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Advantage: Is Denso the Missing Link in the
Academic Literature?**

Evelyn Anderson

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Australia–Japan Research Centre
Asia Pacific School of Economics and Government
The Australian National University
Canberra ACT 0200

Telephone: (61 2) 6125 3780

Facsimile: (61 2) 6125 0767

E-mail: ajrc@anu.edu.au

URL: <http://apseg.anu.edu.au>

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THE ENIGMA OF TOYOTA'S COMPETITIVE ADVANTAGE: IS DENSO THE MISSING LINK IN THE ACADEMIC LITERATURE?

This paper analyses the reasons for the competitiveness of Toyota. It focuses on the company's unique relationship with one partner supplier – Denso – where contingency loss potential is the greatest. A literature review reveals some gaps between the English and Japanese literature. The author uses resource based view literature, game theory literature, transaction cost literature and the concept of positive external economy to explain Toyota's success. She also identifies a future research question: might Toyota's domestic success have arisen partly because its competitors did not understand the way it worked?

Introduction

Until recently, the term *keiretsu* was closely associated with the success of the Japanese automobile industry. *Keiretsu* is a Japanese style of cooperative business relationship Academia has identified two types of *keiretsu*: horizontal and vertical. Vertical *keiretsu* is generally confined to one industry – for example, assembling industries such as cars and electronics – with the lead firm concentrating on a small range of activities. Toyota, for example, designs motor vehicles. It then purchases most of its parts from its *keiretsu* for final assembly. The *keiretsu* member firms are organised in a multi-tier pyramid structure, hence the term 'vertical *keiretsu*'. Horizontal *keiretsu* is a mutated form of *zaibatsu*, which emerged in the 1890s as trading monopolies sanctioned by the Meiji government. The US occupation forces disbanded the *zaibatsu* in post-war Japan, as they were deemed to wield market power hurtful to consumers and the Japanese economy. Many *zaibatsu* re-emerged as horizontal *keiretsu* with their former names intact – for example, Mitsubishi, Sumitomo and Mitsu. Member firms are drawn from distinctly different industries encompassing manufacturing, wholesale, construction, telecommunication, shipping etc, but member firms cluster around a 'main bank' and member firms have substantial cross-shareholdings in each other.

The word *keiretsu* is interchangeable with parts suppliers or the subcontractor system in both the English and Japanese languages. However, the Japanese word *shitauke* (meaning subcontractors) immediately suggests a hierarchical and unequal relationship, unlike the word ‘networking’ in English. *Keiretsu* can be translated as ‘networks’ where partners can be equal, but the Japanese mindset seems to be dominated by the *shitauke* concept, where the relationship between an assembler and suppliers is vertical and unequal. An alternative term for subcontracting is *gaichuu*, outsourcing or buying; the trade-off (substitute) decision for that is *naisei*, which could be translated as in-house production, internalisation, ‘make’, or vertical integration.

The concept of *keiretsu* gained enormous currency in the 1980s, when many observers attributed the success of the Japanese automobile industry as a whole to this uniquely Japanese industrial structure. The number of articles that dealt with this subject matter grew dramatically during the period. Both academic and anecdotal interest in the topic reached new heights in the latter half of the 1990s as two major Japanese assemblers were taken over by foreign concerns and the *keiretsu* system frayed progressively at the edges. This seemingly paradoxical development left many analysts dumbfounded; even today it is unclear how such contradictions can be best reconciled.

Miwa and Ramseyer (2002, p. 170) broke new ground by unequivocally stating that the concept of horizontal *keiretsu*¹ is a fable which exists only as a figment of imagination in the minds of academics and populist journalists. In an earlier article (2000, p. 2650), they suggested that ‘credible commitment’ (Williamson 1983) in the form of relationship-specific investment (RSI) is not common in the automobile industry.

In 1989, Miwa noted that developing a long-term relationship based on credible commitment requires substantial time and energy from both the assembler and the suppliers, but he failed to pursue the question of why both parties would choose this form of governance. He also specifically and explicitly excluded vertical integration as an area for investigation. A later paper (Miwa and Ramseyer 2000) probed the incentive issue by analysing two broad categories of firms – first-tier and second-tier – with different kinds and levels of technology. The vertical integration issue, however, remains unexplored. Had Miwa and Ramseyer addressed the issue of vertical integration versus outsourcing, they would not have invited the following criticism from Masten (2000, p. 2669):

... transaction-cost economists have always regarded contracts and other organizational arrangements as alternative responses to the appropriability hazards engendered by

specific investments. Klein, Crawford, and Alchian, for example, expressly identify vertical integration and contracting as substitute devices for curbing opportunism ...

In this paper, I will demonstrate that Toyota's buy² decision was dictated by unusual historical circumstances and that the way in which Toyota dealt with the RSI issue was therefore unconventional. I show that the noble notion of commitment was made credible in the Japanese automobile industry, but that this was not necessarily with the aid of RSI (in the Williamson paradigm). Rather, the commitment existed in a fabled world, albeit a small one, where the age-old samurai tradition was honoured and the gentleman's word was his bond. The vocabulary and the setting were not what business literature made them out to be, but the economic consequences were as reliable as sound economic theories had predicted.

Unlike most previous literature, this paper concentrates on one company. The company is not Toyota per se, but Denso, an important and related company that has hitherto received little attention from academia or the media. The relationship between Denso and Toyota is similar to that between Microsoft and IBM in the modern era. My study reveals that Toyota does not practise *keiretsu* in the manner broadly perceived. Contrary to majority opinion, but for different reasons from those of Miwa and Ramseyer (2002), I support the argument that Toyota would not have a sustainable competitive advantage if *keiretsu* operated in the way in which it has been wrongly understood to do. This leads to another question: was *keiretsu* a figment of imagination in the minds of Toyota's domestic competitors?

Literature review

There is already a substantial body of literature seeking to explain Toyota's success. I do not review the literature in its entirety, because this would involve substantial translation of Japanese literature that is not yet available to English readers. Rather, I highlight perceptions found in both the English and Japanese literature, identify gaps found within and between each body of literature, and make some critical observations. In particular, I examine transaction costs, game theory and resource based view (RBV) literature.

The English literature to date seems to be dominated by the transaction costs approach, with frequent reference to Williamson's credible commitment and RSIs. Williamson (1985, p. 120) was the first to note in the English literature the existence of an 'unusual relationship' between Toyota and its subcontractors and to identify the fact that Toyota has always stressed

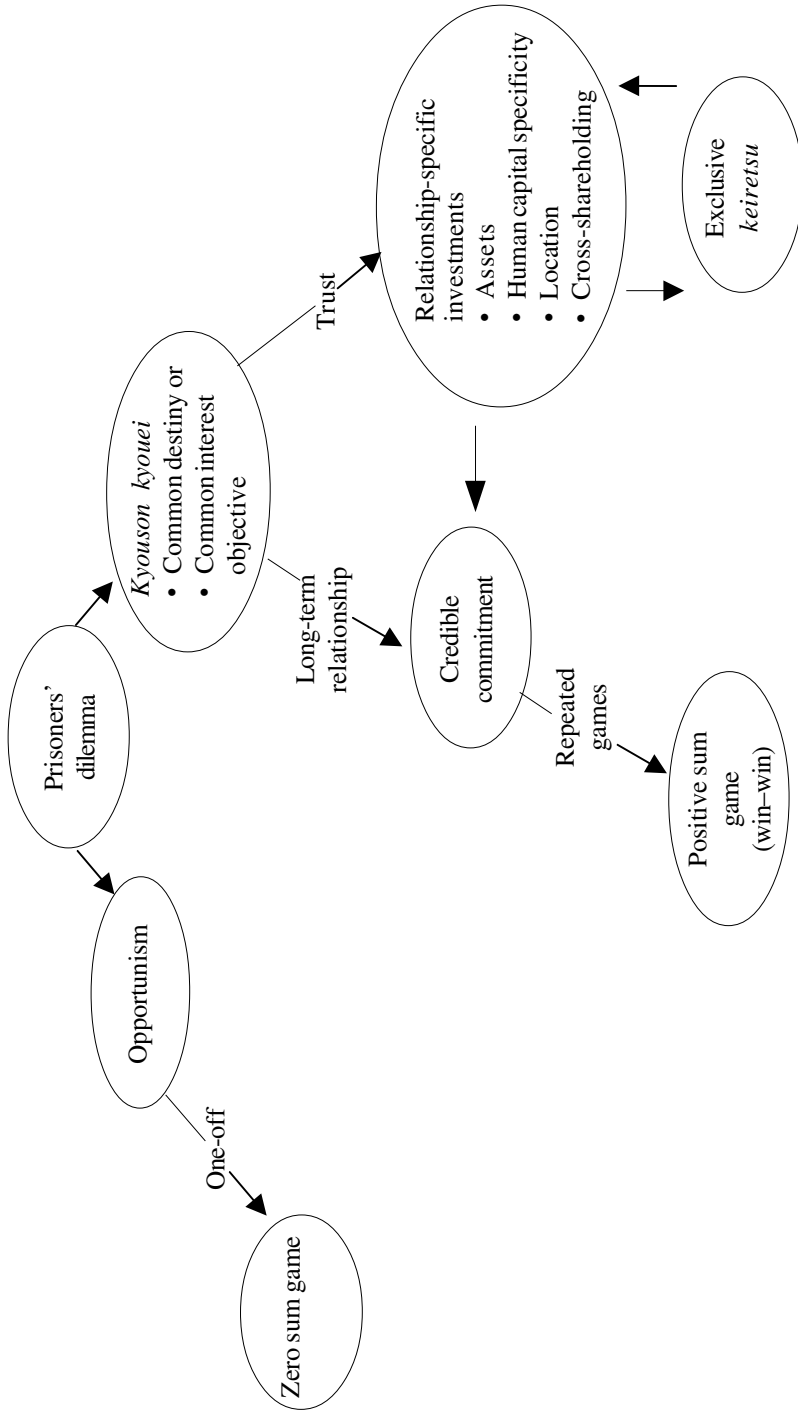
to its suppliers the idea that they share a common destiny. Asanuma (1985, 1989a, b) documents the long-term relationship and relationship-specific skills allegedly developed between Toyota and its parts suppliers following the logic of Williamson (1983) and Klein, Crawford and Alchian (1978). Aoki (1988, 1990) supports Asanuma's observations by concluding that Japanese subcontractors invest heavily in skills specific to their manufacturer's requirements. In a Japanese article, Miwa (1989) theorises how and why the assembler and the parts suppliers in the automobile industry develop incentives, commitment and hostage systems at different stages of their longstanding relationships. Asanuma (1992, p. 106) suggests that the Toyota network is bound by trust, commitment and cooperation. Dyer (1994, p. 176) notes the extensive use of RSIs and concludes that 'dedicated physical assets play an important role in the improvement of product integrity and thus in overall product quality'. Edwards and Samimi (1997, p. 490) note the puzzle of the longstanding relationship between Toyota and its large number of first-tier suppliers and seek an answer in the post-war business environment and the implementation of government policies conducive to Toyota establishing 'an extensive, highly cooperative business network guided by "common destiny"'. Miwa and Ramseyer (2000) take a contrary view. They conclude that neither the first nor the second-tier suppliers commit themselves to RSIs. Moreover, their regression analysis using industry-wide post-1997 data finds no evidence for the existence of an exclusive *keiretsu* system.

Figure 1 summarises how the existing literature uses transaction costs and game theory to interpret Toyota's strength. There are four main points.

First, the existing literature tends to be very vague about parts suppliers. Authors make little specific distinction between even first and second-tier suppliers, let alone Toyota Group³ members. Most appear to analyse first-tier suppliers, but there is some confusion as to whether that includes Toyota Group members. Existing literature implies that Toyota engages in a long-term relationship with all first-tier suppliers as they command quasi-rents. Yet there is no systematic analysis of these firms' technology level or proprietary knowledge or of why Toyota did not ultimately choose vertical integration.

Current literature suggests that Toyota plays a positive sum game by establishing a long-term relationship with approximately 180 companies.⁴ This presents a conceptual challenge for two reasons. First, it requires an assumption that all first-tier firms possess proprietary knowledge and/or RSI and that the cost of vertical integration for Toyota outweighs the quasi-rents extracted by the suppliers – because otherwise Toyota would not choose to expend time and energy in cultivating a long-term relationship with 180 firms. Second, game theory can

Figure 1 How existing literature interprets the Toyota–Denso relationship and success in terms of transaction costs and game theory



sustain a repeated game over a very long period if there are only two players involved (Dixit and Nalebuff 1991, p. 96–97), because the more partners there are, the more complicated the payoff matrix becomes. The breakdown of the OPEC⁵ cartel is testimony to the difficulty of maintaining long-term collaboration when there are more than a few partners involved. It is necessary to restrict the analysis to only one parts supplier if game theory analytical tools are to be engaged.

Second, the existing literature defines RSIs according to the Williamson paradigm – asset specificity (Dyer 1994), human capital specificity (Aoki 1988, 1990; Asanuma 1992; Dyer 1994) and location specificity (Dyer 1994). Gilson and Roe (1993) include cross-shareholdings. To date, no one has identified or explored less obvious or even unwritten contractual governance arrangements.

Third, the Nichibei Kouzou Kaigi (US–Japan Structural Conference) in the mid-1990s singled out the ‘exclusive’ *keiretsu* system as an impediment to foreign participation in Japan’s automobile industry. Yet in 1986 (cited in Ueda 1989, p. 2) Matsui noted the *motokata fukusuuka* phenomenon as parts suppliers diversified their customer base outside their own *keiretsu*. Clearly there is a gulf between common perception and reality, and this has existed for at least a decade. In 2000, Miwa and Ramseyer tried to dispel the common perception that *keiretsu* are exclusive, demonstrating how deeply entrenched this notion is in academic literature. Is it possible that academic perception has been biased towards an ‘exclusive’ *keiretsu* because exclusiveness is required to justify a prisoners’ dilemma relationship and the related RSI based research (see Figure 1)? More importantly, is it possible that Toyota’s rivals also perceived the *keiretsu* system as exclusive prior to 1986?

Fourthly, the literature has yet to explore why Toyota is more successful than its domestic rivals are. Additional research should draw upon the RBV literature.

This paper attempts to explore all four issues identified above. It starts with the big picture, particularly the central question of transaction cost economics – the ‘make or buy’ decision for Toyota in its early history. Denso is chosen as the case study, for the reasons outlined above.

I begin by outlining the early historical circumstances shaping Toyota’s ‘buy’ decision in relation to Denso. I then identify and elaborate on the ‘blind spots’ of current literature and address the observations made above. I avoid the one-size-fits-all pitfall of Toyota-related transaction costs economics literature (Asanuma 1992; Aoki 1988, 1990; Miwa 1989; Dyer 1994). The Toyota success story is a multi-tiered phenomenon and it requires a correspondingly

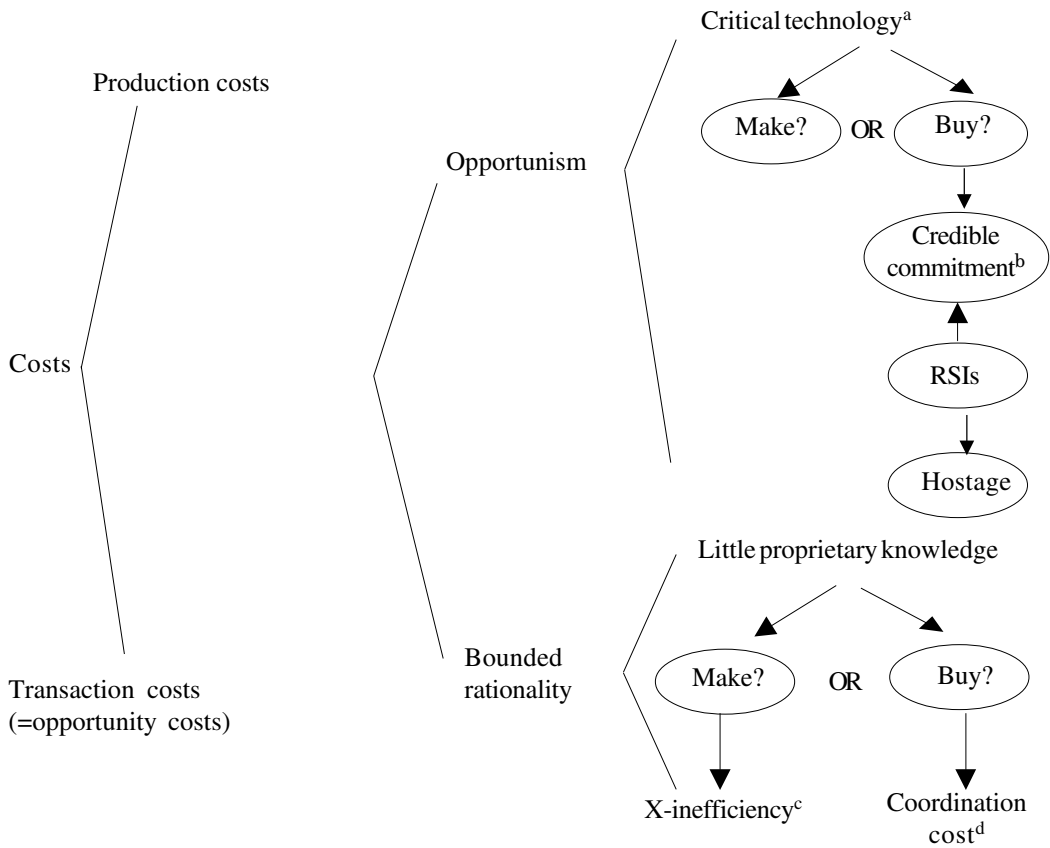
multi-layered analysis to do justice to the complexity involved. The weakness of the current approach is that almost all scholarly contributors treat the first-tier suppliers as a faceless, nameless homogeneous group which has mysteriously earned Toyota's trust – so much so that they are bound in a long-term relationship with Toyota, irrespective of their ability (or the lack of it) to hold Toyota to ransom. If game theory and Williamson's 'credible commitment' were the strategic reasons for Toyota's success, transaction costs should be segregated and analysed on two levels. Costs arising from opportunism should not be confused with coordination costs (where first-tier suppliers make their contribution), which are classified as bounded rationality (see Figure 2). I address this issue before concluding with a summary and raising a future research question.

Of the 35,768 companies (Wada 1991, p. 3) supplying parts to Toyota, it is estimated that one company alone – Denso⁶ – contributes on average 14 per cent of parts value to the almighty car assembler. This figure is particularly impressive when we consider that Toyota's own internal value added amounts to only 30 per cent (Table 1). Denso is one of the 13 companies that constitute the Toyota Group. In stark contrast to the commonly perceived notion that the Japanese automobile industry is a vertical hierarchy, Denso receives exceptional treatment within the Toyota Group. For example, Toyota employees never dare to suggest that Denso is one of its suppliers. Rather, Denso enjoys a special status in the Toyota empire; it is treated as a related or collaborative company on equal footing with the giant auto maker.

Current literature examining the competitive advantage for Japanese auto manufacturers tends to focus on Toyota and portray the company as being at the top of a pyramid, with supplying firms organised in a multi-tier structure beneath. This paper argues that, in explaining Toyota's success, the role of Denso has been overlooked. Existing literature makes regular reference to Toyota's heavy reliance on subcontracting as a source of competitive advantage. The 30 per cent in-house production versus 70 per cent outsourcing and the famed 'Toyota method' have been so faithfully and vigorously copied by most other auto makers in Japan that one starts to wonder what magic this formula holds if it can be so readily duplicated. No one has previously questioned Toyota's dependence on Denso or identified the reasons why other Japanese car assemblers did not internalise the production of electrical and electronic parts.

Transaction cost theory indicates that a firm should internalise production activities that involve proprietary knowledge if the potential loss incurred from opportunistic behaviours on the part of the suppliers outweighs the potential savings from outsourcing such activities. The strategic error made by IBM in subcontracting the company's software development for PCs

Figure 2 Transaction costs economics: taxonomy in the Toyota context



Notes

a Monteverde and Teece (1982).

b Williamson (1983, 1985).

c X-inefficiency (Leibenstein 1966) is not normally classified within transaction costs economics, but is included here as it is relevant to Toyota’s outsourcing decision. It is also a missing link that has been overlooked in current Toyota-related literature. A trade-off relationship normally exists between the make or buy decision at this technology level. However, Toyota was able to reduce both X-inefficiency and coordination cost.

d Alchian and Demsetz (1972); Asanuma (1985, 1989a, b); Womack et al. (1990).

Table 1 Toyota's dependence on Denso

Year	Japanese calendar year	Denso's sales to Toyota (million) (1)	Toyota's COGS (million) (2)	Toyota's outsource value (3) = (2) x 0.7 (4) = (1)/(3)	Denso's share as an outsourced supplier (%) (5) = (1)/(2)	Denso's share in Toyota's total value-added (%)
1969	44	44,241	619,014	433,309.8	10	7
1970	45	NA	711,926	498,348.2	0	0
1971	46	60,458	872,163	610,514.1	10	7
1972	47	71,814	957,213	670,049.1	11	8
1973	48	90,755	1,126,981	788,886.7	12	8
1974	49	115,637	1,252,774	876,941.8	13	9
1975	50	127,391	1,563,994	1,094,795.8	12	8
1976	51	167,572	1,642,627	1,149,838.9	15	10
1977	52	197,309	1,884,930	1,319,451.0	15	10
1978	53	213,465	2,211,013	1,547,709.1	14	10
1979	54	268,187	2,358,389	1,650,872.3	16	11
1980	55	310,416	2,750,174	1,925,121.8	16	11
1981	56	335,914	3,060,952	2,142,666.4	16	11
1982	57	NA	NA	0	0	0
1983	58	411,555	3,701,468	2,591,027.6	16	11
1984	59	461,037	4,208,288	2,945,801.6	16	11
1985	60	514,990	4,618,502	3,232,951.4	16	11
1986	61	535,744	4,972,156	3,480,509.2	15	11
1987	62	538,515	4,864,535	3,405,174.5	16	11
1988	63	600,397	5,306,466	3,714,526.2	16	11
1989	1	NA	5,764,303	4,035,012.1	0	0
1990	2	NA	6,650,643	4,655,450.1	0	0
1991	3	728,743	7,407,084	5,184,958.8	14	10
1992	4	737,718	7,979,345	5,585,541.5	13	9
1993	5	661,444	8,946,262	6,262,383.4	11	7
1994	6	628,575	8,151,904	5,706,332.8	11	8
1995	7	NA	6,876,796	4,813,757.2	0	0

Notes: Toyota outsources approximately 70 per cent of its production. Denso's share of Toyota's outsourced value and total value added can therefore be calculated using steps (1) to (5). For 1969-74, Toyota's COGS (*uriage genka*) are estimated figures based on gross sales (*uriagetaka*) times 0.85. The average of Denso's contribution as an outsourced supplier between 1975 and 1988 is 15 per cent; the average for the whole period is 14 per cent (see sheet 2). Denso accounts for roughly 10 per cent of Toyota's total value added on average. COGS = cost of goods sold; NA = not available.

Source: Nihon no jidousha buhin kougyo (*Auto trade Journal*) various years. Denso's yuuka shouken houkokusho, various years. Yuuka shouken houkokusho, various years

proved an expensive lesson for the computer giant at the time (Jarillo 1993). In contrast, the Toyota–Denso relationship has been successful and enduring. The collaborative effort seems to pay off for both partners, with a win–win outcome: Toyota has won the biggest domestic market share while Denso has become a major global automobile parts company. Although the IBM–Microsoft relationship has been widely documented in the strategic management literature, little attention has been paid to the Toyota–Denso relationship. In this paper, I explore the reasons for the successful collaborative efforts of Toyota and Denso, with an emphasis on the historical context in which the relationship was formed. I also raise the issue of what truly constituted the competitive advantage for the automobile industry in Japan.

Historical perspective

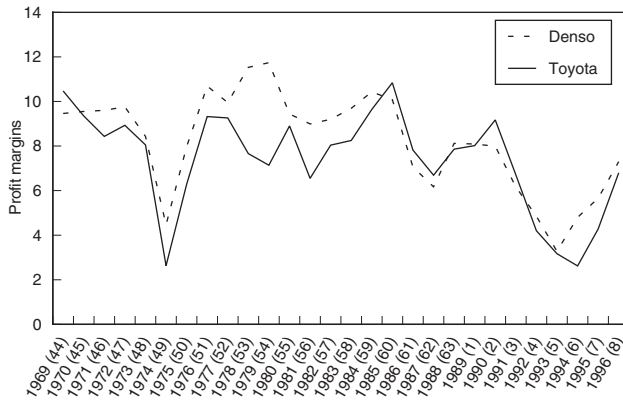
Monteverde and Teece (1982, p. 207) observed:

... (t)he greater is the application of engineering effort associated with the development of any given automobile component, the higher are the expected appropriable rents, and therefore, the greater is the likelihood of vertical integration of production for that component.

An examination of the profit margins of Toyota and Denso reveals that prior to 1985 and for some years after that Denso had a higher profit margin than Toyota (Figure 3). Why did Toyota accept this situation and forgo vertical integration?

Looking at the Toyota–Denso relationship from a historical perspective, we can see that Toyota’s chosen strategy was very much dictated by Toyota’s initial lack of capital. This path-dependency shaped Toyota’s subsequent strategy. Nissan, by comparison, was better endowed with capital (Maruyama and Fujii 1991, p. 130). Yet Nissan also decided to outsource its electrical components. Had Nissan chosen not to copy Toyota’s path-dependent strategy, would it have become the industry’s leader today?

Toyota’s early history was very different from that of companies such as Nissan. Consequently, Toyota bonded strongly with its supplier firms. Industry observers note that Nissan’s *keiretsu* is not as closely knit as Toyota’s (Ohsono 1997, p. 22). A straight copy of Toyota’s *keiretsu* structure may not automatically translate into a competitive advantage for the copying firm. Here I trace the unusual historical circumstances that gave shape to Toyota’s path-dependency strategy based on trust and a common interest objective with Denso.

Figure 3 Profit Margins for Denso and Toyota, 1969–96

Notes: Numbers in parenthesis refer to Japanese calendar years.

Source: Yuuka shooken Hookokusho Various years.

Toyota allegedly started with a capital of £10,000 (the equivalent of ¥1 million at the time). The money was a royalty payment that the founder of the company, Mr Kiichiro Toyoda, received from his father. Mr Sakichi Toyoda invented a weaving machine, and he sold the patent rights to an English company. On his deathbed, Sakichi said that he wished his son to start a car industry. Kiichiro himself was an engineering graduate from Tokyo University. He was aware of the enormity of the problems that he faced.⁷ The final product – one single car – comprised 30,000 parts of several thousand varieties. The initial capital of ¥1 million was soon exhausted as he tried to internalise the whole production process to produce the A1 passenger car No. 1 and the G1 truck No. 1. Kiichiro came to realise that he had no choice but to outsource some of the production processes so that he could preserve his capital. He shed first the special steel department, which manufactured engine metal in small lots, then the special machinery department, then the electrical parts department. Eventually 12 departments became independent companies. The bond between these companies and Toyota remained strong, and in later years they became part of the Toyota Group.

Kiichiro acknowledged that electrical parts were the most important components in the manufacture of cars. He likened electrical parts to the nervous system of the human body and believed that they required specialist research. His ‘make or buy’ decision with regard to electrical parts is summed up in the following extract from Denso’s *Company History* (p. 5):

It is a manufacturer's necessary joy and delight when one can produce an end product with confidence. However, confidence alone is not sufficient, if the consumers do not give the product credit. I would not call that confidence; rather it is more aptly described as self-indulgence. I would use parts produced in-house only if I can produce them with confidence, but this confidence must be validated by the world, which shows its willingness to use the product. If I don't have confidence and neither does the rest of the world, then I would prefer to buy them, until I can produce my own with pride.

The history continues (p. 7):

Thus Toyota adopted a policy of importing electrical parts, and the role of the electrical parts department within Toyota was reduced to one of assessing the functions of imported parts and electrical inspection. Nevertheless, since electrical parts constituted the bulk of imported items in yen value, in Kiichiro's mind, their production would be internalised one day.

The opportunity to produce electrical parts in-house presented itself in 1936, when the Japanese government designated Toyota as the first company to receive 'national protection' and Toyota was required to manufacture cars for the nation as a 'national duty'. The government policy at the time was to discourage imports where possible and to replace them with domestic production. Toyota built a testing factory in a barrack in November that year.

However, it was impossible for Toyota to manufacture enough electrical parts in order to meet its production target of 150 cars per month. Kiichiro modified his ambition and it was decided that part of the requirement would be met through outsourcing to one other company. It so happened that Hitachi was chosen instead of Toshiba, even though the latter had a more superior technology. As it turned out, Hitachi's products proved to be inferior to Toyota's in-house production. That provided an incentive for the electrical department to continue to improve and excel itself. The China Incident in 1937 stimulated demand for cars and trucks and the position of the electrical parts department within Toyota became more secure. In 1940 and 1941, the make or buy decision favoured in-house production by a good margin.

The crisis for the electrical parts department occurred in 1949. Economic circumstances forced Kiichiro to change his mind about in-house production and to shed the department, which, as Nihon Denso, became a separate company. The subsequent tight bonding between Toyota and Denso, born out of the Toyota spirit of a 'shared common destiny' and established at a time of adversity, has been romantically documented in the following summary from Denso's *Company History* (pp. 17–23):

Our company's foundation was laid after the war. The sales for the company between October 1948 and the end of 1949 had been appalling and we were persistently operating in the red. At the time we had three lines of products: radio receivers, horns for three-wheel vehicles and electrical parts for four-wheel cars. Over 1,000 radio receivers were sold per month and that was approximately the full capacity of the technicians employed. The company held a monopoly position in the manufacture of horns for three-wheel vehicles. However, the company's original core business, that of electrical parts for cars, sank to rock bottom. Demand for parts replacement was low and keen competition from other makers in the same industry eroded away what little profit was left. The situation was exacerbated by the deflationary policy pursued by the government since the spring of 1949.

Being a Toyota subsidiary did not lighten our hardship. Toyota's sales plummeted in this tight credit environment and the company was beset with serious management problems. That in turn led to reduced demand for our electrical parts. Although the weaning off of electrical parts had been foreshadowed for some time, it was prematurely hastened as the parent company found itself steeped in financial crises. Toyota had no choice but to trim down for the sake of rebuilding the company.

That April in 1949, Toyota proposed a survival plan with the farming out of three departments: electrical parts, textiles and ceramics. The plan was approved in November and Denso became a separate company in December that year. Mr. Hayashi, as the first president of Denso, was entrusted with the responsibilities of managing the newborn company. Mr. Hayashi joined Toyoda Boushiki in the 7th year of the Taisei Reign, and took on the position of managing director when the company merged with Toyota in year 18 of Taisei. He had no prior experience with electrical parts and at the time of acceptance, he was not even sure if the company was solvent. His comment at the time was 'Since

it is a Toyota-related company, I will give it my best shot even though I have no idea on how to manage it.’

Once the formal handover procedure was complete, Mr Hayashi faced the harsh reality of the situation. He accepted the position on the understanding that Toyoda Kiichiro was not in a hurry to have the ¥140 million loan repaid. What Kiichiro told him in a one-line remark, though, left a big impression in his heart. Kiichiro said, ‘This loan is not a gift to Denso. I hope you’ll never forget what it’s meant to be – it’s money I lent you.’ He then added, ‘Denso does not have a reputation yet. It can only start with Toyota’s backing. I hope you’ll never jeopardise Toyota’s reputation, and would appreciate that you refrain from using the word Toyota in your company name.’ Mr Hayashi said, ‘I didn’t think it was necessary for him to spell out clearly what was already obvious. However, I accepted his words as a gesture of encouragement never to be forgotten. I am thankful to him even to this day for the determination that he has instilled in me to succeed.’⁸

On 16 December 1949, Denso separated from Toyota and became an independent company with an authorised capital of ¥15 million and 1,445 employees. The road to survival was rocky. Ironically, it was through the experience of hardship that Denso was able to share the feeling of mutual value in a common destiny with Toyota. The founding spirit of co-dependent prosperity (*kyouson kyouei*), which was based on a gentleman’s word of promise and trust, eventually fostered a common interest objective, which became the motto of Toyota-style management. This can be gleaned from the following summary from pages 17–23 of Denso’s *Company History*:

Denso at that time had developed a monopoly position in the supply of horns for three-wheel vehicles, through the grants received from MITI for research and development back in 1947. However, the company had not developed any expertise in other products. It became increasingly difficult for Denso to keep all of their 1,500 employees. The company agreed to supply dynamo, starters and distributors to Isuzu to offset the shrinking order of electrical parts from Toyota.⁹ The impact of the deflationary policy affected Isuzu badly too. Isuzu’s production came to a halt in the autumn of 1949, with the inevitable result of massive layoffs and its contracts with Denso were terminated.

The beginning of 1950 saw a further deterioration of the company’s financial position. There was no choice but to lay off some workers so that the company could survive. An announcement was made at the end of March that out of a total workforce of 1,445

employees, 473 were to lose their jobs. As expected, a strike took place and the situation deteriorated from March 23 onward.

The Managing Director, Mr. Iwatsuki, was the one responsible for negotiating with the labour union. He shouted himself hoarse from talking earnestly and persuasively. 'If we all rushed into the same boat after a shipwreck, even those who wanted to help would be unable to help and the whole lot will drown. We are tied by a common destiny and for the moment let's help those who are on the boat by not sinking it. Please accept the company's proposal.' He also promised to rehire those who had been laid off on a priority basis should the company survive.

His talk paid off and the strike ended on April 23. The labour union and management signed an agreement on April 29 and one third of the company's workforce, amounting to 473 members, decided to resign. Even though the strike was resolved, serious problems remained and there was no guarantee of a bright future for the thousand strong members who stayed. The deep recession had people talking of Denso going bankrupt. A thorny path awaited both groups of employees, whether they stayed or chose to leave.

Luckily for the company, the Denso crisis was resolved in a relatively short period of time. The Korean War saved Denso not long afterwards. The resultant improvement in demand conditions led to a shortage of labour. The company was able to carry out its promise by rehiring almost all of the people it had laid off. This management crisis took place within less than six months of Denso becoming independent. There has never been any labour dispute since. Not even once.

This painful experience marked an important episode. It helped shape the company's value system. The Toyota tradition of 'family spirit', 'harmony' and 'common destiny' (*unmei kyoudoutai*) was honoured and maintained within the company.

Denso was to extend this enshrined virtue of fostering a common interest objective with its major partner in subsequent repeated games, and the concept of 'mutual trust' became a resounding theme characterising the relationship between the two.

Relationship-specific investment

Miwa (1989) discussed RSI and cross-shareholding in the context of Williamson's 'credible commitment'. He inferred a hostage relationship between Japanese car assemblers and their first-tier and possibly even lower-tier suppliers as a group. He later changed his mind and (Miwa and Ramseyer 2000) concluded that there was little evidence of RSI in the Japanese automobile industry.

The confusion seems to stem from how one interprets RSI and which suppliers are targeted for investigation. The first-tier suppliers are the wrong targets, because the level of their technology does not warrant extracontractual governance. I believe that Toyota did make important investments in Denso, and vice versa, but neither falls within the Williamson paradigm. I now document the reciprocal RSIs between Toyota and Denso.

Toyota's investment in Denso

As discussed above, Denso started with a Toyota loan or gift of ¥140 million.¹⁰ In 1952, the company invested a further ¥160 million with the help of the government compensation scheme for war vehicle manufacturing. Nevertheless, Denso continued to lag behind its overseas counterparts. The Japanese automobile industry was a late starter compared with its European and American counterparts. The industry managed to catch up on Western technology before the war, but the technology gap widened again after Japan's defeat. Faulty electrical parts were the main reason for breakdowns. Even the materials used for electrical parts were light years behind those of other countries. The turning point came when the German company Bosch appointed Denso as a licensee for its products, which had a reputation for reliability. Denso's *Company History* (p. 33–35) says:

Kiichiro noted how Denso engineers had to struggle on their own to acquire even the most basic technology, and decided the best way to narrow the technology gap within a short period of time would be to learn from the European and American makers who had the advanced technology.

The turning point that marked Denso's success occurred when Bosch decided to appoint the former as the licensee for its products in Japan. Bosch was a well-known brand in Japan for its reliability even before the war. The allied forces discovered that German

war vehicles and army tankers were equipped with Bosch electrical parts. The Bosch reputation soon became well known in America.

It so happened that Bosch was looking for a licensee for a number of strategic reasons. The war had ended and the German economy was recovering like a miracle. Bosch had its eyes on overseas expansion, for the company was concerned about the political tension between the East and the West in a Two-Germany policy. The company had a strong desire to invest its profit and technology in a country with a stable political environment. Japan was considered a suitable candidate for technology transfer at the end of 1952.

Kiichiro was keen to see Denso become the recipient of Bosch technology transfer, and asked Dr. Mishima, a close friend of his at Tokyo University, to introduce Denso to Bosch. Dr. Mishima was a well-known scientist for his invention of magnetic steel. Bosch would not have chosen Denso to be its partner had it not been for Kiichiro's foresight and Dr. Mishima's recommendation. That Dr. Mishima played a key role was obvious if one considers Denso's disadvantages: the company was unknown even within Japan, it had very little in common with Bosch for Denso was so much smaller, and the two differed enormously in capital structure and organisational culture.

Bosch proved to be the best teacher possible for Denso. Although Bosch was a much bigger company than Denso, it was still small by American standards. Bosch also operated in similar economic circumstances as Denso, for both Japan and Germany were defeated in the war. The initial relationship between the two companies weighed heavily in Denso's favour. Bosch was given 80,000 of Denso's shares, which were worth 40 million yen, for the licensing right. Royalty payments could be varied depending on Denso's dividend position. On the other hand, what Denso had learnt from Bosch was more than individual product technology; it incorporated the complete system that gave birth to the 'parts'.

In 1961, Denso was awarded the prestigious Deming Prize for its total quality control (TQC) procedures. This not only enhanced Denso's reputation, but also boosted the confidence of its 5,000 employees, who became very motivated to supply even better quality products.

In summary, Toyota has made two crucial RSIs in Denso, though these are not investments in the conventional sense. The first was an unconditional loan; the second (closest to Williamson's human asset specificity) was a goodwill introduction to Bosch. Both investments were highly valued by Denso, but no 'extracontractual governance' (in the terminology of Miwa and Ramseyer 2000) was put in place, for words and honour alone sufficed to bind in a credible commitment.¹¹

Denso's investment in Toyota

Toyota has often been cited as an exemplar of zero-defect manufacturing. The so-called Toyota method, TQC, as part of the Toyota production system (TPS), gained world fame through the work of Womack, Jones and Roos (1990). Some academic literature even attributes Toyota's sustainable competitive advantage to TPS. However, Denso pioneered the essential features of the TPS, a fact that is not widely known. Denso was awarded the Deming Prize – the hallmark of quality – several years before Toyota was awarded the prize. The following account is by Professor Nemoto, a former Toyota engineer:¹²

TQC was the brainchild of Denso. The company developed this concept about three or four years before Toyota took it up (around 1956–57). Toyota expressed an interest in participating in the Deming Award, at around the same time when Denso won the Prize.

First let's start with Denso. The company realised the importance of quality control, when it won an order to manufacture rifle clips from the US armed forces stationed in Japan at the time. They learned from the Americans the significance of establishing a capability benchmark. The Americans were fanatic about product reliability – understandably so, for a rifle was of little use if it did not fire a bullet each time the trigger was pulled. However, a 100 per cent guarantee would require inspection of every part supplied by Denso, which would be a highly time-consuming process. Denso also knew that capability bench marking was a viable alternative. The MIL 105A was the compliance standard used by the American armed forces and this could be used to establish bench marking. Such compliance heralded the development of Statistical Quality Control (SQC) within Denso.

However, Denso was not content to stop at SQC. The company had a higher aspiration. The time was 1956, or 1957. Denso manufactured around 700 product lines in those days and each lasted on average 1.6 years. Thus checking for defects was required within the

second year of each part's production. Multiply that frequency by 700, and the enormity of the task was daunting. The company began exploring other possibilities for quality management. It noticed that recurrent problems occurred every time a new part was manufactured. Such persistent defect patterns affected not only the quality, but the cost and delivery date as well. The company decided to trace the problems to their sources and realised that prevention was better than cure. It discovered that the design stage and the new product testing stage were the most crucial time to detect and rectify mistakes. The new design may need modification, but the substantial savings that followed certainly justified the extra effort. Denso engineers described this process by coining the phrase 'Design Review'.

Denso was awarded the Deming Prize for having perfected the SQC procedures, which were the realm of quality control engineers only. However, top management realised that quality management should be a company-wide concern. They endorsed wholeheartedly the concept of tracing defects to their origins, and that saw the emergence of Total Quality Control (TQC). At around that time, Toyota also saw the need for a quality management program. Denso informed Toyota of the TQC program that they had been experimenting with. In this respect, Denso was the teacher. Middle and upper management in Toyota were naturally very keen to find out the details of Denso's quality control program, and what they had done to claim the Deming Prize. They came to Denso and studied the techniques of capability benchmarking, and 'Design Review'. Toyota became enthused about these ideas and it had also implemented other projects of its own; one of them was to incorporate parts makers into the 'Design Review' process. Toyota management coined a new phrase for their innovation – TQC. Eventually the company was awarded the Deming Prize in 1965 for developing the Total Quality Control (TQC) program.

Although everyone in the west equates TQC with Toyota, TQC is not a practice exclusive to Toyota. Nissan and all other Japanese car assemblers followed Toyota's suit. However, effectiveness varies. Nissan's program is the closest to Toyota's.

It is thus apparent that Denso's SQC is the forerunner of Toyota's TQC, and the design review process is what Asanuma (1984a, p. 150) has identified as the *shouninzu* process within the Japanese automobile industry.

Toyota is perceived to be successful because of its leadership among its parts suppliers. Another common perception is that Toyota is innovative in establishing and fostering close relationships with its suppliers. However, the above interview sheds light on the less well known fact that quality management issues were actually initiated and identified by Denso, a supplier (albeit a significant one) to Toyota. Like Toyota's RSI in Denso, Denso's reciprocal RSI in Toyota was not quantitative, which may explain why it has not been documented in existing academic literature. Yet this crucial missing link may explain why the Toyota Group is more successful than its domestic competitors. TQC may not itself be the reason, for all other car assemblers in Japan have put in place similar quality management programs. The key to a sustainable advantage may be a strong alliance with an innovative and successful 'partner'¹³ such as the unique relationship between Denso and Toyota. Miwa and Ramseyer (2000, p. 2646) say:

... (i)f production involves large RSIs for which S(upplier) pays, then by RSI theory S(upplier) will need protection against A(ssembler)'s ex post opportunism. Inter alia, it could try to obtain a controlling equity interest in A(ssembler). This does not happen. Even the largest Japanese suppliers do not buy controlling interests in Toyota, Nissan, or even Suzuki. Neither do they seem to negotiate other controls over A(ssembler)'s governance.

In the same article, the authors point out (p. 2643) that Denso has 40,000 employees, has sales of ¥1.3 trillion and, as a first-tier supplier, is 'larger even than a few of the assemblers'. Miwa and Ramseyer have a point: in a prisoners' dilemma game¹⁴ where collaboration led to a win-win outcome but the stakes were high, what measures did Denso have to safeguard itself from possible opportunistic behaviour on Toyota's part? The following discussion shows that Denso did not need to resort to extracontractual governance such as controlling interests in Toyota in order to protect its RSIs in Toyota. Rather, the secret could be customer diversification.

The hostage system

According to Williamson (1983, p. 519), the hostage system is 'widely used to effect credible commitments'. Williamson also says that 'credible commitments ... appear mainly in irreversible, specialized investments' and that one would normally expect that our 'legal system enforces promises in a knowledgeable, sophisticated and low-cost way' but that where legal reinforcement is ineffective 'additional or alternative modes of governance have arisen' and '(b)ilateral efforts

to create and offer hostages are an interesting and economically important illustration'. To date, academics have looked to RSIs as a hostage system signalling credible commitments on the part of both the assembler and the suppliers. I shall argue that the hostage system works differently in the Toyota–Denso relationship.

Denso's weapon

While academia, and possibly Toyota's competitors, busily searched for a checks-and-balances mechanism in the most obvious place (RSI), the quiet Denso weapon was shining in an unnoticed corner where the light was dim. The light was dim because the solution to the problem is counter-intuitive. The unnoticed corner is found in Denso's *Company History* (p. 20):

Kiichiro had some definite ideas about what strategy the automobile industry should adopt. He realised that the electrical parts department would not make progress if it were to rely on business from Toyota only. In his schema, he had allowed for the possibility that the department would team up with other carmakers. He envisaged the electrical parts department would purchase patents from Bosch in his grand plan. It was imperative that Nihon Denso attained a high technological level so that it could enhance Toyota's competitiveness. To that end, Nihon Denso should not be tied to Toyota only and the company should be encouraged to supply quality parts to as many car assemblers as possible in order to become competitive.

The chosen name, Nihon Denso, was symbolic of what Kiichiro had in mind for the company's future.¹⁵ The company could have been named 'Toyota Denso'. However, as Mr. Hayashi recalled Kiichiro's comment ... 'please refrain from using the word Toyota in your company name'; thus 'Toyota Denso' was out of the question.

Kiichiro was very resolute about choosing the right name for this subsidiary. There was no doubt that Kiichiro had an ambitious plan for Nihon Denso to even compete in the export market in the future. He struck off parochial suggestions such as 'Aichi Denso', 'Kariya Denso' and 'Toukai Denso' from the list and settled on 'Nihon Denso' without hesitation or quandary.

It is apparent that Toyota actively promoted customer base diversification (*motokata fukusuuka*) among its suppliers. Toyota's public stance as documented in Denso's *Company*

History points to a glaringly erroneous perception of an exclusive *keiretsu* by people in the West. Denso's dealings with other car manufacturers dated back as far as 1949, with Isuzu being its first customer outside Toyota. A casual examination of the Automotive Yearbooks indicates that Denso supplied electrical components to every single domestic car manufacturer from early on. The 1975 yearbook, for instance, lists the parts Denso supplied to major car companies (Box 1).

In 1975, Nissan was almost the only potential customer excluded from Denso's patronage list. Nissan bought an ignition coil from Denso, but this was a rather insignificant component in the overall scheme of a car and was the only item Nissan bought from Denso. Moreover, the anti-pollution system was the main way to gain competitive advantage at the time; Denso provided this strategic component only to Toyota, Isuzu and Daihatsu, not to Nissan.

This open relationship between Denso and other companies contradicts the perception by Westerners and Japanese alike that the *keiretsu* system was an exclusive system that led to the competitiveness of the automobile industry in Japan. Nissan and others may see the *keiretsu* system as a closed system, but the relationship between Toyota and Denso has never been exclusive. Denso's *Company History* clearly shows that Toyota has always encouraged Denso to diversify, and this has been confirmed in interviews with Mr Takumi Imaizumi.¹⁶ On average, Denso is only 50 per cent dependent on Toyota.¹⁷ Through customer diversification, Denso achieves economies of scale that are passed back to Toyota as lower costs. According to Professor Nemoto (echoing Mr Imaizumi's opinion), Toyota saw no threat in Denso supplying parts to other car manufacturers as long as Nissan was excluded. Nissan was considered to be a powerful competitor; until the early 1990s, Nissan and Toyota had an equal domestic market share of approximately 30 per cent. However, in about 1996 Nissan's domestic market share dropped to 20 per cent while Toyota's increased to 40 per cent. One should not therefore be surprised that in 1997 Denso announced that, as well as selling Nissan ignition coils, it would also sell Nissan air conditioning systems.

To sum up briefly, economies of scale are equally important for parts suppliers and assemblers. Toyota has benefited from Denso's scale economy, which translates into lower costs, yet better-quality products. The paradox is that Denso has attained market power and pricing autonomy by becoming an oligopoly, which has freed it from Toyota's clutch, so to speak. It attains this bargaining power through customer diversification, with Toyota's consent, and not through an 'exclusive' *keiretsu* system based on long-term relational contracts, as the popular media and academia have had us believe for many years.

Box 1 Denso's diversified customers prior to 1975

Toyota	Anti-pollution system, battery generators, engine starter, voltage regulation (voltmeter) power distribution, ignition coil, spark plug, preheating wire, flasher unit, windscreen wiper, horn, speedometer, mileage meter, cable casing, air conditioning system (coolers and heaters)
Nissan	Ignition coil
Mazda	Battery generator, engine starter, voltage regulation, ignition coil, spark plug, flusher unit, cooler
Honda	Battery generator, engine starter, voltage regulator, power distributor, ignition coil, spark plug, magnetic generator, speedometer
Mitsubishi	Battery generator, engine starter, voltage regulator, power distributor, spark plug, flusher unit, windscreen wiper, horn, speedometer, mileage meter, coolers
Isuzu	Anti-pollution system, battery generator, engine starter, flusher unit, speedometer, mileage meter, heaters
Suzuki	Battery generator, engine starter, voltage regulator, power distributor, spark plug, magnetic generator, flusher unit, windscreen wiper, horn, speedometer
Daihatsu	Anti-pollution system, battery generator, voltage regulator, power distributor, spark plug, preheating wire, flasher unit, windscreen wiper, horn, speedometer, mileage meter, air conditioning system (coolers and heaters)
Hino	Battery generator, engine starter, voltage regulator, power distributor, ignition coil, spark plug, preheating wire, flasher unit, windscreen wiper, horn, mileage meter, air conditioning system (coolers and heaters)
Fuji Juko	Battery generator, engine starter, voltage regulator, power distributor, ignition coil, speedometer, coolers
Yamaha	Battery generator, engine starter, voltage regulator, power distributor, ignition coil, spark plug, flusher unit, windscreen wiper, speedometer, heaters.

Source: Automotive Yearbook (1975).

Toyota's weapon

The discussion above shows that Toyota actively encouraged Denso to achieve an oligopoly status. This arose from its own self-interest, but the inevitable and undesirable outcome was

Denso independence, which provides incentives for opportunistic behaviour. How did Toyota circumvent this problem in the context of a prisoners' dilemma?

There are virtually no systematic studies on how Toyota could prevent contingency loss arising from Denso pursuing a dominant strategy. The relationship between the two companies has evolved over a long period, and executives at the helm have changed several times. This presents an additional difficulty in identifying a consistent Toyota strategy on contingency loss minimisation in its relation with Denso.

Exposure to contingency losses exists when one or more of the following three conditions are present: critical technology, monopoly and asset specificity. If monopoly infers market failure, then the Toyota–Denso relationship displays the first two characteristics in Denso's favour. Denso has the critical technology in at least one instance (see below). As demonstrated above, as a result of a deliberate Toyota policy Denso's market and pricing power turn out to be both a strength and an Achilles heel for the auto assembler. That leaves asset specificity as Toyota's only control mechanism over possible Denso opportunistic behaviour since 1970.

Asset specificity in this instance is defined as cross-shareholding. Yet the evidence obtained in preliminary research does not seem to indicate that Toyota uses cross-shareholding as a control mechanism. For example, during the period covered by this paper (1964–1997), Toyota held, on average, 22 per cent of Denso's shares (*Auto Trade Journal*, various years). This does not constitute a controlling interest. By contrast, Nissan had a 54 per cent stake (which constitutes a controlling interest) in Nihon Denshi Kiki in 1991 (Ohsono 1991, p. 23). Anecdotal evidence in the press is very limited but suggests that in the recent past the relationship between Toyota and Denso was not totally tension-free.¹⁸ The 'Toyota weapon' is still shrouded in mystery.

There was one instance where Toyota appears to have temporarily lost control. The payoff structure (as measured by the profit margin) of Toyota and Denso appears to be roughly equal, with the Denso profit slightly higher. Figure 3 shows that the profit margins of the two companies were parallel in most years between 1970 and 1997. A notable exception was 1978–80, when the profit margin of Denso increased and that of Toyota decreased. What could have caused this? One possibility is the introduction of tough exhaust fume legislation in the United States. Senator Muskie, also known as 'Mr Clean', fought for a clean air environment in America and led efforts for the passage of a national anti-pollution legislation. The Muskie Act was enacted in 1970. The Japanese government wisely and proactively required Japanese manufacturers to comply with a series of progressively stringent standards, culminating in the so-called '53 Nen

Hai Gasu Kisei' (Exhaust Gases Legislation Shouwa 53). The year 1978 was the cut-off date for 100 per cent compliance. According to Professor Nemoto,¹⁹ Japanese car manufacturers took this legislation very seriously, for failure to comply with the standards would mean losing both domestic and export sales. The compliance mechanism was highly technical, requiring an innovative solution. According to Denso's *Company History* (summarised from pp. 131–138):

In 1968, (Denso) established the IC Research Centre. The company anticipated the development of an electronic fuel injection system as a crucial part of solving the increasingly stringent environmental standards. The L-EFI developed by Denso eventually broke new grounds by providing reliability and precise control. However L-EFI alone was insufficient in complying with the 1978 anti-pollution standard. The system was finally perfected in 1977, with the development of the O2 sensor, which was an important component identified by Toyota. The complete system of EFI + O2 sensor + Three Element Oxidation was the industry's first. Not only did this system comply with the world's strictest standard imposed by the Japanese government in 1978, it also provided the best fuel economy and driving comfort.

The superiority of the Toyota–Denso collaborative effort in developing a successful critical technology was then apparently reflected in the rapid growth of Denso's market share. This takes us back to the question posed earlier: did Denso pursue a dominant strategy? Only additional research will tell.

A game theory analysis of the early Toyota–Denso relationship

Mr Hayashi, the founding President of Denso and a close friend of Mr Kiichiro Toyoda, passed away in 1970 (Denso's *Company History*, p. 80). This marked the end of a very special relationship between the two companies. Prior to 1970, Denso, the grateful student, excelled, and even surpassed the 'master' in some areas. The student did not forget his master, and wanted to repay his debt. The debt obligation was never formalised on paper, nor was there a need to cast doubt on a trusting relationship by resorting to costly ex ante legalistic fortification – such action would be perceived as an insult to one's integrity and moral commitment. The deep emotional bonding was born out of a common shared destiny arising from the ashes of economic adversity. Yet, strangely, the emotional attachment – normally perceived to be counter to economic rationalism – led to a successful business strategy, one that has proven to be difficult for the pair's

competitors to emulate. This could be the architecture that gave Toyota a ‘sustainable competitive advantage’, in the terminology of Kay (1993). Denso was able to pay back its debt because it was innovative, and it was able to establish a significant market share and consequently achieve economies of scale through diversification of its customer base. Such action was sanctioned and actively encouraged by the master. The pupil was told to find potentially attractive partners, as long as none of them was more attractive than Toyota itself. The master must have been aware of the potential cost of betrayal, yet the master had complete trust in his samurai disciple. The relationship between the two companies was never exclusive, with one exception, but nothing greater than trust was needed to bond them. Commitment was made credible, at least in the first 20 years or so, not so much through RSI (the way Western and Japanese scholars alike have hitherto interpreted it) or cross-shareholding, but through repeated games over a long period of time. Toyota’s might was rooted in a fabled world which was deeply entrenched in a fabled tradition and which withstood the temptation of opportunism.

The role of lower coordination costs

Leibenstein (1966, p. 413) pointed out that as an organisation grows in size and attains monopoly, it becomes increasingly harder to eliminate X-inefficiency,²⁰ because the organisation is dragged down by its own weight through a bloated bureaucracy and lack of motivation on the part of its employees. He conceptualised this lack of efficiency in large corporations as follows:

... for a variety of reasons people and organisations normally work neither as hard or as effectively as they could. In situations where competitive pressure is light, many people will trade the disutility of greater effort, or search for the utility of feeling less pressure and of better interpersonal relations.

One solution is to outsource the organisation’s non-core production activities that require insignificant proprietary knowledge. If higher costs are a result of non-competition, then competition is the natural prescribed medicine. However, outsourcing such non-core activities in the automobile industry incurs substantial coordination costs, as more than 30,000 parts are involved. One would soon start to appreciate the complexity of the purchase department, which would be given the job of coordinating the variation of design and colour within each part category. In other words, in the automobile industry there is a trade-off between X-inefficiency and coordination costs due to the idiosyncratic complexity of the industry.

US auto makers, such as General Motors (GM), initially favoured the 'make' decision, with 70 per cent of components produced internally (Wada 1991, p. 22), as opposed to 30 per cent in Japan (Asanuma 1984a, p. 143). Nevertheless, GM incurred a substantial coordination cost for the 30 per cent of production that was subcontracted. For example, Wada (1991, p. 20) noted:

... in 1978, Toyota employed only 337 people for the purpose of co-ordinating parts suppliers. In contrast, GM had 6000 employees doing similar jobs.

It became apparent that the American method was the inefficient method, incurring possibly X-inefficiency and definitely enormous coordination costs.

Many distinguished scholars have pointed out that Toyota was able to establish a competitive advantage over its American counterparts by resolving this negative relationship. The Japanese media and some academics claimed that *keiretsu* or the vertical supplier relationship (*shitauke kankei*) held the magic for Japan's prowess. The logic was easy to understand. The first-tier suppliers trained the second-tier suppliers, who in turn trained those in the tier below. The goals were clearly articulated, in simple Toyota language: just-in-time delivery and zero defects. The pressure of potential competition (order termination for below-par performance) ensured that suppliers minimised costs. Where necessary, the big brothers from the next tier up would come and lend a helping hand by inspecting books and methods of operations, so suggestions for greater cost reduction could be made. However, some profit, and possibly all of the profit from cost reduction, would be passed back to the biggest brother of all. The Toyota method certainly eliminates X-inefficiency, but the formula commonly perceived as elixir and panacea holds no magic in sum total: it merely redistributes substantial coordination costs from the buyer to the sellers. To put it blatantly, Toyota was able to turn the normally negative relationship between X-inefficiency and coordination costs into a positive one at the expense of its part suppliers.

Someone with an inquiring mind would ask what motivated the parts suppliers to stay in the *keiretsu* network? Needless to say, this issue has been addressed in the literature. 'Common interest objectives' and 'a credible commitment' were the answers. Surprisingly, those giving such answers overlooked the fact that at the lower tiers (including the first tier) these industries have little proprietary knowledge. The threat of contingency loss was minimal, and not even credible, so these industries could not extract quasi-rent²¹ at the time the contract was made. The pay-off for their 'sacrifice' could only be expressed as the possibility of a future gain – a bigger order, for example. The paradox now is not hard to see. The domestic car market (and

the world economy) ultimately will reach its limit, and the pie (and the bigger order that goes with it) will stop expanding one day.²² In such a scenario the more competent suppliers in one *keiretsu* will eventually gain at the expense of other weaker *keiretsu*. Most of Toyota's domestic competitors did not seem to view Toyota's success in that way. In the academic literature, the Toyota method and the 'exclusive' *keiretsu* system were considered the keys to Toyota's success and were copied religiously. Would competitors have chosen the same strategy if they had realised that what benefits an individual company does not necessarily benefit the industry as a whole?

The *keiretsu* system underwent major realignments in the second half of the 1990s. The proactive, innovative and insightful Denso again proved invaluable to the Toyota network, providing a technological solution that minimised coordination costs in real terms. The following account is from Denso's *Company History* (p. 166):

In 1978, Denso developed a bar code system that could be read by computers in response to the just-in-time requirement. The idea first originated from the Point-of-Sale (POS) approach used in the distribution industry. The Toyota Production System became twice as effective with the introduction of this modified system, which was marketed under the brand name of SIMS (Single Source Information Management System) in 1980. The same system is used extensively in Denso, Toyota and other related Toyota Group member firms.

Summary and conclusions

Most previous research has focused on links between Toyota and its first-tier suppliers as a group. Toyota constantly emphasises that the Toyota Group and Toyota itself have equal status, but there has been no previous attempt to study the relationship between the two or the relationship between Toyota and individual group members.

Some literature implies that Toyota's domestic competitors have successfully emulated Toyota by replicating its production system and the *keiretsu* system. There are three glaringly obvious reasons why this cannot be the case. Firstly, the fact that a particular strategy can be copied successfully means that it can no longer provide the foundation for a company's sustainable competitiveness. Secondly, there is an obvious flaw in the assumption that Toyota's rivals have successfully emulated the star performer's strategy, thereby creating a national

competitive advantage: what would next prevent other international firms from doing the same, thus rendering such national competitive advantage ineffective? Thirdly, why would the *keiretsu* system break down if it constituted the core of the competitive edge of Japanese car manufacturers, as commonly perceived?

This paper identifies Denso as the missing link and the key to unravelling the Toyota mystery. Denso's contribution to Toyota's achievement has never been systematically documented. Yet Denso's achievement is impressive. The company began as an electrical department within Toyota but lacked capital, human resources and the requisite technology. Post-war economic circumstances forced Toyota to shed the department. This 'buy' decision subsequently proliferated to involve 70 per cent of Toyota's production and 30,000 parts suppliers, creating an enigma for economists in both Japan and the West. The Toyota success story was shrouded in mystery. Analysts – and possibly competitors – have been examining the wrong parts of the puzzle, simply because 'the light is so much better' there, to borrow the words of Masten (2000, p. 2671).

Denso survived against all odds despite a very difficult start. The company managed to thrive partially through the open relationship that Toyota encouraged with other car makers. Whether that policy was by design or not is a moot point here. The important fact is that, through seeking out customers other than Toyota, Denso gained invaluable expertise and economy of scale. The open relationship with other car manufacturers (Nissan excepted) gave rise to a competitive advantage; this, in turn, translated to a strength for Toyota vis-a-vis the latter's arch rival, Nissan.

With the infusion of Bosch management and technology in the early 1950s (Denso *Company History* 1984, p. 34), Denso developed ahead of Toyota in some areas. It took the prestigious Deming Prize four years ahead of Toyota and paved the way for Toyota's own TQC program. Denso worked closely with Toyota in product design; it was innovative and proactive in product development and it provided Toyota with strategic and creative technological solutions, notably the O₂ sensor and the microcomputer in the electronic fuel injection system. Denso also helped Toyota to lower coordination costs, providing first-tier suppliers with TQC training and, later, a single source information management system. As Denso constitutes about 14 per cent of Toyota's outsourced value, any innovative cost reduction at this level has a greater impact on Toyota's competitiveness than any other measure. Indeed Denso must be an invaluable asset to Toyota.

The hierarchical nature of Japanese society (and of Toyota's competitors) led to researchers focusing on Toyota as the chief commander at the top of a pyramid structure. This paper attempts to document that Toyota's success may not be solely due to Toyota itself. Rather, it argues, Denso, as an equal and collaborative partner, played a pivotal role above the hierarchy. The two together, bound by historical ties, resolved the trust issue in a positive sum repeated game, without resorting to RSI in the legal sense. The Toyota–Denso trust relationship paid off handsomely. Toyota's phenomenal success has been so well documented that it would be superfluous to reiterate it here. Denso's achievement has been equally impressive. Between 1964 and 1974, the company's sales multiplied eight-fold; the company experienced double-digit annual growth on average, in some years reaching 30 per cent; and the number of employees tripled.

This paper demonstrates that the Toyota mythology can be decoded satisfactorily in terms of game theory and transaction cost theory, provided we focus our attention on Toyota's strategic partner, Denso. Previous literature failed to identify where contingency loss is the greatest for Toyota. Researchers mistook the entire first-tier supplier group to be one single entity whose members could, either individually or collectively, pursue a dominant strategy. Moreover, the Toyota production system (with its related concepts of zero defects, just-in-time delivery, 'design review' and relational contracts) does not embody a technology so critical as to render Toyota's competitors incapable of imitation. These are coordination costs with little contingency loss implications for Toyota. Most academics have also failed to understand that Toyota's *keiretsu* is not an exclusive system. One of the secrets of the Toyota success story is its open and non-exclusive *keiretsu* where economy of scale can constitute a competitive advantage.

One mystery remains unsolved. If Denso (and other innovative parts suppliers of Toyota) had created a positive and open external economy for the automobile industry (in terms of superior quality products at low cost), why did the other car manufacturers (Honda²³ excepted) cling to their own *keiretsu* network for so long? Was this uniquely Japanese industrial organisation a causal ambiguity (as defined in the RBV literature) which misled most of Toyota's domestic competitors? Would they have been better off increasing the in-house production ratio and buying the rest from the best and the cheapest on the open market? Was the Toyota–Denso architecture imperfectly imitated?²⁴ Was the prowess of the *keiretsu* system, initially designed as an exclusive system by the majority of Toyota's competitors, a figment of their imagination?

Notes

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- 1 See below.
- 2 That is, the decision to buy components from outside the company as opposed to the 'make decision', the decision to manufacture the parts inside the firm
- 3 The name used for the group of 13 companies comprising Toyota itself and 12 other companies associated with it.
- 4 Firms that act as first-tier suppliers for Toyota. On average, there are about 180 of these.
- 5 Organization of the Petroleum Exporting Countries.
- 6 The present day name 'Denso' is used mostly throughout this paper although the company was called 'Nihon Denso' at inception.
- 7 *Nihon Denso Thirty Five-Year Company History*. This book is available only in Japanese. However, the author has translated substantial portions in order to provide background information for English readers. In this paper it is referred to as Denso's *Company History*.
- 8 Quoted from Hayashi 'Growing With Nihon Denso' in *The Automotive Journal*, July 1967.)
- 9 It should be noted that Denso started diversifying its customer base as early as the 1940s.
- 10 The Denso *Company History* did not make it clear whether this was a loan or a gift. See p. 6 of this paper.
- 11 To quote Masten (2000, p. 2669), '(t)he existence of relationship-specific assets, by itself, implies only the desirability of adopting some protective governance arrangement but says nothing about which such arrangement will be chosen; determining whether contracts, vertical integration or yet some other organisational structure represents the best (least costly) solution requires incorporation of other considerations into the analysis.'
- 12 Graduate School of Management Research at Aichi University and Management Consultant for Toyoda Gosei Co. Ltd. Professor Nemoto was also the chief engineer in charge of Toyota's TQC program and ex-President of Toyoda Gosei. Interviewed on 31 January 1998.
- 13 As distinct from the notion of a supplier in the Japanese context.
- 14 In economics, a type of non-zero-sum game that demonstrates a conflict between rational individual behaviour and the benefits of cooperation in certain situations

- 15 'Nihon' is the Japanese word for Japan; Kiichiro's strategic plan must have envisaged that one day Denso would be large enough to become an oligopoly on a national scale.
- 16 Mr Takumi Imaizumi, Public Relations Department, Denso, interviewed on 26 January 1998.
- 17 Based on calculations made using data from the *Nihon no jidousha buhin sangyou* [*The Japanese Car Parts Industry*] various years.
- 18 See, for example, Ohmura (1991).
- 19 See footnote 9.
- 20 X-inefficiency, also known as X-efficiency, is the failure to minimise costs or maximise returns.
- 21 Payment to a factor of production which is treated as economic rent in the short run but transfer earnings in the long run.
- 22 Abegglen and Stalk (1985, p. 176–177) notes export-oriented Japanese firms prioritise market shares over share price (profit).
- 23 Honda openly admits that it does not operate on a *keiretsu* or subcontracting system and it buys the best parts at the lowest cost on the open market. This is widely acknowledged in trade journals. See for example *Jidousha Nenkan* (1974, p. 295), and *Nihon no Jidousha Buhin Kougyou* (1977, p. 142)
- 24 The Toyota–Denso culture has three important attributes according to Barney (1986, p. 658): the culture was financially valuable, it was rare, and it was imperfectly imitable.

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