equation (1) is represented as follows,

$$q_i = a_i + \sum_{X_i} \alpha_{X_i} x_i \, , \qquad \text{s.t. } \alpha_{X_i} = \gamma f_{X_i}\left(\overline{X}_i\right)\frac{\overline{X}_i}{f\left(\overline{X}_i\right)} \qquad (2)$$

where lowercase means log deviation of each variable from the median firm($q_i = \ln Q_i - \ln Q_*$: * denotes the median firm)[8].

Secondly, the utility of a representative consumer is denoted as the following differentiable non-convex function,

$$U = U\left(\tilde{Q}, Y\right) \qquad (3)$$

where $\tilde{Q}$ is a m×1 vector of quality evaluated units ($\tilde{Q}_i$) of the consumed products, and Y is income[9]. $\tilde{Q}_i = \Lambda_i Q_i$ (the product of consumer's valuation of the quality and the quantity for firm i 's product). Suppose each firm faces downward sloping demand curves conditional on actions of other firms, then the demand function is written as follows,

$$Q_i = D\left(P_i\right) \qquad (4)^{10}.$$

8 In this paper, the median firm is selected based on the revenue per unit labour (man-hour).

9 m is the number of differentiated products.

10 Caplin and Nalebuff (1991)

From equation (4), the price elasticity of demand for firm i's product is obtained as $\sigma_i = -\frac{\partial \ln D(P_i)}{\partial \ln P_i}$. Using it, the markup of firm i is defined as $\mu_i = \frac{1}{1-\frac{1}{\sigma_i}}$.

Thirdly, firm i's profit (Π_i) is written as follows,

$$\Pi_i = P_i(Q_i)\cdot Q_i - C_i(\mathrm{X}_i) \qquad (5),$$

where $C_i(\mathrm{X}_i)$ is the cost function of firm i. Since we assume all firms follow the profit maximisation principle, the following first order condition is obtained,

$$P_i(Q_i)\left(\frac{\gamma Q_i}{f(\mathrm{X}_i)} f_X(\mathrm{X}_i)\right) + P'(Q_i)\frac{\gamma Q_i}{f(\mathrm{X}_i)} f_X(\mathrm{X}_i)Q_i = C_{Xi}(\mathrm{X}_i) \qquad (6).$$

Using $C_{Xi}(\mathrm{X}_i) = W_X$ (W_X is the marginal cost of X) and μ_i, equation (6) is rewritten as follows,

$$P_i\gamma \frac{Q_i}{f(\mathrm{X}_i)} f_X(\mathrm{X}_i) = \mu_i W_X \qquad (7).$$

From equations (2) and (7), we obtain the following relation,

$$\alpha_{X_i} = \mu_i \frac{W_X X_i}{P_i Q_i} = \mu_i s_{Xi} \qquad (8),$$

where s_{Xi} represents the revenue share of variable X for firm i. Equation (8) indicates that the firm-specific mark-up is obtained as a function of the revenue shares as follows,

$$\mu_i = \Psi(s_{Xi}) = \frac{1}{s_{Xi}} \alpha_{X_i} \qquad (9).$$

On the other hand, firm i's revenue ($R_i = Q_i \times P_i$) is determined by production and demand, and is represented as a function of them, $R_i = R(\mathrm{X}_i, \Lambda_i, A_i)$. Applying the mean value theorem, it is also re-written as follows,

$$r_i = \sum_{\mathrm{X}} \overline{\alpha}_i^{X} x_i + \overline{\alpha}_i^{\Lambda} \lambda + \overline{\alpha}_i^{A} a + \varepsilon_i \qquad (10),$$

where $\alpha_i^X = \frac{\partial \ln R_i}{\partial \ln X_i}$ and $\overline{\alpha}_i^X = \frac{\alpha_i^X + \alpha_*^X}{2}$. ε_i is an iid shock.

Among the input variables, capital (k) is usually assumed to be fixed at least in the short run. For variable factors, $\frac{\partial \ln Q_i}{\partial \ln X_i} \cdot \frac{1}{\mu_i} = \frac{\partial \ln R_i}{\partial \ln X_i} = s_{Xi}$. In addition, the relations, $\frac{\partial \ln R_i}{\partial \ln \Lambda_i} = \frac{\partial \ln R_i}{\partial \ln A_i} = \frac{1}{\mu_i}$ is satisfied because the demand function $D(\cdot)$ is monotone in price and Λ_i is consumption-augmenting. From these relations as well as the relations, $\alpha_{Ki} = \gamma - \alpha_{Li} - \alpha_{M_i}$ and $\alpha_i^X = s_{Xi} = \frac{1}{\mu_i} \alpha_{Xi}$, the revenue function is re-written as follows[11],

[11] Klette (1999) and Martin (2008)

$$r_i - \sum_{X \neq K} \bar{s}_{Xi}(x_i - k_i) = \tilde{r}_i = \gamma \frac{\bar{1}}{\mu_i} k_i + \frac{\bar{1}}{\mu_i}(\lambda_i + a_i) + \tilde{\varepsilon}_i \qquad (11)$$

In equation (11), the firm specific quality adjusted productivity ($\omega_i = (\lambda_i + a_i)$) is assumed to follow a Markov process. Using a control function approach, ω_i and μ_i are estimated as follows,

$$\omega_{it} = \phi_{\omega}(k_{it}, k^*, \ln \prod_{it}, \ln \prod^*) \qquad (12),$$

and

$$\frac{1}{\mu_i} = s_{xi}\left(\frac{\partial \ln F_i}{\partial \ln X_i}\right)^{-1} = s_{xi}\Psi(\mathrm{X}_i) \qquad (13),$$

where $\prod$ denotes the net revenue. As follows Martin (2008) and other proxy variable approaches such as Olley & Pakes, Levinsohn and Petrin (2003), Bond and Söderbom (2005), and Ackerberg et al. (2006), ω is assumed to follow a Markov process. That is, $\omega_{it} = g(\omega_{it-1}, \underline{\omega}_{it-1}) + \nu_{it}$, and $\underline{\omega}$ is productivity at the threshold level for surviving. Following the above proxy variable approaches, exit of firms is controlled by a probit regression,

$$P_{it} = P(\ln \mathrm{X}_{it-1}, \ln \mathrm{X}^*_{t-1}, s_{xit-1}, s^*_{xt-1}, \ln \Pi_{it-1}, \ln \Pi^*_{t-1}, t) \qquad (14)$$

Finally equation (11) is estimated as follows,

$$\tilde{r}_{it} = \phi_r\left(\ln \mathrm{X}_{it},\ \ln \mathrm{X}_t^*,\ s_{xit},\ s_{xt}^*,\ \ln \Pi_{it},\ \ln \Pi_t^*\right) \quad (15)$$

where $\phi_r(\cdot)$ is an unknown function and approximated by a polynomial. Using a number of moment conditions, this approach successfully recover an estimate of ω over γ,

$$\frac{\hat{\omega}_{it}}{\gamma} = \frac{\hat{\phi}_{rit}}{g_\mu\left(\ln \mathrm{X}_{it},\ \ln \mathrm{X}_0^*,\ s_{xit},\ s_{x0}^*\right)} - k_{it} \qquad (16)$$

where $\hat{\phi}_{rit}$ is an estimate of $\phi_r(\cdot)$ obtained in the second stage of equation (16). The denominator of the first term in the right hand side is obtained as follows,

$$g_\mu\left(\ln \mathrm{X}_{it},\ \ln \mathrm{X}_0^*,\ s_{xit},\ s_{x0}^*\right) = \frac{\gamma}{2}\left[s_{xit}\Psi\left(\ln \mathrm{X}_{it}\right) + s_{x0}^*\Psi\left(\ln \mathrm{X}_0^*\right)\right] \qquad (17)$$

The estimates of ω rescaled by γ are also used to recover v_{it}, using the following equation,

$$\frac{\hat{\omega}_{it}}{\gamma} = \left(\frac{\hat{\omega}_{it-1}}{\gamma},\ \hat{P}_{it}\right) + v_{it} \qquad (18),$$

where $\hat{P}_{it}$ is the predicted exit probability which is estimated at the first stage of this estimation procedure. Since the shock, v_{it} is independent of all predetermined variables including capital, we can use the following moment restrictions to estimate remaining parameters,

$$E\left\{\left[X_{it-1} \times k_{it}\right]' v_{it}\right\} = 0 \qquad (19).$$

3. Data

In this work, we construct the dataset based upon the Basic Survey of Business Structure and Activity (BSBSA) for the period between 1995 and 2005[12][13]. This is a complete enumeration for firms whose workers are more than 50 or capital is over 30 million Japanese yen in manufacturing and various service industries. As Kiyota and Matsuura (2004) discuss, these statistics cover many activities of firms and are considered reliable. From these statistics, we use total sales as data of total revenues of firms. The proxy of accumulated capital is the value of the tangible fixed assets. Labour input is calculated as man-hours[14]. Following Morikawa (2010), we construct data of regular and contingent workers respectively and sum them up. In addition, the total wage is used as the labour cost. As a proxy of intermediate input, the amount of purchase is used in many existing papers. However, we do not follow them because that data includes many zeros and missing values. Therefore, instead of it, we construct that variable using financial data following Tokui, Inui and Kim (2007) and Kim, Kwon and Fukao (2007). In their papers, the intermediate input is calculated as follows,

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12 This statistics is annually compiled by the Ministry of Economy, Trade and Industry (METI) Japan.

13 We construct a panel data between 1995 and 2006, but data of the last year is only used for controlling exit of firms.

14 The data of working hours are available from Monthly Labour Survey.

$$Intermediate\ Input = COGS + SGA - (TW + Dep + T\ \&\ D) \qquad (20)$$

where *COGS*, *SGA*, *TW*, *Dep* and *T&D* are the cost of goods sold, the selling and general administrative expenses, the total wages, the depreciation and the tax and dues, respectively. In constructing our dataset, we rule out the firms which report zero or negative values as the number of regular workers, the tangible fixed assets, total wage, or intermediate inputs. In many existing papers, capital stock data are constructed by subtracting the land from the tangible fixed assets. However we do not follow them because we consider the location of (or access to) business possibly has a crucial role in production, and the land value can capture such information. In addition to these data for estimating mark-up and productivity, we also obtain data for firm characteristics from the same source (see Appendix 1).

4. Empirical Results and Discussion

In this section, we discuss empirical results and interpretation of them. The questions examined are as follows.

1) Is the expected bias in the estimated TFP by the standard factor share approach really problematic?
2) Is there any correlation between mark-up and productivity?
3) Is the mark-up or productivity gap persistent?
4) What features can we find in mark-up and productivity dynamics of various retail trade industries?
5) What factors are significant to explain differences of mark-up and productivity

across firms?

The former four questions are examined by descriptive analysis, and the last one is basically analysed by regression analysis.

In order to answer to question one, we make clear what the standard factor share approach estimates under the condition of imperfect competition and non-CRS first. From equation (11), it is denoted as follows,

$$TFPS_{it} = \left(\frac{\gamma}{\mu_i} - 1 \right) k_{it} + \frac{1}{\mu_i} \omega_{it} + \varepsilon_{it} \qquad (21).$$

It is obvious that $TFPS_{it} = \omega_{it}$ if and only if γ, μ_i, and ε_i are 1, 1, 0. Unfortunately, we can not directly compare it from our estimate $(TFPV_{it})$ because our estimation approach do not obtain the estimates of γ and ε_i. Instead, we assume $\varepsilon_i = 0$, and $\gamma = 1.00, 1{,}33, 1.67,$ and 2.00, and compare these estimates for each case[15]. Figure 1-1 shows the kernel density of estimated productivities by the standard and our current approaches. It reveals that the bias is not negligible even under the assumption that there is no measurement error. The standard approach seems to exaggerate its productivity dispersion than the current one as γ increases.

On the other hand, this bias is not very problematic if it does not affect the relative positions of firms in their productivity distribution. To examine it, we draw a scatter diagram of them as Figure 1-2 and test their correlation coefficient. The figure shows that there are positive linear correlations between them. The correlation coefficients (= 0.1692, 0.6831, 0.6110 and 0.5867 respectively) are not low, if $\varepsilon_i = 0$. These findings

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[15] Fox (2005) indicates that the service sector also follow increasing returns to scale.

indicate that the productivity estimates of the standard approach are biased but still reliable to some extent if there is no measurement error. However, it is difficult to believe that there is no measurement error in the large scale micro data while it is reasonable to assume that $E(\varepsilon_i)=0$. It implies that productivity estimates of the standard approach are not much reliable under imperfect competition and the policy implications of them are somewhat controversial while the estimate of aggregate productivity is more reliable.

The second question examines the relationship between market power and productivity of firms. Since market power through price-making gives huge effects on firms' performance, examining this relationship is important for further understanding market structure and devising industrial policies. Figures 2-1, 2-2 and 2-3 are the scatter diagrams of those estimates. Interestingly, for all forms of retail trade industries, the diagrams look similar to some extent. They reveal that firms with lower market power have lower productivity although the productivity levels of firms are diversified as the mark-up levels appreciate. It implies that a severe discounting battle does not result from productivity growth. Rather it looks like a war of attrition between less productive firms. It is difficult to expect that such a war of attrition provides some positive contributions to productivity growth in the long-run. On the other hand, for majority of firms, their market powers have no clear or slightly negative correlation with their productivity. It indicates that intensive competition in retail trade industries seems to be positively correlated with higher productivity but it is no so much as our expectation from theoretical implications. In order to efficiently lead competition-friendly industrial policies to greater achievement in productivity growth, our findings suggest that additional policy supports are required. This issue is further discussed later.

The third question discusses the metabolism of this industry. We expect that many firms move from the lower to higher (higher to lower) positions in terms of relative productivity if the market is Schumpeterian-innovative. To examine it, we write transition matrices of firms. Tables 1-1 and 1-2 are transition matrices in the latter half of the 1990s and the first half of the 2000s, respectively. They reveal that transition probabilities on the diagonal are much larger than those off the diagonal. In particular, the top and bottom edges are relatively larger than the middle. In addition neither a leapfrogging nor a free fall of relative productivity is frequent. These findings indicate that the relative levels of firm-specific productivity are persistent, and the retail trade industry is not Schumpeterian-innovative.

For comparison, we also write transition matrices in terms of the firm-specific market power as Tables 1-3 and 1-4. These tables show quite similar pictures to those of productivity. It indicates that the relative positions of the firm-specific market powers are also really persistent. For this finding, we have the following two possible interpretations. One of them is that consumers' valuation for differentiated services is persistent. In this case, firms are likely to keep their reputation in the next year once they obtained. Or once firms joined discounting battles, it is difficult to get out of them. Another possible interpretation of this finding is that some regulations form these gaps of market powers. Further discussion about it is out of the scope of this paper because additional information about the regulations is not available in our data. However, this discussion shows the necessity of an analysis in terms of firm-specific market powers in a study of the reasonable regulations.

For the above three questions, we examine them as issues of all retail trade industries. However, the retail trade industries cover from daily commodities to long-lived durable goods, and their dynamics of productivity and market power may be significantly heterogeneous. Therefore, we discuss the left two questions as issues of each group of retail trade industries[16]. To discuss question four, we plot weighted means of industrial productivities and mark-ups, respectively. Figures 3-1 and 3-2 show them. These figures reveal that relative dynamics of mark-up and productivity are really heterogeneous across industrial groups even within the retail trade industry. For each group, food retailers experience the lower mark-ups and productivities at the same time. It means that their discounting battles neither help nor result from productivity growth.

Since their share in the retail trade industry is largest in terms of both sales and labours (see Appendix2), this finding imply that they largely account for the war of attrition which we discuss before. On the other hand, the retailers of automobiles achieve relatively higher productivity levels while their mark-ups are lower. It indicates that the demand side conditions affect those firm performances. For this industry, it is thought that the fact that small and reasonably priced cars were well sold in the examined period partly explain this finding. Among other groups, retailers of electric equipments obtain an interesting result. Their productivity levels are relatively lower through the examined period while the mark-up levels are higher. This finding seems not to be consistent with our intuitive impression that we observe severe discounting battles of home electronics at a glance. However, it possibly happens if prices of agricultural or heavy equipments other than home electronics are set higher or retailers of newly developed electric equipments have a bargaining power in pricing to some extent. The dynamics of mark-up in cloth retailers is also remarkable. We observe appreciation of their mark-up levels for the first half of the 2000s while productivity is still relatively lower. The

[16] We follow JSIC three digit classification (revised in 2002)

timing of this mark-up appreciation gives us a guess that the regulatory reform for the location of the large scale stores including complex shopping malls partly forms it. To discuss them further, we need details of these industries and regulations although those data are not usually available. However, our findings at least indicate that the demand side conditions as well as the supply side ones should be well considered in devising effective industrial policies to support productivity growth.

To answer question five, we carry out regression analysis for both mark-up and productivity estimates. Following Morikawa and other previous research, we examine the following variables (details of them are in Appendix 1): SCALE (business scale), LABOUR (firm size), AGE (firm age), PROFIT (profitability), CASHFLOW (sales-cashflow ratio), EFFICIENT (efficiency of business), FOREIGNK (ratio of foreign captal), OUTSOURCE (ratio of outsourcing), PART (part-time ratio), WAGE (average quality of workers), DIFFERENT (index of service differentiation), INFO (index of information use), DIVERGE (index of diversification), ESTABLISH (index of market saturation strategy), and SELFK (ratio of self capital). Among these variables, FOREIGNK and OUTSOURCE are examined by a descriptive analysis because many firms record zeros or blanks for them. These variables are classified into the following four groups: firm characteristics, employment structure, firm strategies, and finance. For each of them, we discuss the results.

Tables 2-1 and 2-2 show the results of productivity and mark-up regressions respectively. They reveal that effects of firm characteristics are not always identical across industries and between productivity and market power. Firm ages have positive coefficients on productivity except for automobile retailers while generally negative on market power except for miscellaneous retailers. This finding is possibly interpreted as follows. Long-survived firms reach the higher productivity levels while lose their price-making power because their services are standardised. On the contrary, profitability and efficiency of business usually have negative coefficients on productivity while positive on market power. It implies that firms pursue profit maximisation thought obtaining price-making power rather than raising productivity. The sales-cashflow ratio is positively correlated with productivity while not correlated with market power. It says that soundness of management is positively correlated with productivity levels as expected.

As for employment structures, relying on part-time workers is not helpful for achieving higher productivity and market power. It means that greater use of part-time workers is not desirable for firms to achieve better performances although they rely on those workers to suppress costs. On the other hand, labour quality has positive coefficients on both productivity and market power. Therefore, enhancing labour quality is desirable for firms as we expect. This issue might be related to those of management practice.

Among firm strategy variables, none of these is strongly correlated with their productivity. Therefore, it is difficult to detect desirable directions of industrial policies to support productivity growth from these results. As for market power, the index of information use is positively correlated with market power while the market saturation strategy is negatively correlated. It means that the use of information is important for firms' price-making power. On the other hand, firms which take the market saturation strategy do not pursue their business objective though price-making power. For firms' finance, the ratio of self capital is not significantly estimated for a majority of regressions.

In addition to them, we examine FOREIGNK and OUTSOURCE based on a descriptive analysis. Figures 4-1 and 4-2 are diagrams of kernel density for productivity and market power with respect to FOREIGNK. In these diagrams, firms are classified into FOREIGNK if foreign capital accounts for over a third of their total capital. According to these figures, productivity levels of foreign firms are more diversified toward both the lower and higher sides than those of domestic firms. It indicates that we can not detect the composition effects of foreign firms on aggregate productivity in the retail trade industry. On the other hand, market powers of foreign firms are obviously higher than those of domestic ones. It implies that these larger market powers of foreign firms possibly yield the result that foreign firms have higher productivity than domestic one in preceding papers. It also indicates that the effects of globalisation on productivity should also be examined.

Figures 4-3 and 4-4 are the same diagrams with respect to OUTSOURCE. In these diagrams, firms are classified into firms with outsourcing if their values of OUTSOURCE is positive. If not, they are firms with in-house production. The figures obviously show that productivity levels of firms with outsourcing are higher than firms with in-house production while their market powers are almost same. It indicates that outsourcing is strongly associated with higher productivity in this industry.

In devising industrial policy to support productivity growth, we have to keep in mind that firms are unlikely to accept the policies which lower their market powers because they are thought to pursue profit maximisation through raising them. On the other hand, competition – friendly policies often support productivity growth through lowering them. Ignoring this gap possibly yields unsuccessful results. To briefly discuss this issue, we count how many regressors satisfy the condition which the firm side can accept. In Table 2-3, the second column (+, +) shows it. The third column (+, -) reveals the number of regressors which are favourable for productivity growth but not for market power. The fourth and fifth column are corresponding to the conditions which neither a policy maker nor a firm accepts. This table indicates that the policies which are acceptable for the firm side are relatively limited.

5. Concluding Results

In this paper, we estimate firm-specific mark-up and productivity using a newly developed econometric method, and examine their dispersion. From our results, we obtain the following findings and implications. First, the estimates of productivity relying on some unrealistic assumption such as constant returns to scale and perfect competition are possibly biased. Therefore, implications based on those estimates are controversial, and alternative approaches to relax such assumptions are useful for looking for robust implications, comparing them from the standard one. Secondly, the relationships between market power and productivity are somewhat complicated. The firms with lower market power are less productive. On the other hand, firms with higher market power do not always have higher productivity. These market and competition structures are possibly influential for effectiveness of some competition-friendly policies. Examining why firms with lower productivity can have higher market powers will give further implications for desirable policies. Thirdly the transition matrices reveal that the retail trade industry is not Schumpeterian-innovative. The cause of the persistency of relative productivity and market power should also be examined, such as consumers' behaviour or regulations. Fourthly, relative dynamics of productivity and market power are heterogeneous across groups of firms. Among them, food retail traders obtain lower productivity as well as lower market power. It means that their discounting battles do not result in and from productivity growth, and may deteriorate aggregate performance since they have the largest share in this industry. Therefore, policies focusing on this war of attrition possibly improve aggregate performance of this industry. And finally, productivity and market power have heterogeneous correlations with various regressors. It implies that some competition–friendly policies to support productivity growth may not be acceptable for firms. As a whole, our research indicates that the demand side analysis is also important even in analysis of productivity growth.

Our research still leaves some questions unanswered such as the effects of regulations and the role of ICTs because of data constraints. Those questions should be examined in future research. In addition, we need to expand this research to other industries to further understand them and obtain more reliable policy implications.

Appendix 1: Examined Variables

	Var Name	Note
Characteristics	**SCALE**	log of total sales: business scale
	LABOUR	log of total workers: firm scale
	AGE	log of firm age: length of business continued
	PROFIT	ordinary profit / total sales: profitability
	CASHFLOW	(ordinary profit × 0.6 + depreciation) / total sales: estimated sales-cashflow ratio
	EFFICIENT	total sales/ fixed capital: efficiency of business
	FOREIGNK	ratio of Foreign Capital
	OUTSOURCE	outsourcing / total sales: ratio of outsourcing
Employ	**PART**	part-time workers / total workers: ratio of par-time workers
	WAGE	total wages / total workers: average quality of workers
Strategy	**DIFFERENT**	(R&D + advertisement costs) / total sales: index of service differentiation
	INFO	information cost / total sales: index of information use
	DIVERGE	index of diversification
	ESTABLISH	log of commercial establishment: index of a market saturation strategy
Finance	**SELFK**	net capital / (capital + liabilities): ratio of self capital

Appendix 2: Descriptive Statistics of Data

		Retail	Cloth	Food	Auto	Furn
N of Obs		32908	3741	8229	9079	923
Sales	Max	2505500	1097502	2505500	436728	229664
	Min	80	595	80	613	431
	Ave	20657	37488	29426	13326	17407
	Med	6971	9805	7495	8136	5408
	Var	73480	96098	120293	20581	31224
	Skew	16.1867	5.9211	12.4970	9.0698	3.3548
	Share	1.0000	0.2063	0.3562	0.1780	0.0236
Labour	Max	116721	31177	116721	5011	11110
	Min	50	50	50	50	50
	Ave	658	892	1277	294	591
	Med	224	338	374	198	180
	Var	2375	1849	4373	349	1208
	Skew	20.5107	5.8624	12.4408	5.2097	4.6669

		Furniture	Electric	Drug	Fuel	Miscellaneous
N of Obs		923	1519	1365	3268	4783
Sales	Max	229664	1264235	301710	351647	280046
	Min	431	454	105	635	276
	Ave	17407	29937	13759	10580	12841.2
	Med	5408	5890	5529	5125	5060
	Var	31224	82651	27177	22817	25789.1
	Skew	3.3548	7.0104	5.6900	8.2151	5.1274
	Share	0.0236	0.0669	0.0276	0.0509	0.0904
Labour	Max	11110	11774	10653	5504	16527
	Min	50	50	50	50	50
	Ave	591	481	550	226	495.3
	Med	180	167	237	137	194
	Var	1208	920	1048	328	973.8
	Skew	4.6669	4.7251	5.4620	6.6277	5.6719

References

Ackerberg D., K. Caves and G. Frazer (2006), "Structural Identification of Production Functions", *Working Paper*, (available on the first author's website).

Caballero R. J., T. Hoshi, and A. Kashyap (2008), "Zombie Lending and Depressed Restructuring in Japan", *American Economic Review*, 98 (5), 1943-1977.

Caplin A. and B. Nalebuff (1991), "Aggregation and Imperfect Competition: On the Existence of Equilibrium", *Econometrica*, 59 (1), 25-59.

Eslava M., J. Haltiwanger, A. Kugler, and M. Kugler (2005), "Plant Survival, Market Fundamentals and Trade Leberalization", mimeo.

Fox K., J. (2005), "Returns to Scale, Technical Progress and Total Factor Productivity Growth in New Zealand Industries", *Treasury Working Paper*, No. 05/04, New Zealand Treasury.

Hartwig J. (2006), "Productivity Growth in Service Industries: Has 'Baumol's Disease' Really Been Cured?", *KOF Working Paper*, KOF Economic Institute, ETH Zurich.

Kato A. (2007), "Survey on Productivity in the Service Sector (in Japanese)", *RIETI Policy Discussion Paper*, 07-P-005.

--------- (2009), "Productivity, Returns to Scale and Product Differentiation: An

Empirical Analysis using Japanese Firm-Level Data", *RIETI Discussion Paper* 09-E-009.

Kim Y. G., H. U. Kwon and K. Fukao (2007), "Entry and Exit of Companies and Establishments, and Productivity at the Industry Level (in Japanese)", *RIETI Discussion Paper*, 07-J-022.

Kiyota K. and T. Matsuura (2004), "Construction and Usage of A Panel Data of 'the Basic Survey of the Business Structure and Activity': Problems in Application to Economic Analysis and Arrangement of Data (in Japanese)", *RIETI Policy Discussion Paper*, 04-P-004.

Klette T. J. (1999), "Market Power, Scale Economies, and Productivity: Estimates from a Panel of Establishment Data", *Journal of Industrial Economics*, XLVII (4), 451-476.

Levinsohn J. and A. Petrin (2003), "Estimating Production Functions Using Inputs to Control for Unobservables", *Review of Economic Studies*, 70 (2), 317-342.

Loecker J. D. (2007), "Product Differentiation, Multi-Product Firms and Estimating the Impact of Trade Liberalization on Productivity", *NBER Working Paper*, No. 13155.

Martin R. (2008), "Productivity Dispersion, Competition and Productivity Measurement", *CEP Discussion Paper*, No. 0692.

----------- (2010), “Productivity Spreads, Market Power Spreads, and Trade”, mimeo.

Melitz M. J. (2000), “Estimating Firm-Level Productivity in Differentiated Product Industries”, Harvard, mimeo.

Morikawa M. (2007), “ What Kind of Company Have Higher Productivity? : Company Characteristics and TFP (in Japanese)”, *RIETI Discussion Paper*, 07-J-049.

---------------- (2010), “Working Hours of Part-timers and the Measurement of Firm-Level Productivity”, *RIETI Discussion Paper*, 10-E-015.

Nordhaus, W. D. (2008), “Baumol’s Diseases: A Macroeconomic Perspectives”, *NBER Working Paper*, No. 12218.

Olley S., and A. Pakes (1996), “The Dynamics of Productivity in the Telecommunication Equipment Industry”, *Econometrica*, 64, 1263-1297.

Tokui J., T. Inui and Y. G. Kim (2007), “The Embodied Technical Progress and the Average Vintage of Capital (in Japanese)”, *RIETI Discussion Paper*, 07-J-035.

Triplett J. E. and B. P. Bosworth (2003), “Productivity Measurement Issues in Services Industries: “Baumal’s Disease” Has Been Cured”, *Economic Policy Review*, 9(3), Federal Reserve Bank of New York.

Table 1-1: Transition Matrix of Productivity in the 1990s

		t+1					
	1990s	20	40	60	80	100	exit
	20	**0.5748**	0.1413	0.0348	0.0131	0.0077	0.2283
	40	0.1491	**0.4458**	0.1432	0.0222	0.0040	0.2357
t	60	0.0425	0.1664	**0.4353**	0.1313	0.0104	0.2142
	80	0.0153	0.0272	0.1522	**0.4936**	0.0766	0.2352
	100	0.0047	0.0044	0.0174	0.0936	**0.6128**	0.2670
	entry	0.1805	0.1815	0.1829	0.2085	0.2466	

Table 1-2: Transition Matrix of Productivity in the 2000s

		t+1					
	2000s	20	40	60	80	100	exit
	20	**0.6255**	0.1426	0.0288	0.0117	0.0037	0.1877
	40	0.1517	**0.4859**	0.1359	0.0259	0.0073	0.1933
t	60	0.0336	0.1569	**0.4783**	0.1121	0.0141	0.2049
	80	0.0093	0.0257	0.1462	**0.5221**	0.0807	0.2159
	100	0.0024	0.0047	0.0149	0.1034	**0.6383**	0.2364
	entry	0.1714	0.1783	0.1897	0.2153	0.2454	

Table 1-3: Transition Matrix of Market Power in the 1990s

		t+1					
	1990s	20	40	60	80	100	exit
	20	**0.5662**	0.1017	0.0097	0.0023	0.0007	0.3194
	40	0.0781	**0.5138**	0.1232	0.0124	0.0007	0.2722
t	60	0.0051	0.1057	**0.5122**	0.1288	0.0084	0.2395
	80	0.0014	0.0115	0.1172	**0.5721**	0.0867	0.2112
	100	0.0003	0.0004	0.0041	0.0803	**0.7769**	0.1381
	entry	0.2997	0.2276	0.1977	0.1704	0.1046	

Table 1-4: Transition Matrix of Market Power in the 2000s

		t+1					
	2000s	20	40	60	80	100	exit
	20	**0.5940**	0.0960	0.0123	0.0013	0.0003	0.2960
	40	0.0897	**0.5310**	0.1243	0.0143	0.0020	0.2387
t	60	0.0053	0.1063	**0.5467**	0.1323	0.0043	0.2050
	80	0.0010	0.0123	0.1150	**0.6074**	0.0886	0.1756
	100	0.0007	0.0003	0.0036	0.0767	**0.7956**	0.1230
	entry	0.2931	0.2426	0.1911	0.1631	0.1101	

Table 2-1: Results of Productivity Regressions

TFP

Coeff	Retail	Cloth	Food	Automobile	Furniture	Electric	Pharmacy	Fuel	Miscellaneous
SCALE	0.019***	-0.022**	0.027*	0.065***	-0.014	0.012***	0.015	0.064	0.018***
	(0.004)	(0.006)	(0.011)	(0.021)	(0.008)	(0.009)	(0.023)	(0.010)	(0.018)
LABOUR	-0.048***	0.019***	-0.055***	-0.064***	-0.055**	-0.014**	-0.063	-0.042	-0.006***
	(0.004)	(0.007)	(0.012)	(0.026)	(0.008)	(0.011)	(0.026)	(0.011)	(0.018)
AGE	0.019***	0.015**	0.023*	-0.015***	0.009	0.033	-0.006	0.013***	0.001*
	(0.002)	(0.003)	(0.009)	(0.016)	(0.005)	(0.006)	(0.016)	(0.007)	(0.012)
PROFIT	-0.486***	-0.063**	-0.580	0.092	-0.249**	-1.046	-0.806	-1.041***	-0.419***
	(0.072)	(0.122)	(0.263)	(0.618)	(0.152)	(0.204)	(0.341)	(0.212)	(0.522)
CASHFLOW	1.603***	1.008***	2.351***	1.102***	1.049***	2.340	1.962**	2.624***	1.928***
	(0.106)	(0.166)	(0.437)	(0.869)	(0.203)	(0.263)	(0.511)	(0.329)	(0.803)
EFFICIENT	-0.001***	-0.002***	-0.006***	-0.006***	0.000***	-0.001***	-0.008***	-0.002***	-0.014***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.002)	(0.000)	(0.002)
PART	-0.045***	-0.074	0.008	-0.101***	-0.015	-0.003**	-0.008**	-0.050	-0.075***
	(0.006)	(0.022)	(0.019)	(0.046)	(0.011)	(0.014)	(0.035)	(0.016)	(0.030)
WAGE	0.083***	0.090***	0.081***	-0.023***	0.094***	0.084	0.129**	0.069***	0.043***
	(0.004)	(0.005)	(0.013)	(0.028)	(0.008)	(0.010)	(0.028)	(0.011)	(0.017)
DIFFERENT	0.141**	-0.681	0.091	-0.102***	0.074**	0.533	0.580	0.491	0.209***
	(0.071)	(0.191)	(0.150)	(0.544)	(0.226)	(0.386)	(0.263)	(0.173)	(0.169)
INFO	-0.13	0.163	-0.108	-0.376	0.017	0.670	0.153	-0.085	-0.628
	(0.140)	(0.443)	(0.364)	(0.438)	(0.492)	(0.459)	(0.858)	(0.295)	(0.650)
DIVERGE	0.019***	0.028	0.004	0.030***	0.017	0.005	0.004	0.000	0.003
	(0.005)	(0.010)	(0.016)	(0.031)	(0.011)	(0.013)	(0.028)	(0.013)	(0.020)
ESTABLISH	0.004	0.002*	-0.024	-0.015	0.008	0.003	-0.009	-0.016	0.003
	(0.003)	(0.005)	(0.013)	(0.028)	(0.008)	(0.008)	(0.023)	(0.011)	(0.017)
SELFK	0.003	-0.004	0.005***	0.052	0.029**	0.005**	0.047	-0.016	0.019*
	(0.002)	(0.003)	(0.008)	(0.020)	(0.007)	(0.008)	(0.019)	(0.008)	(0.015)
Constant	-1.092***	-1.089***	-1.099***	0.263***	-0.937***	-1.251	-1.564**	-1.283***	-0.589***
	(0.056)	(0.082)	(0.184)	(0.415)	(0.124)	(0.154)	(0.400)	(0.170)	(0.250)

Note: ***, **, * are 1%, 5% and 10% significance.

Standard Errors are in parentheses.

Table 2-2: Results of Mark-up Regressions

Markup

Coeff	Retail	Cloth	Food	Automobile	Furniture	Electric	Pharmacy	Fuel	Miscellaneous
SCALE	-0.054***	-0.035***	-0.046***	-0.063***	-0.070***	-0.048***	-0.067***	-0.055***	-0.084***
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.004)	(0.002)	(0.004)
LABOUR	0.002***	-0.017**	-0.004***	0.015***	0.015***	-0.001***	0.017***	0.003	0.035
	(0.001)	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)	(0.005)	(0.002)	(0.004)
AGE	-0.005***	-0.003***	-0.009***	-0.006***	-0.006	-0.005***	-0.002**	-0.003***	0.005**
	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)
PROFIT	0.225***	0.209***	0.281***	0.499***	0.159***	0.048***	0.251	0.218	0.194***
	(0.015)	(0.025)	(0.051)	(0.100)	(0.029)	(0.048)	(0.074)	(0.044)	(0.116)
CASHFLOW	0.051**	0.029	0.020	-0.244	0.049	0.373*	0.13	0.043***	0.185
	(0.021)	(0.034)	(0.084)	(0.143)	(0.039)	(.059)	(0.112)	(0.068)	(0.179)
EFFICIENT	0.000***	0.000***	0.001***	0.001***	0.000***	0.000***	0.002***	0.000***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PART	-0.004***	0.005	-0.001***	0.010	-0.009	-0.002	0.000***	-0.006	-0.038*
	(0.001)	(0.005)	(0.004)	(0.007)	(0.002)	(0.004)	(0.007)	(0.003)	(0.007)
WAGE	0.030***	0.022***	0.029***	0.037***	0.043***	0.028***	0.059***	0.036***	0.047***
	(0.001)	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)	(0.006)	(0.002)	(0.004)
DIFFERENT	0.029**	-0.058	0.024	-0.004	-0.040	-0.067	-0.079	0.051	0.053
	(0.013)	(0.039)	(0.025)	(0.071)	(0.039)	(0.098)	(0.052)	(0.032)	(0.038)
INFO	0.163***	-0.281	0.140***	0.137***	0.312**	0.383**	0.388**	0.138***	0.301**
	(0.029)	(0.094)	(0.072)	(0.070)	(0.101)	(0.117)	(0.193)	(0.064)	(0.142)
DIVERGE	-0.001	0.002**	-0.008	0.003	0.000	0.001	-0.004	-0.005	0.002*
	(0.001)	(0.002)	(0.003)	(0.005)	(0.002)	(0.003)	(0.006)	(0.003)	(0.005)
ESTABLISH	-0.004***	0.001***	0.006***	-0.018	-0.006	-0.001***	-0.003	-0.007	0.004***
	(0.001)	(0.001)	(0.002)	(0.004)	(0.002)	(0.002)	(0.005)	(0.002)	(0.004)
SELFK	0.002***	0.003	-0.002***	0.001***	0.006	-0.005	-0.002	0.000**	0.001
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.004)	(0.002)	(0.004)
Constant	1.165***	1.199***	1.154***	1.090***	1.039***	1.151***	0.738***	1.081***	0.955***
	(0.011)	(0.017)	(0.035)	(0.063)	(0.024)	(0.037)	(0.081)	(0.034)	(0.056)

Note: ***, **, * are 1%, 5% and 10% significance.

Standard Errors are in parentheses.

Table 2-3: Relations of Coefficients between Productivity and Market Power

Industry	+, +	+, −	−, +	−, −
Retail	4	4	4	1
Cloth	4	3	4	2
Food	3	5	4	1
Automobile	3	2	5	3
Furniture	6	3	2	2
Electric	4	5	2	2
Pharmacy	3	4	4	2
Fuel	3	3	5	2
Miscellaneous	7	1	4	1

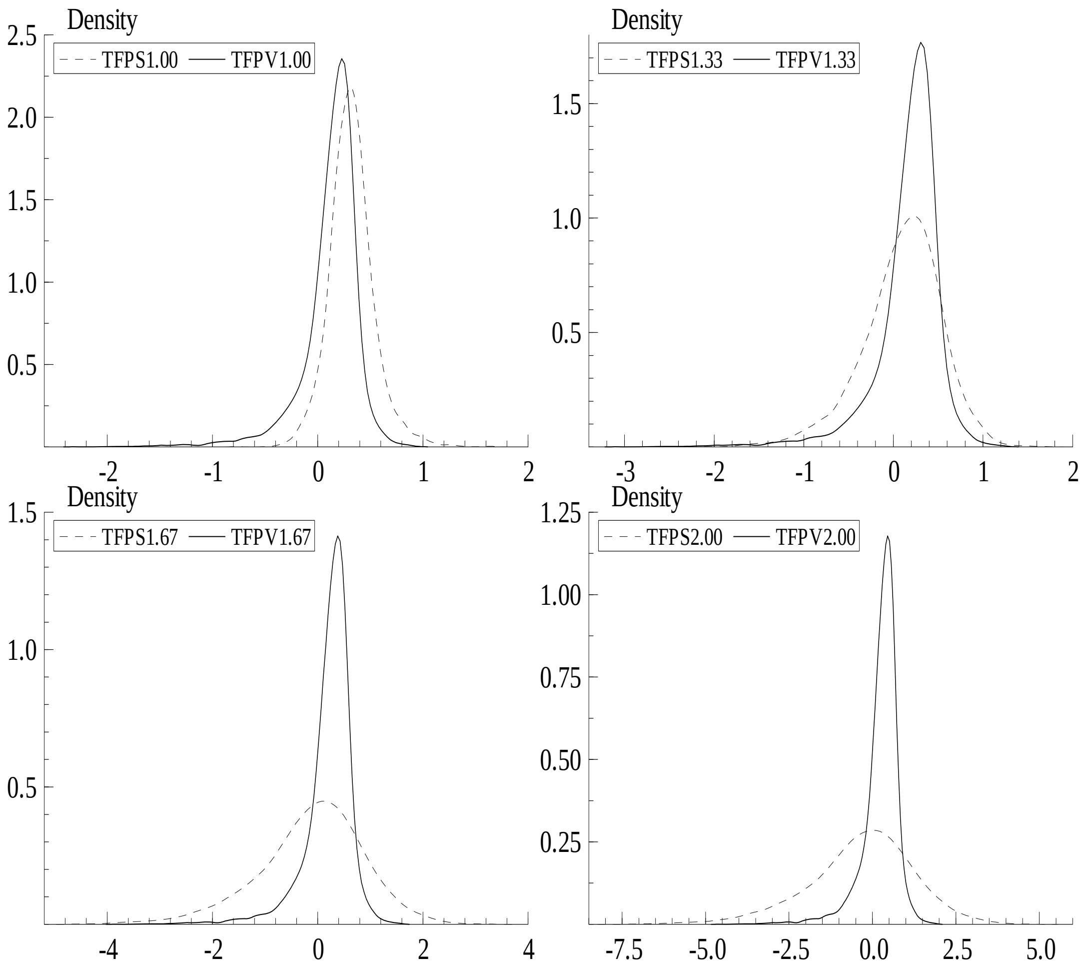
Note: +, + means positive coefficients on productivity and mark-up

+, − means positive coefficients on productivity and negative on mark-up

−, + means negative coefficients on productivity and positive on mark-up

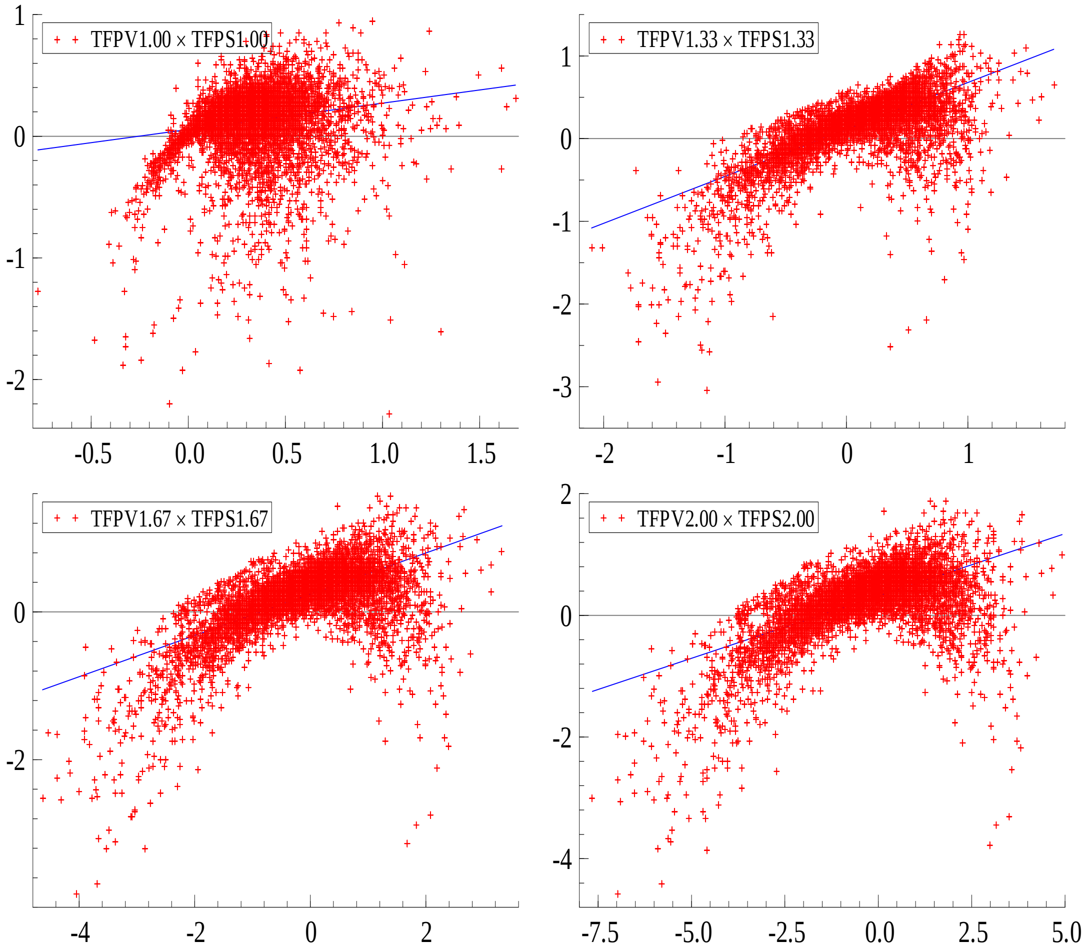
−, − means negative coefficients on productivity and mark-up

Figure 1-1: Kernel Density of Estimated Productivities



Note: TFPS and TFPV are respectively productivity by the standard and the current approaches.

Figure 1-2: Scatter Diagram of Productivity Estimates by the Conventional and the Current Approaches



Note: TFPS and TFPV are respectively productivity by the standard and the current approaches.

Figure 2-1: Relation between TFP and Markup in Retail Trade Industry

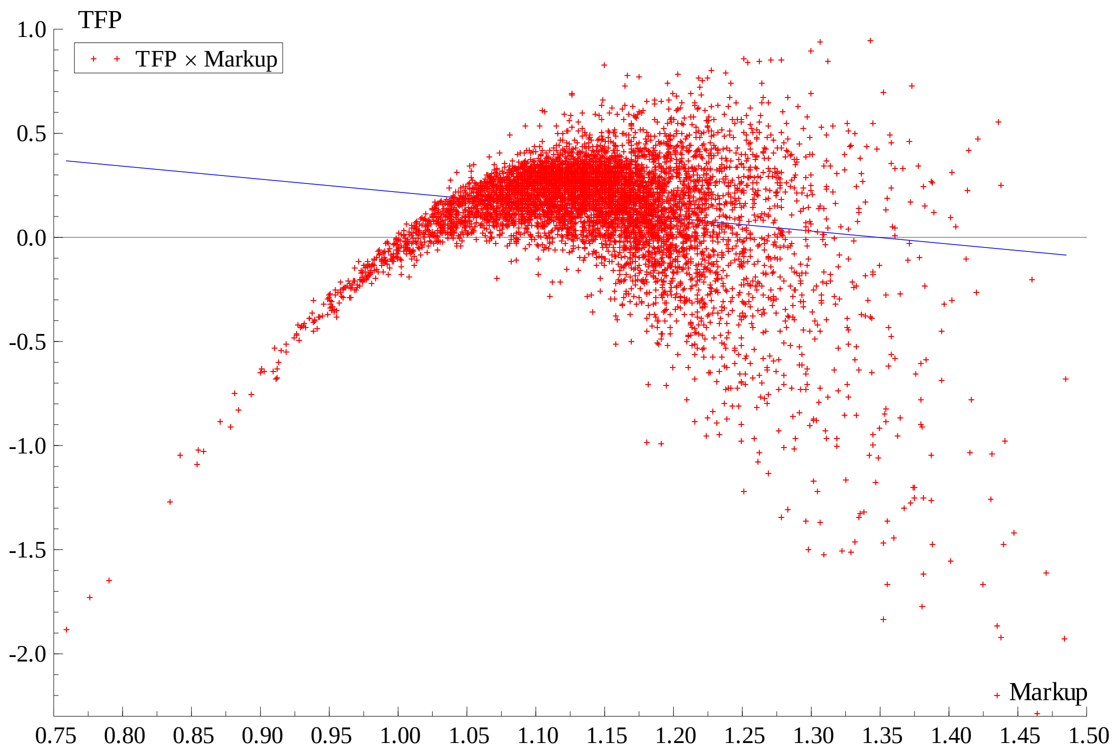


Figure 2-2: Relation between TFP and Markup in Various Retail Trade Industries 1

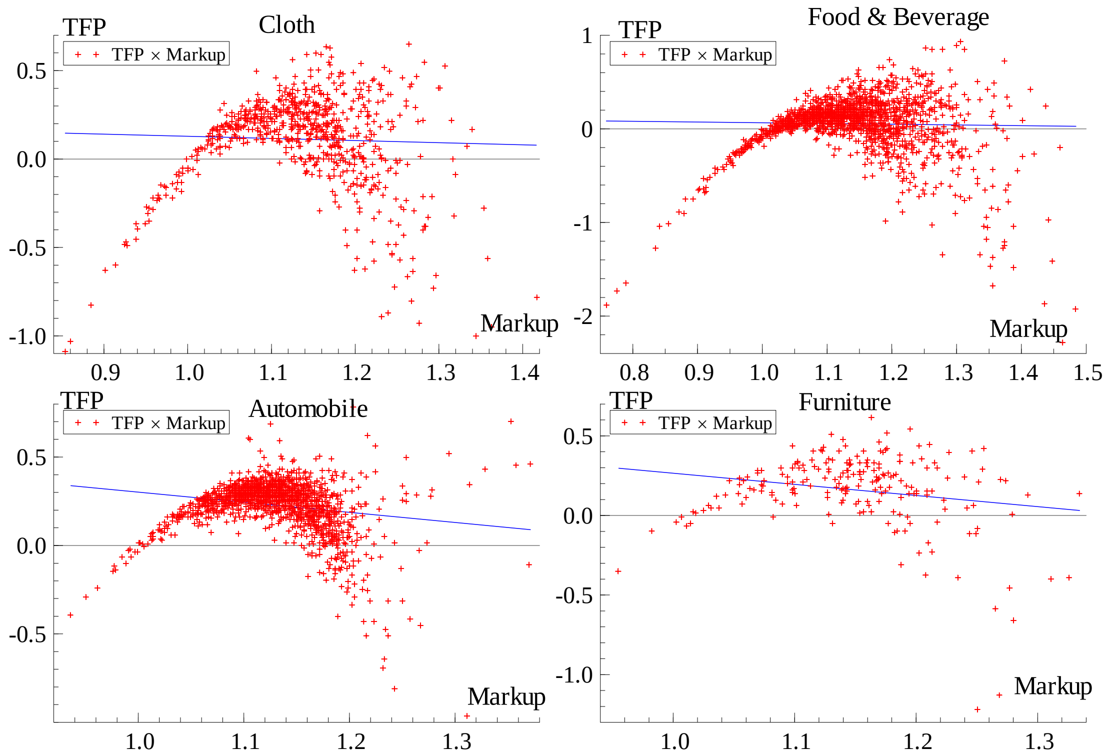


Figure 2-3: Relation between TFP and Markup in Various Retail Trade Industries 2

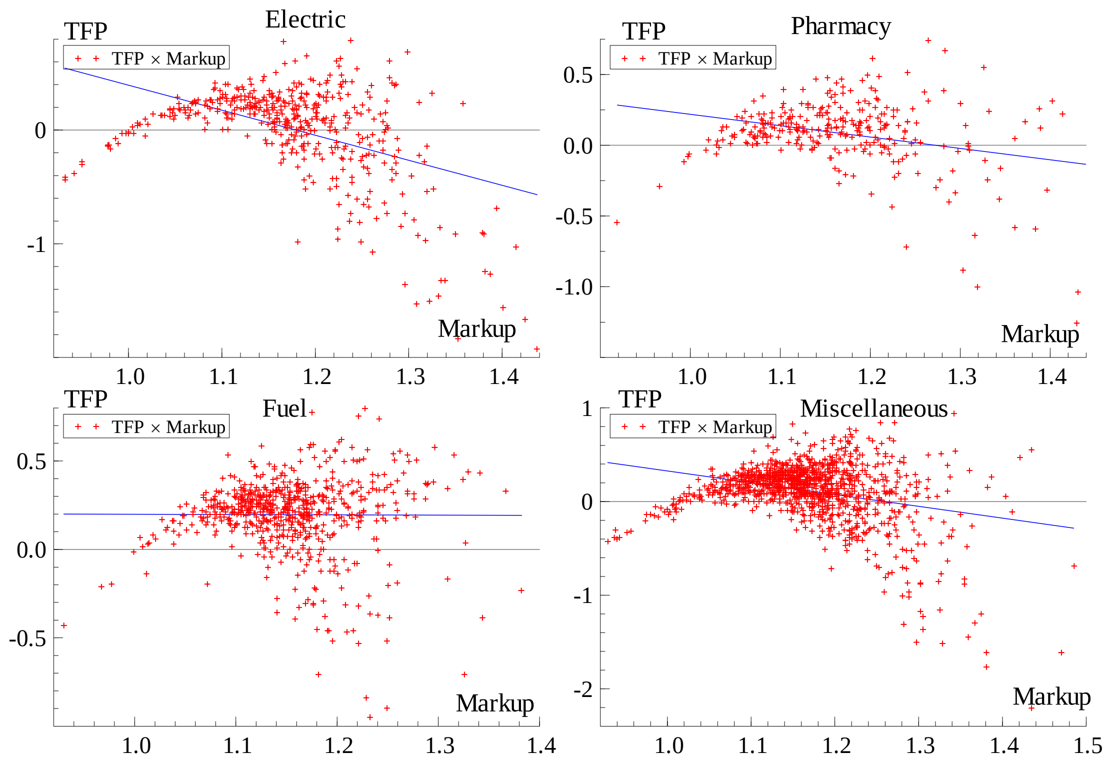
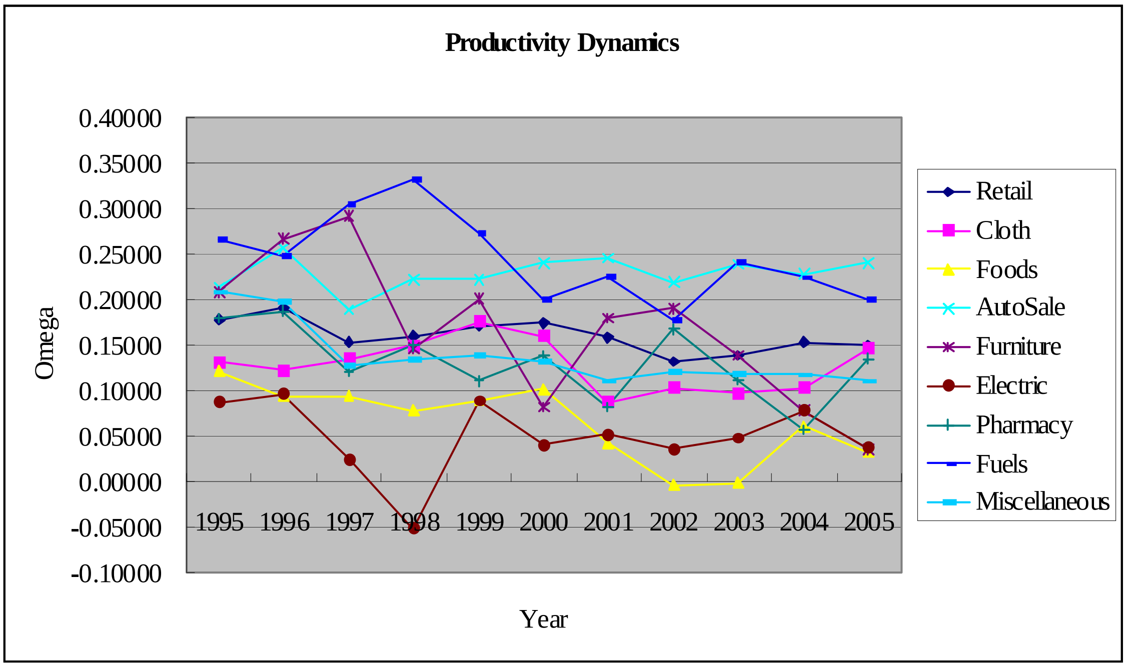


Figure 3-1: Productivity Dynamics



Note: Omega denotes relative levels of productivity

Figure 3-2: Mark-up Dynamics

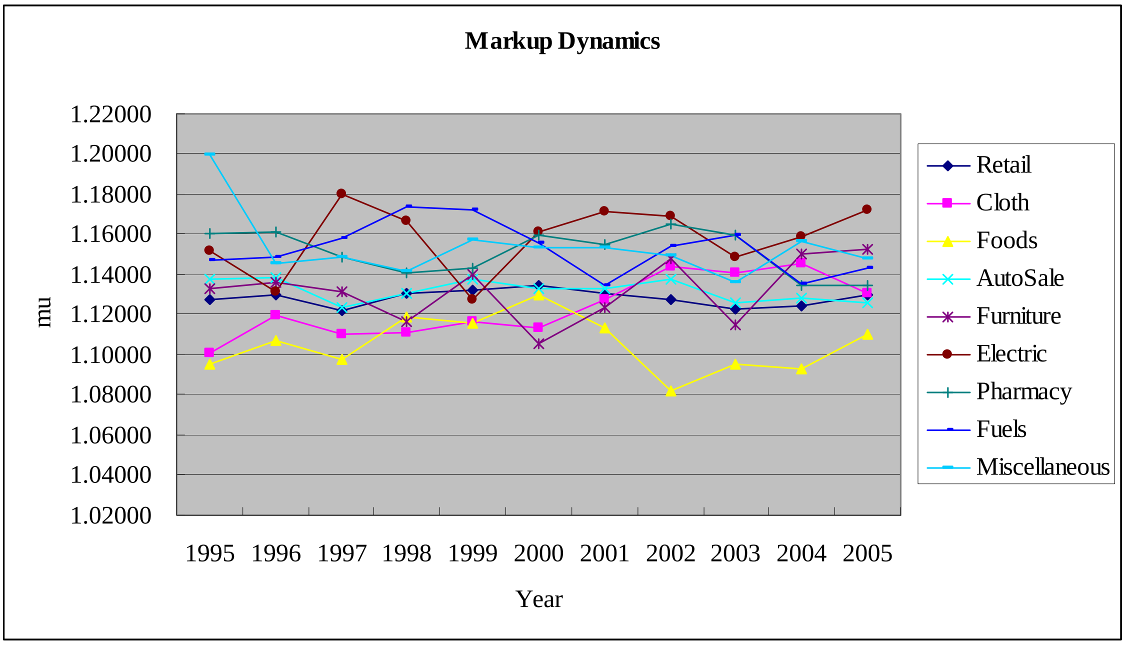
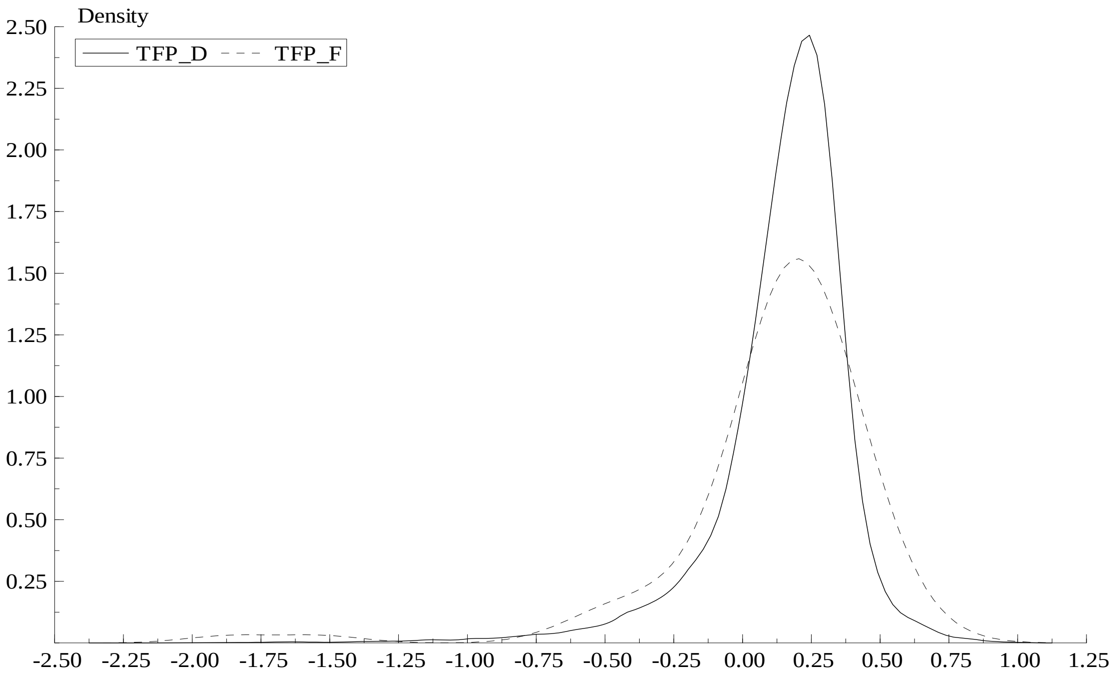
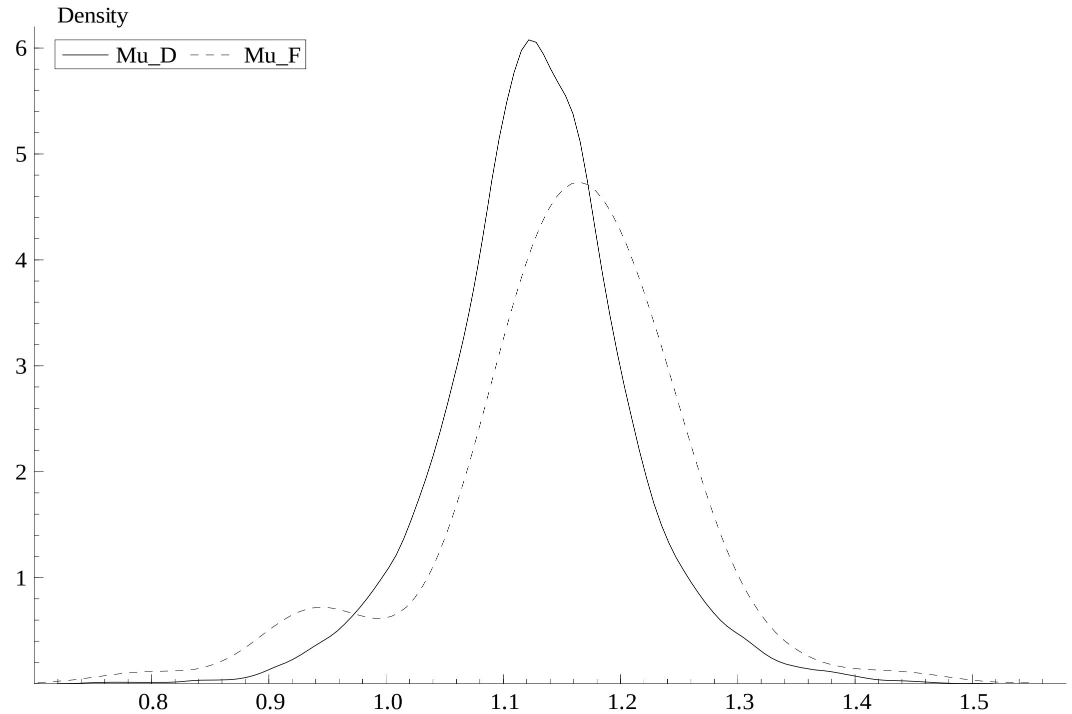


Figure 4-1: Kernel Density of Domestic and Foreign Firms for Productivity



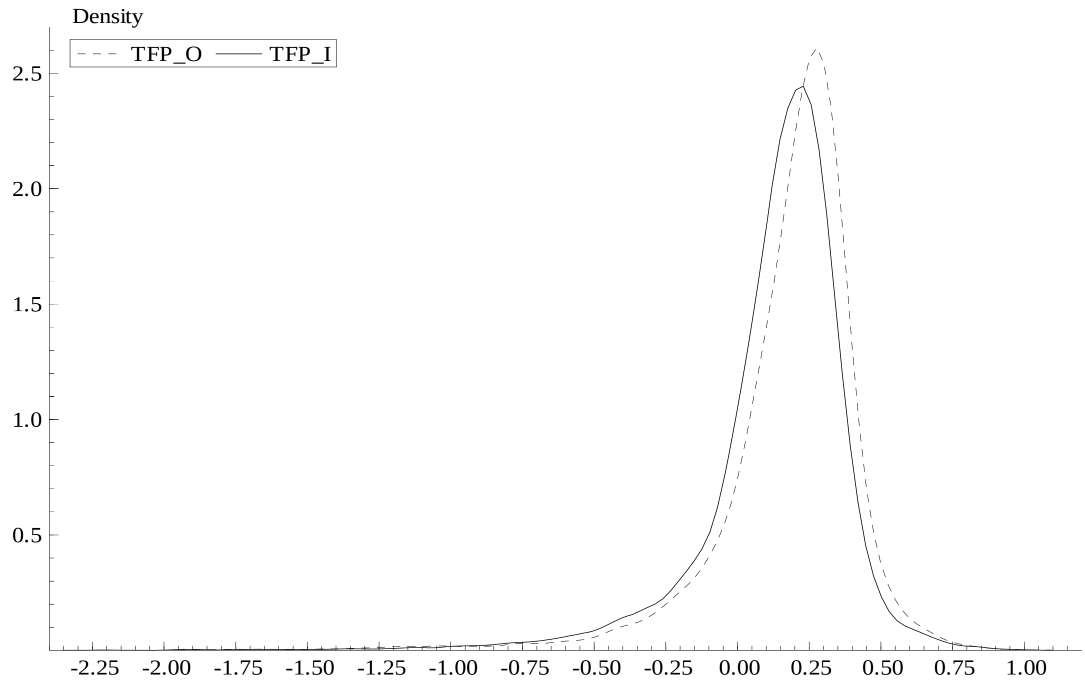
P (TFP_D = TFP_F) =0.2257

Figure 4-2: Kernel Density of Domestic and Foreign Firms for Market Power



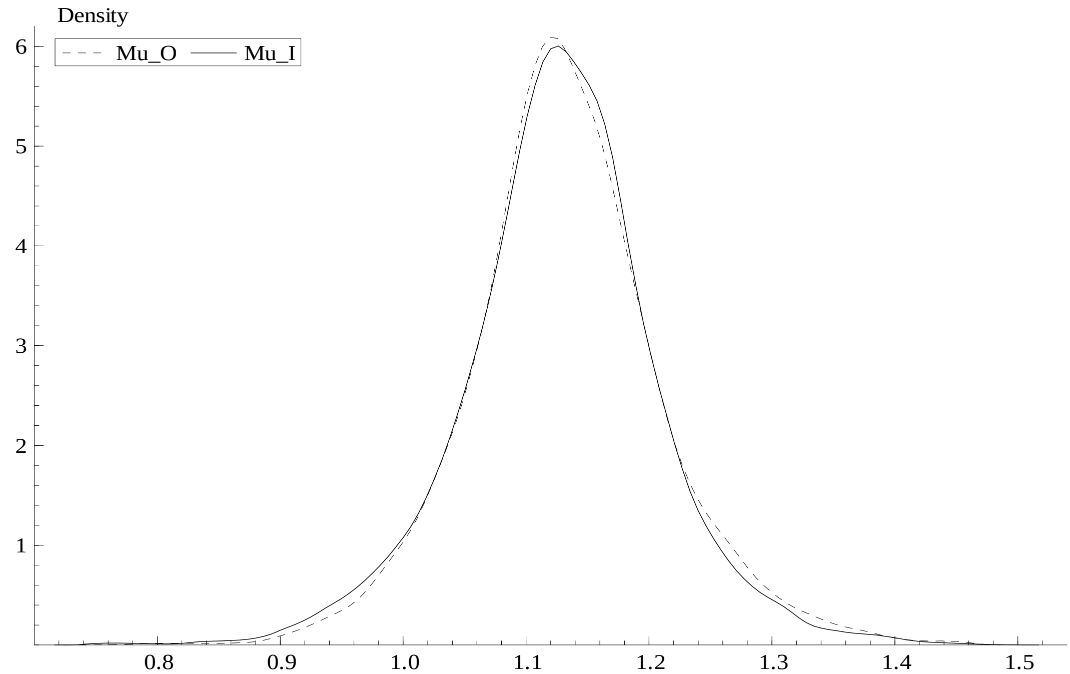
P (Mu_D = Mu_F) =0.0140

Figure 4-3: Kernel Density of In-house and Outsourcing Firms for Productivity



P (TFP_O = TFP_I) =0.0000

Figure 4-4: Kernel Density of In-house and Outsourcing Firms for Market Power



P (Mu_O = Mu_I) =0.0000