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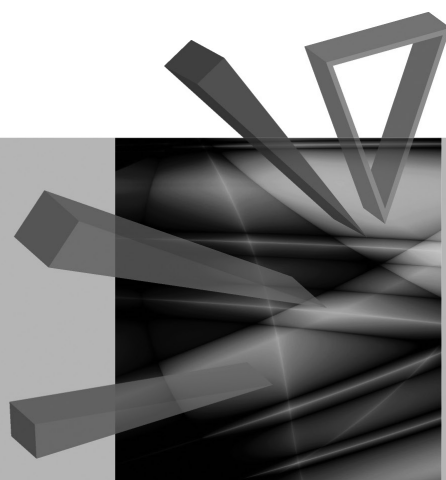
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THE IMPORTANCE OF JAPANESE *KEIRETSU* GROUPS FOR KNOWLEDGE SPILLOVERS

Summary: It is widely recognised that both within and between Japanese vertical *keiretsu* groups considerable knowledge flows occur. The results of empirical research, however, are not explicit. Although they confirm the hypothesis that between companies affiliated in vertical *keiretsu* knowledge transfer occurs, it is only diffusion of imitation processes. What is absent, however, is the diffusion of such knowledge which could provide the basis for generating an innovation. It means that association in *keiretsu* groups promotes only transfers of certain manufacturing patterns or management techniques but not of innovation. The phenomenon of knowledge diffusion has also been observed between companies from various vertical *keiretsu*.

Keywords: knowledge spillovers, *keiretsu*, inter-firm linkages.

1. Introduction

Keiretsu groups are an inseparable element of Japanese economic tradition in some measure. First, *keiretsu* began to appear at the beginning of the 1950s, but a *de facto* grouping of companies in the *keiretsu* form existed before the Second World War and then they were called *zaibatsu*. In general, *keiretsu* networks can be described as Japanese companies holding each other's shares (although not required, and it largely depends on the form of *keiretsu*).

Since the 1980s, the Japanese *keiretsu* groups have been the subject of much controversy. Other countries, including in particular the United States, accused the groups of using unfair business practices and maintaining contacts on an exclusive basis, which has effectively shut down the foreign competition on the Japanese market. In turn, the Japanese scientists have emphasised that such alliances were economically justified. They argued that *keiretsu* promote productivity and economic growth,¹ contribute to improving the profitability of *keiretsu* groups² and facilitate

¹ R.Z. Lawrence, Efficient or exclusionist? The import behavior of Japanese corporate groups, *Brooking Papers on Economic Activity* 1991, No. 1, pp. 311–341.

² D. Bernotas, Ownership structure and firm profitability in the Japanese *keiretsu*, *Journal of Asian Economics* 2005, No. 16 (3), pp. 533–554.

access of *keiretsu* affiliates to stable funding, insulate them from market pressures, reduce business risk, reduce the number of management problems and contribute to cost reduction.³ Finally, some studies suggest that between companies affiliated within a *keiretsu* group and also between companies from different *keiretsu* groups, knowledge transfer occurs, which promotes the innovativeness of both associated companies and groups as a whole. It is believed that this is one of the most important benefits of association in *keiretsu* groups and that many other positive effects (productivity growth, economic growth or costs reduction) are its derivative.⁴

Out of all various inter-firm linkages, so-called vertical *keiretsu* are perceived as the most crucial for knowledge spillovers. It results from the specific structure of mutual ownership and the function played by vertical linkages.

The goal of the article is to present the role of vertical *keiretsu* in knowledge diffusion and attempt to answer the question whether the spillovers are larger among affiliated or among unaffiliated companies.

A hypothesis is put forward that among companies belonging to one *keiretsu* significant knowledge spillovers occur, which allows both improving, e.g., work efficiency or manufacturing processes as well as making breakthrough discoveries (innovations). Moreover, associating in *keiretsu* groups promotes a greater diffusion of knowledge in comparison with unassociated companies.

2. Types of *keiretsu* groups

There are two main forms of inter-corporate linkages in Japan: horizontal and vertical *keiretsu*. The horizontal *keiretsu* gathers entities from different industries around one common financial institution called “the main bank”. In the case of this type of relationship, the biggest companies from a *keiretsu* own shares in each other’s companies, which are rarely the subject of trade. Companies’ linkages which are the result of mutual shareholdings are reinforced by inter-company personnel exchange and membership in “the presidents’ council”. Equity ties with “the main bank” increase companies’ willingness to borrow. Debt linkages are therefore another form of the linkages. Finally, horizontal *keiretsu* can be described as a highly connected web of mutual inter-firm linkages of various natures.

Horizontal *keiretsu* are “descendants” of the pre-war *zaibatsu*. They were family-controlled conglomerates that dominated especially the heavy industry. Involvement in heavy industry strengthened the position of *zaibatsu* groups during the Second

³ For a review of the benefits associated with various forms of *keiretsu*, see: J. McGuire, S. Dow, Japanese *keiretsu*: Past, present, future, *Asia Pacific Journal of Management* 2009, No. 26 (2), pp. 333–351 and S. Dow, J. McGuire, T. Yoshikawa, Disaggregating the group effect: Vertical and horizontal *keiretsu* in changing economic times, *Asia Pacific Journal of Management* 2011, No. 28 (2), pp. 299–323.

⁴ It should be noted that as a result of the Asian crisis of 1990, and various regulations, the linkages within each *keiretsu* group relax and benefits from the association in such alliances decrease. For some *keiretsu* disadvantages even begin to outweigh benefits.

World War, since Japanese troops were dependent on equipment supplies delivered by *zaibatsu*. However, after the War, *zaibatsu* were liquidated by the decision of Holding Companies Liquidation Commission (HCLC) since Americans argued that they had contributed to escalating the warfare. Shares of particular companies belonging to different *zaibatsu* were distributed to individuals, with preference given to the employees of those companies and local communities.⁵

Zaibatsu re-emerged in the early 1950, albeit as (horizontal) *keiretsu* that time, after the Tokyo Stock Exchange was allowed to reopen in 1949. Then, the shareholders of the former *zaibatsu*'s shares sold them to financial institutions.

At the beginning of 1950s, a new form of inter-firm linkages appeared that had no counterpart in the past – vertical *keiretsu*. The core of vertical *keiretsu* is a major manufacturing company (e.g., a car manufacturer) with its customers and suppliers centered around it. Companies affiliated vertically, similarly to the horizontal ones, are linked by mutual ownership; however, shareholdings in the vertical groups are asymmetric. Namely, the core firm and main suppliers hold a significant stake in smaller suppliers (but not likely the control stake), while small firms hold a small stake (if any) in the core firm or main suppliers.⁶ Moreover, the core manufacturing firm usually holds larger stakes in those suppliers whose supplies are more vital for the company (both in terms of quantity and difficulty of manufacturing) as well as those whose supplies are a significantly larger part of their own production.⁷ It is also characteristic of vertical *keiretsu* that agreements between companies tend to be oral and their cooperation is based on mutual trust and promises; whereas the written contract is not very complex and includes few details of an agreement.⁸

Vertical integration of firms is characteristic not only of Japanese economy, but also other national economies, including the economy of the United States. However, it is interesting that Japanese vertically integrated firms are smaller on the average than their American counterparts in terms of the number of employees and sales value.⁹ Japanese firms produce less of their output “in-house”¹⁰ and also have a lower share of production costs accounted for by internal production.¹¹ Despite this fact, Japanese groups are able to sell more products in relation to the number of employees than American firms and the value added share in manufacturing

⁵ D. Bernotas, *op. cit.*

⁶ J. McGuire, S. Dow, *op. cit.*

⁷ C. Ahmadjian, *Japanese Auto Parts Supply Networks and the Governance of Inter-firm Exchange*, Working Paper, Graduate School of Business, Columbia University, New York 1997.

⁸ B. Drelich-Skulska, P. Skulski, Rola *keiretsu* i *sogo ssha* we współczesnej gospodarce Japonii, [in:] J. Rymarczyk, M. Sutkowski (Eds.), *Internacjonalizacja i globalizacja gospodarki polskiej. Handel międzynarodowy i inwestycje zagraniczne*, Materiały Konferencyjne, No. 867, Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Wrocław 2000, pp. 113–127.

⁹ L. Branstetter, Vertical *keiretsu* and knowledge spillovers in Japanese manufacturing: An empirical assessment, *Journal of the Japanese and International Economies* 2000, No. 14, pp. 73–104.

¹⁰ J. Dyer, W. Ouchi, Japanese-style partnerships: Giving companies a competitive edge, *Sloan Management Review* 1993, Vol. 35.

¹¹ L. Branstetter, Vertical *keiretsu*..., *op. cit.*

accounted for by small and medium enterprises is also higher in Japan than in the United States. Furthermore, inter-firm relations and interdependence of vertically affiliated Japanese companies are stronger than in other countries, which leads to the fact that it is mainly Japan that is identified as a place with a high number of vertically integrated companies and it is in Japan that they play a greater role, also in the transfer of knowledge between the companies creating a network of vertical connections.

3. Methods of estimating knowledge spillovers

There are many channels of both international and domestic knowledge spillovers. The most important ones include labour mobility (particularly scholars and technical staff), technology purchases, import and export of goods and services and foreign direct investment. Vertical inter-firm linkages, e.g., Japanese *keiretsu* are also considered a significant channel of knowledge diffusion although they promote knowledge spillovers only in some countries.

Since knowledge is an abstract concept that is intangible and cannot be expressed in units like, e.g., kilogrammes, metres or joules, it is very difficult to measure it directly. This applies also to estimating knowledge spillovers. Therefore, many ways of measuring knowledge diffusion are encountered in literature. However, each author estimates the scope of know-how using an indirect method.

In most of the knowledge spillovers analyses, it is assumed that spillovers have a positive effect on particular economic indicators, e.g., total factor productivity (TFP) or production costs. Thus, e.g., TFP increase is interpreted as a confirmation of knowledge diffusion.

If one wants, therefore, to evaluate the scope of knowledge spillovers between particular companies belonging to one *keiretsu*, the correlation between R&D activities or innovativeness of one company and the increase in total factor productivity of other companies belonging to a *keiretsu* has to be measured. If the correlation is positive, it can be concluded that knowledge transfer occurred, since it is acknowledged that productivity growth is a result of a knowledge stock increase.

Apart from TFP, the amount and value of sale,¹² production costs,¹³ the number of patents (patent citations)¹⁴ and wages¹⁵ are considered to be the measures of

¹² Sales value as a measure of knowledge spillovers was used, among others, by E. Sinani, K. Meyer, Spillovers of technology transfer from FDI: the case of Estonia, *Journal of Comparative Economics* 2004, No. 32, pp. 445–466.

¹³ Production costs as a measure of knowledge spillovers were used, among others, by K. Suzuki, R&D spillovers and technology transfer among and within vertical *keiretsu* groups, *International Journal of Industrial Organization* 1993, No. 11, pp. 573–591.

¹⁴ Patent citations data as a measure of knowledge spillovers was used, among others, by L. Branstetter, *Is Foreign Direct Investment a Channel of Knowledge Spillovers? Evidence from Japan's FDI in the United States*, NBER Working Paper Series, No. 8015, 2000.

¹⁵ Wages as a measure of knowledge spillovers were used, among others, by B. Aitken, A. Harrison, R. Lipsey, Wages and foreign ownership. A comparative study of Mexico, Venezuela and the United

knowledge spillovers. Therefore, while estimating the scope of knowledge spillovers between companies within one *keiretsu* group, one can also measure the correlation between R&D activities of one company and the increase in sales volume/value, the reduction of production costs, the increase in the number of patents or the increase in employees' salaries in other companies affiliated in the same *keiretsu*.

Choosing one particular measure of knowledge spillovers depends on the researcher and usually depends on data availability as well as the particular knowledge transfer channel which is the subject of an analysis. However, total factor productivity is the most commonly used measure of knowledge spillovers.¹⁶

By analogy, the transfer of knowledge from one *keiretsu* group to another as well as other channels of knowledge spillovers are measured.

An essential fault of conclusions drawn on the basis of empirical research analysing the effects of knowledge spillovers is the fact that they *de facto* equate positive correlation with causality. Namely, the positive correlation between, e.g., a large number of foreign investors in a given country and an increase in TFP of companies from that country will be interpreted as a confirmation of knowledge spillovers effects, while actually TFP growth may result from factors other than presence of foreign investors.

The method that is “based on assumptions” in the smallest degree is considered to be the method of patents citation. In this case, the correlation is assessed between, e.g., R&D activities of a certain *keiretsu* group, e.g. X, and the number of patent citations to the earlier research outputs of inventors from *keiretsu* X cited by the researchers from other *keiretsu* groups in their patent applications. It is assumed that the more often inventors from other *keiretsu* groups or unaffiliated companies cite results of the inventors from *keiretsu* X in their patent applications, the more important position of *keiretsu* X as a channel of knowledge spillovers is.

The undoubted advantage of this approach is also that it estimates the effect of specific, potential channel of knowledge transfer on the emergence of new innovations, and not only on the propagation of imitation processes. It is disadvantageous, however, in that patent citations represent only a partial measure of know-how diffusion since there are many innovations that are not subject to patent protection.

States, *Journal of International Economics* 1996, No. 40, pp. 345–371.

¹⁶ TFP as a measure of knowledge spillovers was used, among others, in research estimating knowledge diffusion through: (a) foreign direct investment: M. Blömstrom, F. Sjöholm, Technology transfer and spillovers: does local participation with multinationals matter?, *European Economic Review* 1999, No. 43; B. Smarzyńska Javorcik, K. Saggi, M. Spatareanu, *Does It Matter Where You Come from? Vertical Spillovers from Foreign Direct Investment and the Nationality of Investors*, Policy Research Paper Series, No. 3449, The World Bank, 2004, (b) foreign trade: F. Sjöholm, Exports, imports and productivity: results from Indonesian Establishment data, *World Development* 1999, No. 27 (4), pp. 705–717, (c) technology import: T. Nakamura, International knowledge spillovers and technology imports: Evidence from Japanese chemical and electric equipment industries, *Journal of the Japanese and International Economies* 2011, No. 15, pp. 271–297.

The pioneers of this method were A. Jaffe, M. Trajtenberg and R. Henderson,¹⁷ who used patent citations to show that the closer the external source of information is, the greater the effect of knowledge diffusion from that source on one's own know-how.

4. Vertical *keiretsu* and knowledge spillovers

Knowledge spillovers between vertical *keiretsu* companies occur somewhat naturally for the production company becomes involved in purposeful technology transfer actions with its suppliers. *Engineering and management personnel* from the production company is often delegated to suppliers for long periods of time in order to support them with a technical help and coordinate the diffusion of *management practices*. Main suppliers are also frequently included in development projects of the core firm, thus participating in its research and development activities. Such inter-firm knowledge spillovers may in turn have a significant and positive effect on the productivity and innovativeness of both the suppliers and the core firm.

Despite the fact that the essence of the vertical *keiretsu* relationship is the co-operation between the producer and its suppliers in R&D activities as well as in improving the quality of made-to-order products, there is not much empirical research addressing the question of knowledge spillovers, both inside as well as between various *keiretsu* groups.

The relationship between the association within vertical *keiretsu* and the research productivity of the associated company was confirmed, among others, by A. Rokuhara's research.¹⁸ K.B. Clark and T. Fujimoto came to even more far-reaching conclusions. They used automobile industry data and proved that vertical *keiretsu* not only promotes companies' R&D activities but also that vertically associated Japanese firms also have an ability to develop new car models faster and with lower costs than American and European automobile companies.¹⁹ In turn, T. Nishiguchi extended Clark and Fujimoto's conclusions to electronic industry.²⁰

Proofs of R&D spillovers in vertical *keiretsu* were also found by K. Suzuki, who used data from electromechanical industry.²¹ He proved that R&D activity of the core *keiretsu* company significantly contributed to variable costs reduction of its suppliers

¹⁷ A. Jaffe, M. Trajtenberg, R. Henderson, *Geographic localization of knowledge spillovers as evidenced by patent citations*, *Quarterly Journal of Economics* 1993, No. 108 (3), pp. 577–598.

¹⁸ A. Rokuhara (Ed.), *R&D and Antimonopoly Policy*, Gyousei Press, Tokyo 1985, after: L. Branstetter, *Vertical keiretsu...*, *op. cit.*

¹⁹ K.B. Clark, T. Fujimoto, *Product Development Performance: Strategy, Organization, and Management in the World Auto Industry*, Harvard Business School Press, Boston 1991, after: L. Branstetter, *Vertical keiretsu...*, *op. cit.*

²⁰ T. Nishiguchi, *Strategic Industrial Sourcing*, Oxford UP, London 1994, after: L. Branstetter, *Vertical keiretsu...*, *op. cit.*

²¹ K. Suzuki, *op. cit.*

in 1982–1989. In relation to the previous research, he also pointed out that knowledge diffusion also occurred between companies from separate vertical *keiretsu* groups. He claimed that the effect of knowledge spillovers appeared between the core firms of various vertical *keiretsu*, between the suppliers from various *keiretsu* groups as well as between the core firms of given *keiretsu* groups and the suppliers of other vertical *keiretsu* groups. It needs to be also noted that the reduction of variable costs of suppliers is always more strongly influenced by R&D activities of their own core firms than the core firms from other *keiretsu* groups.

Nevertheless, none of the above mentioned authors did conduct a comparative analysis of Japanese firms associated and unassociated within vertical *keiretsu*, which means that they did not answer the question whether a vertical alliance is more conducive to know-how diffusion or it is more likely that the companies not belonging to *keiretsu* are more able to receive knowledge spillovers.

An attempt to comprehend this issue is the analysis made by L. Branstetter, who used data on both affiliated and unaffiliated firms representing five various Japanese industries.²² The results of his estimations are consistent with the hypothesis made by previous researchers, according to whom affiliation within vertical *keiretsu* increases knowledge spillovers and encourages technology transfer. However, Branstetter proved that in 1983–1989 know-how diffusion had a significant and statistically important effect only on the increase in total factor productivity, while the effect on the number of firms' patterns was small. These results suggest that the co-operation within vertical *keiretsu* stimulates diffusion of imitation processes (incremental process technology improvements) rather than the innovativeness of firms. Unfortunately, on the basis of Branstetter's analysis, it still cannot be determined in which case knowledge diffusion is more effective: among the firms belonging to vertical *keiretsu* or between unaffiliated firms. Already presented evidence shows only that know-how spillovers occur both within and entirely outside vertical *keiretsu* relationship, but it does not explicitly indicate which spillovers effects are stronger.

In the case of vertical *keiretsu* linkages, there is no doubt that they promote knowledge spillovers processes. However, it is not sure that know-how flows within vertical *keiretsu* are faster and better than between firms entirely outside the vertical alliances.

5. Concluding remarks

Issues related to the diffusion of knowledge are essential to modern economies since knowledge in a broad sense has been recognised as a key factor in economic growth and development. Hence, in the literature much attention is paid to, among others, channels of international and domestic know-how transfer as well as ways of increasing the efficiency of those channels. In particular, there are many analyses

²²L. Branstetter, *Vertical keiretsu...*, *op. cit.*

concerning foreign direct investment (FDI), which is currently perceived as one of the most important elements of knowledge absorption and diffusion processes.

The literature on the role of vertical inter-firm linkages in the diffusion of know-how, however, is relatively poor. It is probably a result of the assumption that connections of this type are a significant source of knowledge spillovers but only in some national economies.

This also applies to Japanese vertical *keiretsu* groups although, according to a common belief, the spreading of innovation or R&D between the producer and its suppliers is virtually an essence of vertical associations in Japan. What is more, the majority of existing research has focused on estimating the effects of knowledge spillovers between companies belonging to the same *keiretsu* and only some of them analyse knowledge flows between different *keiretsu* groups.

The results of existing empirical research confirm the hypothesis that between companies affiliated within the vertical *keiretsu*, and exactly from the producer to its suppliers, knowledge flows occur. Unfortunately, it is only diffusion of imitation processes since suppliers do not create innovation (new knowledge) thanks to obtained knowledge, but only use it to increase profits.

Positive external effects in the form of knowledge diffusion were observed also between companies from various vertical *keiretsu*, both between the core firms and their suppliers, as well as between the core firm and the suppliers from different vertical *keiretsu* groups. In this case, however, it cannot be determined whether knowledge spillovers foster innovation in companies because the applied testing method does not allow doing it.

Based on the existing research, it is not possible to explicitly determine whether knowledge diffusion is higher between companies affiliated in vertical *keiretsu* or rather between unaffiliated companies.

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ZNACZENIE JAPOŃSKICH GRUP KEIRETSU DLA ROZPRZESTRZENIANIA SIĘ WIEDZY

Streszczenie: Powszechnie uważa się, że zarówno wewnątrz, jak i między japońskimi pionowymi grupami *keiretsu* dochodzi do znacznych przepływów wiedzy. Wyniki badań empirycznych nie są jednak jednoznaczne. Potwierdzają wprawdzie hipotezę, że pomiędzy spółkami stowarzyszonymi w pionowym *keiretsu* dochodzi do przepływu wiedzy, jednakże jest to jedynie rozprzestrzenianie się procesów imitacji. Nie dochodzi natomiast do rozprzestrzeniania się takiej wiedzy, na podstawie której możliwe byłoby wygenerowanie innowacji. Oznacza to, że stowarzyszanie się w grupy *keiretsu* sprzyja jedynie przepływowi pewnych wzorców produkcji czy metod zarządczych, lecz nie innowacyjności. Zjawisko dyfuzji wiedzy zaobserwowano także pomiędzy spółkami z różnych pionowych *keiretsu*.

Słowa kluczowe: transfer wiedzy, *keiretsu*, powiązania między przedsiębiorstwami.