

RIETI Discussion Paper Series 13-E-062

Competition and Innovation: An inverted-U relationship using Japanese industry data

YAGI Michiyuki Tohoku University

MANAGI Shunsuke RIETI



The Research Institute of Economy, Trade and Industry http://www.rieti.go.jp/en/

Competition and Innovation: An inverted-U relationship using Japanese industry data

YAGI Michiyuki

Graduate School of Environmental Studies, Tohoku University

and

MANAGI Shunsuke

Graduate School of Environmental Studies, Tohoku University Research Institute of Economy, Trade and Industry

Abstract

This study replicates a model of Aghion et al. ("Competition and Innovation: An inverted-u relationship," *Quarterly Journal of Economics* 2005; 120(2):701-728), which suggests that an inverted-U relationship exists between competition and innovation. We apply patent data and a competition measure based on Japanese firm-level and industry-average data from 1964 to 2006. In a constant slope model using a full dataset, we find the same inverted-U relationship as did Aghion-Bloom-Blundell-Griffith-Howitt (ABBGH). In decade and industry fixed-effects slope models, we find the inverted-U relationship to be fragile.

Keywords: Competition; Innovation; Patent; Inverted-U relationship; Endogeneity; *JEL classification*: O31, L00, O25

RIETI Discussion Papers Series aims at widely disseminating research results in the form of professional papers, thereby stimulating lively discussion. The views expressed in the papers are solely those of the author(s), and do not represent those of the Research Institute of Economy, Trade and Industry.

This study is conducted as a part of the Project "Economic Analysis of Environmental, Energy, and Resource Strategies Following the Great East Japan Earthquake" undertaken at Research Institute of Economy, Trade and Industry (RIETI).

1. Introduction

Understanding the relationship between competition and innovation has long been a major focus of industrial organization both theoretically and empirically (Cohen, 2010). Schumpeter (1934) argued that more monopolistic firms can more readily perform R&D activities because of reduced market uncertainty and more stable funding. Since then, many studies have examined the so-called Schumpeterian hypotheses that innovation activity is promoted by large firms and by imperfect competition (Kamien and Schwartz, 1975; Acs and Audretsch, 1987).

The former Schumpeterian hypothesis that innovation activity is promoted by large firms is mainly supported in the literature. Many previous studies mainly found a positive relationship although it is unclear whether the positive relationship is more or less proportional to the firm size (Acs and Audretsch, 1988a,1988b; Cohen and Klepper, 1996). In particular, many studies in the literature have shown that the amount of R&D conducted by performers are closely related to the size of the firm, while R&D productivity declines with firm size (Cohen and Klepper, 1996).

On the other hand, the latter Schumpeterian hypothesis that innovation activity is promoted by imperfect competitionhas been inconclusive. Many empirical studies, in which a market concentration measure is often used as a competition measure, show a positive relationship between competition and innovation (i.e., more competition is associated with more innovation) (Acs and Audretsch, 1988a, 1988b; Blundell *et al.*, 1995).

Aghion *et al.* (2005), hereafter ABBGH, build a stylized model to support an inverted-U pattern between product market competition and innovation. ABBGH also empirically support this pattern using UK industry data (seventeen industries over the period 1973 to 1994) using price-cost margin (PCM) measure as a competition measure.

However, prior empirical studies to test for the inverted-U relationship have been inconclusive. Tingvall and Poldahl (2006) test the inverted-U relationship using Swedish manufacturing firms data from 1990 to 2000. They use firm-level R&D data as an innovation measure and the Herfindahl-Hirschman Index (HHI) and PCM as competition measures. Their results show that the inverted-U relationship is supported by the HHI but not by the PCM. Technology gap spread hypothesis in ABBGH which suggests technology gap increases with competition is supported both by HHI and by PCM. In addition, according a complementarity between the degree of neck-and-neckness and competition ABBGH suggest, the effect of interaction between HHI and technology neck-and-neckness makes the inverted-U relationship sharpened. When using the PCM, however, they do not find any support for complementarities between the degree of neck-and-neckness and competition on R&D.

Correa (2012) analyzes how the establishment of the United States Court of Appeals for the Federal Circuit in 1982 has affected the relationship between innovation and competition in ABBGH. He finds a structural break in the early 1980s, using the same dataset as ABBGH. He argues, taking this break into consideration, the inverted-U empirical relationship found by ABBGH does not hold.

The purpose of our study is to replicate ABBGH and analyze the robustness of ABBGH using larger dataset and applying most comprehensive set of variables.¹ In this study, we use Japanese firm-level and industry-average data with sixty industries over the period 1964 to 2006.

In a constant slope model using full dataset, we find the same inverted-U relationship as ABBGH do. In decade and industry fixed-effects slope models, we find the inverted-U relationship is easy to be fragile. Then, we also check technology gap spread prediction of ABBGH, and this prediction holds in this study. Finally, controlling for endogeneity between competition and innovation using source weighted real exchange rates as instrument variables (IVs), we find also the inverted-U seems fragile.

The rest of the paper is structured as follows. Section 2 discusses the model of ABBGH and our empirical strategy for the robustness of ABBGH. Section 3 shows the data used in our estimation. Section 4 presents our estimation results. Section 5 concludes.

2. Model and empirical strategy for checking the robustness of ABBGH

¹ Studies related to innovation study in Japan include Ijichi et al. (2004, 2010), Inui et al. (2012) and Motohashi (2012). Ijichi et al. (2004, 2010) carry out a questionnaire survey about innovation activities towards Japanese firms in industry sectors. Inui et al. (2012) examine the test of inverted-U relationship between total factor productivity and 1-Lerner index, using Japanese firm data. Motohashi (2012) examines the relationship between firms' enter and exit and innovation activity.

In this study we test three major hypotheses: the inverted-U hypothesis, technological spread predictions, and a possible endogeneity of competition. First, we analyze the inverted-U hypothesis using ordinary least squares (OLS) and within estimator. The reason why we do not use count data model is because patent variables in this study are not count data. We also estimate decade and industry fixed-effects slopes using interaction terms in order to check the robustness whether the inverted-U relationship is detected in each slope.

2.1 Model in this study

Following ABBGH and Correa (2012), the conditional citation weighted patents p_{jt} follow a Poisson regression:

$$p_{jt} = \exp\left\{\beta_0 + \beta_1 c_{jt} + \beta_2 c_{jt}^2 + \phi \hat{U}_{jt} + \sum_{j=1}^{17} \alpha_j D_j + \sum_{t=1973}^{1994} \gamma_t D_t + u_{jt}\right\}$$
(1)

where c_{jt} is 1 minus the Lerner Index (competition index) in industry *j* at time *t*, \hat{v} denotes the vector of residuals from OLS regression of competition index on policy and foreign-industry instruments, and the sums represent industry and time fixed effects.

In this study we also estimate citation weighted patents p_{it} at firm level, following Tingval and Poldahl (2006). This is because industry classification is often inappropriate to classify certain firms. This is also because, although competition is easily thought of as an industry property, firms in same industry often try to create their own segment to profile their product and escape competition.

In this study we regress competition variable on patent variable at firm and industry level, using OLS and within estimator (i.e., a fixed-effects model) as follows:

$$\ln p_{it} = \beta_0 + \beta_1 c_{it} + \beta_2 c_{it}^2 + \sum_{t=1965}^{2006} \gamma_t D_t + \alpha_i + u_{it}$$
(2)

where *i* denotes firm or industry. In order to test inverted-U curve is robust in each decade and each industry, we also estimate a fixed-effects slope model as follows:

$$\ln p_{it} = \beta_0 + \beta_1 c_{it} + \beta_k D_k c_{it} + \gamma_1 c_{it}^2 + \gamma_k D_k c_{it}^2 + \sum_{t=1965}^{2006} \lambda_t D_t + \alpha_i + u_{it}, k = 2...J$$
(3)

where k denotes each decade or each industry except for base decade or base industry to avoid

multi-collinearity.

We combine main effect (base) and each fixed-effects coefficient, and refer to it as combined coefficient (e.g., in equation (3), combined coefficient of c_{it} where k = 2 is $(\beta_1 + \beta_2)c_{it}$). We also make standard error of the combine coefficient using a square root of the sum of variances and covariances in each coefficient. We test whether each slope makes inverted-U shape using an inverted-U test as described below.

2.2 Inverted-U test

The inverted-U hypothesis in this study is tested by the inverted-U test following Lind and Mehlum (2010). A general formulation of linear regression model, which includes a quadratic or an inverse term, is as follows

$$y_i = \alpha + \beta x_i + \gamma f(x_i) + \xi z_i + \varepsilon_i, \quad i = 1, ..., n$$
(4)

where x is the explanatory variable of main interest whereas y is the variable to be explained, ε is an error term, and z is a vector of control variables. Given equation (2) and the assumption of only one extremum point, the requirement for an inverted-U shape is that a slope of the curve is positive at the start and negative at the end of a reasonably chosen interval of x-values [xl, xh]. Then an inverted-U shape is implied by the conditions as follows:

$$\beta + \gamma f'(x_h) < 0 < \beta + \gamma f'(x_l)$$
⁽⁵⁾

Then, a test of conditions in equation (5) at the α -level of confidence is equivalent to the null hypotheses H_o^L and H_o^H of the two standard one-sided tests,

$$H_0^L: \beta + \gamma f'(x_l) \le 0 \text{ vs. } H_1^L: \beta + \gamma f'(x_l) > 0$$
(6)

$$H_0^H: \beta + \gamma f'(x_h) \ge 0 \text{ vs. } H_1^H: \beta + \gamma f'(x_h) < 0.$$
⁽⁷⁾

A $(1-2\alpha)$ confidence interval for a extremum point (i.e., $-\hat{\beta}/\hat{\gamma}) - \hat{\beta}/\hat{\gamma}$ is given by $[\hat{\theta}_l, \hat{\theta}_h]$ as defined in equations (6) and (7) as follows:

$$f'(x_l) < \hat{\theta}_l = \frac{s_{12}t_{\alpha}^2 - \hat{\beta}\hat{\gamma} - t_{\alpha}\sqrt{\left(s_{12}^2 - s_{22}s_{11}\right)t_{\alpha}^2 + \hat{\gamma}^2 s_{11} + \hat{\beta}^2 s_{22} - 2s_{12}\hat{\beta}\hat{\gamma}}}{\hat{\gamma}^2 - s_{22}t_{\alpha}^2},$$
(8)

$$f'(x_h) > \hat{\theta}_h \equiv \frac{s_{12}t_{\alpha}^2 - \hat{\beta}\hat{\gamma} + t_{\alpha}\sqrt{\left(s_{12}^2 - s_{22}s_{11}\right)t_{\alpha}^2 + \hat{\gamma}^2 s_{11} + \hat{\beta}^2 s_{22} - 2s_{12}\hat{\beta}\hat{\gamma}}}{\hat{\gamma}^2 - s_{22}t_{\alpha}^2}, \qquad (9)$$

where $\hat{\theta}_l$ and $\hat{\theta}_h$ are the roots of the same quadratic equation.

2.3 Technological gap spread hypothesis and instrument variables estimation

We test technological gap spread prediction in ABBGH (i.e., proposition 4). This states "in equilibrium, the average technology gap between leaders and followers should be an increasing function of the overall level of industry wide competition (ABBGH, p.718)." This is tested by regressing the firm-level and industry-average technology gap on the Lerner index with year dummies using OLS and within estimator.

Using interaction terms of competition and technology gap as well as ABBGH, we also try to replicate the proposition 5 in ABBGH. That is, "the peak of the inverted U is larger, and occurs at a higher degree of competition, in more neck-and-neck industries (ABBGH, p.717)." ABBGH support two empirical findings about the proposition 5 (ABBGH, p.719); (1) more neck-and-neck industries show a higher level of innovation activity for any level of product market competition, and (2) the inverted-U curve is steeper for the more neck-and-neck industries.

To test the proposition 5 in ABBGH, a model in this study and ABBGH is as follows:

$$\ln p_{it} = \beta_0 + \beta_1 c_{it} + \beta_2 c_{it}^2 + \gamma_1 c_{it} m_{it} + \gamma_2 c_{it}^2 m_{it} + \sum_{t=1965}^{2006} \lambda_t D_t + \alpha_i + u_{it}$$
(10)

where *m* denote technology gap as described in following section, and *m* takes a positive value. In this study, we regard a slope of c_{it} and c_{it}^2 as a baseline, and first test whether the baseline is inverted-U curve. We next check whether γ_2 is significantly negative in order to check whether the inverted-U curve is steeper in more neck-and-neck industries than baseline. When γ_2 is negative, the inverted-U curve get steeper in neck-and-neck firms or industries because *m* takes a positive value.

In addition, we study the robustness of the inverted-U curve by considering the endogeneity

between competition and innovation, using two-stage least squares (2SLS) and within 2SLS. Along with a full set of year dummies, we use source-weighted real exchange rate (see Bertrand (2004)) as instrument variables (IVs). We make two kinds of the source-weighted real exchange rates, which are in advanced economies defined by IMF and in the other countries.

It is noted that there are missing values of technology gap and the instrument variables due to limitations of available data. Therefore, when testing the second and third instruments above, the subsample size decreases from the entire sample size.

3. Data

The data for this study consists of Japanese firm and industry-average data, patent data, and the source-weighted real exchange rate (Appendix Table A1 presents descriptive statistics of data in this study). The firm and industry-average data come from the Nikkei NEEDS database by Nikkei Inc. The patent data are obtained from the Institute of Intellectual Property (IIP) (see Goto and Motohashi (2007) for detail). In regard to the source-weighted real exchange rate, local currency and consumer price index (CPI) are obtained from the World Bank Database (http://data.worldbank.org) and Eurostat (http://ec.europa.eu/eurostat), and industry import data is obtained from the Japan Industrial Productivity Database (JIP) 2011 (see Fukao *et al.*, 2007).

3-1. Firm and Industry data

Japanese firm and industry-average data are based on non-consolidated financial statements. The entire sample has 95,544 firm-level observations from 1964 to 2006, and 2,580 industry-average observations. We grouped the industry-level data into 60 industries in accordance with the JIP Sector Classification (Appendix Table A2).

3-2. Patents

For this study, we construct three types of patent data from 1964 to 2006 from the IIP database. First, we match the firm data with a patent assignee list from the IIP database. Then, we cover changes in

business names and head office addresses for all of the samples from investor relations and financial reports, among others. Consequently, we match the business names with the assignee name found in a database. Some characters in the list are occasionally wrong, probably due to the degree of accuracy of optical character recognition; hence, we re-check the matched list for errors.

We organize two types of patent data. One of the patent variables is the number of patent applications, which is simply counted by applicant year. We divide the patent applications by joint applications, and by patent application index standardized in 1971 to control joint application effect and application inflation effect as follows:

$$Pat_{i,t} = \sum_{n} \left(\frac{\text{Patent application}_{n,i,t}}{\text{Joint application}_{n,i,t}} \right) \cdot \frac{\text{Total patent application}_{t}}{\text{Total patent application}_{1971}}$$
(11)

where n, i, and t denote respectively each application, each firm, and application year.

Another patent variable is citation weighted patent application. Because there is a truncation problem when raw citation count data is used, we use quasi-structural approach in Hall et al. (2001) to control citing and cited year effects, and obsolescence and diffusion effect. First, we estimate these above effects using full patent dataset of IIP database in the follow model:

$$\log[C_{kst} / P_{ks}] = \alpha_0 + \alpha_s + \alpha_t + \alpha_k + \exp(-\beta_{1k}L) / (1 - \exp(-\beta_{2k}))$$

(12)

where *C* and *P* denote respectively the total number of raw citation count and raw patent applications, and *s*, *t*, and *L* denote respectively applicant year of citing patent, applicant year of cited patent, and lagged year between applicant year of citing patent and cited patent. $\exp(\exp(-\beta_1 L) \cdot (1-\beta_2))$ denotes probability density function of the citation-lag distribution in each *L*, and we impose the constraint over *L* (*L*=0...46) is unity. Second, we divide raw citation count data by these parameters following Hall et al. (2001) as follows:

$$Cite_{i,s} = \sum_{t} \sum_{k} \left\{ \frac{\sum_{n} \left(RawCite_{i,s,t,k,n} / \text{Joint application of cited patent}_{i,n,s} \cdot \frac{\text{Total patent application}_{s}}{\text{Total patent application}_{1971}} \right) \\ \frac{\exp(\alpha_{s} \cdot \alpha_{t} \cdot \alpha_{k}) \cdot \exp(\exp(-\beta_{1k}(t-s)) / (1 - \exp(-\beta_{2k})))}{(1 - \exp(-\beta_{2k}))} \right\}$$
(13)

where i denotes each firm. Appendix A3.1 and A3.2 shows the estimated result in equation (12).

When Pat and Cite take 0, we substitute 0.0001.

3-3. Market competition measures

We use the PCM measure as a market competition measure for this study.^{2,3} ABBGH suggest a PCM (denoted by li) and 1- industry average Lerner Index (denoted by 1-L) as follows:

$$li_{it} = \frac{\text{operating profit}_{it} - \text{financial cost}_{it}}{\text{sales}_{it}}$$
(14)

$$1 - L_{jt} = 1 - \frac{1}{N_{jt}} \sum_{i \in j} li_{it}$$
(15)

where *i*, *j*, and *t* index firms, industry, and time, and N_{jt} is the number of firms in industry *j* in year *t*. We use non-operating expenditure as the financial cost.

In a firm-level regression, we use 1-li as well as Tingvall and Poldahl (2006). At firm level we assume each firm would have each market and face each market competition even if within the same industry. In addition, we use 0.5-99.5th percentile of 1-li because 1-li usually takes a value from 0 to 1, but takes a value from 0.01 to 679 in this study. The 0.5-99.5th percentile of 1-li takes a value from 0.641 to 1.394, and median of the 0.5-99.5th percentile is 0.973. 1-L (at industry average) takes a value from 0.841 to 1.135. Figure 1 shows scatter plots of *Pat, Cited* and the number of firms (histogram) towards 1-li.

3-4. TFP and the technology gap

Following ABBGH, the technology gap at firm level for this study is:

$$m_{it} = \left(TFP_{Ft} - TFP_{it}\right) / TFP_{Ft}$$
(16)

where *F* denotes the frontier firm, which has the highest total factor productivity (TFP) for each industry, and *i* denotes each firm. At industly level we use industry average value of m_{ii} .

² Generally, Lerner index is defined as (P-MC)/P where P and MC denote respectively price and marginal cost. However, the marginal cost is hardly observed as empirical data.

³ HHI is another market competition measure. Because we have only sample data of Japanese firms, however, we could not identify all or typical (e.g. top 10) firm's share in each industry and could not make HHI.

We measure TFP from 1970 to 2006 using a first order approximation of Cobb-Douglas, not assuming linear homogeneous production function. We measure capital, labor, and intermediate goods shares for each industry by a log-log regression model controlling firm and year fixed effects. Using the estimated capital, labor, and intermediate goods shares, we estimate TFP and m_{it} of each firm.

For our output variable, we use sales divided by industry output deflator which is calculated from dataset of JIP2011. For a labor variables, we use the number of regular employees. For a capital variables, we use capital stock estimated by perpetual inventory method. An initial value of capital stock for a base year is estimated by a nominal value of fixed physical capital divided by industry investment deflator from dataset of JIP2011. The base year is 1970, or is the next old year when there is missing value in 1970. Capital investment variable are a decrease or increase in nominal depreciable fixed physical capital and a nominal depreciation cost, which are divided by industry investment deflator. We use a depreciation rate as 8.67%, which is the average depreciation rate of each depreciable fixed physical capital in Hayashi and Inoue (1991).

For an intermediate good variable, we use sales cost plus sales administrative expense, excluding total wage and depreciation cost. The intermediate good variable is divided by the industry intermediate good deflator from JIP2011.

3-5. Instrument variables

As IVs, we use the source-weighted real exchange rate between 1980 and 2006 from JIP2011, World Bank database, and Eurostat. Following Bertrand (2004), we use the source-weighted real exchange rate (*XRI*) movements to generate exogenous variation in the level of import penetration by industry, and *XRI* in this study is as follows:

$$XR_{j,t} = \sum_{i} \left(LCU_{i,t} \cdot \frac{CPIJ_{t}}{CPI_{i,t}} \cdot \frac{IMP_{j,i,t}}{\sum_{i} IMP_{j,i,t}} \right),$$
(17)

$$XRI_{j,t} = \frac{XR_{j,t}}{XR_{j,2005}}$$
(18)

where *i*, *j*, and *t* denote each country, each industry, and year, respectively. *LCU* denotes local currency unit in JPY. *CPI* and *CPIJ* denote consumer price index of each country and Japan, respectively. *IMP* denotes volume of imports from each country toward each industry in Japan.

Compared to nominal local currency, this real exchange rate removes three kinds of effects. First, consumer price inflation is adjusted by multiplying each local currency per yen by consumer price index (CPI) in Japan divided by CPI in each country. Second, the CPI-adjusted exchange rate is weighted by import share from each country in each industry (where import share data is from JIP2011). Third, the source-weighted exchange rate is divided by the rate in 2005 to be standardized. An increase of this exchange rate in certain industry means the substantive rise in the value of the yen in the industry. We make two kinds of this exchange rate, which are in advanced economies defined by IMF in 2013, and in the other countries. Appendix A4 shows the country list used in making the source-weighted real exchange rate in this study.

4. Results

4.1 Inverted-U test

We test the inverted-U relationship between 1-li and 1-L, and patent in constant slope and fixed-effects slope models using OLS and within estimator at firm level (Table 1.1) and at industry level (Table 1.2). At firm level the inverted-U tests are all statistically significant. On the other hand, We find the same inverted-U curve, but the inverted-U curve is not observed at industry level when considering industry fixed effects. At industry level, the inverted-U curve is observed only in entire sample without considering industry fixed effects (columns 1 and 2 in Table 1.2). The extremum point of the inverted-U curve is about 1.00, and the 90% confidence interval are about from 0.95 to 1.05.

We next examine whether the inverted-U relationship is robust at firm level in a model in which inverted-U slope varies in each decade (Table 2.1 and 2.2) or each industry (Table 3). In a decade fixed-effects slope model (Table 2.1 and 2.2), without considering the fixed-effects intercept

of each firm (columns 1 and 2), inverted-U curves are significant both in entire sample and manufacturing industries in all of each decade except for 1960s. On the other hand, when controlling the fixed-effects intercept of each firm (columns 3 and 4), inverted-U curves are significant only in 1970s, 1980s and 1990s.

Tables 3 shows result of inverted-U tests in a industry fixed-effects slopes model in entire sample (Appendix Table A5 shows the detailed result of Table 3). Without considering the fixed-effects intercept of each firm (columns 1 and 2), inverted-U curves are statistically significant in 15 of 41 manufacturing industries and in 4 of 19 non-manufacturing industries. On the other hand, when controlling the fixed-effects intercept of each firm (columns 3 and 4), the inverted-U curves are not statistically significant except one of the service industries (i.e., #07:mining industry). We find the inverted-U curve seems robust when considering a constant slope using panel data of multiple industries with some decade, but is easy to be fragile when considering fixed-effects slopes of each decade or each industry.

In addition, we regress Pat and Cite on 1-li in order to check 1-Lerner index semi-elasticities (Table 4) using a following model:

$$\ln p_{it} = \beta_0 + \beta_1 c_{it} + \beta_k D_k c_{it} + \sum_{t=1965}^{2006} \lambda_t D_t + \alpha_i + u_{it}, k = 2...I$$
(19)

We refer to combined coefficient of c_{it} as *1–Lerner index* semi-elasticity. Without considering the fixed-effects intercept of each firm (columns 1 and 2 in Table 4), median of Lerner index semi-elasticity of Pat and Cite is 0.274 and -0.270, respectively. It means that an increase in *1–Lerner index* by 0.01 (1%) is correlated with 0.00274% and -0.0027% increases of Pat and Cite, respectively. On the other hand, when controlling firm fixed effects (columns 3 and 4 in Table 4), median of Lerner index semi-elasticity of Pat and Cite is 0.375 and 0.027, respectively. Medians of Lerner index semi-elasticity of Pat and Cite are 0.902 and 0.759, respectively, in manufacturing industries, and -1.514 and -1.346, respectively in non-manufacturing industries.

4.2 Test of technology gap spread hypothesis

In ABBGH, there are two kinds of innovation intensities for neck-and-neck firms (i.e., technology levels are neck-and-neck in industries) and for unleveled firms (i.e., follower firms), and the composition effect of the two intensities makes the inverted-U curve at industry level (proposition 1, 2, and 3). We check the propositions, dividing the entire sample into neck-and-neck firms (i.e., firms with above median technological gap) and unleveled firms (i.e., firms with above median technological gap). Without considering the fixed-effects intercept of each firm (columns 1, 2, 5, and 6 in Table 5), the inverted-U curves are all statistically significant. On the other hand, when controlling the fixed-effects intercept of each firm (columns 3, 4, 7, and 8), the inverted-U curve is statistically significant only in neck-and-neck firms.

Columns 1 and 2 of Table 6 shows TFP gap elasticities of Pat and Cite using within estimator. TFP gap elasticities of Pat and Cite are -0.333 and -0.507, respectively. It means an 0.01 increase in TFP gap of each firm within each industries is related to 0.00333% and 0.00507% decreases in Pat and Cite, respectively.

Table 6 also shows the test of the technology gap spread prediction (i.e., the proposition 4 in ABBGH). It reports the results from regressing firm-level or industry-average technology gap on the Lerner index with a full set of year dummies (Columns 3 and 5) and a full set of year and firm or industry dummies (Columns 4 and 6). At the firm level there is a significantly positive coefficient (Columns 3 and 4). On the other hand, at the industry level there is a significantly negative coefficient in Column 5, but is a positive significant relationship in Column 6. In our sample, when controlling fixed effects, the proposition 4 in ABBGH holds both at the firm level and industry-average level.

Tables 7.1 and 7.2 show the replicative result of proposition 5 in ABBGH, using interaction terms between 1–Lerner Index and TFP gap. At firm level, the baseline curve is inverted-U in a statistically significant way using OLS (columns 1 and 2 in Table 7.1), but not inverted-U using within estimator (columns 3 and 4). Then, because coefficient of $(1-li)^2 \cdot m_{it}$ is positively significant, the inverted-U curve is not steeper in the neck-and-neck firms than baseline (columns 1 and 2 in Table 7.1).

On the other hand, at industry level, the baseline curve is inverted-U in a statistically significant way only using $\ln Cite$ as a dependent variable (columns 2 and 4 in Table 7.2). Then, because coefficient of $(1-li)^2 \cdot m_{it}$ is positively significant in column 3 (OLS), and negatively significant in column 4 (within estimator), the inverted-U curve is not steeper in column 3 and steeper in column 4 in neck-and-neck industries than baseline.

In addition, we find the effect of interaction term between TFP gap and competition on Pat and Cite often turns over within the range of competition in an unstable way. For example, in industry-level regressions using lnCite as a dependent variable, the interaction terms between TFP gap and competition have a negative effect on Cite in [0.683, 1.101] and [0.954, 1.176], and a positive effect on Cite in [1.101, 1.176] and [0.683, 0.954] in columns 3 and 4 in Table 6.2, respectively.

4.3 Instrument variables estimation

We check whether the inverted-U will be detected when control endogeneity between competition and Lerner index using 2SLS and within 2SLS. Because we could make the real exchange rate only between 1980 to 2006 in certain industries, sub-sample size decreases to 37,958.

Table 7.1 and 7.2 show results of regressions and second stage of (within) 2SLS at firm level (Table 7.3 show result of first stage of 2SLS). First, using OLS without considering firm fixed-effects (in columns 1 and 3 of Table 7.1), we find the same inverted-U relationship using OLS in sub-sample. On the other hand, in second stage of 2SLS (in columns 2 and 4 of Table 7.1), the inverted-U curve is not statistically significant, and there is a negative relationship between 1–L and Pat and Cite. Second, using within estimator in this sub-sample (in columns 1 and 3 of Table 7.2), the inverted-U curve is not statistically significant. Using the sub-sample in second stage of within 2SLS (in columns 2 and 4 of Table 7.2), the inverted-U curve is not statistically significant. Using the sub-sample in second stage of within there is a negative relationship between 1–L and there is a negative relationship between 1.2), the inverted-U curve is not statistically significant. Using the sub-sample in second stage of within 2SLS (in columns 2 and 4 of Table 7.2), the inverted-U curve is not also statistically significant, and there is a negative relationship between 1–Lerner index and Pat (and Cite).

5. Conclusions

In this study we examine the robustness of ABBGH, which suggest an inverted-U relationship exists between competition and innovation. In a constant slope model using full dataset, we find the same inverted-U relationship as ABBGH do. On the other hand, in a fixed-effects slope model of each decade or each industry, inverted-U relationship could not be observed. When considering the endogeneity using the source-weighted real exchange rates as IVs, inverted-U is not observed. In addition, the technology gap spread hypothesis that expected technology gap increases with competition holds in this study. However, the interaction terms between competition and technology gap does not make the inverted-U relationship sharpened in this study. The effect of the interaction terms is often changed from positive to negative, or from negative to positive in the range of competition variable.

Our study and ABBGH show that when using several tens of industry data in several decades, the relationship between profit rate and innovation propensity seems inverted-U. It seems to suggest that firms or industries with low profit rate promote innovative activity because the extremum point of the inverted-U curve is near 1 in the 1-Lerner index. The inverted-U relationship is often fragile, however, when considering the slope of inverted-U curve varies in each decade or especially in each industry.

In manufacturing industries, when considering the fixed-effects slope of each industry and intercepts of each firm, the competition does often not affect innovation activity in a statistically significant way. The fixed-effects intercept is interpreted as technological opportunities in the literature (see Cohen (2010)). On the other hand, in non-manufacturing industries, when considering the fixed-effects slope of each industry and intercepts of each firm, firms with high profit rate often promote innovative activities (i.e., the median of 1-Lernear Index semi-elasticity of patent variables is about -1.5 in this study).

When it comes to competition policy, neck-and-neck industry (i.e., the technical gap is narrow in each firm) seems to promote innovative activity. A 1% decrease in TFP gap is correlated with a 0.3% increase in patent applications in this study (Table 5). However, competition policy which makes inefficient firms to withdrawal from market should be carefully considered before it is

implemented, following the literature. In the literature firm size is often positively correlated with R&D propensity, but negatively correlated with R&D productivity (Cohen and Klepper, 1996). Therefore, even if existing firms would get large in the market, innovation activities might be promoted by an increase in the number of firms rather than an increase in the size of each firm. This comparison is one of the remaining issues in the future study, and another remaining issue is that how follower firms act in each industry when a frontier firm develops its own technological capability.

References

- Acs, Z.J., and D.B. Audretsch, 1988a, "Innovation in Large and Small Firms: An Empirical Analysis," *American Economic Review*, Vol.78(4), pp. 678–690. http://www.jstor.org/stable/1811167
- Acs, Z.J., and D.B. Audretsch, 1988b, "Testing the Schumpeterian Hypothesis," *Eastern Economic Journal*, Vol.14(2), pp.129–140.
- Aghion, P., N. Bloom, R. Blundell, R. Griffith, and P. Howitt, 2005. "Competition and innovation: An inverted-U relationship," *The Quarterly Journal of Economics*, Vol.120(2), pp.701–728. DOI: 10.1162/0033553053970214
- Bertrand, M., 2004., "From the invisible handshake to the invisible hands? How import competition changes the employment relationship," *Journal of Labor Economics*, Vol.22(4), pp.723–765. DOI:0734-306X/2004/2204–0001\$10.00
- Blundell, R., R. Griffith, and J.V. Reenen, 1995, "Dynamic count data models of technological innovation," *The Economic Journal*, Vol.105(429), pp.333–344. http://www.jstor.org/stable/2235494
- Cohen, W. M., 2010, "Chapter 4 fifty years of empirical studies of innovative activity and performance," in B. H. Hall & N. Rosenberg, eds, Handbook of The Economics of. Innovation, Vol. 1, North-Holland, pp. 129–213. DOI: 10.1016/S0169-7218(10)01004-X
- Cohen, W.M, and S. Klepper, 1996, "A reprise of size and R&D," *Economic Journal*, Vol.106 (437), pp.925–951. DOI:10.2307/2235365

- Correa, J.A., 2012, "Innovation and competition: an unstable relationship," *Journal of Applied Econometrics*, Vol.27(1), pp.160–166. DOI: 10.1002/jae.1262
- Fukao, K., S. Hamagata , T. Inui, K. Ito, H.U. Kwon, T. Makino, T. Miyagawa, Y. Nakanishi, and J. Tokui, 2007, "Estimation Procedures and TFP Analysis of the JIP Database 2006," RIETI Discussion Paper Series, 07-E-003. URL: http://www.rieti.go.jp/en/publications/summary/07010003.html
- Goto, A., and K. Motohashi, 2007, "Construction of a Japanese Patent Database and a first look at Japanese patenting activities," *Research Policy*, Vol.36(9), pp.1431–1442. DOI: 10.1016/j.respol.2007.06.005
- Hall, B.H., A.B. Jaffe, and M. Trajtenberg, 2001, "The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools," NBER Working Paper No. 8498. October 2001.
- Hayashi, F., and T. Inoue, 1991, "The relation between firm growth and Q with multiple capital goods: Theory and evidence from panel data on Japanese Firms," *Econometrica*, Vol.59(3), pp.731–753. Stable URL: http://www.jstor.org/stable/2938226
- Ijichi, H, T. Iwasa, H. Odagiri, H. Keira, T. Koga, A. Goto, Y. Tawara, A. Nagata, and Y. Hirano, 2004, "Report on Japanese National Innovation Survey 2003," Ministry of Education, Culture, Sports, Science and Technology, National Institure of Science and Technology Policy. http://hdl.handle.net/11035/871
- Ijichi, H, T. Iwasa, H. Odagiri, H. Keira, T. Koga, A. Goto, Y. Tawara, A. Nagata, and Y. Hirano, 2010, "Report on Japanese National Innovation Survey 2009," Ministry of Education, Culture, Sports, Science and Technology, National Institure of Science and Technology Policy. http://hdl.handle.net/11035/657
- Inui, T., A. Kawakami, and T. Miyagawa, 2012, "Market competition, differences in technology, and productivity improvement: An empirical analysis based on Japanese manufacturing firm data," *Japan and the World Economy*, Vol.24(3), pp.197–206.
- Kamien, M.I., and N.L. Schwartz, 1975, "Market structure and innovation: a survey," Journal of Economic Literature, Vol.13(1), pp.1–37.

- Lind, J.T., and H. Mehlum, 2010, "With or Without U? The Appropriate Test for a U-Shaped Relationship," *Oxford Bulletin of Economics and Statistics*, Vol.72(1), pp.109–118. DOI: 10.1111/j.1468-0084.2009.00569.x
- Motohashi, K., 2012, "Open Innovation and Firm's Survival: An empirical investigation by using a linked dataset of patent and enterprise census", RIETI Discussion Paper Series 12-E-036. http://www.rieti.go.jp/jp/publications/dp/12e036.pdf
- Schumpeter, J., 1934, "The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle," Cambridge, Mass: Harvard University Press.
- Tingvall, P.G., and A. Poldahl, 2006, "Is there really an inverted U-shaped relation between competition and R&D?", *Economics of Innovation and New Technology*, Vol.15(2), pp.101–118. DOI: 10.1080/10438590500129755

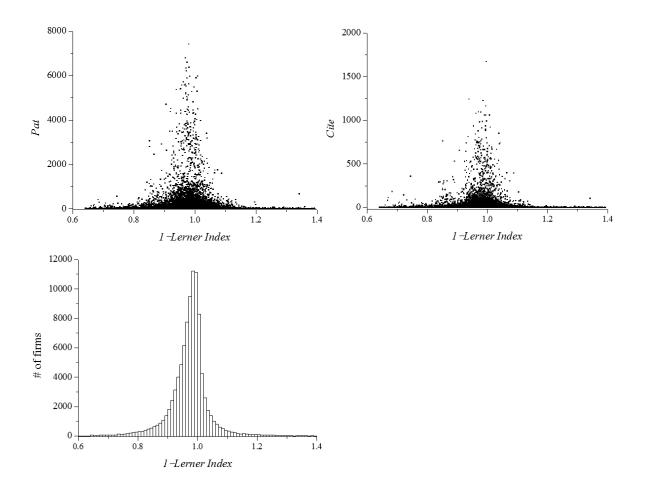


Figure 1. Scatter plots of the number of patent application and cited weighted patents, and histogram of the number of firms (0.01 interval) towards 1–*Lerner index*

Entire sample	1	2	3	4
Dep.	lnPat	InCite	lnPat	lnCite
Procedure	OLS	OLS	within	Within
	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)
1-li	50.735***	48.150***	6.192***	7.498***
	(2.308)	(2.412)	(1.590)	(1.775)
$(1-li)^2$	-25.927***	-24.766***	-3.095***	-3.754***
	(1.183)	(1.236)	(0.792)	(0.884)
Constant	-28.693***	-30.649***	-8.43***	-12.226***
	(1.139)	(1.190)	(0.803)	(0.896)
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	94510	94510	94510	94510
Group			3459	3459
Year	64-06	64-06	64-06	64-06
Adj-R2	0.020	0.039		
Within R2			0.161	0.205
Inverted U test	-21.003***	19.317***	3.777***	-4.085***
	Inverted-U	Inverted-U	Inverted-U	Inverted-U
Extremum point	0.978	0.972	1.000	0.999
90% confidence interval	[0.970, 0.987]	[0.962, 0.981]	[0.943, 1.058]	[0.947, 1.050]
Manufacturing Industries	5	6	7	8
Dep.	lnPat	lnCite	lnPat	InCite
Procedure	OLS	OLS	within	within
	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)
1-li	55.255***	56.265***	14.493***	16.233***
	(3.225)	(3.567)	(2.359)	(2.702)
$(1-li)^2$	-29.925 ***	-30.623***	-6.938***	-7.880 ***
	(1.628)	(1.801)	(1.166)	(1.335)
constant	-28.277 ***	-32.280***	-10.715 ***	-15.293***
	(1.609)	(1.779)	(1.195)	(1.368)
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	55062	55062	55062	55062
Group			1691	1691
Year	64-06	64-06	64–06	64-06
Adj-R2	0.073	0.109		
Within R2			0.1992	0.270
Inverted U test	14.546***	13.240***	-5.233***	-5.404***
	Inverted-U	Inverted-U	Inverted-U	Inverted-U
Extremum point 90% confidence interval	0.923	0.919	1.044	1.030
	[0.911, 0.934]	[0.905, 0.931]	[1.014, 1.084]	[1.000, 1.067]

Table 1.1 Inverted-U test in entire sample and manufacturing industries at firm level

Dep. Procedure l-L $(l-L)^2$ Constant Year dummy Industry fixed effects Obs Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval Manufacturing Industries Dep. Procedure	InPat OLS Coef.(S.E.) 114.460** (65.830) -72.615** (-2.15) -72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995 (0.962, 1.249]	InCite OLS Coef.(S.E.) 261.885*** (60.989) -134.641*** (31.336) -130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973 [0.955, 0.990]	InPat within Coef.(S.E.) -126.091*** (33.559) 62.880*** (17.093) 62.643*** (16.475) Yes Yes 2580 60 64-06 0.1669 -	InCite Within Coef.(S.E.) 33.344 (26.354) -20.098 (13.423) -16.783 (12.938) Yes Yes 2580 60 64-06 0.6073 0.730
I-L $(I-L)^2$ Constant Year dummy Industry fixed effects Obs Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	Coef.(S.E.) 114.460** (65.830) -72.615** (-2.15) -72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	Coef.(S.E.) 261.885*** (60.989) -134.641*** (31.336) -130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	Coef.(S.E.) -126.091*** (33.559) 62.880*** (17.093) 62.643*** (16.475) Yes Yes Yes 2580 60 64-06	Coef.(S.E.) 33.344 (26.354) -20.098 (13.423) -16.783 (12.938) Yes Yes 2580 60 64-06 0.6073
$(1-L)^2$ Constant Year dummy Industry fixed effects Obs Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	114.460** (65.830) -72.615** (-2.15) -72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	261.885*** (60.989) -134.641*** (31.336) -130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	-126.091*** (33.559) 62.880*** (17.093) 62.643*** (16.475) Yes Yes 2580 60 64-06	33.344 (26.354) -20.098 (13.423) -16.783 (12.938) Yes Yes 2580 60 64-06 0.6073
$(1-L)^2$ Constant Year dummy Industry fixed effects Obs Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	(65.830) -72.615** (-2.15) -72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	(60.989) -134.641*** (31.336) -130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	(33.559) 62.880*** (17.093) 62.643*** (16.475) Yes Yes 2580 60 60 64-06	(26.354) -20.098 (13.423) -16.783 (12.938) Yes Yes 2580 60 64-06 0.6073
Constant Year dummy Industry fixed effects Obs Group Year Adj–R2 Within R2 Inverted U test Extremum point 90% confidence interval Manufacturing Industries Dep.	-72.615** (-2.15) -72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	-134.641*** (31.336) -130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	62.880*** (17.093) 62.643*** (16.475) Yes Yes 2580 60 60 64-06	-20.098 (13.423) -16.783 (12.938) Yes Yes 2580 60 64-06 0.6073
Constant Year dummy Industry fixed effects Obs Group Year Adj–R2 Within R2 Inverted U test Extremum point 90% confidence interval Manufacturing Industries Dep.	(-2.15) -72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	(31.336) -130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	(17.093) 62.643*** (16.475) Yes Yes 2580 60 64-06	(13.423) -16.783 (12.938) Yes Yes 2580 60 64-06 0.6073
Year dummy Industry fixed effects Obs Group Year Adj–R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	-72.115** (-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	-130.536*** (29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	62.643*** (16.475) Yes Yes 2580 60 64-06	-16.783 (12.938) Yes Yes 2580 60 64-06 0.6073
Year dummy Industry fixed effects Obs Group Year Adj–R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	(-2.25) Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	(29.679) Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	(16.475) Yes Yes 2580 60 64-06	(12.938) Yes 2580 60 64-06 0.6073
Industry fixed effects Obs Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	Yes No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	Yes No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	Yes Yes 2580 60 64-06	Yes Yes 2580 60 64-06 0.6073
Industry fixed effects Obs Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	No 2580 64-06 0.0187 -1.888* Inverted-U 0.995	No 2580 64-06 0.1681 -4.24*** Inverted-U 0.973	Yes 2580 60 64–06	Yes 2580 60 64-06 0.6073
Obs Group Year Adj–R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	2580 64-06 0.0187 -1.888* Inverted-U 0.995	2580 64-06 0.1681 -4.24*** Inverted-U 0.973	2580 60 64-06	2580 60 64-06 0.6073
Group Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	64-06 0.0187 -1.888* Inverted-U 0.995	64-06 0.1681 -4.24*** Inverted-U 0.973	60 64–06	60 64-06 0.6073
Year Adj-R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	0.0187 -1.888* Inverted-U 0.995	0.1681 -4.24*** Inverted-U 0.973	64-06	64-06 0.6073
Adj–R2 Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	0.0187 -1.888* Inverted-U 0.995	0.1681 -4.24*** Inverted-U 0.973		0.6073
Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	-1.888* Inverted-U 0.995	-4.24*** Inverted-U 0.973	0.1669	0.6073
Within R2 Inverted U test Extremum point 90% confidence interval [Manufacturing Industries Dep.	Inverted-U 0.995	Inverted-U 0.973	0.1669 -	
Extremum point 90% confidence interval [Manufacturing Industries Dep.	Inverted-U 0.995	Inverted-U 0.973	_	0.730
90% confidence interval [Manufacturing Industries Dep.	0.995	0.973		
90% confidence interval [Manufacturing Industries Dep.				
90% confidence interval [Manufacturing Industries Dep.	0.962, 1.249]	[0.055, 0.000]		
Manufacturing Industries Dep.		[0.933, 0.990]		
Dep.				
	5	6	7	8
Procedure	lnPat	lnCite	lnPat	lnCite
	OLS	OLS	within	Within
	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)
1-L	-111.582**	-73.433	-31.089	-14.454
	(53.656)	(57.493)	(23.887)	(26.430)
$(1-L)^2$	55.256**	36.121	15.233	6.662
	(27.451)	(29.414)	(12.108)	(13.397)
constant	58.856**	38.139	18.510	8.700
	(26.207)	(28.081)	(11.773)	(13.026)
Year dummy	Yes	Yes	Yes	Yes
Industry fixed effects	No	No	Yes	Yes
Obs	1517	1517	1517	1517
Group			41	41
Year	64-06	64-06	64-06	64-06
Adj-R2	-0.0052	0.1852		
Within R2			0.1101	0.6717

Table 1.2 Inverted-U test in entire sample and manufacturing industries at industry level

	Entire sample	1	2	3	4
	Dep.	lnPat	lnCite	lnPat	lnCite
	Procedure	OLS	OLS	within	within
Period		Combined	Combined	Combined	Combined
		Coef.	Coef.	Coef.	Coef.
1960s	1-li	28.199***	20.590**	-16.486***	-17.857***
	2	(9.157)	(9.570)	(5.058)	(5.643)
	$(1-li)^2$	-17.372***	-12.858 * * *	10.754***	12.327***
		(4.668)	(4.879)	(2.586)	(2.885)
1970s	1-li	43.573***	41.219***	12.779***	15.103***
	(1.1.2)	(5.599)	(5.851)	(3.112)	(3.472)
	$(1-li)^2$	-22.958***	-21.708**	-5.165***	-6.023**
1000	1 1.	(2.779)	(8.438)	(1.539)	(2.947)
1980s	1-li	62.097***	61.424***	23.701***	26.935***
	$(1 + 1)^2$	(5.920) -33.085***	(6.186) -33.277***	(3.372)	(3.762)
	$(1-li)^2$	(3.059)	(10.218)	-11.683*** (1.727)	-13.553*** (3.710)
1990s	1-li	56.243***	56.969***	12.163***	14.318***
19908	$I = \iota \iota$	(4.714)	(4.927)	(2.810)	(3.135)
	$(1-li)^2$	-27.242^{***}	(4.927) -27.941***	-6.519***	-7.998***
	$(1 \ u)$	(2.416)	(6.375)	(1.415)	(2.494)
2000s	1-li	45.782***	42.098***	0.684	0.167
20005	1 11	(3.933)	(4.111)	(2.472)	(2.758)
	$(1-li)^2$	-22.581***	-20.823***	-1.786	-1.574
	(1 11)	(2.055)	(4.614)	(1.268)	(2.001
common	constant	-22.961***	-25.210***	-14.516***	-18.692***
		(2.827)	(2.955)	(1.654)	(1.845)
	Year dummy	Yes	Yes	Yes	Yes
	Firm fixed effects	No	No	Yes	Yes
	Obs	94510	94510	94510	94510
	Group			3459	3459
	Year	70-06	70-06	70-06	70-06
	Adj-R2	0.0217	0.0396		
	Within R2			0.1640	0.2088
1960s	Inverted-U test	1.828*	1.211	-	-
	(Result)	Inverted-U			
	Exremum point	0.812			
	90% confidence interval	[0.616, 0.880]			
1970s	Inverted-U test	6.812***	6.172***	-1.322	-1.234
	(Result)	Inverted-U	Inverted-U		
	Exremum point	0.949	0.949		
	90% confidence interval	[0.920,0.972]	[0.916, 0.975]		
1980s	Inverted-U test	9.635***	8.788***	-5.966***	-6.541***
	(Result)	Inverted-U	Inverted-U	Inverted-U	Inverted-U
	Exremum point	0.938	0.923	1.014	0.994
	90% confidence interval	[0.921, 0.954]	[0.903, 0.939]	[0.989, 1.048]	[0.969, 1.022]
1990s	Inverted-U test	-9.425***	-9.578***	3.733***	3.573***
	(Result)	Inverted-U	Inverted-U	Inverted-U	Inverted-U
	Exremum point	1.032	1.019	0.933	0.895
	90% confidence interval	[1.015, 1.054]	[1.002, 1.040]	[0.867, 0.974]	[0.820, 0.937]
2000s	Inverted-U test	-9.190***	-8.170***		
	(Result)	Inverted-U	Inverted-U		
	Exremum point	1.014	1.011		
	90% confidence interval	[0.994, 1.038]	[0.989, 1.038]		

Table 2.1 Inverted–U test of Fixed–effects Slopes of each decade at firm level in entire sample

		1	2	3	4
	Dep.	lnPat	lnCite	lnPat	InCite
	Procedure	OLS	OLS	within	within
Period		Combined	Combined	Combined	Combined
		Coef.	Coef.	Coef.	Coef.
1960s	1-li	45.613***	38.271***	-4.515	-11.254
		(11.338)	(12.540)	(6.862)	(7.853
	$(1-li)^2$	-26.504***	-21.966***	5.027	9.451**
		(5.799)	(6.414)	(3.505)	(4.011
1970s	1-li	63.410***	66.145***	22.609***	28.049***
	2	(6.474)	(7.160)	(4.052)	(4.637
	$(1-li)^2$	-33.701***	-34.756***	-9.579**	-11.834**
		(10.227)	(12.512)	(3.971)	(5.201
1980s	1-li	74.935***	79.445***	33.792***	39.384***
	2	(7.721)	(8.540)	(4.936)	(5.648
	$(1-li)^2$	-40.792***	-43.729**	-16.595^{***}	-19.733**
		(15.430)	(18.878)	(6.221)	(8.147
1990s	1-li	57.541***	63.359***	10.070**	12.333**
		(6.714)	(7.426)	(4.441)	(5.083
	$(1-li)^2$	-29.852***	-33.289**	-5.542	-7.320
		(11.444)	(14.001)	(4.879)	(6.390
2000s	1-li	39.786***	37.740***	9.408**	6.85
		(6.569)	(7.265)	(4.271)	(4.888
	$(1-li)^2$	-22.219*	-21.582	-6.647	-5.802
		(11.352)	(13.888)	(4.727)	(6.190
common	constant	-22.122***	-22.992***	-2.617	-5.538**
		(-3.98)	(6.15)	(2.107)	(2.412)
	Year dummy	Yes	Yes	Yes	Yes
	Firm fixed effects	No	No	Yes	Yes
	Obs	55009	55009	55009	55009
	Group			1691	1691
	Year	64-06	64-06	64-06	64-06
	Adj-R2	0.0738	0.1096		
	Within R2			0.2034	0.2749
1960s	Inverted-U test	2.925***	2.298**	-	-
	(Result)	Inverted-U	Inverted-U		
	Exremum point	0.860	0.871		
	90% confidence interval	[0.764, 0.906]	[0.717, 0.925]		
1970s	Inverted-U test	8.359***	8.075***	-2.621***	-2.762***
	(Result)	Inverted-U	Inverted-U	Inverted-U	Inverted-U
	Exremum point	0.941	0.952	1.180	1.185
	90% confidence interval	[0.917, 0.960]	[0.928, 0.971]	[1.122, 1.305]	[1.129, 1.298]
1980s	Inverted-U test	8.287***	7.738***	-6.009***	-6.581***
17005	(Result)	Inverted-U	Inverted-U	Inverted-U	Inverted-U
	Exremum point	0.919	0.908	1.018	0.998
	90% confidence interval	[0.897, 0.936]	[0.884, 0.927]	[0.994, 1.048]	[0.975, 1.023]
1990s	Inverted-U test	7.956***	7.719***	1.808*	1.570
17703					1.570
	(Result)	Inverted–U	Inverted–U	Inverted–U	
	Exremum point	0.964	0.952	0.909	
2000.	90% confidence interval	[0.942, 0.983]	[0.929, 0.971]	[0.546, 0.980]	
2000s	Inverted-U test	4.896***	3.944***	0.580	-
	(Result)	Inverted-U	Inverted-U		
		0.005	1 1 1 7 1		
	Exremum point 90% confidence interval	0.895 [0.850, 0.926]	0.874 [0.812, 0.912]		

Table 2.2 Inverted-U test of Fixed-effects Slopes of each decade at firm level in manufacturing industries

	1	2	3	4
Dep.	lnPat	lnCite	lnPat	lnCite
Procedure	OLS	OLS	within	within
Industry	Inv-U	Inv-U	Inv-U	Inv-U
	test	test	test	test
Manufacturing industries				
#08 Livestock products	-0.41	-0.36	-0.54	-0.29
#10 Flour and grain mill products	0.42	0.31	-0.02	-
#11 Miscellaneous foods and related products	2.74***	2.31**	—	-
#12 Prepared animal foods and organic fertilizers	_	-	-	-
#13 Beverages	-0.11	-0.06	-	-
#15 Textile products	3.08***	2.62***	-	-
#16 Lumber and wood products	1.50	1.29	-	-
#18 Pulp, paper, and coated and glazed paper	1.86*	1.52	-	-
#20 Printing, plate making for printing and bookbinding	1.35	1.03	0.16	-
#22 Rubber products	1.72*	1.51	0.08	-0.18
#23 Chemical fertilizers	-0.77	-0.87	-0.52	-0.25
#24 Basic inorganic chemicals	-	-	-	-0.14
#25 Basic organic chemicals	-	-	-	-
#26 Organic chemicals	2.48**	1.99**	-	0.03
#28 Miscellaneous chemical products	-1.53	-1.40	_	-0.03
#29 Pharmaceutical products	3.36***	2.77***	_	-0.13
#30 Petroleum products	-0.67	1.03	-0.25	-0.24
#32 Glass and its products	1.57	1.20	0.16	0.16
#33 Cement and its products	-1.72*	1.68*	-1.35	-0.82
#34 Pottery	0.72	0.45	-0.27	-0.48
#35 Miscellaneous ceramic, stone and clay products	_	_	-0.07	-0.03
#36 Pig iron and crude steel	-1.25	-1.23	-0.34	-0.36
#37 Miscellaneous iron and steel	-0.88	-0.65	_	-0.29
#38 Smelting and refining of non-ferrous metals	-0.02	_	-0.15	_
#39 Non-ferrous metal products	-1.32	-0.69	-0.48	-0.27
#40 Fabricated constructional and architectural metal products	-0.15	_	_	-0.03
#41 Miscellaneous fabricated metal products	2.28**	1.86*	-0.60	-0.41
#42 General industry machinery	2.77***	2.34**	-0.31	-0.20
#43 Special industry machinery	-3.06***	-3.09***	-0.23	-0.34
#44 Miscellaneous machinery	-3.08***	2.99***	_	0.10
#45 Office and service industry machines	1.64	1.22	_	-0.68
#46 Electrical generating, transmission, distribution and	-1.41	-1.27	-0.69	-0.72
industrial apparatus				
#47 Household electric appliances	3.40***	-2.63***	_	-0.26
#49 Communication equipment	-0.53	-0.07	-0.36	-0.21
#52 Electronic parts	-3.25***	2.94***	_	-0.01
#53 Miscellaneous electrical machinery equipment	-3.56***	3.05***	-0.18	-0.41
#54 Motor vehicles	0.85	0.80	_	0.04
#55 Motor vehicle parts and accessories	_	_	-0.64	-0.37
#56 Other transportation equipment	1.97**	1.72*	0.05	-0.03
#57 Precision machinery & equipment	3.07***	2.70***	_	_
#59 Miscellaneous manufacturing industries	2.46**	2.26**	_	-0.36
Non-manufacturing industries				
#07 Mining	-5.77***	-5.33***	-3.33***	-2.99**
#09 Seafood products	_	_	0.45	0.26
#60 Construction	1.82*	1.59	-0.29	-0.37
#61 Civil engineering	-0.60	-0.91	-0.55	0.05
#62 Electricity	-	-0.11	-0.09	-0.76
#63 Gas, heat supply	-1.17	1.00	-0.22	-0.01
#67 Wholesale	-1.06	-0.78	-	-
#68 Retail	1.94*	1.80*	_	0.04
	2.23**	1.99**	_	- 0.04
#69 Finance				
#69 Finance #71 Real estate			0.23	0.16
#69 Finance #71 Real estate #73 Railway	-1.43 1.49	-1.47 1.37	0.23	0.16

Table 3 Inverted–U test of Fixed–effects Slope of each industry at firm level

#75 Water transportation	1.94*	1.56	-	-
#76 Air transportation	-0.43	0.70	-0.14	-
#77 Other transportation and packing	1.36	1.10	_	-
#78 Telegraph and telephone	1.31	1.18	_	-
#89 Entertainment	-1.94*	-1.64	_	-
#95 Accommodation	-1.35	-1.26	_	-
#110 Other services	2.91***	2.45**	_	-
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	94510	94510	94510	94510
Group			3459	3459
Year	64-06	64-06	64-06	64-06
Adj-R2	0.3662	0.3696		
Within R2			0.1669	0.2113
# of significant Inverted-U slopes				
Entire sample (60 industries)	24	19	1	1
Manufacturing industries (41 industries)	17	15	0	0
Non-manufacturing industries (19 industries)	7	4	1	1

Note: In regression model, ***, **, and * denote significances at the 1, 5, and 10% level, respectively. Detailed result of these

regression is shown in Appendix Table A5

Dep.		l lnPat		2 InCite		3 InPat		4 InCite	
proced	lure	OLS		OLS		Within		Within	
Industr		Combined		Combined		Combined		Combined	
	-	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Manuf	acturing								
#08	1-li	0.440*	0.238	-0.244	0.257	13.692***	3.351	8.898**	0.257
#10	1-li	-1.065^{***}	0.270	-1.111***	0.321	0.789	4.054	-1.773	0.321
#11	1-li	-1.464^{***}	0.195	-1.879 * * *	0.230	-1.903*	1.059	-1.661	0.230
#12	1-li	-1.229***	0.286	-2.353***	0.251	44.434***	8.440	54.131***	0.251
#13	1-li	0.247	0.259	-0.474	0.313	-3.092	2.608	-1.866	0.313
#15	1-li	-0.665^{***}	0.190	-1.150***	0.208	-2.515***	0.700	-2.141	0.208
#16	1-li	-0.604 **	0.238	-1.048 * * *	0.183	-5.294***	1.918	-6.872^{***}	0.183
#18	1-li	-0.628 * * *	0.203	-1.089***	0.198	-1.493	1.338	-2.908	0.198
#20	1-li	-0.750***	0.241	-1.072^{***}	0.202	-5.411*	3.121	-6.200	0.202
#22	1-li	1.937***	0.219	1.679***	0.213	-3.709*	2.093	-0.561	0.213
#23	1-li	0.685**	0.290	0.067	0.279	-1.807	3.768	0.384	0.279
#24	1-li	2.886***	0.231	2.749***	0.292	4.205	2.909	9.569*	0.292
#25	1-li	4.987***	0.334	5.029***	0.340	5.994	4.148	-0.936	0.340
#26	1-li	2.784***	0.207	2.656***	0.322	1.092	1.632	-1.009	0.322
#28	1-li	2.564***	0.193	2.320***	0.128	3.279***	0.834	3.860*	0.128
#29	1-li	2.834***	0.217	2.001***	0.144	3.706***	0.848	2.605**	0.144
#30	1-li	0.821***	0.239	0.212	0.197	9.801***	3.796	3.446	0.197
#32	1-li	2.553***	0.260	2.224***	0.264	-1.557	2.379	-3.473	0.264
#33	1-li	0.301	0.219	0.235	0.241	3.451**	1.685	0.759	0.241
#34	1-li	0.626**	0.247	0.470**	0.226	0.902	1.950	1.203	0.226
#35	1-li	0.198	0.220	-0.297	0.224	8.755***	1.538	11.258***	0.224
#36	1-li	0.356*	0.214	0.061	0.181	-0.205	1.009	-1.758	0.181
#37	1-li	-0.057	0.202	-0.638***	0.158	5.375***	1.208	6.597***	0.158
#38	1-li	1.933***	0.238	1.944***	0.196	5.704***	1.751	4.587*	0.196
#39	1-li	1.794***	0.207	1.430***	0.202	1.492	1.855	4.458	0.202
#40	1-li	-2.998***	0.239	-3.530***	0.202	6.199**	2.445	9.928***	0.202
#41	l-li	-0.107	0.200	-0.725***	0.190	1.435	1.122	-0.104	0.190
#42	l-li	0.752***	0.203	0.456***	0.132	1.457	1.014	1.069	0.132
#43	l-li	1.455***	0.191	0.909***	0.122	0.683	0.507	0.410	0.122
#44 #45	1-li	1.302***	0.198	0.941***	0.110	0.254	0.773	-0.589	0.110
#45 #46	1-li	1.956*** 3.204***	0.306	1.064*** 3.014***	0.277	-2.518 3.188**	2.842	-0.899	0.277
#46 #47	1-li		0.208	3.962***	0.283		1.275	5.141	0.283
#47 #49	1–li 1–li	3.918*** 3.117***	0.203 0.206	3.122***	0.143 0.147	-2.994*** 2.750**	1.085 1.152	2.685 4.853***	0.143 0.147
#49 #52	1-li 1-li	2.022***	0.200	1.949***	0.147	4.260***	0.923	4.855***	0.147
#52 #53	1-li 1-li	2.512***	0.204	2.407***	0.144	0.551	0.923	0.347	0.144
#55 #54	1 - li	5.205***	0.202	5.546***	0.135	-5.727	3.776	-2.305	0.133
#54 #55	1 - li	1.899***	0.237	1.680***	0.188	13.662***	1.839	17.292***	0.188
#56	1 - li	0.415**	0.200	0.043	0.170	-0.668	1.511	0.923	0.170
#57	1 - li	3.118***	0.209	3.057***	0.142	-2.804***	0.967	-0.332	0.142
#59	l - li	0.717***	0.204	0.377***	0.144	-0.292	1.299	3.744**	0.144
	anufacturin							-	
#07	1–li	-2.225***	0.249	-2.506***	0.269	1.574	1.381	2.391	1.541
#09	1-li	0.238	0.285	-0.847***	0.290	-0.744	4.086	0.392	0.290
#60	1-li	-1.196***	0.194	-1.297***	0.123	-1.592	1.419	0.158	0.123
#61	1-li	-1.552***	0.193	-2.109***	0.104	0.495	1.352	-3.571	0.104
#62	1-li	0.718***	0.262	0.463**	0.216	14.242***	3.430	6.242	0.216
#63	1-li	-1.508***	0.255	-1.960***	0.276	1.365	2.382	2.594	0.276
#67	1-li	-3.829***	0.186	-4.096***	0.194	-2.650 ***	0.824	-3.679	0.194
#68	1-li	-5.239***	0.192	-5.172 ***	0.084	-4.402***	1.199	-5.855***	0.084
#69	1-li	-5.308***	0.221	-5.292***	0.151	-1.770 **	0.826	-0.921	0.151
#71	1-li	-4.871***	0.210	-4.796***	0.166	-0.304	0.754	-0.802	0.166
#73	1-li	-4.308***	0.211	-4.185***	0.152	1.090	1.461	2.649	0.152
#74	1-li	-4.307***	0.214	-4.483***	0.172	-10.187 ***	3.460	-5.071	0.172
	1-li	-4.396***	0.209	-4.418 * * *	0.164	-3.922***	1.124	-8.001**	0.164

Table 4. 1–Lerner Index semi-elasticity of Pat and Cite in each industry

#76	1-li	-1.743***	0.300	-2.140 * * *	0.286	6.868*	3.801	-2.611	0.286
#77	1-li	-5.220 ***	0.211	-5.008 * * *	0.285	-7.127 ***	1.478	-9.711**	0.285
#78	1-li	-1.606^{***}	0.247	-1.929***	0.211	-1.780	1.724	-1.255	0.211
#89	1-li	-5.102 ***	0.220	-4.912***	0.218	-1.514*	0.867	-2.084	0.218
#95	1-li	-5.035 * * *	0.251	-4.771***	0.227	-4.647***	1.527	-5.774***	0.227
#110	1-li	-4.253***	0.196	-4.439***	0.207	-1.128***	0.433	-1.346	0.207
	constant	-3.899	0.204	-6.994***	0.221	-5.507 ***	0.203	-8.649***	0.226
Year du	mmy	Yes		Yes		Yes		Yes	
Firm fix	ted effects	No		No		Yes		Yes	
(Obs	94510		94510		94510		94510	
G	roup					3459		3459	
Ŋ	lear	64-06		64-06		64-06		64-06	
Ad	lj–R2	0.3918		0.3605					
Wit	hin R2					0.1669		0.2089	
Entire	e sample								
Me	edian	0.274	ŀ	-0.27	0	0.375	5	0.027	1
[min	n, max]	[-5.308, 5	.205]	[-5.292, 5	.546]	[-10.187, 4	4.434]	[-9.711, 54.131]	
Manut	facturing								
Ind	ustries								
Me	edian	0.821		0.470)	0.902	2	0.759)
[min	n, max]	[-2.998, 5	.205]	[-3.530, 5	.546]	[-5.727, 44	1.434]	[-6.872, 54	4.131]
Non-M	anufacturi	L /		L /		L /		Ľ /	
ng In	dustries								
U	edian	-4.25	3	-4.18	5	-1.51	4	-1.34	6
[min	n, max]	[-5.308, 0		[-5.292, 0		[-10.187, 1		[-9.711, 6	

Neck-and-neck firms				
(i.e. firm's TFP is above the median)	1	2	3	4
Dep.	lnPat	lnCite	lnPat	lnCite
Procedure	OLS	OLS	within	within
	Coef.	Coef.	Coef.	Coef.
	(S.E.)	(S.E.)	(S.E.)	(S.E.)
1-li	62.068***	60.763***	13.401***	14.818***
	(4.925)	(5.392)	(3.565)	(4.152)
$(1-li)^2$	-32.285***	-31.700***	-6.519***	-7.232***
	(2.568)	(2.812)	(1.805)	(2.102)
Constant	-29.889 * * *	-32.842^{***}	-7.299 ***	-11.802***
	(2.374)	(2.599)	(1.767)	(2.058)
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	39286	39286	39286	39286
Group			2240	2240
Year	64-06	64-06	64-06	64-06
Adj-R2	0.0375	0.0579		
Within R2			0.1186	0.1740
Inverted U test	-12.228***	-11.038***	-3.157***	-3.036***
	Inverted-U	Inverted-U	Inverted-U	Inverted-U
Extremum point	0.961	0.958	1.028	1.024
90% confidence interval	[0.949, 0.974]	[0.945, 0.972]	[0.981, 1.111]	[0.976, 1.112]
TT 1 1 10				
Unleveled firms	~	6	7	0
(i.e. firm's TFP is below the median)	5	6	7	8
Dep.	lnPat OLS	lnCite OLS	InPat	InCite
Procedure			within	within
	Coef.	Coef.	Coef.	Coef.
1 1.	(S.E.)	(S.E.)	(S.E.)	(S.E.)
1–li	35.135***	32.392***	2.553	3.114
$(1-li)^2$	(2.549)	(2.581)	(1.765)	(1.937)
(1-ll)	-17.242^{***}	-16.072^{***}	-1.283	-1.584*
	(1.298)	(1.314)	(0.871)	(0.956)
constant	-21.774 ***	-23.321***	-5.323*** (0.903)	-8.894***
V	(1.273)	(1.288)		(0.991)
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	55224	55224	55224	55224
Group	64.00	64.06	3302	3302
Year	64-06	64-06	64-06	64–06
Adj-R2	0.011	0.0262	0 1471	0 1002
Within R2	11	11.000-5-5-5	0.1471	0.1803
Inverted U test	-11.611***	-11.009***	1.367	1.485
	Inverted-U	Inverted-U		
Extremum point 90% confidence interval	1.019	1.008		
	[1.003, 1.036]	[0.991, 1.026]		

Table 5 In	erted-U test of neck-and-neck firms and unleveled firms in entire sample
Neck-and-ne	firms

	1	2	3	4	5	6
	Firm level	Firm level	Firm level	Firm level	Industry Average	Industry Average
Dep.	lnPat	InCite	TFP gap	TFP gap	TFP gap	TFP gap
procedure	Within	Within	OLS	Within	OLS	Within
•	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
	(S.E.)	(S.E.)	(S.E.)	(S.E.)	(S.E.)	(S.E.)
m_{it} (TFP gap)	-0.333***	-0.507***				
	(0.064)	(0.074)				
1-li			0.356***	0.489***	-0.242 **	0.408***
			(0.012)	(0.010)	(0.112)	(0.075)
Constant	-4.506***	-7.717***	-0.009 * * *	-0.194 ***	0.456***	-0.173**
	(0.056)	(0.066)	(0.013)	(0.010)	(0.111)	(-2.36)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	No	Yes		
ndustry fixed effects					No	Yes
Obs	78932	78932	78471	78471	2082	2082
Group	2887	2887		2882		59
Year	70-06	70-06	70-06	70-06	70-06	70-06
Adj-R2			0.1300		0.0145	
Within R2	0.0931	0.1379		0.2392		0.1069

Table 6 TFP gap semi-elasticity of innovation and Test of TFP gap spread hypothesis

	1	2	3	4
	Firm level	Firm level	Firm level	Firm level
Dep.	lnPat	lnCite	lnPat	InCite
procedure	OLS	OLS	Within	Within
	Coef.	Coef.	Coef.	Coef.
	(S.E.)	(S.E.)	(S.E.)	(S.E.)
1–li	44.702***	43.534***	4.491***	4.177*
	2.849	3.086	1.947	2.282
$(1-li)^2$	-21.644***	-21.305***	-1.054	-0.755
	1.552	1.680	1.031	1.208
(1-li)×TFP gap	-9.523***	-9.601***	4.240***	4.655***
	1.157	1.253	0.711	0.833
$(1-li)^2 \times \text{TFP gap}$	3.622***	3.709***	-4.758***	-5.370 ***
	1.181	1.279	0.724	0.848
Constant	-25.397***	-27.819 * * *	-7.816***	-11.007 ***
	1.344	1.456	0.940	1.101
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	78471	78471	78471	78471
Group			2882	2882
Year	70-06	70-06	70-06	70-06
Adj-R2	0.0842	0.0883		
Within R2			0.0948	0.1394
Inverted-U test for baseline curve	-9.855***	-9.230***	-	_
(i.e., $1-li$, $1-li$ _squared)	(Inverted-U)	(Inverted-U)		
(Extremum point)	1.033	1.022		
[confidence interval]	[1.007, 1.063]	[0.995, 1.054]		
Is curve in neck-and-neck industries steeper than baseline?	No	No	_	_
Effect of TFP gap on Innovation				
Range of positive effect	[0.641, 1.394]	-	[0.891, 1.394]	[0.867, 1.394]
Range of negative effect	-	[0.641, 1.394]	[0.641, 0.891]	[0.641, 0.867]

Table 7.1 Replications of TFP gap interaction terms in ABBGH at firm level

	1	2	3	4
	Industry	Industry	Industry	Industry
	Average	Average	Average	Average
Dep.	InPat	InCite	InPat	InCite
procedure	OLS	OLS	Within	Within
-	Coef.	Coef.	Coef.	Coef.
	(S.E.)	(S.E.)	(S.E.)	(S.E.)
1–li	62.964	161.903**	-32.731	58.986**
	73.687	74.554	27.920	27.401
$(1-li)^2$	-36.537	-88.304**	19.175	-30.248**
	37.206	37.644	14.008	13.748
(1-li)×TFP gap	-39.334***	-40.604***	22.853***	10.712**
	13.532	13.691	5.085	4.990
$(1-li)^2 \times \text{TFP gap}$	35.074**	36.870***	-23.984***	-11.222**
	13.897	14.061	5.216	5.119
Constant	-144.874 ***	-74.898 * *	15.390	-29.674**
	17.272	36.992	13.927	13.668
Year dummy	Yes	Yes	Yes	Yes
Industry fixed effects	No	No	Yes	Yes
Obs	2082	2082	2082	2082
Group			59	59
Year	70-06	70-06	70-06	70-06
Adj-R2	0.0929	0.1260		
Within R2			0.1027	0.5011
Inverted-U test for baseline curve	0.564	1.764*	_	2.027**
(i.e., $1-li$, $1-li$ _squared)		(Inverted-U)		(Inverted-U)
(Extremum point)		0.917		0.975
[confidence interval]		[0.532, 0.967]		[0.758, 1.038]
Is curve in neck-and-neck				Yes
is curve in neck-and-neck				
industries steeper than baseline?	—	No		105
industries steeper than baseline?	_	INO		105
	-	[1.101, 1.176]	[0.683, 0.953]	[0.683, 0.954]

Table 7.2 Replications of TFP gap interaction terms in ABBGH at industry level

1.1	1.2	2.1	2.2
Firm-level	Firm-level	Firm-level	Firm-level
			$(1-L)^2$
			Within
			Coef. (S.E.)
	· · · ·		0.00233**
			(0.000999)
			-0.000163
			(0.000865)
			0.00113***
			(0.000403)
			-0.000386***
			(0.0000993)
()		(0.00004)3)	(0.0000775)
		Ves	Yes
			Yes
			37958
51930	51930		37958 1640
80-04	80-06		80-06
		80-00	80-00
0.0253	0.0252		
		0.0539	0.0518
33.9***	33.72***	68.89***	66.12***
3.1	3.2	4.1	4.2
Industry Average	Industry Average	Industry Average	Industry Average
l-L		1-L	$(1-L)^2$
OLS	OLS	Within	Within
Coef. (S.E.)	Coef. (S.E.)	Coef. (S.E.)	Coef. (S.E.)
-0.000772	-0.00148	-0.000509	-0.00101
(0.000707)	(0.00137)	(0.000845)	(0.00165)
0.000156	0.000262	0.000236	0.000445
(0.000559)	(0.00108)	(0.000517)	(0.00101)
0.00115***	0.00224***	0.000120	0.000208
(0.000359)			(0.000680)
(0.0000000)	(0.000090)	(0.000349)	(0.000000)
-0.0000425	-0.0000859	(0.000349) 0.0000243	0.0000456
-0.0000425	-0.0000859	0.0000243	0.0000456
-0.0000425 (0.0000724)	-0.0000859 (0.000140)	0.0000243	0.0000456
-0.0000425 (0.0000724) 0.968***	-0.0000859 (0.000140) 0.937	0.0000243 (0.0000618)	0.0000456 (0.000121)
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes	-0.0000859 (0.000140) 0.937 (0.00845) Yes	0.0000243 (0.0000618) Yes	0.0000456 (0.000121) Yes
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes No	-0.0000859 (0.000140) 0.937 (0.00845) Yes No	0.0000243 (0.0000618) Yes Yes	0.0000456 (0.000121) Yes Yes
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes	-0.0000859 (0.000140) 0.937 (0.00845) Yes	0.0000243 (0.0000618) Yes Yes 1154	0.0000456 (0.000121) Yes Yes 1154
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes No 1154	-0.0000859 (0.000140) 0.937 (0.00845) Yes No 1154	0.0000243 (0.0000618) Yes Yes 1154 43	0.0000456 (0.000121) Yes Yes 1154 43
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes No 1154 80-06	-0.0000859 (0.000140) 0.937 (0.00845) Yes No 1154 80-06	0.0000243 (0.0000618) Yes Yes 1154	0.0000456 (0.000121) Yes Yes 1154
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes No 1154	-0.0000859 (0.000140) 0.937 (0.00845) Yes No 1154	0.0000243 (0.0000618) Yes Yes 1154 43 80-06	0.0000456 (0.000121) Yes Yes 1154 43 80-06
-0.0000425 (0.0000724) 0.968*** (0.00436) Yes No 1154 80-06	-0.0000859 (0.000140) 0.937 (0.00845) Yes No 1154 80-06	0.0000243 (0.0000618) Yes Yes 1154 43	0.0000456 (0.000121) Yes Yes 1154 43
· · · · ·	Firm-level $l-L$ OLS Coef. (S.E.) 0.0000787 (0.000383) 0.00164*** (0.000812*** (0.000199) 0.000126** (0.000212) Yes No 37958 80-06 0.0253 33.9*** 3.1 Industry Average $l-L$ OLS Coef. (S.E.) -0.000772 (0.000156) (0.000559) 0.00156 (0.000559) 0.00155	Firm-level Firm-level $l-L$ $(l-L)^2$ OLS OLS 0.0000787 0.000326 (0.000383) (0.000752) 0.00164*** 0.00281*** (0.000451) (0.000885) 0.000812*** 0.00161*** (0.000199) (0.000390) 0.000126** 0.000223** (0.000555) (0.000109) 0.970*** 0.943*** (0.00212) (0.00416) Yes Yes No No 37958 37958 33.9*** 33.72*** 3.1 3.2 Industry Average Industry Average $l-L$ $(l-L)^2$ OLS OLS Coef. (S.E.) Coef. (S.E.) -0.000772 -0.00148 (0.000707) (0.00137) 0.000156 0.000262 (0.000559) (0.00108) 0.00115*** 0.00224***	1.1 1.2 2.1 Firm-level Firm-level Firm-level $l-L$ $(l-L)^2$ $l-L$ OLS OLS Within Coef. (S.E.) Coef. (S.E.) Coef. (S.E.) 0.0000787 0.000326 0.00139*** (0.000383) (0.000752) (0.000496) 0.00164*** 0.00281*** -0.000175 (0.000451) (0.000385) (0.000430) 0.000126** 0.000223** -0.000208*** (0.000199) (0.000212) (0.000199) 0.000126** 0.00023** -0.000208*** (0.000155) (0.000109) (0.0000493) 0.970*** 0.943*** (0.000416) Yes Yes Yes No No Yes No No Yes 37958 37958 37958 33.9*** 33.72*** 68.89*** 3.1 3.2 4.1 Industry Average Industry Average $l-L$ OLS

Table 8.1 Result of 2SLS (IV) estimates (1st stage of 2SLS) at firm and industry level

Firm-level	1	2	3	4
	Firm level	Firm level	Firm level	Firm level
Dep.	lnPat	lnCite	lnPat	lnCite
Procedure	2nd stage of	2nd stage of	2nd stage of	2nd stage of
	2SLS	2SLS	Within 2SLS	Within 2SLS
	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)
1-li	-2093.372***	-2419.987***	6.762	41.414
	(426.568)	(495.991)	(126.900)	(160.039)
$(1-li)^2$	1081.286***	1251,418***	13.678	-2.294
	(230.673)	(268.214)	(66.477)	(83.837)
Constant	1008.246***	1159.625***	(******)	(001001)
	(197.628)	(229.791)		
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	37958	37958	37948	37948
Group	51750	51750	1650	1650
Year	80-06	80-06	80-06	80-06
Adj-R2			00 00	00 00
Centered R2			-0.5974	-0.3106
Overidentification test			0.3974	0.3100
Sargan Statistics	0.298	0.417		
Sargan-Hansen statistic	0.298	0.417	9.167***	13.152***
Inverted U test			0.677	13.132***
Inverted U test	-	—	0.077	—
Industry Average	5	6	7	8
	Industry Average	Industry Average	Industry Average	Industry Average
Dep.	lnPat	lnCite	lnPat	InCite
Procedure	2nd stage of	2nd stage of	2nd stage of	2nd stage of
	2SLS	2SLS	Within 2SLS	Within 2SLS
	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)	Coef.(S.E.)
1-L	-9528.170*	-9836.756*	-826.507	-1106.411
	5527.865	5773.393	1375.436	1251.777
$(1-L)^2$	4908.37*	5063.5*	444.427	576.242
	2837.431	2963.459	718.781	654.159
Constant	4624.276*	4775.493*		
	2691.221	2810.755		
Year dummy	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Obs	1154	1154	1154	1154
			43	43
Group			80-06	80-06
1	80-06	80-06		
Year	80-06	80-06	00 00	
Year Adj-R2	80-06	80-06 -		-0 6570
Year Adj-R2 Centered R2	80-06	80-06	-4.7957	-0.6529
Year Adj-R2 Centered R2 Overidentification test	_	_		-0.6529
Adj-R2 Centered R2 Overidentification test Sargan Statistics	80-06 - 2.827	80-06 - 3.013	-4.7957	
Year Adj-R2 Centered R2 Overidentification test	_	_		-0.6529

Table 8.2 Result of 2SLS in entire sample at firm and industry level

Appendix

Table A1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Firm level					
Entire sample					
Sales	95518	122130.6	617703.5	1	214000
Sales cost	93751	102610.5	589645.1	1	212000
Operating profit	95496	5106.5	23556.2	-197000	9480
Non-operating cost	94969	3060.3	15067.4	1	5880
# of regular employee	95408	2023.8	5755.4	1	3040
R&D	50479	2644.6	16519.7	1	7050
Capital stock	80634	46908.2	268656.9	-124000	130000
TFP	78932	2.954	3.293	0.009	261
# of raw patent application	95550	72.557	526.384	0	189
# of raw cited counts	95550	30.181	220.434	0	79
Pat	95544	27.737	199.407	0.0001	9200
Cite	95544	4.021	31.411	0.0001	1670
Technology gap (m_{it})	78932	0.360	0.222	0	0.9
1-li (1-Lerner Index)	95470	0.996	2.399	0.01	6
1-li (0.5–99.5th percentile)	94516	0.973	0.066	0.641	1.3
Manufacturing Industries					
Sales	55315	91109.6	316287.9	20	102000
Sales cost	55227	72569.3	261777	5	82700
Operating profit	55299	4315.4	17403.1	-197000	8610
Non-operating cost	55242	2423.4	8693.3	1	2270
# of regular employee	55294	2198.1	5506.1	1	922
R&D	38299	3098.2	18356.5	1	7050
Capital stock	49518	36148.5	126942.9	-20925	29700
TFP	49421	2.238	2.176	0.4601	261
# of raw patent application	55317	120.062	684.956	0	189
# of raw cited counts	55317	49.716	286.369	0	79
Pat	55317	46.236	259.789	0.0001	9200
Cite	55317	6.643	40.850	0.0001	1670
Technology gap (m_{it})	49421	0.308	0.193	0	0.9
1-li (1-Lerner Index)	55298	0.977	0.084	0.01	5.8
1-li (0.5–99.5th percentile)	55062	0.976	0.064	0.641	1.3
Industry level (firm average)					
Sales (Real value)	2082	166467.3	246527.2	1244.9	20800
R&D (Real value)	2082	2729.6	9301.6	1.1	1670
TFP	2082	2.977	2.895	0.553	41
Pat	2580	30.476	70.766	0.0001	646
Cite	2580	4.357	11.934	0.0001	154
Average Technology gap (m_{it})	2082	0.254	0.169	0	0.9
1-L	2580	0.974	0.032	0.841	1.1
XRI_AdvancedEconomies	1161	1.534	3.543	0.012	40.8
XRI_DevelopingCountries	1161	9.612	121.116	0	2292.

Table A2. JIP2006 Sector Classification

# 11/2006 Sector Classification Sector (Nikes (NF-LDS Sector Code) Manufacturing industries ham products (101007), milk products (101009), confectionery products (101006), flavoring materials (101003) 10 Floor and grain mill products (101001) floor and grain mill products (101002), confectionery products (101006), flavoring materials (10000) 11 Progenetic fertilizers floor and grain mill products (10000) 12 Progenetic fertilizers accoholic beverage (101002), confectionery products (103022), solid products (103024), secondary processing products (103025), other products (103024), secondary processing products (103025), exclination and solad (107063), oxygen (107066), pasticide destricts and destal products (107063), axygen (107064), pasticide construction and aread second (109032), medicinal products for professional use (109082), medicinal products (11102) glass products (11763), alies (11102), professional use (109082), medicinal products (11763), alies (11764), cast and foregout sector (119083)		HP2006 Sector Classification	
8 Livestock products ham products (10007), milk products (101009) 10 Floor and grain mill products ham products (101007), milk products (101007) 12 Prepared animal foods and relatel products materials (101008), other foods (101010) 13 Beverages alcoholic beverage (101005) stager (10102), cotton spinners (103022), sitk spinners. (103023), wood spinners (103024), secondary processing products (103025), other products (103024) 14 Lamber and wood products products (103021) cotton spinners (103022), sitk spinners. (103022), peep products (10322) 15 Textile products products (103021) cotton spinners (103022), secondary processing products (103025), other products (103021) 16 Lamber and wood products printing pate making for products (10322) printing (13321) 11 Tristile products printing (13321) tire manufacturers (107060) 28 Basic lencous chemical products cottom products (10706) printing (13321) 29 Printing and bookbinding chemical moducts (10706) printing (10321) optimers (107060) 28 Basic lencous inclusis chemical products (107063) products (107063) 29 Printing and book	#	JIP2006 Sector Classification	Sector (Nikkei NEEDS Sector Code)
10 Flour and grain mill products 11 Miscellaneous foods and related pare discussion or spin section of the			
11 Missellaneous foods and related products sugar (10102), food oil (10100), confectionery products (101006), flavoring matrials (101008), other foods (101010) 12 Prepared animal foods and organic fertilizers alcoholic beverage (101005) 13 Beverages alcoholic beverage (101005) 14 Lamber and wood products huiding products (103021), cotton spinners (103022), silk spinners (103023), wool spinners (103023), wool spinners (103024), secondary processing products (103025) 18 Pult, paper, and coated products printing paper and coated products (10322) 28 Rubber products printing (13321) 28 Rubber products tire manufacturing (113121), other products (105042) 29 Printing, and bookbinding tire manufacturing (107063), oxygen (107066) 29 Basic inogranic chemicals chonical social (107003), oxygen (107066) 20 Printing and bookbinding chonical social (107070), materials (10706), peroducts (10707), commetrials (10706), peroducts (10707), materials (107070), materials (107070), materials (107070), materials (107070), peroducts (10707), commetrials (107070), peroducts (10707), materials (107070), materials (107070), peroducts (10707), materials (107070), peroducts (107071) 20 Patamaceutical products products (10707), materials (107070), peroducts (107071) 31 Potery potacts			
products materials (101008), other foods (101010) 12 Prepared animal foods and organic fertilizers feeding stuff (101001) 13 Beverages alcoholic beverage (101005) 14 Textile products (103023), secondary processing products (103023), other products (103024), secondary processing products (103025), other products (103024), secondary processing products (103025), other products (103024), secondary processing products (103025), other products (103024), secondary processing products (103024) 14 Lamber and wood products printing (13321) 15 Textile products printing (13321) 16 Lamber products printing (13321) 17 Printing and bookhinding grain chemicals printing (13321) 18 Basic inorganic chemicals products (107064) 29 Pharmaceutical products products (107064) 20 Petroleum products petroleum chemical sproducts (107071) 21 Glass and its products products (11102) 22 Rescellaneous chemical products products (11102) 23 Besic inorganic chemicals products products (11102) 24 Pottery products		Flour and grain mill products	
12 Prepared animal foods and organic fortilizers feeding suff (101001) 13 Beverages alcoholic beverage (101005) 14 Lumber and wood products (103023), wool spinners (103024), secondary processing products (103025), other products (103025), other products (105041), other products (105042) 14 Pulting, plate making for printing (13321) printing (133221) 15 Texnic chemicals chemicals (107065) 16 Chemical ferilizers chemicals (107065) 17 Miscellaneous chemicals products 18 products graph foodic (107065) 19 Pharmaceutical products major chemical and products (11102) 10 glass products (115141) major chemical and sizes (11102), petroleum and coal products (111102) 17 Gleaneous ion and steel products (115142) 18 Steillaneous iron and steel products (115142) 19 Non-ferrous metals products graph roducts (115143) 19 Non-ferrous metals products graph roducts (115145)	11		
organic fertilizers Intervages 13 Beverage (10005) 14 Textile products 15 Textile products 16 Lumber and wood products 17 Pulp, paper, and coated and glazed paper 18 Pulp, paper, and coated and glazed paper 19 printing, plate making for printing (13321) 11 time maxing for grantic chemicals 12 Rubber products 12 Chemical fertilizers 13 Basic inorganic chemicals 14 Toorganic chemicals 15 Basic inorganic chemicals 16 Uniting or Materian (110062) 17 Pharmaceutical products 18 Petroleum products 19 Pharmaceutical products 19 Pharmaceutical products 19 Patroleum products 19 Protery 20 Patroleum products 21 Patroleum products 22 Patroleum products 23 Pottery 24 Pottery <			
13 Beverages alcoholic beverage (101005) 15 Textile products chemical synthetic fiber (13022), cotton spinners (103022), sik spinners (103023), wood spinners (103024), secondary processing products (103025), other products (103024) 16 Lumber and wood products pinning, plate making for printing (13321) 17 Printing, plate making for printing (13321) printing (13322) 28 Rubber products the manufacturing (113121), other products (113122) 29 Paramic of chemicals chemical fertilizers 20 fronting, plate making for printing (13321) plant food (107062) 21 Rubber products tire manufacturing (103068), conting materials (107067), other materials (107067) 22 Rubber products spiroteleum enting and powders (107065) 23 Chemical fortilizers major chemical and products (107070, other materials (107070), other materials (107070), major chemics and dental powders (107065) 29 Pharmaceutical products perfolum enting and powders (107065) 30 Petroleum products products (11101), petroleum and coal products (11102) 31 Cement and its products products (115143) 32 Cement and its products products (115144) 33 Miscel	12	Prepared animal foods and	feeding stuff (101001)
15 Textile products chemical synthetic fiber (103021), cotton spinners (103022), soliding roducts (103025), order products (103026) 16 Lamber and wood products pulp, paper, and coaded and glazed paper 20 Printing, plate making for printing and bookhinding in add toxis (113321) printing (133321) 21 Rubber products printing (133321) 22 Rubber products printing (133321) 23 Chemical fertilizers plant food (107062) 24 Basic inorganic chemicals printing (133321) 25 Basic inorganic chemicals printing (133321) 26 Organic chemicals printing (133321) 27 Pharmaceutical products printing (13322) 28 Miscellaneous chemical products printing (13322) 29 Pharmaceutical products printing (1332) 20 Petroleum products printing (1332) 21 Chemical start food (107063) synthetic resin (107061) 22 Pharmaceutical products products (117061), open-area formaceutical products (117162) 23 Chemical start food (107063) products (117161), open-area formaceutical formaceutical products (115142) 24 Botery products (115143) products (117163), alloy iron products (117162), interproducts (117163), alloy iron products (117163), acat and forged ste		organic fertilizers	
16 Lumber and wood products (103023), wood spinners (103024), secondary processing products (103025), other products (103025), other products (103025), other products (103025), other products (105042) 18 Pulp, paper, and coated and glazed paper printing (133221) 20 Printing, plate making for printing (133221) printing (133221) 21 Rubber products fire manufacturing (11121), other products (113122) 22 Rubber products plant food (107063), oxygen (107066) 23 Chemical ferilizers plant food (107065), oxygen (107066) 24 Basic organic chemicals products 25 Basic organic chemicals products part food (107065), oxygen (107066) 26 Organic chemicals products products products 30 Petroleum products glass products (11514) products (11102) glass products (11102) 31 Pottery glass and its products group trans raw materials of cernent (115142) howrware (115143) 32 Pottery Miscellaneous ino and steel products (11120), alter products (117163), ata and foregd steel 33 Pottery madring and refining of archiron towrware (1	13	Beverages	alcoholic beverage (101005)
16 Lumber and wood products (103023), wood spinners (103024), secondary processing products (103025), other products (103025), other products (103025), other products (103025), other products (105042) 18 Pulp, paper, and coated and glazed paper printing (133221) 20 Printing, plate making for printing (133221) printing (133221) 21 Rubber products fire manufacturing (11121), other products (113122) 22 Rubber products plant food (107063), oxygen (107066) 23 Chemical ferilizers plant food (107065), oxygen (107066) 24 Basic organic chemicals products 25 Basic organic chemicals products part food (107065), oxygen (107066) 26 Organic chemicals products products products 30 Petroleum products glass products (11514) products (11102) glass products (11102) 31 Pottery glass and its products group trans raw materials of cernent (115142) howrware (115143) 32 Pottery Miscellaneous ino and steel products (11120), alter products (117163), ata and foregd steel 33 Pottery madring and refining of archiron towrware (1	15	Textile products	chemical synthetic fiber (103021), cotton spinners (103022), silk spinners
Image: constructionproducts (103026)First Construction18Pulp, paper, and coated and glazed paperprinting, plate making for printing and bookbindingmajor paper producers (105041), other products (105042)20Printing, plate making for printing and bookbindingprinting (133321)21Rubber productsplatified (13322)22Rubber productsplatified (13322)23Chemical fertilizers printing (13322)platified (13122)24Basic inorganic chemicals products (choroical printing of manufactures (107063), oxygen (107066)25Basic inorganic chemicals productschoroine and soda (107063), oxigen (107066)26Organic chemicals productschoroine and soda (107063), oxigen (107066)27Pharmaceutical productsgior chemicals (1070700), other materials (107069), pesticide chemicals (1070070), other materials (107069), pesticide chemicals (107069), optical products (111102)26Giass and its products (119082), medicinal products for professional use (109082), medicinal products (109083)26Petroleum products (119143)37Miscellaneous ceramic, stone and clay products38Smelling and refining of major milling manufactures (119183), obter milling products (117163)39Non-ferous metal products39Non-ferous metal products40Fabricated constructional and refrous metal matchines (121204), machines (121203), agricultural machines (121204), machines (121203), agricultural machines (121204), estima machines (121203), agricultural machines (121204) <t< td=""><td></td><td>I I I I I I I I I I I I I I I I I I I</td><td></td></t<>		I I I I I I I I I I I I I I I I I I I	
16 Lumber and wood products building products (133323) 18 Puil, paper, and coated and glazed paper major paper produces (105041), other products (105042) 20 Printing, plate making for printing and bookbinding printing (133321) 21 Rubber products tire manufactures (107062) 22 Rubber products plant food (107062) 23 Chemical ferilizers plant food (107063) 24 Basic organic chemicals patro devices (107070), other materials (107071), major Abenicals (107070), other materials (107071) 29 Pharmaceutical products glass oducts (107070), other materials (107071), major Abenicals (107070), other materials (107071) 29 Pharmaceutical products glass products (107070), other materials (107070), major Abenicals (107070), other materials (107070) 20 Glass and its products glass products (115141) 21 Glass and its products glass products (115142) 22 Patery brownware (115142) 23 Miscellaneous iron and steel products (117163), alloy iron products (117167) 23 Smelting and refining of non-ferrous metal products press machines (121201), texti emachines (12108), eraris machines (121201), texti emachines (121076) 34 Potery broachine (12200), machines for transportation, construction and internal combustion (121204), machines 3			
18 Pulp. paper, and coated and glazd paper major paper producers (105041), other products (105042) 20 Printing, plate making for printing and bookbinding printing (133321) 21 Rubber products plant food (107063) 22 Rubber products plant food (107063) 23 Chemical fertilizers plant food (107064) 24 Basic organic chemicals particle resin (107064) 25 Miscellaneous chemical products major Admine and soda (107065) 26 Pharmaceutical products major Admine Admufacturers (107064) 27 Pharmaceutical products major Admine Admufacturers (107068) 28 Miscellaneous chemical products pertoleum refining and saise (11110), pertoleum and coal products (107083) 29 Patraceutical products products (15141) glass products (115143) 31 Pottery brownware (115144) brick refractories (117164), and and forged steel 39 Nort-ferrous metal products adminum processing products (117164), and and forged steel 39 Nort-ferrous metal products adminum processing products (117163), and products (117163) 40 Fabricated con	16	Lumber and wood products	
glazed paper printing, plate making for printing (133321) Printing, plate making for printing and bookbinding tire manufacturing (113121), other products (113122) 28 Rubber products plant food (107063) 29 Rubber products plant food (107063) 20 Organic chemicals petroleum chemistry (107064) 20 Synthetic resin (107063) synthetic resin (107063) 20 Miscellaneous chemical products ingior chemical and manufacturers (107064) 29 Pharmaceutical products glazed products 20 Glass and its products glazed products 21 Glass and its products glass products (115141) 23 Pottery brownware (115144) 24 Bracic and erable products integrated steel 25 Smelting and refining of noor-ferrous metals noor-ferrous metals 36 Pottery brownware (115145) 37 Miscellaneous cramic, stone and crub steel special steel products (117163), alloy iron products (117164), cast and forged steel products (117165), stainless products (117164), cast and forged steel products (117165), stainless products (117165), stainless products (117164) <t< td=""><td></td><td></td><td></td></t<>			
20 Printing, plate making for printing and bookbinding printing (133321) 21 Rubber products tire manufacturing (113121), other products (113122) 22 Rubber products plant food (107062) 23 Chemical fertilizers plant food (107062) 24 Basic inorganic chemicals synthetic resin (107065) 25 Miscellaneous chemical products synthetic resin (107065) 26 Organic chemicals posterics and demat powders (107067), 27 Pharmaceutical products petroleum chemical manufacturers (107061), fats and washing powders (107067), 28 major Adsime Manufacturers (107081), medicinal products for professional use (109082), medicinal products for professional use (109083), medicinal products for products (107067), 29 Pharmaceutical products petroleum refining and sales (11101), petroleum and coal products (11102) 20 glass products products (15144) 31 Pottery brick refractories (15145) 32 Miscellaneous ceramic, stone and relap roducts refronto (15146) 33 Pottery brick refractories (15145) 34 Miscellaneous coratructional and products products (117163), nopen-arc furnace (117162) 35 meeting and refning of non-ferous metal products products (117163), nopen-arc furnace (117162) 36 Precis	10		major paper producers (105041), other products (105042)
printing and bookbinding time manufacturing (113121), other products (113122) plant food (107062)23Robiber products imaging chemicals basic organic chemicals (Organic chemicals major chemicals (107063)24Basic organic chemicals organic chemicals (109082), medicinal products (107066), pesticide chemicals (107070), other materials (107071)25Pharmaceutical products (109082), medicinal products for professional use (109082), medicinal products (109083), medicinal products (10114), petroleum products (115143)26Class and its products (115143)31Portery (115143)32Fortery (115143)33Miscellaneous eramic, stone and clay products (115143)34Portery (115143)35Miscellaneous iron and steel mon-ferrous metals mort-ferrous metals mort-ferrous metals mortics34Postery (115143)35Miscellaneous fabricated metal products41Miscellaneous fabricated metal products42General industry machinery Office and service industry machines43Special industry machinery Office and service industry machines44Miscellaneous electrical machines45Miscellaneous electrical machines46Central industry machinery Office and service industry machines47Housebold electric appliances (121205), chearing and sci (121204), exert machines (121206), sewing machines (121206), eramidater (121206), entral machines (121206), entral machines (121206), eramidater (121206), entral machines (121206), eramidater (121206), entral machines (1	20		1.1. (100001)
22 Rubber products 32 Chemical Fertilizers 34 Pair God (107062) 29 Pharmaceutical products 20 Organic chemicals 21 Basic inorganic chemicals 22 Disciplication chemicals 23 Chemical Statistics 24 Basic inorganic chemicals 25 Miscellaneous chemical products 26 Priarmaceutical products 27 Pharmaceutical products 28 Petroleum products 29 Pharmaceutical products 30 Petroleum products 41 Potery 31 Scement and its products 42 Potery 33 Miscellaneous iron and steel 34 Potery 35 Miscellaneous iron and steel 36 Potery 37 Miscellaneous irabircated metal 38 Smelting and refining of non-ferrous metals 40 Fabricated constructional and architestrue introl (15165), stainless products (119176), and products (119182) 41 Miscellaneous machinery entroducts	20		printing (133321)
23Chemical tertilizersplant food (107062)24Basic organic chemicalschorine and soda (107063), oxygen (107066)25Basic organic chemicalspetroleum chemistry (107064)26Organic chemicalsmajor chemical manufacturers (107061), fats and washing powders (107067),27Pharmaceutical productsmajor chemical manufacturers (107063), coating materials (107069), pesticide28Miscellaneous chemicals (107070), other materials (107009), pesticide29Pharmaceutical productspetroleum products30Petroleum productspetroleum refining and aslas (111101), petroleum and coal products (111164)31Cement and its productsproducts (115141)34Potteryglass products (115145)35Miscellaneous ceramic, stone and clay productsproducts (117165), stainless products (117165), stainless products (117166), other products (117167)36Smelting and refining of non-ferrous metalsnorferrous metals37Miscellaneous fabricad metal productsproducts38Special industry machineryother metallic products (119183), electrical cables (119184) iron frame, iron tower and bridge (19185)41Miscellaneous machineryother metallic products (12200), assign anchines (121200), staines (121200), staines (121201), other machines (121201), estimation (121201), estimation (121201), estimation (121201), estimation (121201), estimation (121202), staines (121202), staines (121203), other machines (121201), staines (121202), automobile orona (12322), other products41Miscellaneous machinerygeneral electrical manufacturers (123221), elec			
24 Basic inorganic chemicals Organic chemicals Pharmaceutical products chlorine and soda (107063), oxygen (107066) petroleum chemistry (107063), oxygen (107064) synthetic resin (107063), oxygen (107065), coating materials (107067), major chemical major Medicine Manufacturers (109081), medicinal products for professional use (109082), medicinal products for professional use (109082), medicinal products (111102) glass products (115141) 29 Pharmaceutical products petroleum products (115143) petroleum and coal products (111102) glass products (115144) 31 Cement and its products clay products products (115145) products (117165), stanites products (117167) major mailling manufacturers (117161), open-arc furnace (117162) aproducts (117165), stanites products (119183), electrical cables (119184) 33 Smelling and refining of non-ferrous metals products other metallic products (119183), electrical cables (119184) 44 Miscellaneous machinery orducts other machines (121200), machines for transportation, construction and internal combustion (121204), machines (121206), sewing machines (121206), electronic angregating machines (121206), sewing machines (121206), electronic angregating machines (121209) 47 Household electric appliances Communication equipment industria apparatus general electrical machines (12120			
25Basic organic chemicals organic chemicals miscellaneous chemical productspertoleum chemistry (107064) synthetic resin (107065)28Miscellaneous chemical productsproductsmajor chemical manufacturers (107061), fats and washing powders (107067), major chemical manufacturers (109081), medicinal products for professional use (109082), medicinal products for the public sector (109083)30Petroleum products and its productspetroleum refining and sales (111101), petroleum and coal products (111102) glass products (115141) primary raw materials of cement (115142), secondary processing of cement (115143)34Pottery Miscellaneous iron and steel special steel products (117165), alloy iron products (117162) special steel products (117165), alloy iron products (117167) major milling manufactures (119181), other milling products (117165), stainless products (117165), alloy iron products (117167) major milling manufactures (119181), other milling products (117163) iron frame, iron tower and bridge (119185)34Pottery Miscellaneous fabricated metal productsaluminum processing products (119186) iron frame, iron tower and bridge (119185)34Special industry machinery machines of (121204), machines (121205), chemical engineering machines (121203), agricultural machines (121204)34Special industry machinery machinesproducts (112163), iterile machines (121203), agricultural machines (121204) machines (121205), chemical engineering machines (121206), sewing machines (121207) bearing machines (121209)35Miscellaneous fabrical machines outces in anditory equipment machines (121226)products (12223) electronic equipments (123223) electrical general electrical manufactur	23		
25Basic organic chemicals organic chemicals miscellaneous chemical productspertoleum chemistry (107064) synthetic resin (107065)28Miscellaneous chemical productsproductsmajor chemical manufacturers (107061), fats and washing powders (107067), major chemical manufacturers (109081), medicinal products for professional use (109082), medicinal products for the public sector (109083)30Petroleum products and its productspetroleum refining and sales (111101), petroleum and coal products (111102) glass products (115141) primary raw materials of cement (115142), secondary processing of cement (115143)34Pottery Miscellaneous iron and steel special steel products (117165), alloy iron products (117162) special steel products (117165), alloy iron products (117167) major milling manufactures (119181), other milling products (117165), stainless products (117165), alloy iron products (117167) major milling manufactures (119181), other milling products (117163) iron frame, iron tower and bridge (119185)34Pottery Miscellaneous fabricated metal productsaluminum processing products (119186) iron frame, iron tower and bridge (119185)34Special industry machinery machines of (121204), machines (121205), chemical engineering machines (121203), agricultural machines (121204)34Special industry machinery machinesproducts (112163), iterile machines (121203), agricultural machines (121204) machines (121205), chemical engineering machines (121206), sewing machines (121207) bearing machines (121209)35Miscellaneous fabrical machines outces in anditory equipment machines (121226)products (12223) electronic equipments (123223) electrical general electrical manufactur	24	Basic inorganic chemicals	chlorine and soda (107063), oxygen (107066)
26 28 Miscellaneous chemical products major chemical annufacturers (107061), fats and washing powders (107067), cosmetics and dental powders (107068), coating materials (107070), pesticide chemicals (107070) other materials (107070) major Medicine Maufacturers (10908), medicinal products for the public sector (109083) pertoleum refining and sales (11101), petroleum and coal products (111102) glass products (115141) primary raw materials of cement (115142), secondary processing of cement (115143)30Petroleum products Genent and its products clay productsprimary raw materials of cement (115142), secondary processing of cement (115143) brick refractories (115145) carbon (115146)31Smelting and refining of non-ferrous metals productsintegrated steel products (117165), staliness products (117166), other products (117165) stalines products (117165), due products (117165) admines traited products41Miscellaneous fabricated metal productsother metallic products (119183) electrical cables (119184) iron frame, iron tower and bridge (119185)42General industry machinery machines versionpress machines (121202), machines (121204) machines (121204)44Miscellaneous machinery machinesproducts (112162), temical engineering machines (121205), chemical engineering machines (121204) machines (121205), chemical engineering machines (121205)45Motor vehicles parts and accessoriesgeneral electrical machines (123222), electronic equipments (123223) communicators (12327), automobile-related equipments (123228), other products (123227), automobile components (123225) automobile components (123221), electronic equipments (123223) automobile components (123222), automobile hodies (127263) <br< td=""><td>25</td><td></td><td>petroleum chemistry (107064)</td></br<>	25		petroleum chemistry (107064)
28Miscellaneous chemical productsmajor chemical manufacturers (107061), fats and washing powders (107067), cosmetics and dental powders (107061), fats and washing powders (107067), other materials (107071)29Pharmaceutical productsmajor chemical manufacturers (109081), medicinal products for professional use (109082), medicinal products for the public sector (199083)30Petroleum productspetroleum refining and sales (111101), petroleum and coal products (111102)31Cement and its productspetroleum refining and sales (111101), petroleum and coal products (11114)32Potterybrow ware (115144)33Miscellaneous ceramic, stone and clay productsintegrated steel manufactures (117161), open-arc furnace (117162)34Potterybrok terfactories (115145)35Miscellaneous fabricated mata productsintegrated steel manufactures (117161), open-arc furnace (117162)36Non-ferrous metal productsintegrated steel manufactures (117161), open-arc furnace (117162)37Miscellaneous fabricated metal productsintegrated steel manufactures (119181), other milling products (117167)38Smelting and refining of nor-ferrous metal productsintegrated steel manufactures (119181), other milling products (119182)40Fabricated constructional and architectural metal productsintegrates steel manufactures (121020), agricultural machines41Miscellaneous fabricated metal productsintegrates steel manufactures (12202), machines for transportation, construction and internal combustion (121204)42General industry machinerypress machines (121200), machines for transportation, construction and	26		synthetic resin (107065)
29Pharmaceutical productsconfinetics and dental powders (107068), coating materials (107069), pesticide chemicals (107070), other materials (107071) major Medicine Manufacturers (109081), medicinal products for the public sector (109083) petroleum reducts for the public sector (109083) petroleum relining and asles (111101), petroleum and coal products (111102) glass products (115141) primary raw materials of cement (115142), secondary processing of cement (115143)34Pottery Miscellaneous ceramic, stone and clay productsbrick refractories (115145) carbon (115145) torik refractories (115145) carbon (115145)37Miscellaneous ron and steel productsprimary raw materials products (117165), stainles products (117165) major milling manufactures (119181), other milling products (119182) aluminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)41Miscellaneous fabricated metal productsother metallic products (119186) machines (121202), machines (121203), agricultural machines (121204) machines (121205), chemical engimeering machines (121206), sewing machines (121207) bearing machines (121209) machines (121209)43Miscellaneous machinery Household electric appliances machines (121209)44Miscellaneous electrical machines (121205)45Motor whicle machinery equipment Motor whicle parts and accessories56Other transportation equipment Miscellaneous electrical machinery equipment57			
29Pharmaceutical productschemicals (107070), other materials (107071)	-	r	
29Pharmaceutical productsmajor Medicine Manufacturers (109081), medicinal products for the public sector (109083)30Petroleum products31Glass and its products32Glass and its products33Cement and its products34Pottery35Miscellaneous ceramic, stone and clay products36Pig iron and crude steel37Miscellaneous iron and steel38Smelting and refining of non-ferrous metals40Fabricated constructional and architectural metal products41Miscellaneous machinery42General industry machinery43Special industry machinery44Miscellaneous starbinery45Office and service and stribution and industrial apparatus46Electrical generating, transmission, distribution and industrial apparatus47Household electric appliances48Sincellaneous nachinery49More vehicle parts and accessories40Flectrical generating, transmission, distribution and industrial apparatus41Miscellaneous machinery42General industry machinery43Special industry machinery44Miscellaneous electrical machines45Defice and service appliances46Electrical generating, transmission, distribution and industrial apparatus47Household electric appliances48Miscellaneous electrical machinery equipment49Moor vehicle services<			
30Petroleum products Glass and its products(109082), medicinal products of the public sector (109083) petroleum refining and sales (111101), petroleum and coal products (11102) glass products (11514)31Cement and its products(119082), medicinal products of cement (115142), secondary processing of cement (115143)34Potterybrownware (115144)35Miscellaneous ceramic, stone and clay productsbrownware (115143) integrated steel anotactures (117161), open-arc furnace (117162) special steel products (117165), alloy iron products (117167) major milling manufactures (117161), open-arc furnace (117162) major milling manufactures (117163), alloy iron products (117167) major milling manufactures (117161), open-arc furnace (117162) major milling manufactures (117163), alloy iron products (117167) major milling manufactures (117163), alloy iron products (117167) major milling manufactures (119183), electrical cables (119182) anchitectural metal products ducts fulficated onstructional and architectural metal products ducts41Miscellaneous fabricated metal productspress machines (121202), machines for transportation, construction and internal combustion (121204), newing machines (121207) bearing machines (121208), other machines (121206), sewing machines (121207) bearing machines (121209) machines43Special industry machinery machinespress machines (121202), machines for transportation, construction and internal combustion (121204), other machines (121206), sewing machines (121207) bearing machines (121209) machines (121209) machines44Miscellaneous electrical machinespress machines (121203), other machines (121206), sewing machines (121207) bearing machines (121209) mac	29	Pharmaceutical products	
30Petroleum products Glass and its products (11102) glass products (11101), petroleum and coal products (11102) glass products (11514)31Cement and its products (115143)32Pottery Miscellaneous ceramic, stone and clay products33Smelting and refining of non-ferrous metal products34Pottery35Smelting and refining of non-ferrous metal products36Niscellaneous iron and steel products37Miscellaneous iron and steel products38Smelting and refining of non-ferrous metal products40Fabricated constructional and architectural metal products in digratice turb metal products41Miscellaneous fabricated metal products42General industry machinery General industry machinery44Miscellaneous machinery machines45Office and service industry machines46Electrical generating, transmission, distribution and industrial apparatus Miscellaneous electrical machines47Household electrical products48Miscellaneous electrical machines49Miscellaneous electrical machines41Miscellaneous electrical machines42Generating, transmission, distribution and industrial apparatus machines44Miscellaneous electrical machines45Electronic parts electronic carts46Electronic parts electronic appliances communication equipment machines47Household electrical machinery equipment electro	2)	i harmaceutical products	
32 33Glass and its products Cement and its productsglass products (115141) primary raw materials of cement (115142), secondary processing of cement (115143)34 35Pottery maschinesbrick refractories (115144) brick refractories (115145) carbon (115146)36 36 37Pig iron and crude steel productsbrick refractories (115145) carbon (115146)38 39 40 41Smelting and refining of non-ferrous metalsintegrated steel manufactures (117165), alloy iron products (117164), cast and forged steel products (117165), stainless products (117166), other products (117167) major milling manufactures (119181), electrical cables (119182) iron frame, iron tower and bridge (119185)41 42 43 44 44 44 43 45 44Special industry machinery machinespress machines (121202), machines for transportation, construction and internal combustion (121204) machines (121205), other machines (121206), sewing machines (121207) bearing machines (121208), other machines (121206), sewing machines (121207) bearing machines (121208), other machines (121206), sewing machines (121207) bearing machines (121208), other machines (121206) bearing machines (12222), control instruments (123223) communicators (123227), automobile related equipments (123223) communicators (123227), automobile related equipments (123228), other products (12329)46 47 48 49 40 41Household electric appliances communication equipment machinery equipment accessoriesgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123227), automobile related equipments (123228), other products (123229)49 44 45 46 46 47 47 47 47 47 <b< td=""><td>20</td><td>Petroleum producto</td><td></td></b<>	20	Petroleum producto	
33Cement and its productsprimary raw materials of cement (115142), secondary processing of cement (115143)34PotteryMiscellaneous ceramic, stone and clay productsbrownware (115144)35Miscellaneous iron and steelproducts (115145)36Pig iron and crude steelspecial steel products (117163), alloy iron products (117164), cast and forged steel products (117165), alloy iron products (117167) major milling manufactures (119183), electrical cables (119184)39Non-ferrous metalsaluminum processing products (119183), electrical cables (119184)40Fabricated constructional and architectural metal products productsaluminum processing products (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerypress machines (121200), other machines (121205), sewing machines (121207)44Miscellaneous machinery machinesoffice and service industry machines45Office and service industry machineselectrical geneering machines (121209)46Electrical generating, transmission, distribution and industrial apparatus Bgeneral electrical manufacturers (123221), electronic equipment (123229)47Household electrical machinery equipmentgeneral electrical manufactures (123225)53Miscellaneous electrical machinery quipmentgeneral electrical manufactures (127261) automobile roducts (127261) automobile roducts (127262			
34Pottery(115143)35Miscellaneous ceramic, stone and clay productsbrownware (115144)36Miscellaneous iron and steelbrick refractories (115145) carbon (115146)37Miscellaneous iron and steelproducts (117163), alloy iron products (117164), cast and forged steel products (117165), stainless products (117166), other products (117167) major milling manufacturers (119181), other milling products (119182)39Non-ferrous metals architectural metal productsaluminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinery machinesother metallic products (112004) machines tools (121204)43Special industry machinery machinespress machines (121202), machines for transportation, construction and internal combustion (121204) machines (121205), chemical engineering machines (121206), sewing machines (121207) bearing machines (121208), other machines (1212010) office and service industry machines46Electrical generating, transmission, distribution and industrial apparatus47Household electric appliances Communication equipment 248Deterronic press machinery equipment anchinery equipment49Contromication equipment machinery equipment machinery equipment56Other transportation equipment Miscellaneous manufacturing industries57Precision machinery & equipment Miscellaneous manufacturing industries59Precision machinery & equipment			
34Potterybrownware (115144)35Miscellaneous ceramic, stone and clay productsbrick refractories (115145) carbon (115146)36Pig iron and crude steelintegrated steel manufactures (117161), open-arc furnace (117162)37Miscellaneous iron and steelspecial steel products (117163), alloy iron products (117164), cast and forged steel products (117165), stainless products (117166), other products (117167)38Smelting and refining of non-ferrous metalaurchitectural metal products39Non-ferrous metal productsaluminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerypress machines (121202), machines (121203), agricultural machines (121205), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machinery office and service industry machinesoffice machines (121209)47Household electric apliances machinery equipmentgeneral electrical manufacturers (12322), control instruments (123226)53Miscellaneous electrical machinery equipmentgeneral electrical manufacturers (12322), electronic equipments (123223)54Motor vehicles machinery equipmentgeneral electrical manufacturers (127261) autombile components (127262), automobile bodies (127263)55Other transportation equipment machinery effective apliances	33	Cement and its products	
35Miscellaneous ceramic, stone and clay productsbrick refractories (115145) carbon (115146)36Pig iron and crude steel miscellaneous iron and steelbrick refractories (117161), open-arc furnace (117162) special steel products (117165), stainless products (117166), other products (117167) major milling manufactures (119181), other milling products (119182)39Non-ferrous metal roductsaluminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machineryother metallic products (119100), eswing machines (121202), machines for transportation, construction and internal combustion (121204), textile machines (121205), chemical engineering machines (121206), sewing machines (121205), chemical engineering machines (121206), sewing machines (121207) bearing machines (121209)44Miscellaneous machinery machinespress machines (121209), textile machines (121200), sewing machines (121207) bearing machines (121209)45Office and service industry machinesheavy electrical manufacturers (12322), control instruments (123226)47Household electric appliances machinery equipment accessoriesgeneral electrical manufactures (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipment Miscellaneous manufacturing industriessitpbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (127263) automobile components (123322), office supplies (133324), other products (133325)57Precision machinery & equipment Misce		_	
clay productscarbon (115146)36Pig iron and crude steel37Miscellaneous iron and steel38Smelting and refining of non-ferrous metals39Non-ferrous metals30Non-ferrous metal products40Fabricated constructional and architectural metal products41Miscellaneous fabricated metal products42General industry machinery43Special industry machinery44Miscellaneous machinery45Office and service industry machines46Electrical generating, transmission, distribution and industrial apparatus47Household electrica plianees machinery quipment48Electroical generating, transmission, distribution and industrial apparatus47Household electrica plianees machinery quipment58Other transportation equipment machinery quipment54Motor vehicles machinery quipment55Other transportation equipment Miscellaneous manufacturing industrial apparatus56Other transportation equipment Miscellaneous manufacturing industries57Precision machinery & equipment Miscellaneous manufacturing industries57Precision machinery & equipment Miscellaneous manufacturing industries58Notor vehicles machinery quipment59Notor vehicles machinery industries50Noter transportation equipment Miscellaneous manufacturing industries59Noter transportation equipment Miscellaneous manufacturing industri			
36Pig iron and crude steel Miscellaneous iron and steelintegrated steel manufactures (117161), open-arc furnace (117162) special steel products (117165), alloy iron products (117166), cast and forged steel products (117165), stainless products (117161), other products (117167) major milling manufacturers (119181), other milling products (119182)38Smelting and refining of non-ferrous metalsauminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)40Fabricated constructional and architectural metal productsauminum processing products (119186) products (119186)41Miscellaneous fabricated metal productspress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinery machinesmachines (121204)44Miscellaneous machinery machinesoffice and service industry machines46Electrical generating, transmission, distribution and industrial apparatusheavy electrical manufacturers (12322), control instruments (123226)47Household electrica appliances dectrica patineesgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)53Motor vehicle parts and accessoriesautomobile products (127261) automobile products (127262), automobile bodies (127263) automobile products (123228), other products (123225)54Other transportation equipment Miscellaneous manufacturing industriesshipbuilding (125241), wheeled vehicles (123228) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other	35	Miscellaneous ceramic, stone and	brick refractories (115145)
37Miscellaneous iron and steelspecial steel products (117163), alloy iron products (117164), cast and forged steel products (117165), stainless products (117166), other products (117167) major milling manufacturers (119181), other milling products (119182)38Smelting and refining of non-ferrous metalsaluminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)40Fabricated constructional and architectural metal productsaluminum processing products (119183), electrical cables (119184) iron frame, iron tower and bridge (119185)41Miscellaneous fabricated metal productspress machines (121202), machines for transportation, construction and internal combustion (121204) machines42General industry machinery machinerypress machines (121200), textile machines (121203), agricultural machines (121205), chemical engineering machines (121206), sewing machines (121207) bearing machines (121208), other machines (121207) bearing machines (121209)44Husehold electric appliances communicators quipment machinery equipment machinery equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123227), automobile-related equipments (123228), other products (123229) automobile products (127261) automobile components (127262), automobile bodies (127263)56Other transportation equipment Miscellaneous manufacturing industriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (133322), other products (133324), other products (133325) musical instruments (133322), office supplies (133324), other products (133325)		clay products	carbon (115146)
38Smelting and refining of non-ferrous metalsproducts (117165), stainless products (117166), other products (119182)39Non-ferrous metalsaluminum processing products (119183), electrical cables (119184)40Fabricated constructional and architectural metal productsaluminum processing products (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerypress machines (121202), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machinery machinesbearing machines (121209)45Office and service industry machinesheavy electrical manufacturers (123221), electronic equipments (123223)46Electrical generating, transmission, distribution and industrial apparatuselectrical manufacturers (123221), electronic equipments (123223)47Household electric appliances machinery equipmentgeneral electrical manufacturers (123221), electronic equipments (123223)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicle parts and accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263)55Motor vehicle parts and accessoriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (133324), other products (133325) musical instruments (133322), office supplies (133324), other	36	Pig iron and crude steel	integrated steel manufactures (117161), open-arc furnace (117162)
38Smelting and refining of non-ferrous metalsproducts (117165), stainless products (117166), other products (119182)39Non-ferrous metalsaluminum processing products (119183), electrical cables (119184)40Fabricated constructional and architectural metal productsaluminum processing products (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerypress machines (121202), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machinery machinesbearing machines (121209)45Office and service industry machinesheavy electrical manufacturers (123221), electronic equipments (123223)46Electrical generating, transmission, distribution and industrial apparatuselectrical manufacturers (123221), electronic equipments (123223)47Household electric appliances machinery equipmentgeneral electrical manufacturers (123221), electronic equipments (123223)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicle parts and accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263)55Motor vehicle parts and accessoriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (133324), other products (133325) musical instruments (133322), office supplies (133324), other	37	Miscellaneous iron and steel	special steel products (117163), alloy iron products (117164), cast and forged steel
38Smelting and refining of non-ferrous metalsmajor milling manufacturers (119181), other milling products (119182)39Non-ferrous metal productsaluminum processing products (119183), electrical cables (119184)40Fabricated constructional and architectural metal productsaluminum processing products (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerymachine tools (121201), textile machines (121203), agricultural machines (121205), chemical engineering machines (121206), sewing machines (121207) bearing machines (121208), other machines (121206), sewing machines (121207) bearing machines (121209)44Miscellaneous machinery office and service industry machinesheavy electrical machines (123222), control instruments (123226)47Household electric appliances Communication equipment machinery equipment machinery equipment machinery equipment for vehiclesgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123227), automobile-related equipments (123228), other products (123229)53Miscellaneous electrical machinery equipment accessoriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (123223)54Motor vehicle parts and accessoriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (123223)57Precision machinery & equipment Miscellaneous manufacturing industriesshipbuilding (
non-ferrous metalsnon-ferrous metals39Non-ferrous metal products40Fabricated constructional and architectural metal products41Miscellaneous fabricated metal products42General industry machinery43Special industry machinery44Miscellaneous machinery45Office and service industry machines46Electrical generating, transmission, distribution and industrial apparatus47Household electric appliances Communication equipment48Special industry equipment machines49Communication equipment accisories56Other transportation equipment miscellaneous machinery equipment57Precision machinery equipment machines58Other transportation equipment machines59Precision machinery equipment machines50Other transportation equipment machines56Other transportation equipment machines57Precision machinery & equipment machines56Other transportation equipment machines57Precision machinery & equipment machines58Non-manufacturing industries50Non-manufacturing industries50Non-manufacturing industries50Non-manufacturing industries50Non-manufacturing industries50Non-manufacturing industries50Non-manufacturing industries50Non-manufacturing industries51Miscellaneous manufacturing industries <td>38</td> <td>Smelting and refining of</td> <td></td>	38	Smelting and refining of	
 Non-ferrous metal products aluminum processing products (119183), electrical cables (119184) Fabricated constructional and architectural metal products Miscellaneous fabricated metal products General industry machinery Special industry machinery Miscellaneous machinery Office and service industry machines Electrical generating, transmission, distribution and industrial apparatus Household electric appliances Electronic equipment Electronic equipment Electronic equipment Miscellaneous electrical machiney equipment Motor vehicles Motor vehicles Motor vehicles Motor vehicles Motor vehicles Sion machinery & equipment Special machinery (123227), automobile products (123228), other products Motor vehicles Subibiliding (125241), wheeled vehicles (129281) bicycles (123222), office supplia (13322), office supplies (13324), other products (133322), office supplies (133324), other products (133322), office supplies (133324), other products (133325) 	20		major mining manaratario (11) 101), ontor mining products (11) 102)
40Fabricated constructional and architectural metal productsiron frame, iron tower and bridge (119185)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerymachine tools (121201), textile machines (121203), agricultural machines (121205), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machinery Office and service industry machinesoffice machines (121209)46Electrical generating, transmission, distribution and industrial apparatus Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123227), automobile-related equipments (123228), other products (123229)53Motor vehicles machinery equipment machinery equipmentautomobile products (127261) automobile components (127262), automobile bodies (127263) automobile components (123223)54Motor vehicle parts and accessoriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283)57Precision machinery & equipment Miscellaneous manufacturing industriesshipbuilding (125241), wheeled vehicles (12324), other products (133325)50Non-manufacturing industriesshipbuilding (125241), wheeled vehicles (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)	30		aluminum processing products (119183) electrical cables (119184)
architectural metal productsother metallic products (119186)41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerymachines (121201), textile machines (121203), agricultural machines (121205), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machinery Office and service industry machinesoffice machines (121208), other machines (121200)45Office and service industry machinesoffice machines (121209)46Electrical generating, transmission, distribution and industrial apparatusheavy electrical manufacturers (123221), electronic equipments (123223) communication equipment47Household electric appliances Discellaneous electrical machinery equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123227)53Miscellaneous electrical machinery equipmentautomobile products (127261) automobile products (127261) automobile components (127262), automobile bodies (127263) accessories54Motor vehicle parts and accessoriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (123324), other products (133325)57Precision machinery & equipment Miscellaneous manufacturing industriesshipbuilding (13322), office supplies (133324), other products (133325)58Non-manufacturing industriesshipbuildis (13322), office supplies (133324), other products (133325)			
41Miscellaneous fabricated metal productsother metallic products (119186)42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerymachines (121201), textile machines (121203), agricultural machines (121205), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machinery machinesbearing machines (121208), other machines (121200) office machines (121209)46Electrical generating, transmission, distribution and industrial apparatusheavy electrical machines (123222), control instruments (123226)47Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic parts machinery equipment (123229)general electronic components (123225)53Miscellaneous electrical machinery equipment accessoriesautomobile products (127261) automobile products (127261) automobile bodies (127263) accessories56Other transportation equipment Miscellaneous manufacturing industriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (133324), other products (133325) musical instruments (133322), office supplies (133324), other products (133325)	40		non manie, non tower and ondge (119103)
products General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)43Special industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204)44Miscellaneous machinerymachines (121205), chemical engineering machines (121206), sewing machines (121207)44Miscellaneous machineryoffice and service industry machines46Electrical generating, transmission, distribution and industrial apparatusheavy electrical machines (123222), control instruments (123223) communicators (123224)47Household electric apliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (127261) automobile products (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)57Non-marufacturing industriesshipbuilding (133322), office supplies (133324), other products (133325)			other motelling and heats (110186)
42General industry machinerypress machines (121202), machines for transportation, construction and internal combustion (121204) machine tools (121201), textile machines (121203), agricultural machines (121205), chemical engineering machines (121203), agricultural machines (121205), chemical engineering machines (121203), agricultural machines (121205), chemical engineering machines (121201) bearing machines (121208), other machines (121201) office and service industry machines44Miscellaneous machinery Office and service industry machinesbearing machines (121208), other machines (121210) office machines (121209)45Office and service industry machinesbearing machines (121209)46Electrical generating, transmission, distribution and industrial apparatusheavy electrical manufacturers (123221), electronic equipments (123223) communicators (123224) electronic components (123225)53Miscellaneous electrical machinery equipmentgeneral electrical manufacturers (123225) batteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipment miscellaneous manufacturing industriesshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (123224) electronic supplies (13324), other products (133325) musical instruments (133322), office supplies (133324), other products (133325)	41		other metallic products (119186)
 43 Special industry machinery 44 Miscellaneous machinery 45 Office and service industry machines 46 Electrical generating, transmission, distribution and industrial apparatus 47 Household electric appliances 48 Communication equipment 49 Miscellaneous electrical manufacturers (123221), electronic equipments (123223) 40 Communication equipment 41 Miscellaneous electrical machines 42 Electronic parts 43 Bipbuilding (125241), wheeled vehicles (129281) 44 Motor vehicle parts and accessories 45 Other transportation equipment 46 Diffice machines 47 Household is provided and the products (127261) automobile products (129283) 48 Motor vehicle parts and accessories 49 Other transportation equipment 40 Motor vehicle parts and accessories 56 Other transportation equipment 57 Precision machinery & equipment 57 Precision machinery & equipment 58 Motor vehicle parts and accessories 59 Miscellaneous manufacturing industries 50 Non-manufacturing industries 51 Non-manufacturing industries 52 Non-manufacturing industries 53 Non-manufacturing industries 			
 43 Special industry machinery 44 Miscellaneous machinery 45 Office and service industry machines 46 Electrical generating, transmission, distribution and industrial apparatus 47 Household electric appliances 48 Communication equipment 49 Electronic parts 40 Electronic parts 41 Miscellaneous electrical machines 42 Electronic parts 43 Miscellaneous electrical machines 44 Household electric appliances 45 Communication equipment 46 Electronic parts 47 Household electrical machines 48 Electronic parts 49 Communication equipment 40 Electronic parts 41 Electronic parts 42 Electronic parts 43 Electronic parts 44 Electronic parts 45 Electronic parts 46 Electronic equipment 47 Household electrical 48 machinery equipment 49 Communication equipment 40 Electronic parts 41 Electronic parts 42 Electronic parts 43 Electronic parts 44 Electronic equipment 45 Electronic parts 46 Electronic equipment 47 Household electrical 48 machinery equipment 49 Communication equipment 40 Electronic equipment 41 Electronic equipment 41 Electronic equipment 42 Electronic equipment 43 Electronic equipment 44 Electronic equipment 45 Electronic equipment 46 Electronic equipment 47 Electronic equipment 48 Electronic equipment 49 Electronic equipment 40 Electronic equipment 40 Electronic equipment 41 Electronic equipment 41 Electronic equipment 42 Electronic equipment 44 Electronic equipment 45 Electronic equipment 46 Electronic equipment 47 Electronic equipment 48 Electronic equipment 49 Electronic equipment 40 Electr	42	General industry machinery	
 44 Miscellaneous machinery 45 Office and service industry machines 46 Electrical generating, transmission, distribution and industrial apparatus 47 Household electric appliances 48 Communication equipment 49 Communication equipment 40 Electronic parts 41 Miscellaneous electrical 42 machinery equipment 43 Miscellaneous electrical 44 machinery equipment 45 Motor vehicles 46 Motor vehicle parts and accessories 47 Precision machinery & equipment 48 Motor vehicles 49 Other transportation equipment 40 Diter transportation equipment 41 Motor vehicles 41 Motor vehicles 42 Motor vehicles 43 Motor vehicles 44 Motor vehicles 45 Motor vehicles 46 Motor vehicles 47 Precision machinery & equipment 48 Anton manufacturing industries 49 Other transportation equipment 40 Diter transportation equipment 41 Struers 41 Motor vehicles 42 Motor vehicles 43 Motor vehicles 44 Motor vehicles 45 Motor vehicles 45 Motor vehicles 46 Motor vehicles 47 Precision machinery & equipment 48 Anton accessories 49 Diter transportation equipment 40 Diter transportation equipment 41 Single (125241), wheeled vehicles (129281) 42 bicycles (129282), other products (129283) 44 Anton bic products (133322), other products (133324), other products (133325) 			
 44 Miscellaneous machinery 45 Office and service industry machines 46 Electrical generating, transmission, distribution and industrial apparatus 47 Household electric appliances 48 Communication equipment 49 Communication equipment 40 Electronic parts 41 Miscellaneous electrical 42 machinery equipment 43 Miscellaneous electrical 44 machinery equipment 45 Motor vehicles 46 Motor vehicle parts and accessories 47 Precision machinery & equipment 48 Motor vehicles 49 Other transportation equipment 40 Diter transportation equipment 41 Motor vehicles 41 Motor vehicles 42 Motor vehicles 43 Motor vehicles 44 Motor vehicles 45 Motor vehicles 46 Motor vehicles 47 Precision machinery & equipment 48 Anton manufacturing industries 49 Other transportation equipment 40 Diter transportation equipment 41 Struers 41 Motor vehicles 42 Motor vehicles 43 Motor vehicles 44 Motor vehicles 45 Motor vehicles 45 Motor vehicles 46 Motor vehicles 47 Precision machinery & equipment 48 Anton accessories 49 Diter transportation equipment 40 Diter transportation equipment 41 Single (125241), wheeled vehicles (129281) 42 bicycles (129282), other products (129283) 44 Anton bic products (133322), other products (133324), other products (133325) 	43	Special industry machinery	machine tools (121201), textile machines (121203), agricultural machines
44Miscellaneous machinerybearing machines (121208), other machines (121210)45Office and service industry machinesoffice machines (121209)46Electrical generating, transmission, distribution and industrial apparatusheavy electrical machines (123222), control instruments (123226)47Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (125241), wheeled vehicles (129281) bicycles (129282), other products (129283)57Precision machinery & equipment Miscellaneous manufacturing industriesshipbuilding (125241), wheeled vehicles (123224), other products (133322), office supplies (133324), other products (133325)			
45Office and service industry machinesoffice machines (121209)46Electrical generating, transmission, distribution and industrial apparatusheavy electrical machines (123222), control instruments (123226)47Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic parts machinery equipmentelectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)Non-manufacturing industries	44	Miscellaneous machinerv	
46machines Electrical generating, transmission, distribution and industrial apparatusheavy electrical machines (123222), control instruments (123226)47Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile–related equipments (123228), other products (123229)54Motor vehicles automobile products (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipment bicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)57Precision machinery & equipment Miscellaneous manufacturing industrieshorologes (131301), cameras (131302), measuring gauges (131303)59Miscellaneous manufacturing industriesmusical instruments (133322), office supplies (133324), other products (133325)			
 46 Electrical generating, transmission, distribution and industrial apparatus 47 Household electric appliances 49 Communication equipment 52 Electronic parts 53 Miscellaneous electrical 54 Motor vehicles 55 Motor vehicle parts and accessories 56 Other transportation equipment 57 Precision machinery & equipment 59 Miscellaneous manufacturing industries 50 Non-murufacturing industries 46 Electrical generating, transmission, distribution and industrial apparatus 47 Household electric appliances 58 General electrical manufacturers (123224) 59 Precision machinery & equipment 50 Non-murufacturing industries 50 Non-murufacturing industries 			
transmission, distribution and industrial apparatustransmission, distribution and industrial apparatus47Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipment bicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)57Precision machinery & equipmenthorologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)50Non-marufacturing industriesindustries	46		heavy electrical machines (123222) control instruments (123226)
industrial apparatusgeneral electrical manufacturers (123221), electronic equipments (123223)47Household electric appliancesgeneral electrical manufacturers (123221), electronic equipments (123223)49Communication equipmentcommunicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehiclesautomobile products (127261) accessories56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283)57Precision machinery & equipment Miscellaneous manufacturing industrieshorologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)	-0		123222, contou machines (123222), control instruments (123220)
47Household electric appliances Communication equipmentgeneral electrical manufacturers (123221), electronic equipments (123223) communicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263)56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283)57Precision machinery & equipment Miscellaneous manufacturing industrieshorologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)			
49Communication equipmentcommunicators (123224)52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263)56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283)57Precision machinery & equipmentbicycles (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)Non-manufacturing industries	47		
52Electronic partselectronic components (123225)53Miscellaneous electrical machinery equipmentbatteries (123227), automobile-related equipments (123228), other products (123229)54Motor vehicles accessoriesautomobile products (127261) automobile components (127262), automobile bodies (127263) accessories56Other transportation equipment bicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)57Precision machinery & equipment industrieshorologes (131302), office supplies (133324), other products (133325)			
 Miscellaneous electrical machinery equipment Motor vehicles Motor vehicle parts and accessories Other transportation equipment Single products (127261) Single products (127262), automobile bodies (127263) Single products (127262), automobile bodies (127263) Single products (129281) Single products (129282), other products (129283) Precision machinery & equipment Miscellaneous manufacturing industries Non-manufacturing industries 			
machinery equipment(123229)54Motor vehiclesautomobile products (127261)55Motor vehicle parts and accessoriesautomobile components (127262), automobile bodies (127263)56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)70Precision machinery & equipment industries57Precision machinery & equipment industries58Miscellaneous manufacturing industries			
54Motor vehiclesautomobile products (127261)55Motor vehicle parts and accessoriesautomobile components (127262), automobile bodies (127263)56Other transportation equipmentshipbuilding (125241), wheeled vehicles (129281) bicycles (129282), other products (129283)57Precision machinery & equipmenthorologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)58Non-manufacturing industries	53		
 Motor vehicle parts and accessories Other transportation equipment Precision machinery & equipment Miscellaneous manufacturing industries Non-manufacturing industries 			
accessories accessories 56 Other transportation equipment shipbuilding (125241), wheeled vehicles (129281) 57 Precision machinery & equipment horologes (131301), cameras (131302), measuring gauges (131303) 59 Miscellaneous manufacturing industries musical instruments (133322), office supplies (133324), other products (133325)	54		
accessories accessories 56 Other transportation equipment shipbuilding (125241), wheeled vehicles (129281) 57 Precision machinery & equipment horologes (131301), cameras (131302), measuring gauges (131303) 59 Miscellaneous manufacturing industries musical instruments (133322), office supplies (133324), other products (133325)	55	Motor vehicle parts and	automobile components (127262), automobile bodies (127263)
56 Other transportation equipment shipbuilding (125241), wheeled vehicles (129281) 57 Precision machinery & equipment horologes (129282), other products (129283) 57 Miscellaneous manufacturing nusical instruments (131302), measuring gauges (131303) 70 Miscellaneous manufacturing nusical instruments (133322), office supplies (133324), other products (133325) 70 Non-mufacturing industries 50			
57Precision machinery & equipment Miscellaneous manufacturing industriesbicycles (129282), other products (129283) horologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)Non-manufacturing industries	56		shipbuilding (125241), wheeled vehicles (129281)
57 59Precision machinery & equipment Miscellaneous manufacturing industrieshorologes (131301), cameras (131302), measuring gauges (131303) musical instruments (133322), office supplies (133324), other products (133325)Non-manufacturing industriesNon-manufacturing industries		T	
59 Miscellaneous manufacturing industries musical instruments (133322), office supplies (133324), other products (133325) Non-manufacturing industries musical instruments (133322), office supplies (133324), other products (133325)	57	Precision machinery & equipment	
industries Non-manufacturing industries			
Non-manufacturing industries	59		musicar instruments (155522), onice supplies (155524), other products (155525)
	N		
7 Mining coal (237361), other materials (237362)			
	7	Mining	coal (237361), other materials (237362)

9	Seafood products	seafood products (235341)
60	Construction	major construction companies (241401), midsize construction companies
		(241402), residential houses (241405)
61	Civil engineering	civil engineering, road building and dredging (241403), electrical facilities
		engeneering (241404), other products (241406)
62	Electricity	electrical power services (267661)
63	Gas, heat supply	gas power services (269681)
67	Wholesale	general merchants and traders (243421), automobile selling (243422), food selling
		(243423), textile selling (243424), machinery and metal goods selling (243425),
		chemical products selling (243426), building materials selling (243427), electrical
		machineries selling (243428), other products selling (243429)
68	Retail	department stores (245441), grocery supermarkets (245442), installment selling
		(245443)
		other retailing (245444)
69	Finance	other financial services (252511)
71	Real estate	rental services (253521), real estate brokers (253522)
73	Railway	major private railroad companies (255541), midsize private railroad companies
		(255542)
74	Road transportation	bus and other companies (255543), land transportation companies (257561)
75	Water transportation	major marine transportation companies (259581), coastwise services (259582),
		overseas shipping services (259583)
76	Air transportation	air transport services (261601)
77	Other transportation and packing	warehousing (263621), transportation-related services (263622)
78	Telegraph and telephone	telecommunication services (265641)
89	Entertainment	film distributors (271701), amusement facilities (271702)
95	Accommodation	hotel services (271703)
110	Other services	other services (271704)

Full model					
	Coef.	S.E.			
Constant	-3.915	0.771			
Citing Year Effects (base					
1964	-4.737	0.861			
1965	-4.729	0.755			
1966	-4.595	0.695			
1967	-3.256	0.673			
1968	-3.367	0.682			
1969	-3.124	0.687			
1970	-2.697	0.682			
1972 1973	0.311 0.377	0.643 0.615			
1973	0.476	0.615			
1974 1975	1.027	0.640			
1975	0.846	0.627			
1970	0.818	0.589			
1978	1.070	0.605			
1979	1.168	0.590			
1980	1.225	0.619			
1981	1.071	0.616			
1982	1.278	0.605			
1983	1.286	0.612			
1984	1.777	0.588			
1985	1.793	0.605			
1986	1.890	0.597			
1987	2.118	0.595			
1988	2.149	0.572			
1989	2.280	0.609			
1990	2.435	0.607			
1991	2.456	0.602			
1992	2.882	0.584			
1993	3.219	0.581			
1994	3.253	0.598			
1995	3.500	0.575			
1996	3.625	0.574			
1997	3.685	0.571			
1998	3.722	0.594			
1999	4.036	0.560			
2000	4.164 4.396	0.585			
2001 2002		0.586			
	4.599 4.874	0.588			
2003 2004	4.874 5.028	0.587 0.580			
2004 2005	5.224	0.580			
2005	5.185	0.589			
2000	4.915	0.585			
2007	4.572	0.578			
2000	4.241	0.584			
2009	4.864	0.605			
Cited Year Effects	1.001	0.005			
1965-69	1.945	0.134			
1970-74	1.557	0.145			
1975-79	0.819	0.179			
1980-84	0.026	0.213			
1985-89	-0.772	0.242			
1999-94	-1.274	0.298			
1995-99	-1.649	0.370			
2000-04	-2.548	0.429			
2005-09	-4.291	0.423			
2010	-7.130	0.582			

 $\label{eq:alpha} \mbox{Table A3.1} \ \underline{\mbox{Estimation of Citation Probabilities from IIP} \ \mbox{patent data}$

Beta1: Obsolescence Beta2: Diffusion	-0.042 -1.149	$0.005 \\ 0.174$
Obs R-squared	1645).3967	

Application	(1)	(2)	(3)	(4)	(5)
Year	Total	Index of	Citing Year	Pure Propensity	Simulated
Ical	Patents	Patent Total	Coefficient	to Cite Effect	Cumulative Lag
	1 atents	(1971=1)	(from Table 3)	[(3)/(2)]	Distributions
1964	38384	0.372	0.009	42.405	1.000
1964	42463	0.372	0.009	46.538	1.000
1965	46476	0.411	0.009	40.538	1.000
1960	48037	0.450	0.010	12.067	1.000
			0.039		
1968 1969	55835	0.541 0.596	0.033	15.673	$1.000 \\ 1.000$
	61551		0.044	13.558	1.000
1970 1971	77053	0.746		11.073	
	103238	1.000	1.000	1.000	1.000
1972	127434	1.234	1.364	0.905	1.000
1973	141482	1.370	1.458	0.940	1.000
1974	146242	1.417	1.610	0.880	1.000
1975	156657	1.517	2.793	0.543	1.000
1976	157919	1.530	2.331	0.656	1.000
1977	157999	1.530	2.265	0.676	1.000
1978	162982	1.579	2.914	0.542	0.999
1979	172569	1.672	3.216	0.520	0.999
1980	188125	1.822	3.403	0.535	0.999
1981	215451	2.087	2.918	0.715	0.998
1982	234062	2.267	3.588	0.632	0.998
1983	251376	2.435	3.620	0.673	0.997
1984	281199	2.724	5.912	0.461	0.995
1985	296936	2.876	6.010	0.479	0.994
1986	311280	3.015	6.617	0.456	0.992
1987	329264	3.189	8.317	0.383	0.989
1988	328058	3.178	8.576	0.371	0.986
1989	337067	3.265	9.781	0.334	0.981
1990	353767	3.427	11.419	0.300	0.976
1991	354566	3.434	11.658	0.295	0.969
1992	350295	3.393	17.850	0.190	0.961
1993	347392	3.365	25.004	0.135	0.950
1994	335192	3.247	25.874	0.125	0.938
1995	349496	3.385	33.105	0.102	0.923
1996	356750	3.456	37.539	0.092	0.906
1997	369729	3.581	39.828	0.090	0.885
1998	379620	3.677	41.331	0.089	0.861
1999	357517	3.463	56.578	0.061	0.833
2000	431019	4.175	64.321	0.065	0.800
2001	410458	3.976	81.087	0.049	0.763
2002	390164	3.779	99.346	0.038	0.719
2003	379853	3.679	130.808	0.028	0.670
2004	377792	3.659	152.609	0.024	0.615
2005	357352	3.461	185.592	0.019	0.552
2006	375100	3.633	178.601	0.020	0.482
2007	363117	3.517	136.259	0.026	0.404
2008	346722	3.358	96.696	0.035	0.318
2009	232028	2.248	69.499	0.032	0.222
2010	53233	0.516	129.565	0.004	0.116
-		-			

Table A3.2 Potential Deflators for Citing Patent Totals

Table A4 Country list in creating real exchange rates

Advanced economies (24 countries)	The other countries (79 countries)
Australia, Austria, Belgium, Canada,	Algeria, Bahamas, Bahrain, Barbados, Belize, Bhutan, Botswana, Brunei
Cyprus, Denmark, Finland, France,	Darussalam, Burkina Faso, Burundi, Cameroon, Cape Verde, Central
Greece, Hong Kong SAR (China),	African Republic, Chad, Colombia, Congo, Rep., Costa Rica, Cote d'Ivoire,
Iceland, Ireland, Italy, Korea Rep.,	Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, Arab Rep., El
Luxembourg, Netherlands, New	Salvador, Equatorial Guinea, Ethiopia, Fiji, Gabon, Gambia, The, Grenada,
Zealand, Norway, Portugal,	Guatemala, Haiti, Honduras, Hungary, India, Indonesia, Iran, Islamic Rep.,
Singapore, Spain, Swaziland,	Jamaica, Jordan, Kenya, Kuwait, Lesotho, Libya, Malawi, Malaysia, Malta,
Sweden, United States	Mauritius, Morocco, Myanmar, Nepal, Niger, Nigeria, Pakistan, Panama,
	Papua New Guinea, Paraguay, Philippines, Qatar, Rwanda, Samoa, Saudi
	Arabia, Senegal, Seychelles, Solomon Islands, South Africa, Sri Lanka, St.
	Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Switzerland,
	Syrian Arab Republic, Tanzania, Thailand, Togo, Tonga, Trinidad and
	Tobago, Uganda, Vanuatu, Zambia

Notes: We use country data which do not have missing values of more than 5 years. When there are missing values, we substitute average values of adjacent data into the missing values. When CPI is 0, we substitute 0.1.

		1	2	3	4
	Dep.	lnPat	lnCite	lnPat	lnCite
	Procedure	OLS	OLS	within	within
		Combined coef.	Combined coef.	Combined coef.	Combined coef
		(S.E.)	(S.E.)	(S.E.)	(S.E.)
	cturing industries				
ŧ08	1-li	32.945***	30.286***	235.931***	141.725**
		(5.102)	(5.525)	(69.731)	(77.808)
	$(1-li)^2$	-14.554***	-13.440***	-113.907***	-68.062*
		(4.865)	(5.269)	(35.711)	(39.848)
#10	1-li	51.533***	52.211***	5.392	-11.206
		(7.039)	(7.622)	(49.452)	(55.180)
	$(1-li)^2$	-34.974 ***	-36.603***	-2.566	5.137
		(6.907)	(7.479)	(27.037)	(30.168)
<i>‡</i> 11	1-li	35.322***	32.956***	-35.599***	-44.900 ***
		(2.305)	(2.496)	(11.336)	(12.650)
	$(1-li)^2$	-18.875 ***	-17.787 ***	16.665***	21.387***
		(1.550)	(1.679)	(5.582)	(6.229)
<i>‡</i> 12	1-li	-23.578**	-25.997*	-908.828**	-629.141
		(11.553)	(12.510)	(450.725)	(502.933)
	$(1-li)^2$	40.863***	41.288***	485.849**	348.264
		(11.543)	(12.499)	(229.669)	(256.271)
<i>‡</i> 13	1-li	29.375***	26.648***	-10.431	-58.290*
		(3.669)	(3.973)	(21.017)	(23.451)
	$(1-li)^2$	-11.018***	-9.873**	3.796	29.233*
	· · ·	(3.284)	(3.556)	(10.805)	(12.057)
ŧ15	1-li	39.652***	36.605***	-10.709	-1.187
		(2.099)	(2.272)	(7.831)	(8.738)
	$(1-li)^2$	-22.295***	-20.611***	3.941	-0.454
	· · ·	(1.246)	(1.349)	(3.751)	(4.185)
ŧ16	1-li	47.196***	43.391***	-10.941	-8.868
		(2.973)	(3.219)	(27.222)	(30.375)
	$(1-li)^2$	-29.771***	-27.290***	2.708	0.959
	()	(2.439)	(2.641)	(13.048)	(14.560)
ŧ18	1-li	47.183***	44.783***	-11.186	-67.730**
		(2.509)	(2.717)	(23.175)	(25.859)
	$(1-li)^2$	-29.847***	-28.775***	4.662	31.186**
	(1 11)	(1.859)	(2.013)	(11.129)	(12.418)
ŧ20	1-li	41.293***	41.752***	40.087	-19.756
120	1 11	(3.555)	(3.850)	(44.347)	(49.484)
	$(1-li)^2$	-24.333***	-26.077***	-23.258	6.939
	(1 11)	(3.184)	(3.448)	(22.620)	(25.240)
ŧ22	1–li	51.257***	48.225***	16.790	31.023
	1 11	(3.110)	(3.368)	(29.589)	(33.016)
	$(1-li)^2$	-31.569***	-29.649***	-10.264	-15.813
	(1 11)	(2.605)	(2.820)	(14.781)	(16.493)
ŧ23	1–li	37.460***	36.957***	255.659***	138.841*
40	1 11	(5.394)	(5.840)	(89.252)	(99.590)
	$(1-li)^2$	(3.394) -18.867***	(3.840) -19.851***	(89.232) -126.339***	(99.390) -67.947*
	$(1 \ ll)$				(48.817)
-24	1-li	(5.119) 26.542***	(5.544) 18.567***	(43.749)	
24	$I = \iota \iota$			-25.654	100.254
	$(1 + 1i)^2$	(4.456)	(4.825)	(89.308)	(99.653)
	$(1-li)^2$	-5.490	1.612	15.317	-46.427
25	1 1.	(4.182)	(4.529)	(45.724)	(51.021)
25	1-li	15.223***	14.823**	-147.379	-83.290
	(1 1:)	(5.580)	(6.043)	(96.541)	(107.724)
	$(1-li)^2$	8.086	7.642	77.770	41.753
		(5.368)	(5.813)	(48.918)	(54.584)
\$26	1-li	44.941***	46.513***	-0.291	5.362
	2	(2.821)	(3.055)	(22.181)	(24.750)
	$(1-li)^2$	-24.350 ***	-26.978 * * *	0.682	-3.177

Table A5 Detailed result of Table 3 (at firm level)

		(2.262)	(2.450)	(11.026)	(12.303)
#28	1-li	36.987***	35.185***	9.783	15.516
		(2.246)	(2.432)	(10.801)	(12.052)
	$(1-li)^2$	-16.454***	-15.767***	-3.300	-5.914
		(1.431)	(1.549)	(5.469)	(6.103)
#29	1-li	47.040***	44.290***	8.125	16.431**
		(2.308)	(2.500)	(7.590)	(8.470)
	$(1-li)^2$	-26.716***	-25.664***	-2.366	-7.411*
		(1.501)	(1.625)	(4.046)	(4.515)
#30	1-li	35.260***	39.282***	173.740*	160.465
		(4.550)	(4.927)	(105.397)	(117.605)
	$(1-li)^2$	-16.527***	-22.065 ***	-82.458	-78.965
		(4.226)	(4.576)	(52.985)	(59.122)
#32	1-li	46.824***	48.993***	35.039	40.814
	2	(3.869)	(4.190)	(45.686)	(50.977)
	$(1-li)^2$	-26.458***	-29.884 ***	-18.686	-22.611
		(3.497)	(3.787)	(23.303)	(26.002)
#33	1-li	38.066***	38.402***	284.624***	186.836***
	(1 1)	(3.090)	(3.346)	(36.034)	(40.208)
	$(1-li)^2$	-19.848***	-21.123***	-140.030***	-92.664***
	1 1.	(2.574)	(2.787)	(17.927)	(20.004)
#34	1-li	65.269***	65.652***	44.621	86.677**
	(1.1)2	(3.138)	(3.398)	(27.325)	(30.490)
	$(1-li)^2$	-47.321***	-48.780***	-21.950	-42.922**
1125	1 1.	(2.663)	(2.884)	(13.691)	(15.277)
#35	1-li	27.096***	19.961***	39.362*	43.424
	$(1-li)^2$	(2.845)	(3.081)	(23.803)	(26.561)
	(1-11)	-8.827***	-2.982	-15.490	-16.274
#36	1-li	(2.280) 33.435***	(2.468) 31.934***	(12.031) 30.451**	(13.425) 30.450**
#30	1-11	(2.418)	(2.618)	(13.197)	(14.726)
	$(1-li)^2$	-15.084***	-14.749^{***}	-15.300**	-16.071**
	$(1 \ ll)$	(1.708)	(1.849)	(6.569)	(7.330)
#37	1-li	31.559***	28.542***	15.706	60.266***
11.51	1 11	(2.523)	(2.732)	(16.644)	(18.572)
	$(1-li)^2$	-13.697***	-12.130***	-5.065	-26.336**
	(1 11)	(1.868)	(2.023)	(8.149)	(9.093)
#38	1-li	31.058***	29.296***	40.782*	-17.513
		(3.204)	(3.469)	(23.673)	(26.415)
	$(1-li)^2$	-11.208***	-10.303***	-17.557	11.069
		(2.692)	(2.915)	(11.818)	(13.186)
#39	1-li	37.915***	32.904***	93.396***	71.944**
		(3.020)	(3.270)	(30.480)	(34.010)
	$(1-li)^2$	-18.215***	-14.427 ***	-44.965***	-33.009**
		(2.497)	(2.704)	(14.885)	(16.609)
#40	1-li	24.610***	20.855***	-7.606	45.457
	2	(3.855)	(4.174)	(54.863)	(61.218)
	$(1-li)^2$	-9.537***	-7.154*	6.944	-17.897
		(3.499)	(3.789)	(27.603)	(30.800)
#41	1-li	45.428***	42.805***	57.569***	40.494**
	(1 1)	(2.391)	(2.590)	(13.371)	(14.920)
	$(1-li)^2$	-27.831***	-26.688***	-28.440***	-20.564**
	1 1.	(1.667)	(1.805)	(6.753)	(7.535)
#42	1-li	45.097***	43.261***	39.782***	28.491**
	(1.1)2	(2.229)	(2.413)	(13.238)	(14.771)
	$(1-li)^2$	-26.361***	-25.690***	-18.135***	-12.971**
#12	1 1:	(1.481)	(1.603)	(6.249)	(6.973) 20 667***
#43	1-li	38.977***	37.569***	19.589***	29.667***
	$(1-li)^2$	(2.045) -19.513***	(2.214) -19.521***	(6.070) -9.161***	(6.774) -14.179***
	(1-u)	(1.141)	(1.236)		
#44	1-li	(1.141) 39.539***	(1.236) 39.743***	(2.933) -0.170	(3.273) 7.068
π 44	1 11	(2.202)	(2.384)	(8.067)	(9.001)
		(2.202)	(2.304)	(0.007)	(7.001)

	$(1-li)^2$	-20.309***	-21.804***	0.217	-3.819
		(1.356)	(1.468)	(4.014)	(4.479)
#45	1-li	46.114***	45.959***	4.712	102.247***
		(3.536)	(3.829)	(25.551)	(28.510)
	$(1-li)^2$	-26.506***	-28.234***	-3.691	-52.766***
		(3.169)	(3.432)	(12.992)	(14.497)
#46	1-li	38.856***	37.051***	72.820***	88.725***
		(2.616)	(2.833)	(15.496)	(17.291)
	$(1 - li)^2$	-17.682***	-16.940***	-36.228***	-43.485***
	()	(1.930)	(2.090)	(8.039)	(8.970)
47	1-li	48.199***	43.220***	-10.218	41.249**
• /	1 11	(2.324)	(2.517)	(14.353)	(16.015)
	$(1-li)^2$	-26.388***	-19.480***	3.543	-18.756**
	(1 11)	(1.597)	(1.469)	(6.969)	(7.776)
49	1-li	35.064***	31.994***	46.968***	42.427***
12	1 11	(2.447)	(2.650)	(15.143	(16.897)
	$(1-li)^2$	-13.905***	-11.670***	-21.819***	-18.535**
	$(1 \ ll)$	(1.752)	(1.897)	(7.454)	(8.317)
52	1-li	42.378***	40.676***	8.689	15.376*
52	1 11	(2.315)	(2.507)	(9.242)	(10.312)
	$(1-li)^2$			-2.243	
	(1-ii)	-22.485^{***}	-21.729^{***}		-5.626
50	1 1:	(1.548)	(1.676)	(4.669)	(5.210)
\$53	1-li	43.544***	42.881***	15.245*	35.518***
	(1 1)?	(2.247)	(2.433)	(8.884)	(9.913)
	$(1-li)^2$	-23.178***	-23.519***	-7.370*	-17.652***
		(1.447)	(1.567)	(4.441)	(4.956)
54	1-li	69.528***	66.560***	-45.007	26.465
		(5.174)	(5.602)	(117.446)	(131.050)
	$(1-li)^2$	-46.638***	-44.182***	19.640	-14.369
		(4.911)	(5.318)	(58.678)	(65.475)
ŧ55	1-li	31.082***	28.880***	163.757***	135.616***
	2	(3.063)	(3.317)	(34.055)	(37.999)
	$(1-li)^2$	-11.125***	-10.002***	-75.989***	-59.891***
		(2.575)	(2.788)	(17.221)	(19.216)
56	1-li	46.932***	43.274***	5.467	8.523
		(2.673)	(2.894)	(22.917)	(25.571)
	$(1-li)^2$	-28.527 ***	-26.116***	-2.901	-3.595
		(2.078)	(2.250)	(10.854)	(12.111)
ŧ57	1-li	49.916***	47.950***	-0.671	-3.168
	_	(2.311)	(2.502)	(10.888)	(12.150)
	$(1-li)^2$	-29.032 ***	-27.993 ***	-1.053	1.424
		(1.567)	(1.697)	(5.400)	(6.026)
ŧ59	1-li	44.477***	39.499***	-2.864	52.097***
		(2.478)	(2.683)	(15.014)	(16.753)
	$(1-li)^2$	-26.050***	-22.193***	1.301	-24.332***
		(1.794)	(1.943)	(7.529)	(8.401)
		(1./)+/	(1.713)	(7.52)	(0.401)
Non-ma	anufacturing industries	(1.774)	(1.913)	(1.52))	(0.401)
	nufacturing industries	29.484***		47.743***	
		29.484***	25.128***	47.743***	30.163**
	1—li	29.484*** (2.366)	25.128*** (2.562)	47.743*** (11.826)	30.163** (13.196)
		29.484*** (2.366) -13.6247***	25.128*** (2.562) -10.479***	47.743*** (11.826) -22.066***	30.163** (13.196) -13.279*
ŧ07	l-li $(1-li)^2$	29.484*** (2.366) -13.6247*** (1.601)	25.128*** (2.562) -10.479*** (1.734)	47.743*** (11.826) -22.066*** (5.610)	30.163** (13.196) -13.279* (6.260)
07	1—li	29.484*** (2.366) -13.6247*** (1.601) 26.060***	25.128*** (2.562) -10.479*** (1.734) 18.747***	47.743*** (11.826) -22.066*** (5.610) 154.600**	30.163** (13.196) -13.279* (6.260) 98.109
07	$l - li$ $(1 - li)^2$ $l - li$	29.484*** (2.366) -13.6247*** (1.601) 26.060*** (4.352)	25.128*** (2.562) -10.479*** (1.734) 18.747*** (4.713)	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224)	30.163** (13.196) -13.279* (6.260) 98.109 (76.127)
07	l-li $(1-li)^2$	29.484*** (2.366) -13.6247*** (1.601) 26.060*** (4.352) -7.692*	25.128*** (2.562) -10.479*** (1.734) 18.747*** (4.713) -2.250	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209**	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970
ŧ07 ŧ09	$I-li$ $(1-li)^{2}$ $I-li$ $(1-li)^{2}$	29.484*** (2.366) -13.6247*** (1.601) 26.060*** (4.352) -7.692* (4.013)	25.128*** (2.562) -10.479*** (1.734) 18.747*** (4.713) -2.250 (4.346)	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917)	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193)
ŧ07 ŧ09	$l - li$ $(1 - li)^2$ $l - li$	29.484*** (2.366) -13.6247*** (1.601) 26.060*** (4.352) -7.692* (4.013) 43.589***	25.128*** (2.562) -10.479*** (1.734) 18.747*** (4.713) -2.250 (4.346) 40.842***	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943*	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193) 53.389**
ŧ07 ŧ09	1-li $(1-li)^2$ 1-li $(1-li)^2$ 1-li	29.484*** (2.366) -13.6247*** (1.601) 26.060*** (4.352) -7.692* (4.013) 43.589*** (2.559)	25.128*** (2.562) -10.479*** (1.734) 18.747*** (4.713) -2.250 (4.346) 40.842*** (2.771)	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943* (18.226)	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193) 53.389** (20.337)
¥07 ¥09	$I-li$ $(1-li)^{2}$ $I-li$ $(1-li)^{2}$	29.484*** (2.366) -13.6247*** (1.601) 26.060*** (4.352) -7.692* (4.013) 43.589*** (2.559) -26.993***	25.128*** (2.562) -10.479*** (1.734) 18.747*** (4.713) -2.250 (4.346) 40.842*** (2.771) -25.202***	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943* (18.226) -15.660*	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193) 53.389** (20.337) -25.626**
¥07 ¥09 ¥60	$ 1-li (1-li)^2 1-li (1-li)^2 1-li (1-li)^2 $	$\begin{array}{c} 29.484^{***}\\ (2.366)\\ -13.6247^{***}\\ (1.601)\\ 26.060^{***}\\ (4.352)\\ -7.692^{*}\\ (4.013)\\ 43.589^{***}\\ (2.559)\\ -26.993^{***}\\ (1.945)\end{array}$	$\begin{array}{c} 25.128^{***}\\ (2.562)\\ -10.479^{***}\\ (1.734)\\ 18.747^{***}\\ (4.713)\\ -2.250\\ (4.346)\\ 40.842^{***}\\ (2.771)\\ -25.202^{***}\\ (2.106) \end{array}$	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943* (18.226) -15.660* (8.753)	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193) 53.389** (20.337) -25.626** (9.767)
#07 #09 #60	1-li $(1-li)^2$ 1-li $(1-li)^2$ 1-li	$\begin{array}{c} 29.484^{***}\\ (2.366)\\ -13.6247^{***}\\ (1.601)\\ 26.060^{***}\\ (4.352)\\ -7.692^{*}\\ (4.013)\\ 43.589^{***}\\ (2.559)\\ -26.993^{***}\\ (1.945)\\ 28.319^{***}\end{array}$	$\begin{array}{c} 25.128^{***}\\ (2.562)\\ -10.479^{***}\\ (1.734)\\ 18.747^{***}\\ (4.713)\\ -2.250\\ (4.346)\\ 40.842^{***}\\ (2.771)\\ -25.202^{***}\\ (2.106)\\ 27.713^{***}\end{array}$	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943* (18.226) -15.660* (8.753) 72.854***	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193) 53.389** (20.337) -25.626** (9.767) 12.112
ŧ07 ŧ09 ŧ60	$ 1-li (1-li)^2 1-li (1-li)^2 1-li (1-li)^2 1-li (1-li)^2 1-li $	$\begin{array}{c} 29.484^{***}\\ (2.366)\\ -13.6247^{***}\\ (1.601)\\ 26.060^{***}\\ (4.352)\\ -7.692^{*}\\ (4.013)\\ 43.589^{***}\\ (2.559)\\ -26.993^{***}\\ (1.945)\\ 28.319^{***}\\ (2.617)\end{array}$	$\begin{array}{c} 25.128^{***}\\ (2.562)\\ -10.479^{***}\\ (1.734)\\ 18.747^{***}\\ (4.713)\\ -2.250\\ (4.346)\\ 40.842^{***}\\ (2.771)\\ -25.202^{***}\\ (2.106)\\ 27.713^{***}\\ (2.834) \end{array}$	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943* (18.226) -15.660* (8.753) 72.854*** (22.910)	$\begin{array}{c} 30.163^{**} \\ (13.196) \\ -13.279^{*} \\ (6.260) \\ 98.109 \\ (76.127) \\ -52.970 \\ (41.193) \\ 53.389^{**} \\ (20.337) \\ -25.626^{**} \\ (9.767) \\ 12.112 \\ (25.564) \end{array}$
Non-ma #07 #09 #60 #61	$ 1-li (1-li)^2 1-li (1-li)^2 1-li (1-li)^2 $	$\begin{array}{c} 29.484^{***}\\ (2.366)\\ -13.6247^{***}\\ (1.601)\\ 26.060^{***}\\ (4.352)\\ -7.692^{*}\\ (4.013)\\ 43.589^{***}\\ (2.559)\\ -26.993^{***}\\ (1.945)\\ 28.319^{***}\end{array}$	$\begin{array}{c} 25.128^{***}\\ (2.562)\\ -10.479^{***}\\ (1.734)\\ 18.747^{***}\\ (4.713)\\ -2.250\\ (4.346)\\ 40.842^{***}\\ (2.771)\\ -25.202^{***}\\ (2.106)\\ 27.713^{***}\end{array}$	47.743*** (11.826) -22.066*** (5.610) 154.600** (68.224) -84.209** (36.917) 30.943* (18.226) -15.660* (8.753) 72.854***	30.163** (13.196) -13.279* (6.260) 98.109 (76.127) -52.970 (41.193) 53.389** (20.337) -25.626** (9.767) 12.112

#62	1-li	24.041***	29.264***	85.120	392.520***
		(5.267)	(5.703)	(94.310)	(105.235)
	$(1-li)^2$	-4.559	-11.366*	-37.320	-203.409***
11.60	1 1.	(5.256)	(5.691)	(49.633)	(55.382)
#63	1-li	34.851***	35.235***	42.319	9.331
	$(1-li)^2$	(3.976)	(4.305)	(35.375)	(39.473)
	(1-11)	-18.430^{***}	-20.248 ***	-21.436	-3.521
#67	1-li	(3.701) 25.307***	(4.007) 22.888***	(18.474) -6.037	(20.614) -10.774
#07	1-11	(2.153)	(2.332)	(9.114)	(10.169)
	$(1-li)^2$	-11.165***	-9.875***	1.661	3.478
	$(1 \ ll)$	(1.310)	(1.419)	(4.443)	(4.958)
#68	1–li	29.179***	25.696***	0.815	14.847
1100	1 11	(2.393)	(2.591)	(15.161)	(16.917)
	$(1-li)^2$	-16.476***	-13.752***	-2.644	-10.527
	(1 11)	(1.639)	(1.775)	(7.695)	(8.586)
#69	1-li	29.423***	26.650***	-7.626	-5.512
		(2.373)	(2.570)	(6.542)	(7.300)
	$(1-li)^2$	-16.449***	-14.482***	3.130	2.453
		(1.526)	(1.652)	(3.469)	(3.871)
#71	1-li	25.641***	24.806***	14.025**	12.064
		(2.312)	(2.503)	(6.644)	(7.414)
	$(1-li)^2$	-12.078***	-12.092***	-7.592**	-6.815
		(1.453)	(1.573)	(3.497)	(3.903)
#73	1-li	34.199***	31.025***	-22.010	-29.220
		(2.707)	(2.931)	(19.344)	(21.584)
	$(1-li)^2$	-20.581***	-18.149 ***	11.504	15.882
		(2.105)	(2.279)	(9.616)	(10.729)
#74	1-li	36.634***	31.464***	-87.117	-236.812**
	(1 1)2	(3.989)	(4.320)	(85.181)	(95.048)
	$(1-li)^2$	-23.163***	-18.960***	39.708	119.613**
1175	1 1:	(3.658)	(3.961)	(43.928)	(49.017)
#75	1-li	29.415***	29.622***	-19.039	-52.160***
	$(1-li)^2$	(2.463) -15.888***	(2.668) -16.947***	(16.339) 7.275	(18.231) 21.219**
	(1-ii)	(1.784)	(1.932)	(7.823)	(8.729)
#76	1-li	(1.784) 29.988***	35.665***	78.983	(3.729) -13.321
π70	1 11	(5.383)	(5.829)	(72.094)	(80.444)
	$(1-li)^2$	-13.802***	-20.775***	-35.927	5.380
	(1 11)	(5.121)	(5.545)	(35.898)	(40.056)
#77	1-li	31.304***	31.399***	-24.472	-24.617
		(2.865)	(3.103)	(19.905)	(22.211)
	$(1-li)^2$	-18.606***	-19.417***	9.378	8.067
	~ /	(2.293)	(2.483)	(10.704)	(11.943)
#78	1-li	44.823***	40.685***	-52.845***	-59.025***
	_	(2.928)	(3.171)	(16.834)	(18.784)
	$(1-li)^2$	-28.997***	-25.939***	26.593***	30.085***
		(2.436)	(2.638)	(8.718)	(9.728)
#89	1-li	26.874***	25.276***	-12.789*	-25.791***
		(2.280)	(2.468)	(7.515)	(8.385)
	$(1-li)^2$	-13.762***	-12.849***	5.776	12.144**
1105	1 1.	(1.466)	(1.588)	(3.823)	(4.266)
#95	1-li	26.204***	25.318***	-27.484	-34.898
	$(1 + 1)^2$	(2.591)	(2.805)	(18.054)	(20.145)
	$(1-li)^2$	-13.251***	-12.967 ***	10.818	13.794
#110	1 1:	(1.964) 29.820***	(2.126) 27.912***	(8.513) -12.193***	(9.499) -11.777***
#110	1-li				
	$(1-li)^2$	(2.092) -15.927***	(2.266) -15.082***	(3.933) 5.581***	(4.388) 5.262**
	(1 11)	(1.149)	(1.244)	(1.971)	(2.200)
	constant	-21.779***	-24.015***	-13.111***	-15.873***
	e stistuit	(0.997)	(1.080)	(1.605)	(1.791)
	Year dummy	Yes	Yes	Yes	Yes
	5				

Firm fixed effects	No	No	Yes	Yes
Obs	94510	94510	94510	94510
Group			3459	3459
Year	70-06	70-06	70-06	70-06
Adj-R2	0.3662	0.3696		
Within R2			0.1669	0.2113