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Selection and Imitation in Institutional Evolution: Analysis of Institutional Change in Japan, 1960-1999

Tetsuji Okazaki
The University of Tokyo

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Tetsuji Okazaki*

The University of Tokyo, and

Research Institute of Economy, Trade and Industry

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1. Introduction

This paper presents an empirical framework to analyze institutional change, and applies it to economic institutions in Japan, specifically the main bank system and long-term employment. Institutional analysis is one of the fields of economics and economic history that has undergone considerable development in recent years. Since the seminal works of Douglas North (North and Thomas[1973]; North[1990]), many economists and economic historians have come to agree with the idea that "institution matters." (Aoki[1998, 2001]; Clague[1997]; Crafts[1997]; Greif[1997, 1998a, 2003; Hoff and Stiglitz[2000]; Matthews[1986]; Mantzavinous[2001]; Milgrom, North and Weingast[1990]; Willamson[1999, 2000]].

The essential part of the recent development of institutional analysis is the use of game theory to analyze institutions. Institutions are defined as regular patterns of activities which are the equilibria of a game played by members of a society. It implies that institutions are self-enforcing. In other words, the concept of institutions as equilibria enables us to explain the existence of institutions endogenously (Aoki[2001]; Greif[1997, 2003]).

One of the most important remaining issues in institutional analysis is how to explain institutional change. While stability is an essential attribute of institutions, and is well explained by the concept of institutions as equilibria, institutions have another essential attribute, namely that they can change over time. The new books of the two leading scholars on institutional analysis mainly focus on theoretical discussions of institutional change (Aoki[2001]; Greif[2003]). In this paper, I intend to make some contributions to the analysis of institutional change from an empirical perspective.

There have been two approaches to institutional analysis; one based on classical game theory and the other on evolutionary game theory (Greif[1998a, 1998b]). In addition, Aoki[2001] recently proposed a subjective game approach. The basic idea of the empirical framework presented in this paper comes from evolutionary game theory, evolutionary biology and organizational ecology, but it is general enough to be applicable to all of the above three theoretical approaches. The empirical results of this paper will provide us with useful information to discriminate which mechanisms really worked or work in specific times and places.

The paper is organized as follows. Section 2 discusses related literature and the framework. Section 3 explains the data. Section 4 and 5 presents the results of empirical analysis. Section 6 concludes the paper.

2. Literature and Framework

The seminal work of Alchian[1950]was the first to apply the ideas of evolutionary biology extensively to economics. In this insightful paper, Alchian proposed a view that the economy is a system of selection which selects those agents whose mode of activities fit the environment. Specifically, those firms which fit well into the environment are more likely to earn positive profits,

and therefore survive. On the other hand, those firms which do not fit into the environment are more likely to make losses, and therefore be removed from the economy. Consequently, the existing population of firms consists of those whose mode of activities is fitted to the environment. As we can easily see, this is a direct application of Darwinian evolutionary biology. Actually, Alchian[1950] compares heredity inheritance to imitation, mutation to innovation, and natural selection to selection by positive profits (p.220).

If we assume classical Darwinian theory applies, then by application of evolutionary biology we conclude that the existing mode of activities are uniquely determined by the exogenous environment. It is remarkable that while one of the main purposes of Darwin[1859] was to explain diversity of species, Darwin considered that diversity is basically determined by variety in the natural environment. However, since then, the landscape of evolutionary biology has changed substantially. The most important change was the development of evolutionary game theory by John Maynard Smith (Smith[1982]). Evolutionary game theory has essentially changed the meaning of the term environment in evolutionary biology. The environment now includes not only the exogenous natural environment but also the demographic environment, which brings strategic relationships into biological evolution. Hence, it is possible that evolution results in different equilibrium states, even if the natural environment is the same.

In the same year, a seminal work in the field of economics, Nelson and Winter[1982], was published. While a major contribution of this book is formalizing an evolutionary model of economic growth and competition, it also contains rich insights on the evolution of an economic organization. This includes the concept of organizational routine, which is a persistent feature of the organization that determines its possible behavior (p.14). Nelson and Winter[1982] focuses on the change in the population of organizations with these routines over time, rather than the change in a routine within each organization. The latter changes, mutations or innovations, however, are also thought to play an important role. The change in the organizational population is thought to be basically determined by differences in the survival and growth rates between organizations with various routines.

From Nelson and Winter[1982], two large bodies of research, closely interrelated with each other, have developed, namely research on organizational ecology (Hannan and Freeman[1989]; Carroll and Hannan[1995, 1999]; Hannan and Carroll[1992]), and the empirical research on the endogenous change of the market structure in the field of industrial organizations (Agrawal and Gort[1996]; Baldwin[1995]; Caves[1998]; Dunne and Hugh[1994]; Evans[1987]; Klepper[2002]; Sutton[1997]).

Organizational ecology aims at explaining the change in organizational diversity over time. It focuses on a couple of demographic variables with respect to organizations, namely the founding (birth) and death rates, and investigates the factors which influence on these rates, specifically, density and age. The industrial organization literature, on the other hand, is interested in the change over time of market share distribution, market concentration, and its efficiency implications. Gibrat's Law is

one of the issues (Sutton[1997]). They focus on such firm-specific attributes as age and scale as exogenous variables.

Integrating the above literature, we can derive a framework for the empirical analysis of institutional change. As institutions are defined as self-enforcing regularities of activities, the first step in conducting empirical research on institutional change is to measure how pervasive a certain mode of activity is in the society. More specifically, we measure the ratio of firms with a certain relevant attribute to the total firm population. The ratio is measured in terms of firm numbers as well as sales. Next, we measure the same ratio after a certain interval to determine whether that attribute is proliferating or declining. Where the ratio is measured in terms of sales, the difference between the initial year and final year can be decomposed into the following four factors, (i) the difference in the growth rates between those firms which existed in the initial year and those that survived over the interval, (ii) the difference in the exit (death) rates, (iii) the difference in the entry (birth) rates, and (iv) the rate of conversion to or from the attribute over the interval. Where the ratio is measured in terms of the number of firms, the difference between the initial year and the final year can be decomposed into (ii), (iii) and (iv). All of these four factors can be interpreted as measures of "fitness" in a Darwinian sense. (i), (ii) and (iii) relate to selection, while (iv) relate to imitation.

We can further analyze the determinants of (i) and (ii) by extending a standard model of firm growth from the industrial organization literature to incorporate institutional variables).

$$G_t=g[A_{t-1}, S_{t-1}, I_{t-1}]+u_t \qquad (1)$$

where G_t refers to sales growth of each firm over the period t-1 to t. A, S and I refer to age, size, and the institutional attribute of each firm respectively. u_t is an error term with a normal distribution and a mean of zero. As some of the firms in period t-1 have exited by period t, growth rates for those firms cannot be observed. Also, it is possible that the growth rate is correlated with the probability of exit. Therefore, in order to correct for sample selection bias, we assume the probability of firm survival is

$$Pr[D_t=1]=Pr[e_t>-V[A_{t-1}, S_{t-1}, I_{t-1}]] \qquad (2)$$

where D_t is a dummy variable which equals 1, if the firm survives until period t, and zero, otherwise e_t is an error term with a normal distribution and a mean of zero. We can simultaneously estimate equation (1) and (2) by maximizing likelihood function (Amemiya[1984]; Green[2000]). The coefficient of I_{t-1} in equation (1) and (2) [determines][gives us information about] the fitness of i) and ii) of the institutional attribute, respectively. This framework is also useful because by modifying equation (1) and (2), we can analyze the interaction of two or more institutions.

$$G_t=g[A_{t-1}, S_{t-1}, I_{t-1}, I'_{t-1}, I_{t-1}*I'_{t-1}]+u_t \quad (3)$$

$$Pr[D_t=1]=Pr[e_t>-V[A_{t-1}, S_{t-1}, I_{t-1}, I_{t-1}*I'_{t-1}] \quad (4)$$

where I'_{t-1} denotes the variable measuring another institution. If the coefficient of the cross term of the two institutional variables in equation (3) or (4) is positive, the fitness of one enhances the fitness of the other. In other words, these institutions are complementary in the selection process, and they will co-evolve. On the other hand, if the coefficient is negative, these two institutions are substitutive. In this sense, we can empirically capture the institutional complementarity (Aoki[2001]) and its evolutionary implications in this framework.

3.The data

The first step is to identify the firm population. Here I use all of the industrial companies which were listed on the First Section of the Tokyo Stock Exchange (TSE I) at the end of 1960, 1970, 1980, 1990 and 1999, respectively. The listing data are obtained from various issues of the Monthly Statistical Bulletin of the TSE (*Tosho Tokei Geppo*). Industrial companies include manufacturing, mining, agriculture and fishery companies. We follow the industry classifications applied to firms by the TSE. There were 433, 507, 593, 703, and 766 industrial companies listed on the TSE I at the end of 1960, 1970, 1980, 1990, and 1999 respectively. Out of the sample firms in 1960, 1970, 1980 and 1990, I excluded 0, 3, 1 and 4 firms respectively, which ceased to be classed as industrial firms in the following 10 years. These firms make up the sample firm population for this paper (Table 1). As firms have changed their names from time to time, we cannot know which have entered and exited by simply comparing the firm populations between two years. Information on entry, exit and name changes was obtained from the various issues of the Statistical Year Book of the TSE until 1983 and the Year Book of the TSE after that. New entrants are considered to be new listings on to the TSE and conversions from the Second Section of the TSE (TSE II) to the TSE I. Likewise, exiting firms are those firms exiting from the TSE or converting to the TSE II.

The financial data on the sample firms are collected from the TSE[1961] for 1960, and from the Nikkei NEEDS database for the other years[1]. Concerning each year and firm, the data of the financial term which ended latest in that year are used. The flow data (sales and profit) were converted into an annual figure.

This paper employs two institutional variables; one variable focuses on the main bank relationship and the other focuses on long-term employment. The main bank relationship refers to a long-term relationship between a bank and a firm in which the bank plays a central role in financing and in the corporate governance via its monitoring function (Aoki, Patrick and Sheard[1994]; Hoshi

[1] While the database of the Development Bank of Japan includes the financial data from 1956, it sums the data of merged firms for the years before the merger, with respect to the period prior to 1983. Therefore, this database is not appropriate for the purposes of this paper.

and Kashyap[2001]). There are several ways to identify a main bank relationship. Nakatani[1984] and Hoshi et al [1990, 1991] relied on the classification in *Nenpo Keiretsu no Kenkyu* , while Weinstein and Yafeh[1998] relied on the *Industrial Grouping in Japan* by Dodwell Marketing Consultants. Kang[1993] and Kang and Shivdansani[1995] identified a main bank relationship if the largest lender was also the largest shareholder. In this paper where we are focusing on the change over time of the main bank relationship itself it is important that the classification be objective and reproducible. However, the definition by Kang[1993] and Kang and Shivdansani[1995] is too narrow, as according to Kang and Shivdansani[1995] only 18% of the firms had a main bank relationship in 1984(p.38).

Therefore, I define a main bank relationship as existing if the largest lender of a firm does not change for three years. For example, for 1960, if a firm's largest lender was the same in 1958, 1959 and 1960, this firm is identified as having a main bank relationship. This is one of the criteria by which *Nenpo Keiretsu no Kenkyu* identifies keiretsu group firms. Borrowing data were obtained from the TSE[1959, 1960, 1961] for 1960, and the various issues of *Nenpo Keiretsu no Kenkyu* for the other years except 1998 and 1999. The data on 1998 and 1999 were obtained from the Development Bank of Japan (DBJ) database. Based on the measure employed, we cannot identify a main bank relationship for those firms which were listed on the TSE within the two years prior to 1960, 1970, 1980, 1990 and 1999. In the rest of the paper, these companies are referred to as firms where data on the main bank relationship were not available[2].

The measure of long-term employment used was the average age of the male employees minus the average tenure of the male employees for each firm, which directly measures the average age of entry to each firm. In the typical case of "life time employment," a person is assumed to enter a certain firm just after they graduated from high school or university and will stay there until the age of mandatory retirement, meaning there is no recruitment in between those points. Therefore, the lower the average age of entry is, the closer the employment system of that company is to the typical "lifetime employment". The data on the average age and tenure comes from the TSE[1961] for 1960, and various issues of the *Diamond Kaisha Yora*n for 1970, 1980 and 1990, and the DBJ database for 1999.

4. Rise and fall of main bank system: Change of "fitness"

Table 1 summarizes the data on the pervasiveness of the main bank relationship in terms of the numbers of firms as well as sales. In terms of firm numbers, we can say that roughly 70% of industrial firms for which borrowing data were available have had a main bank relationship since 1960 in the sense defined above. At the same time we find changes over time. From 1960 to 1980, the

[2] Besides these firms, there are several firms for which borrowing data were not available in the sources mentioned above, which, in turn, is because complete borrowing data were not available in their business reports.

percentage of the firms with a main bank relationship went up. Then, from 1980 it declined until 1990, and in the 1990s it rose slightly again. Based on sales, the percentage of firms with a main bank relationship in 1960 was 76.3%. While this rose to 78.5% in 1970, it has declined since then. In this sense, the decline of the main bank system can be observed earlier in terms of sales than in terms of firm number. Also, unlike the case of firm numbers, the sales percentage continued to decline in the 1990s. In conclusion, we can say that until 1970, the main bank relationships were in a rising phase, and since then they have been declining. How has this change in the composition of the firm population occurred over time ? This is the basic question of the evolutionary framework discussed in section 1.

To address this question each firm's main bank relationship was followed over time. The results are shown in Tables 2-5. First, let us focus on the change from 1960 to 1970. The population of 433 industrial firms in 1960, was composed of 286 firms with a main bank, 136 firms without a main bank, and 11 firms for which data were not available. Out of the 286 firms with a main bank, 58 firms (20.5%) had exited by 1970. The 228 survivors are classified into the firms which were still with a main bank in 1970 (184), those which no longer had a main bank by 1970 (41), and those for which 1970 data were not available (3). Focusing on the surviving firms, we find that 81.8 % of the firms with a main bank in 1960 also had one in 1970. On the other hand, out of the 136 firms without a main bank in 1960, 33 firms (24.6%) had exited by 1970. The exit rate was slightly higher than for those with a main bank. Also, it is remarkable that out of the 103 survivors without a main bank in 1960, 68 firms came to have a main bank relationship in 1970. The ratio of the firms without a main bank that changed their attribute was much higher than that for firms with a main bank.

Besides the 433 firms existing in 1960, there were 166 new entrants into the population by 1970. Out of them, 77 firms were with a main bank and 48 firms were without a main bank in 1970, while the other 44 firms did not have data available, mainly because they entered after 1968. The ratio of the firms with a main bank for the newcomers is 61.6 %, excluding the 44 firms for which data were not available. In other words, among the newcomers, the ratio of firms with a main bank was lower than in the population existing in 1960, which lowered the ratio of the firms with a main bank in the total firm population. The entry, exit and conversion of attributes in the 1960s described above, made the firm population in 1970[3].

Similar analysis of the change from 1970 to 1980 is possible (Table 3). The industrial firm population in 1970 was 504, which was composed of 331 firms with a main bank, 124 were without a main bank, and 49 firms for which the data were not available. Out of the 331 firms with a main bank, 18 firms (5.5%) had exited by 1980. 254 of the 313 surviving firms (81.2%) also had a main bank in 1980. On the other hand, out of the 124 firms without a main bank, 6 firms (4.9%) exited. Unlike

[3] As noted also in Table 3, the 3 firms which moved out of the industrial sector in the 1970s were excluded from the population in 1970.

the 1960s, the exit rate was slightly lower for the firms without a main bank. Out of the 118 survivors without a main bank in 1970, 79 firms (67.5%) came to have main bank in 1980, which implies that there is still a substantial amount of conversion from the non-main bank group to the main bank group occurring in the 1970s. The ratio of firms with a main bank among the 114 newcomers was 62.2%, almost the same as in the 1960s.

As described above, movement in the firm population was basically similar between the 1960s and 1970s, except that the exit rate was generally much lower in the 1970s. However, in the 1980s the movement in the characteristics shown above changed substantially (Table 4). The industrial firm population in 1980 was 592, which was composed of 421 firms with a main bank, 144 firms without a main bank, and 27 firms for which data were not available. Exit rates were generally very low in the 1980s. Out of the 411 survivors with a main bank in 1980, 321 firms (78.1%) also had a main bank in 1990. Out of the 142 survivors without a main bank in 1980, 70 firms (49.3%) came to have a main bank in 1990. The ratio of those converting from the group non- main bank group to the main bank group was substantially lower than the ratio in the 1970s. A similar change is observed in the composition of the newcomers. The ratio of firms with a main bank for the newcomers, for which data were available, is 48.1%. In other words, newcomers without a main bank outnumbered those with a main bank.

Finally, in 1990, the industrial firm population consisted of 699, which was composed of 440 firms with a main bank, 218 firms without a main bank, and 41 firms for which data were not available. Exit rates went up again, especially for firms with a main bank. As a result the exit rate of the firms with a main bank (5.0%) was much higher than that of the firms without a main bank (1.4%). Out of the 418 surviving firms with a main bank, 363 firms (86.8%) also had a main bank in 1999. This ratio was the highest among the periods observed here. On the other hand, out of the 215 surviving firms without a main bank, 93 firms (43.3%) came to have a main bank in 1999. This ratio was still lower than in the 1980s. Also, among the 64 newcomers for which data were available, 34 firms (53.1%) were with a main bank.

Based on the results in Table 2-5, we can decompose the change in the percentage of firms with a main bank into the contributions of the difference in the exit (death) rates, the difference in the entrance (birth) rates, and the change in attribute over the intervals tested, which correspond to (ii), (iii) and (iv) in section 2. To examine these contributions we express the number of firms with a main bank and the number of firms without a main bank at time 1 based on the variables at time 0 with the parameters capturing (ii), (iii) and (iv).

$$M^1=[M^{0\cdot}(1-d_m)-X_m^{\,1}]\cdot(1-c_m)+M^{0\cdot}b_m+[N^{0\cdot}1-d_n)-X_n^{\,1}]\cdot c_n \quad (5)$$

$$N^1=[N^{0\cdot}(1-d_n)-X_n^{\,1}]\cdot(1-c_n)+N^{0\cdot}b_n+[N^{0\cdot}(1-d_m)-X_m^{\,1}]\cdot c_m \quad (6)$$

M^i: Number of firms with a main bank at time i

N^i :Number of firms without a main bank at time i

X_j^i:Number of firms with(m) or without(n) a main bank for which data were not available at time i

b_j : Entry (birth) rate of firms with(m) or without(n) a main bank[4]

d_j : Exit (death) rate of firms with(m) or without(n) a main bank[5]

c_j: Ratio of the firms which converted from "with a main bank" to "without a main bank" (m) or from "without a main bank" to "with a main bank" (n)[6]

Using these formulae and assuming counterfactual b_j , d_j, and c_j, we can calculate the counterfactual percentage of the firms with a main bank in time 1($M^{1'}$, $N^{1'}$). In order to make clear the contribution to the fitness of the factors (ii), (iii) and (iv), we assume the following conditions, respectively.

$$d_m=d_n=(d_m \cdot M_0+d_n \cdot N_0)/(M_0+N_0) \quad (7)$$

$$b_m=b_n=(b_m \cdot M_0+b_n \cdot N_0)/(M_0+N_0) \quad (8)$$

$$c_m=c_n=0 \quad (9)$$

The difference, $M^1/(M^1+N^1)-M^{1'}/(M^{1'}+N^{1'})$ can be interpreted as the contribution of each of the fitness factors, (ii), (iii) and (iv). The results are shown in Table 6. The major reason why the share of firms with a main bank in terms of firm number increased in the 1960s and 1970s was the number of firms converting from the non-main bank to the main bank group. In these periods, while most of the firms with a main bank in the initial year had a main bank also in the final year, many firms converted from "without a main bank" to "with a main bank." However, the large positive effect of these conversions was mitigated by the negative effect of new entrants.

In the 1980s, however, while the negative effect of new entrants substantially increased, the effect of the conversions was reversed. Namely, as the ratio of firms converting from "without a main bank" to "with a main bank" declined, conversions started to affect the percentage of the firms with a main bank negatively. Finally, in the 1990s, the effect of conversions became positive again at the same time as the negative effects of new entrants decreased, which brought about the increase in the share of the firms with a main bank. In conclusion, the major factors of the change in the main bank system were conversions and new entrants. This implies, that based on the number of firms, the fitness factor which predominately affected the pervasiveness of main bank relationships has been imitation, not selection.

Similar analyses are also possible in terms of sales. By measuring the percentage of firms with a

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[4] (Number of newcomers with a main bank)/M^0, and number of newcomers without a main bank/N^0

[5] (Number of exiting firms with a main bank)/M^0, and (number of exiting firms without a main bank)/N^0

[6] (Number of the firms which had a main bank in time 0 and lost it in time 1)/(M^0-$d_m M^0$) and (Number of the firms which did not have a bank in time 0 and had one in time 1)/(M^1-$d_n N^0$)

main bank, we not only have a more relevant measure of the pervasiveness of the main bank system, we can also examine the effect of the fitness factor (i), namely the growth rate. The counterparts of Tables 2-5 are Tables 7-10. Based on sales for the 1960s, the percentage of firms that had a main bank and exited was 10.6%, while those that exited without a main bank was 7.0%. The lower ratios compared with the results for the firm numbers imply that the exiting firms were relatively small. Comparing firms with a main bank and those without a main bank, we find that the average scale of the exiting firms was larger in the former group. Based on sales, the percentage of companies that survived between 1960 and 1970 and had a main bank in both years was 86.3%. Conversely, based on sales, the percentage of surviving companies that did not have a main bank in 1960 but came to have a main bank in 1970 was 64.1%. This implies that conversions from "without a main bank" to "with a main bank" took place on a substantial scale, which is almost identical to the results for firm numbers. Further, the share of newcomers in 1970 with a main bank based on sales was 62.0%. The percentage of firms with a main bank was generally higher than the results for firm numbers, which means that the firms with a main bank were relatively large.

In the 1970s, the conversions from "with a main bank" to "without a main bank" increased remarkably, although in the 1980s, conversions from "without a main bank" to "with a main bank" declined. Also, in terms of the sales of newcomers, the percentage of firms without a main bank became larger than the percentage with a main bank. The [patterns observed][changes] in the 1980s were similar to those found based on firm numbers; however, the movement observed in the 1990s was different. Based on firm numbers, the changes in the 1980s were similar to the changes in the 1990s, however, the changes for the sales while in the same direction as the 1980s, were far more [significant][substantial] in the 1990s. Conversions from "without a main bank" to "with a main bank" declined to as low as 22.1%, and the share of firms without a main bank amongst newcomers increased to 70.8%. The difference between the results for the different measures implies that the firms without a main bank became larger.

In order to decompose the change in the percentage of firms with a main bank based on sales, we redefine the notations and rewrite the equations (5), (6) as follows.

$$M^1=[M^{0\cdot}(1-d_m)-X_m^{\,1}]\cdot(1-c_m)\cdot g_{mm}+M^{0\cdot}b_m+[N^{0\cdot}(1-d_n)-X_n^{\,1}]\cdot c_n\cdot g_{nm} \quad (10)$$

$$N^1=[N^{0\cdot}(1-d_n)-X_n^{\,1}]\cdot(1-c_n)\cdot g_{nn}+N^{0\cdot}b_n+[N^{0\cdot}(1-d_m)-X_m^{\,1}]\cdot c_m\cdot g_{mn} \quad (11)$$

M^i: Sales of firms with a main bank at time i

N^i :Sales of firms without a main bank at time i

X_j^i:Sales of firms with(m) or without(n) a main bank for which data were not available at time i

b_j : Entry (birth) rate of firms with(m) or without(n) a main bank in terms of sales[7]

[7] (Sales of newcomers with a main bank)/M^0, and sales of newcomers without a main bank/N^0. Note that here and in the following notes M^i and N^i are in terms of sales.

d_j : Exit (death) rate of firms with(m) or without(n) a main bank in terms of sales[8]

c_j: Ratio of firms which converted from "with a main bank" to "without a main bank" (m) or from "without a main bank" to "with a main bank" (n) in terms of sales[9]

g_{mm}: Growth rate of sales for firms which had a main bank at both time 0 and time1

g_{nm} : Growth rate of sales for firms which did not have a main bank at time 0 and had a main bank at time 1

g_{nn}: Growth rate of sales for firms which did not have a main bank at either time 0 or time 1

g_{mn}: Growth rate of sales for firms which had a main bank at time 0 and did not have a main bank at time 1

To make clear the contribution of the fitness factors (i), (ii), (iii), (iv), we assume the following conditions respectively.

$$g_{mm}=g_{nn}=[g_{mm}\cdot\{M^{0}\cdot(1-d_m)\cdot(1-c_m)-X_m^{1}\}+g_{nn}\cdot\{N^{0}\cdot(1-d_n)-X_n^{1}\}]/$$
$$[M^{0}\cdot(1-d_m)(1-c_m)-X_m^{1}+N^{0}\cdot(1-d_n)(1-c_n)-X_n^{1}]$$
$$g_{nm}=g_{mn}=[g_{nm}\cdot\{M^{0}\cdot(1-d_m)\cdot c_m-X_m^{1}\}+g_{mn}\cdot\{N^{0}\cdot(1-d_n)\cdot c_n-X_n^{1}\}]/$$
$$[[M^{0}\cdot(1-d_m)\cdot c_m-X_m^{1}+N^{0}\cdot(1-d_n)\cdot c_n-X_n^{1}] \quad (12)$$

$$d_m=d_n=(d_m\cdot M_0+d_n\cdot N_0)/(M_0+N_0) \quad (13)$$

$$b_m=b_n=(b_m\cdot M_0+b_n\cdot N_0)/(M_0+N_0) \quad (14)$$

$$c_m=c_n=0 \quad (15)$$

The results are shown in Table 11. The increase in the percentage of firms in the 1960s was basically due to conversions from "without a main bank" to "with a main bank." Also, new entries had a substantial negative effect on the percentage of the firms with a main bank. These are similar to the results found for firm numbers. In the 1970s however, unlike firm numbers, the percentage of firms with a main bank started to decline. There are three major reasons. First, new entries continued to have a negative effect. Second, the effect of conversions was reversed. Finally the effect of growth was also reversed. The final point implies that the average growth rate for the firms with a main bank was lower than that for the firms without a main bank. The effect of the growth rate expanded in the 1980s and became the largest negative factor. In the 1990s, these three negative effects continued, and as a result, the percentage of firms with a main bank continued to decline, unlike the results for firm numbers. It is notable that when the percentage of firms with a main bank is measured in terms of sales, the fitness factors representing selection has a substantial effect as well as the fitness factors representing imitation.

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[8] (Sales of exiting firms with a main bank)/M^0, and (sales of exiting firms without a main bank)/N^0

[9] (Sales of firms which had a main bank at time 0 and lost it by time 1)/(M^0-d_mM^0) and (Sales of the firms which did not have a bank at time 0 and had one by time 1)/(N_0-d_nN^0)

5. Selection, complementarity and co-evolution

In this section I estimate equations (1),(2),(3) and (4) in section 1, using the data explained in section 2. Table 12 reports the results on (1) and (2), with respect to the 1960s. In both of the equations (a) and (b) in Table 12, a dummy variable indicating mergers as well as industry dummies were added. The merger dummy equals 1, if the firm acquired other listed companies, and 0, otherwise. MAIN is a dummy variable which equals 1, if the firm had a main bank relationship as defined in section 3. Age is measured in years from when the firm was established. Age and sales are logarithmic values. The coefficients of age and sales are positive and statistically significant in the survival regression in equation (a). Older and larger firms were more likely to survive in the 1960s. On the other hand, they were not significant in the growth regression. Also, the coefficient of the main bank variable is not significant in either the survival or growth regressions. Equation (b) includes an interaction term between the main bank variable and sales. The coefficient of this term is significantly negative, while the coefficient of the main bank dummy is significantly positive. This means that the main bank relationship had a positive effect on firm survival, but this effect diminished as the firm scale increased. The turning point at which the effect of the main bank relationship on firm survival ceases was calculated to be 2,823 million yen. This is much smaller than the minimum size of the industrial firm population here. Therefore, we can say that while the main bank relationship had a positive effect on the survival of smaller firms, its effect was negative for firms listed on the TSE I. This result is consistent with the fact that the contribution of firm exits is negative in Table 12.

Table 13 reports the results for the 1970s. We do not find significant coefficients in the survival regressions. This may be because there are few firm exits observed over this period. Also, the main bank variable is not significant in the growth regressions. The results for the 1980s are basically the same, although the results are not reported. These results show that the main bank relationship was neutral with respect to the impact of selection on institutional evolution in the 1970s and 1980s. Table 14 reports the results for the 1990s. In both the survival and growth regressions, the main bank variable is negative and statistically significant. Therefore, the main bank relationship had a negative effect on the selection process with respect to firm survival as well as firm growth. Integrating the results of the previous section, we can say that main bank relationships lost their fitness in an evolutionary sense in the 1990s.

Finally I will examine the issue of institutional complementarity. To accomplish this I add a variable that measures the average entrance age of male employees of each firm (ENTAGE) and include an interaction term between it and the main bank variable. In the 1960s, the coefficient of ENTAGE is negative and statistically significant in the growth regression (Table 15). This implies that those firms which did not recruit employees in the middle of their careers, namely those firms which

had a long-term employment system, tended to have a higher growth rate. In this sense, long-term employment had evolutionary fitness over this period. Also, the coefficient of the interaction term, MAIN*ENTAGE is negative. While it is not significant at the 10% level, its p-value is 13.5%. So, although the statistical significance is not high, we can say that there was institutional complementarity between the main bank relationship and long-term employment in the sense that they enhanced the fitness of each other. In other words, the main bank relationship and long term employment co-evolved in the 1960s.

In the 1970s, the coefficient of ENTAGE is also significantly negative, which means that long term employment still had high fitness in this period (Table 16). However, the coefficient of the interaction term becomes positive and declines in significance. This implies that the co-evolutionary relationship of the main bank relationship and long term employment disappeared in this period. In the 1980s and 1990s, the coefficient of ENTAGE and MAIN*ENTAGE are statistically insignificant (Table17, 18). Therefore, the co-evolutionary relationship is no longer observed, and also the fitness of long-term employment itself declined over this period.

Concluding remarks

In this paper I applied the ideas of evolutionary biology and evolutionary ecology to the empirical analysis of the evolution of institutions in postwar Japan. The basic question is how selection and imitation have worked in the evolution of the economic institutions in Japan. I focused on four factors of fitness, namely (i)growth rates, (ii)exit (death) rates, (iii)entry (birth) rates, and (iv)the rate of conversion of the attribute. (i), (ii) and (iii) represent selection, while (iv) represents imitation in the evolutionary process. Constructing a data set of industrial firms, I examined how the composition of the population has changed over time with respect to institutional attributes, specifically the presence of a main bank relationship, and to what extent the fitness factors (i)-(iv) contributed to that change.

Several findings emerged. First, where the pervasiveness of the main bank relationship was measured based on firm numbers, the main bank system expanded until the 1970s, after which it contracted, before it partially recovered in the 1990s. The fitness factors which have mainly contributed to the change in the composition of population are (iv) the conversion rate and (iii) the entry rate. While the entry rate has continued to have a substantial negative effect on the percentage of firms with a main bank relationship, the change in the sign of the conversion effect between the 1970s and 1980s represents the turning point for the main bank system from a period of expansion to a period of contraction. Second, where we measured the pervasiveness of the main bank relationship in terms of sales, the main bank system started to contract earlier, in the 1970s. Here the growth rate as well as the entry and conversion rates contributed to the changes in the population. While the growth rate had a positive effect in the 1960s, after that its effect has been negative. This brought about the

earlier decline of the main bank system and its continuing decline in the 1990s.

Next I econometrically analyzed the effect of the exit and growth rates on the evolution of the main bank system, using a sample selection model. It was found that the main bank relationship was basically neutral with respect to exit and growth until the 1980s, and that it had a negative effect on survival in the 1990s. Finally, I examined the institutional complementarity between the main bank relationship and long-term employment and found that in the 1960s these two institutions worked cooperatively on firm growth. In this sense, the main bank system and long-term employment were complementary and they co-evolved during this period. After this period however, the co-evolution is not observed.

The framework applied to the postwar Japanese institutions in this paper is highly versatile, and is applicable to the evolution of many other institutions and organizations in various times and places. For example, using this framework, we can analyze evolution of the governance structure of firms including the family and zaibatsu firms, the organizational structure of firms including the U-form and M-forms, the production system including factory and putting out, and so forth. In this sense, I expect this framework will become a basic tool for the empirical analysis of institutional change.

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Table 1 Composition of firm population by financial relationship

		1960	1970	1980	1990	1999
Number of firms	With main bank	286	331	421	440	519
		(67.8)	(72.7)	(74.5)	(66.9)	(70.3)
	Without main bank	136	124	144	218	219
		(32.2)	(27.3)	(25.5)	(33.1)	(29.7)
	Data n.a.	11	49	27	41	28
	Total	433	504	592	699	766
Sales(million yen)	With main bank	5,040,244	22,976,507	68,308,962	100,926,640	105,609,540
		(76.3)	(78.5)	(73.5)	(67.1)	(65.6)
	Without main bank	1,562,786	6,292,616	24,643,028	49,542,098	55,271,652
		(23.7)	(21.5)	(26.5)	(32.9)	(34.4)
	Data n.a.	135,348	2,429,198	1,976,657	4,403,557	2,189,759
	Total	6,738,378	31,698,321	94,928,647	154,872,294	163,070,951

Notes: See the text.

Note: The population of all of the firms listed at the Section I of Tokyo Stock Exchange, except a few firms which moved out of non-industrial sector in the following decades.

Table 2 Change of the financial relationship of firms(1960-1970)

A.Number of firms

1960		1970 Survive				Exit	Total
		With main bank	Without main bank	Data n.a.	Total		
Firms existing in 1960	With main bank	184	41	3	228	58	286
	Without main bank	68	33	2	103	33	136
	Data n.a.	4	3	3	10	1	11
	Total	256	77	8	341	92	433
New comers		77	48	41	166	0	166
Total		333	125	49	507	92	599

B.Ratio(%)

1960		1970 Survive				Exit	Total
		With main bank	Without main bank	Data n.a.	Total		
Note: The population of a	With main bank	*81.8*	*18.2*	1.0	79.7	20.3	100.0
	Without main bank	*67.3*	*32.7*	1.5	75.7	24.3	100.0
	Data n.a.	*57.1*	*42.9*	27.3	90.9	9.1	100.0
	Total	*76.9*	*23.1*	1.8	78.8	21.2	100.0
New comers		*61.6*	*38.4*	24.7	100.0	0.0	100.0
Total		*72.7*	*27.3*	8.2	84.6	15.4	100.0

Notes:The denominators of the italic figures in panel B are (Total-Exit-Data n.a.).

Table 3 Change of the financial relationship of firms(1970-1980)

A.Number of firms

1970		1980 Survive				Exit	Total
		With main bank	Without main bank	Data n.a.	Total		
Firms existing in 1970	With main bank	254	59	0	313	18	331
	Without main bank	79	38	1	118	6	124
	Data n.a.	34	13	0	47	2	49
	Total	367	110	1	478	26	504
New comers		56	34	24	114	0	114
Total		423	144	25	592	26	618

B.Ratio(%)

1970		1980 Survive				Exit	Total
		With main bank	Without main bank	Data n.a.	Total		
Note: The population o	With main bank	*81.2*	*18.8*	0.0	94.5	5.5	100.0
	Without main bank	*67.5*	*32.5*	0.8	95.1	4.9	100.0
	Data n.a.	*72.3*	*27.7*	0.0	96.2	3.8	100.0
	Total	*76.9*	*23.1*	0.2	94.8	5.2	100.0
New comers		*62.2*	*37.8*	21.1	100.0	0.0	100.0
Total		*74.6*	*25.4*	4.0	95.6	4.4	100.0

Notes:The denominators of the italic figures are (Total-Exit-Data n.a.).

Three firms which moved out of manufacturing industry are not included from 1970 to 1980.

One firm which moved into manufacturing industry from 1970 to 1980 is not included.

Table 4 Change of the financial relationship of firms(1980-1990)

A.Number of firms

1980		1990 Survive With main bank	Without main bank	Data n.a.	Total	Exit	Total
Firms existing in 1980	With main bank	321	90	0	411	10	421
	Without main bank	70	72	0	142	2	144
	Data n.a.	13	14	0	27	0	27
	Total	404	176	0	580	12	592
New comers		39	42	41	122	0	122
Total		443	218	41	702	12	714

B.Ratio(%)

1980		1990 Survive With main bank	Without main bank	Data n.a.	Total	Exit	Total
Note: The population o	With main bank	*78.1*	*21.9*	0.0	97.6	2.4	100.0
	Without main bank	*49.3*	*50.7*	0.0	98.6	1.4	100.0
	Data n.a.	*48.1*	*51.9*	0.0	100.0	0.0	100.0
	Total	*69.7*	*30.3*	0.0	98.0	2.0	100.0
New comers		*48.1*	*51.9*	33.6	100.0	0.0	100.0
Total		*67.0*	*33.0*	5.7	98.2	1.8	100.0

Notes:The denominators of the italic figures are (Total-Exit-Data n.a.).
One firm which moved out of manufacturing industry are not included.

Table 5 Change of the financial relationship of firms(1990-1999)

A.Number of firms

		1999					
		Survive				Exit	Total
1990		With main bank	Without main bank	Data n.a.	Total		
Firms existing in 1990	With main bank	363	55	0	418	22	440
	Without main bank	93	122	0	215	3	218
	Data n.a.	29	12	0	41	0	41
	Total	485	189	0	674	25	699
New comers		34	30	29	93	0	93
Total		519	219	29	767	25	792

B.Ratio(%)

		1999					
		Survive				Exit	Total
1990		With main bank	Without main bank	Data n.a.	Total		
Note: The population o	With main bank	*86.8*	*13.2*	0.0	95.0	5.0	100.0
	Without main bank	*43.3*	*56.7*	0.0	98.6	1.4	100.0
	Data n.a.	*70.7*	*29.3*	0.0	100.0	0.0	100.0
	Total	*72.0*	*28.0*	0.0	96.4	3.6	100.0
New comers		*53.1*	*46.9*	31.2	100.0	0.0	100.0
Total		*70.3*	*29.7*	3.7	96.7	3.3	100.0

Notes:The denominators of the italic figures are (Total-Exit-Data n.a.).

Four firms which moved out of manufacturing industry are not included from 1990 to 1999.

Fourteen firm which moved into manufacturing industry from 1990 to 1999 is not included

Table 6 Decomposition of the change share of the firms with main bank: Number of firms

%

		1960-1970	1970-1980	1980-1990	1990-1999
Total change		4.93	1.86	-7.49	3.46
Contribution	Exit rate	0.37	-0.04	-0.10	-0.47
	New entry	-1.25	-1.56	-4.49	-0.81
	Conversion	5.90	3.53	-3.03	5.15
Ratio to the total change	Exit rate	7.5	-2.3	1.3	-13.6
	New entry	-25.4	-84.0	60.0	-23.4
	Conversion	119.5	190.1	40.4	149.0

This data of the end year includes those firms which moved to non manugacturing industries in next 10 years. Therefore the total change slightly different from that obtained from the previous table.

Note: The population of all of the firms listed at the Section I of Tokyo Stock Exchange, except a few firms which

Table 7 Change of the financial relationship of firms(1960-1970)

A.Sales (million yen)

1960		1970 Sales in 1960 Survive	Exit	Total	Sales in 1970 Survive With main bank	Without main bank	Data n.a.	Total
Firms existing in 1960	With main bank	4,507,067	533,177	5,040,244	17,056,388	2,697,878	976,682	20,730,948
	Without main bank	1,452,823	109,963	1,562,786	3,947,145	2,210,452	253,252	6,410,849
	Data n.a.	135,348	6,059	141,408	72,812	165,768	404,950	643,530
	Total	6,095,239	649,199	6,744,438	21,076,345	5,074,098	1,634,884	27,785,327
New comers		0	0	0	2,012,299	1,231,482	794,314	4,038,095
Total		6,095,239	649,199	6,744,438	23,088,644	6,305,580	2,429,198	31,823,422

B.Ratio(%)

Note: The population of all of the firms listed

1960		1970 Sales in 1960 Survive	Exit	Total	Sales in 1970 Survive With main bank	Without main bank	Data n.a.	Total
Firms existing in 1960	With main bank	89.4	10.6	100.0	*86.3*	*13.7*	4.7	100.0
	Without main bank	93.0	7.0	100.0	*64.1*	*35.9*	4.0	100.0
	Data n.a.	95.7	4.3	100.0	*30.5*	*69.5*	62.9	100.0
	Total	90.4	9.6	100.0	*80.6*	*19.4*	5.9	100.0
New comers					*62.0*	*38.0*	19.7	100.0
Total		90.4	9.6	100.0	*78.5*	*21.5*	7.6	100.0

Notes:The denominators of the italic figures are (Total-Data n.a.).

Table 8 Change of the financial relationship of firms(1970-1980)

A.Sales (million yen)

		1980 Sales in 1970			Sales in 1980			
		Survive	Exit	Total	Survive			
1970					With main bank	Without main bank	Data n.a.	Total
Firms existing in 1970	With main bank	22,546,473	430,034	22,976,507	48,842,953	13,390,829	0	62,233,782
	Without main bank	6,098,235	194,381	6,292,616	12,586,450	6,088,693	680,590	19,355,733
	Data n.a.	7,827,778	0	7,827,778	4,208,321	3,619,457	0	7,827,778
	Total	36,472,486	624,415	37,096,901	65,637,724	23,098,979	680,590	89,417,293
New comers		0	0	0	2,959,835	1,544,049	687,812	5,191,696
Total		36,472,486	624,415	37,096,901	68,597,559	24,643,028	1,368,402	94,608,989

B.Ratio(%)

		1980 Sales in 1970			Sales in 1980			
Note: The population of all of the firms listed a		Survive	Exit	Total	Survive			
1970					With main bank	Without main bank	Data n.a.	Total
Firms existing in 1970	With main bank	98.1	1.9	100.0	*78.5*	*21.5*	0.0	100.0
	Without main bank	96.9	3.1	100.0	*67.4*	*32.6*	3.5	100.0
	Data n.a.	100.0	0.0	100.0	*53.8*	*46.2*	0.0	100.0
	Total	98.3	1.7	100.0	*74.0*	*26.0*	0.8	100.0
New comers					*65.7*	*34.3*	13.2	100.0
Total		98.3	1.7	100.0	*73.6*	*26.4*	1.4	100.0

Notes:The denominators of the italic figures are (Total-Data n.a.).

Table 9 Change of the financial relationship of firms(1980-1990)

A.Sales (million yen)

1980		1990 Sales in 1980 Survive	Exit	Total	Sales in 1990 Survive With main bank	Without main bank	Data n.a.	Total
Firms existing in 1980	With main bank	66,265,181	2,043,781	68,308,962	77,816,506	22,393,336	0	100,209,842
	Without main bank	24,358,485	284,543	24,643,028	19,614,346	22,522,212	0	42,136,558
	Data n.a.	1,976,657	0	1,976,657	1,147,433	1,872,277	0	3,019,710
	Total	92,600,323	2,328,324	94,928,647	98,578,285	46,787,825	0	145,366,110
New comers		0	0	0	2,734,220	2,718,887	4,403,557	9,856,664
Total		92,600,323	2,328,324	94,928,647	101,312,505	49,506,712	4,403,557	155,222,773

B.Ratio(%)

Note: The population of all of the firms listed at 1980		1990 Sales in 1980 Survive	Exit	Total	Sales in 1990 Survive With main bank	Without main bank	Data n.a.	Total
Firms existing in 1980	With main bank	97.0	3.0	100.0	*77.7*	*22.3*	0.0	100.0
	Without main bank	98.8	1.2	100.0	*46.5*	*53.5*	0.0	100.0
	Data n.a.	100.0	0.0	100.0	*38.0*	*62.0*	0.0	100.0
	Total	97.5	2.5	100.0	*67.8*	*32.2*	0.0	100.0
New comers					*50.1*	*49.9*	44.7	100.0
Total		97.5	2.5	100.0	*67.2*	*32.8*	2.8	100.0

Notes:The denominators of the italic figures are (Total-Data n.a.).

Table 10 Change of the financial relationship of firms(1990-1999)

A.Sales (million yen)

1990		1999 Sales in 1990 Survive	Exit	Total	Sales in 1999 Survive With main bank	Without main bank	Data n.a.	Total
Firms existing in 1990	With main bank	97,729,651	3,196,989	100,926,640	88,446,366	9,469,712	0	97,916,078
	Without main bank	49,064,070	478,028	49,542,098	11,493,055	40,549,556		52,042,611
	Data n.a.	4,403,557	0	4,403,557	3,951,724	1,088,022		5,039,746
	Total	151,197,277	3,675,017	154,872,294	103,891,146	51,107,289	0	154,998,435
New comers		0	0	0	1,718,394	4,164,363	2,189,759	8,072,516
Total		151,197,277	3,675,017	154,872,294	105,609,540	55,271,652	2,189,759	163,070,951

B.Ratio(%)

Note: The population of all of the firms listed 1990		1999 Sales in 1990 Survive	Exit	Total	Sales in 1999 Survive With main bank	Without main bank	Data n.a.	Total
Firms existing in 1990	With main bank	96.8	3.2	100.0	*90.3*	*9.7*	0.0	100.0
	Without main bank	99.0	1.0	100.0	*22.1*	*77.9*	0.0	100.0
	Data n.a.	100.0	0.0	100.0	*78.4*	*21.6*	0.0	100.0
	Total	97.6	2.4	100.0	*67.0*	*33.0*	0.0	100.0
New comers					*29.2*	*70.8*	27.1	100.0
Total		97.6	2.4	100.0	*65.6*	*34.4*	1.3	100.0

Notes:The denominators of the italic figures are (Total-Data n.a.).

Table 11 Decomposition of the change of the share of the firms with main bank: sales

%

		1960-1970	1970-1980	1980-1990	1990-1999
Total change		2.22	-4.93	-6.31	-1.43
Contribution	Growth rate	0.27	-0.83	-2.86	-1.00
	Exit rate	-0.37	-0.07	-0.22	-0.39
	New entry	-1.95	-2.69	-1.55	-1.03
	Conversion	4.18	-1.02	-1.87	1.1
Ratio to the total change	Growth rate	12.2	16.8	45.3	70.1
	Exit rate	-16.8	1.5	3.5	27.1
	New entry	-88.0	54.6	24.6	72.0
	Conversion	188.5	20.7	29.6	-79.3

The sales share of the firms with main bank.
This data of the end year includes those firms which moved to non manugacturing industries in next 10 years.
Therefore the total change slightly different from that obtained from the previous table.
Note: The population of all of the firms listed at the Section I of Tokyo Stock Exchange, except a few firms which

Table 12 Main bank relationship , firm survival and growth 1960-1970

	(1)					(2)				
	Survival			Growth		Survival			Growth	
Age	0.3330	2.420	**	-0.0018	-0.299	0.3217	2.234	**	-0.0012	-0.219
Sales	0.6230	9.564	***	-0.0020	-0.254	0.9130	6.973	***	-0.0048	-0.575
Main	-0.1606	-0.934		-0.0038	-0.674	3.0440	2.254	**	-0.0485	-0.947
Main*Sales						-0.3831	-2.454	**	0.0048	0.837
Constant	-5.7458	-6.875	***			-7.9375	-6.773	***		
Merger				0.0359	2.530 **					
Fishery				0.1534	1.627				0.1755	1.943 *
Mining				0.0731	0.774				0.0962	1.044
Foods				0.1320	1.447				0.1549	1.752 *
Textile				0.1406	1.517				0.1632	1.823 *
Paper and pulp				0.1436	1.559				0.1663	1.860 *
Chemical				0.1588	1.744 *				0.1813	2.055 **
Coal and petroleum products				0.1622	1.636				0.1873	1.909 *
Note: The population of all of the firms listed at the Section I of				0.1517	1.476				0.1751	1.752 *
Ceramics				0.1430	1.552				0.1648	1.848 *
Steel				0.1719	1.873 *				0.1946	2.181 **
Non-ferrous metals				0.1849	1.897 *				0.2071	2.154 **
Metal products				0.1404	1.472				0.1631	1.789 *
Machinery				0.1837	1.991 **				0.2061	2.310 **
Electric machinery				0.1842	1.982 **				0.2071	2.295 **
Transportation machinery				0.1946	2.081 **				0.2167	2.386 **
Precision machinery				0.2045	2.190 **				0.2272	2.508 **
Other manufacturing				0.1777	1.920 **				0.1992	2.225 **
Sigma					14.537 ***				0.0415	13.154 ***
Log of Likelihood function					423.421					426.548

Table 13 Main bank relationship , firm survival and growth 1970-1980

	(a)					(b)				
	Survival		Growth			Survival		Growth		
Age	0.8160	0.348	-0.0063	-1.140		0.0537	0.221	0.0537	0.22122	
Sales	0.2350	1.633	0.0022	0.300		0.0312	0.112	0.0312	0.1117	
Main	-0.0956	-0.426	-0.0024	-0.473		-3.0172	-0.882	-3.0172	-0.88211	
Main*Sales						0.2904	0.861	0.2904	0.8607	
Constant	-0.9961	-0.612				1.1534	0.370			
Merger			0.5507	4.433	***			0.0547	4.402	***
Fishery			0.1245	1.199				0.1250	2.44286	**
Mining			0.0985	0.960				0.0991	1.917	*
Foods			0.1009	0.997				0.1015	2.110	**
Textile			0.0567	0.553				0.0569	1.171	
Paper and pulp			0.0972	0.959				0.0978	1.971	**
Chemical			0.1090	1.070				0.1096	2.269	**
Coal and petroleum products			0.1906	1.818	*			0.1911	3.626	***
Note: The population of all of the firms listed at the Section I			0.1107	1.020				0.1112	1.799	*
Ceramics			0.1042	1.015				0.1048	2.146	**
Steel			0.0894	0.875				0.0902	1.865	*
Non-ferrous metals			0.7523	0.742				0.0759	1.589	
Metal products			0.0917	0.905				0.0922	1.976	**
Machinery			0.0764	0.752				0.0769	1.629	*
Electric machinery			0.0974	0.961				0.0980	2.048	**
Transportation machinery			0.0969	0.940				0.0974	1.984	**
Precision machinery			0.1159	1.145				0.1165	2.429	**
Other manufacturing			0.1157	1.129				0.1161	2.400	**
Sigma			0.0323	20.133	***			0.0322	20.067	***
Log of Likelihood function				786.397					787.157	

Table 14 Main bank relationship , firm survival and growth 1990-1999

	Survival			Growth		
Age	-0.1278	-0.311		-0.0038	-1.211	
Sales	0.0699	0.790		0.0040	2.665	***
Main	-0.5670	-2.281	**	-0.5670	-2.281	**
Constant	1.9155	0.898				
Merger				0.0367	3.477	***
Fishery				-0.0655	-1.769	*
Mining				-0.0087	-0.031	
Foods				-0.0451	-0.177	
Textile				-0.0230	-0.074	
Paper and pulp				-0.0126	-0.458	
Chemical				-0.0352	-1.258	
Coal and petroleum products				-0.0344	-0.528	
Rubber				-0.2517	-0.873	
Ceramics				-0.0563	-2.025	**
Note: The population of all of the firms listed at the Section I				-0.0419	-1.510	
Non-ferrous metals				-0.0123	-0.483	
Metal products				-0.0276	-1.019	
Machinery				-0.0130	-0.483	
Electric machinery				-0.0243	-0.861	
Transportation machinery				-0.0028	-0.275	
Precision machinery				-0.0165	-0.610	
Other manufacturing				-0.0127	-0.421	
Sigma				0.0333	20.730	***
Log of Likelihood function					1160.810	

Table 15 Complementarity between main bank relationship and long-term employment, 1960-1970

	(a)				(b)			
	Survival		Growth		Survival		Growth	
Age	0.3292	2.345 **	-0.0030	-0.523	0.3217	2.193 **	-0.0026	-0.473
Sales	0.6415	9.487 ***	-0.0032	-0.446	0.8887	6.733 ***	-0.0060	-0.781
Main	-0.1501	-0.858	0.0706	1.423	2.8515	2.074 **	0.0149	0.197
Main*Sales					-0.3547	-2.259 **	0.0054	0.911
Constant			-5.7280	-6.735 ***	-7.7427	-6.5236 ***		
Merger			0.0360	2.503 **			0.0357	2.591 **
Entage			-0.0023	-1.732 *			-0.0024	-1.828 *
Entage*Main			-0.0032	-1.496			-0.0029	-1.388
Fishery			0.2285	2.500 **			0.2595	2.724
Mining			0.1453	1.591			0.1773	1.833
Foods			0.2030	2.316 **			0.2352	2.535
Textile			0.2036	2.268 **			0.2357	2.491
Paper and pulp			0.2115	2.366 **			0.2434	2.577
Note: The population of all of the firms listed at the Section I of Tol			0.2287	2.596 ***			0.2603	2.787
Coal and petroleum products			0.2351	2.481 **			0.2662	2.678
Rubber			0.2164	1.977 **			0.2499	2.217
Ceramics			0.2155	2.412 **			0.2465	2.612
Steel			0.2458	2.756 ***			0.2751	2.922
Non-ferrous metals			0.2574	2.738 ***			0.2891	2.888
Metal products			0.2102	2.279 **			0.2420	2.528
Machinery			0.2505	2.790 ***			0.2822	2.988
Electric machinery			0.2434	2.694 ***			0.2759	2.893
Transportation machinery			0.2664	2.933 ***			0.2976	3.111
Precision machinery			0.2609	2.873 ***			0.2931	3.065
Other manufacturing			0.2387	2.633 ***			0.2707	2.852
Sigma			0.0410	14.039 ***			0.0409	13.214
Log of Likelihood function				409.187				412.100

Table 16 Complementarity between main bank relationship and long-term employment, 1970-1980

	Survival			Growth		
Age	0.0834	0.355		-0.0080	-1.489	
Sales	0.2369	1.645	*	0.0014	0.200	
Main	-0.9543	-0.425		0.0508	-1.190	
Main*Sales						
Constant	-1.0222	-0.627				
Merger				0.0562	4.550	***
Entage				-0.0035	-2.225	**
Entage*Main				0.0021	1.161	
Fishery				0.2187	2.005	**
Mining				0.1909	1.780	*
Foods				0.1928	1.804	*
Textile				0.1463	1.356	
Paper and pulp				0.1882	1.759	*
Chemical				0.2006	1.867	*
Note: The population of all of the firms listed at the Section I of Toky				0.2837	2.574	***
Rubber				0.2032	1.777	*
Ceramics				0.1975	1.821	*
Steel				0.1827	1.695	*
Non-ferrous metals				0.1683	1.564	
Metal products				0.1871	1.732	*
Machinery				0.1687	1.571	
Electric machinery				0.1898	1.773	*
Transportation machinery				0.1896	1.745	*
Precision machinery				0.2072	1.942	*
Other manufacturing				0.2105	1.919	*
Sigma				0.0316	19.454	***
Log of Likelihood function					787.680	

Table 17 Complementarity between main bank relationship and long-term employment, 1980-1990

	Survival		Growth	
Age	0.5589	0.124	-0.0082	-0.561
Sales	0.0360	0.394	-0.0013	-0.149
Main	-0.2260	-0.567	0.0300	0.541
Constant	1.5947	0.793		
Merger			0.0437	0.653
Entage			0.0012	1.005
Entage*Main			-0.0016	-1.140
Fishery			0.4101	0.174
Mining			0.2423	0.104
Foods			0.5045	0.218
Textile			0.0432	0.186
Paper and pulp			0.0501	0.216
Chemical			0.0552	0.238
Coal and petroleum products			0.0050	0.022
Note: The population of all of the firms listed at			0.0637	0.267
Ceramics			0.0585	0.251
Steel			0.0320	0.138
Non-ferrous metals			0.0523	0.224
Metal products			0.0726	0.311
Machinery			0.0704	0.303
Electric machinery			0.0929	0.400
Transportation machinery			0.0749	0.321
Precision machinery			0.0909	0.389
Other manufacturing			0.0794	0.341
Sigma			0.0349	0.155
Log of Likelihood function				1024.590

Table 18 Complementarity between main bank relationship and long-term employment, 1990-1999

	Survival			Growth		
Age	-1.1154	-0.283		-0.0068	-1.186	
Sales	0.0714	0.808		0.0040	2.538	
Main	-0.5608	-2.253	**			
Constant	1.8473	0.867				
Merger				0.0367	3.439	***
Entage				0.0000	0.000	
Entage*Main				0.0000	-0.040	
Fishery				-0.0065	-1.544	
Mining				-0.0082	-0.239	
Foods				-0.0476	-1.404	
Textile				-0.0226	-0.614	
Paper and pulp				-0.0122	-0.362	
Chemical				-0.0348	-1.023	
Coal and petroleum products				-0.0332	-0.469	
Rubber				-0.0248	-0.711	
Ceramics				-0.5547	-1.634	
Steel				-0.0414	-1.216	
Non-ferrous metals				-0.0120	-0.369	
Metal products				-0.0272	-0.814	
Machinery				-0.0126	-0.378	
Electric machinery				-0.0238	-0.692	
Transportation machinery				-0.0075	-0.216	
Precision machinery				-0.0160	-0.478	
Other manufacturing				-0.0121	-0.336	
Sigma				0.0334	19.996	
Log of Likelihood function					116.830	