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Life Insurance, Natural Disasters, and Human Capital Investment: A Case of Early 20th Century Japan

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Abstract:

This paper examines the role of life insurance buffering negative income shocks on schooling. We focus on middle school grade promotion rates under earthquake disasters in early 20th century Japan. We constructed a dataset on grade promotions by gender, life insurance claims, and information on the deadliness of earthquakes, at the prefecture-level. The results of mediation analyses indicate that life insurance significantly buffered the negative impact of earthquakes on the promotion of boys to higher grades, while for girls the buffering effect of life insurance was mostly small and insignificant, which is consistent with the theoretical prediction.

Keywords: Life insurance, Education, Human Capital, Natural disaster, Japan

JEL classification numbers: G22, G52, I22, N25, O16

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1. Introduction

In theory, life insurance, as well as non-life insurance, transfers risk and thereby improves resource allocation (Yaari 1965; Barro and Friedman 1977; Lewis 1989: Zweifel, Eisen, and Eckles 2021). If this is true, then the availability of life insurance should have a positive effect on economic growth. Based on this idea, a number of empirical studies have explored the relationship between the availability of life insurance and economic growth (Outrevill 1996; Ward and Zurbruegg 2000; Anderson, Eriksson, and Lindmark 2010; Chen, Lee, and Lee. 2012; Yinusa, and Akinlo 2013; Orofuke, and Maku 2023), and found positive association. However, these studies focus on macroeconomic relationships using country-level data and do not examine the channels through which life insurance affect economic growth. One such mechanisms is human capital, where its returns are unsure due to individuals' uncertain life span, and thus life insurance can serve to reduce this uncertainty (Yaari, 1965), ultimately leading to greater economic growth. In this regard, Shindo (2023) explicitly sets up a macroeconomic model of growth that incorporates life insurance and investment in human capital and shows, using macro-economic data for Japan for calibration, that life insurance leads to 0.167 percentage points higher human capital. However, to the best of our knowledge, there is as of date no empirical study that investigated whether life insurance indeed affected such growth enhancing channels exploiting more granular data. In this paper we thus explore the role that life insurance played in encouraging investment in human capital at the regional level using the case study in early 20th Century Japan. In particular we use unanticipated earthquake shocks to life insurance claims to identify whether these affected promotion to higher grades in secondary schools.

The case of pre-war WWII Japan (1910–1940) is particularly relevant for the task at hand. Firstly, during this period, Japan experienced numerous natural disasters. That is, there were a number of earthquakes that caused significant loss of life and injuries, such as the Great Kanto Earthquake of 1923 (approximately 105,000 deaths and missing persons), the Kita Tajima Earthquake

of 1925 (428 deaths), the Kita Tango Earthquake of 1927 (2,925 deaths), the Kita Izu Earthquake of 1930 (272 deaths), and the Showa Sanriku Earthquake of 1933 (3,064 deaths).[1] In addition to these earthquakes, the period was also marked by frequent other disasters such as typhoons and large fires, and through this experience people came to realize the potential importance of purchasing insurance (Okazaki et al., 2025).

Secondly, pre-WWII was also a time when Japan was achieving higher levels of educational attainment, and appreciating the benefits of education, based on the modern education system implemented in the late 19th century. For instance, male enrollment rate at secondary schools increased from just 5.2% in 1900 to 51.5% in 1940 (Ministry of Education 1962, p.181). In this regard, the promotion of children's education was a significant concern for families, where parents placed great importance in ensuring their children, and particularly the boys, received a higher level of education as a means to secure better career opportunities. Importantly for our context, families who had purchased life insurance were able to continue their children's (boys') education even after the heads of households, and thus main breadwinners, died in a natural disaster, the Great Kanto Earthquake of 1923 (Oda, 1924).

Our approach in this paper is to empirically explore whether the uptake in life insurance in Japan in the early 20th century aided in buffering any negative impact on schooling of secondary school students arising from earthquakes. To this end we digitalized prefecture level grade promotion rates for middle school (*chugakko*) for boys and higher girl's school (*koto jogakko*) for girls, and combined this with digitalized data on life insurance claims and earthquakes for an over 30 year period (1910-1940). We then used mediation analysis on these data to disentangle the direct impact of earthquakes on boy promotion rates from the indirect impact that it had by potentially increasing life insurance claims. Our

[1] Among these, the Great Kanto Earthquake caused enormous human and physical damage, particularly in Tokyo and Yokohama Cities. The estimated physical damage was approximately 35.5% of Japan's GNP in 1922 (Imaizumi et al., 2016; Okazaki et al., 2019).

results indicate that earthquakes directly reduced the promotion of boys and girls to higher grades, but that for boys a rise in life insurance claims could dampen any fall in promotion. In contrast, for girls the effect of life insurance buffering a negative impact of an earthquake on promotion was mostly insignificant.

The rest of the paper is organized as follows. In the next section we outline the relevant historical background of Japan. Section III explains our data and provides descriptive statistics. In Section IV we outline our econometric approach. Results of this approach are given in Section V. Concluding remarks are provided in the final section.

2. Historical Background

2-1 Emergence of the modern life insurance industry in Japan

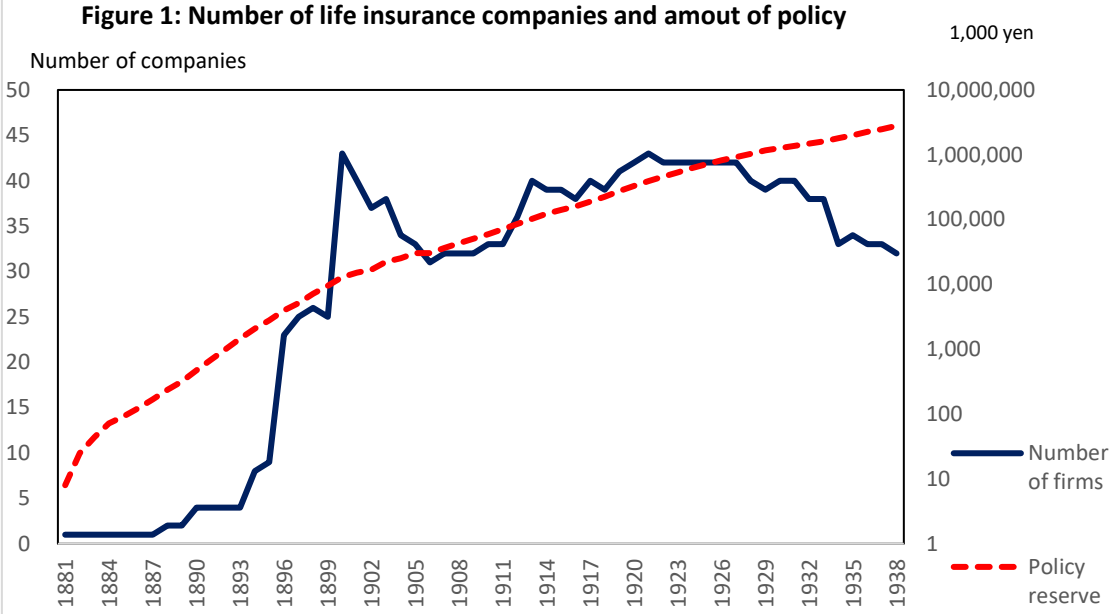
After opening the country in 1853, the modern idea of insurance was introduced to Japan. Yukichi Fukuzawa, the founder of Keio University, visited Europe in 1860 and published a book titled *Seiyo Tabi Annnai (A Guide for a Travel in the West)* in 1867. In this book Fukuzawa explained the idea of insurance, classifying life insurance, fire insurance, and marine insurance. On life insurance he wrote that people sometimes organized a cooperative, and if a member encounters a disease or other disasters, the other members would help him, or help his wife and children after his death, by pooling money (Nippon Mutual Life Insurance Co. 1992, pp.9-13).

The idea of life insurance was materialized by ex-students of Fukuzawa as Meiji Life Insurance Co., the first modern life insurance company in Japan, founded in 1881 and supported by Mitsubishi zaibatsu. Following Meiji Life Insurance, two other companies led the Japanese life insurance industry, namely Teikoku Life Insurance Co. and Nippon Mutual Life Insurance Co., founded in 1888 and 1889, respectively. Teikoku Life insurance was based on a network of Navy officers, while Nippon Mutual Life Insurance was supported by the business community in Osaka. Meiji Life Insurance and Teikoku Life Insurance used the

British Seven Offices' mortality table to compute the insurance premium, while Nippon Mutual Life Insurance asked a professor of the Tokyo Imperial University, Rikitaro Fujisawa, to construct a mortality table based on the Japanese data (Innan ed.1966, pp.47-53).

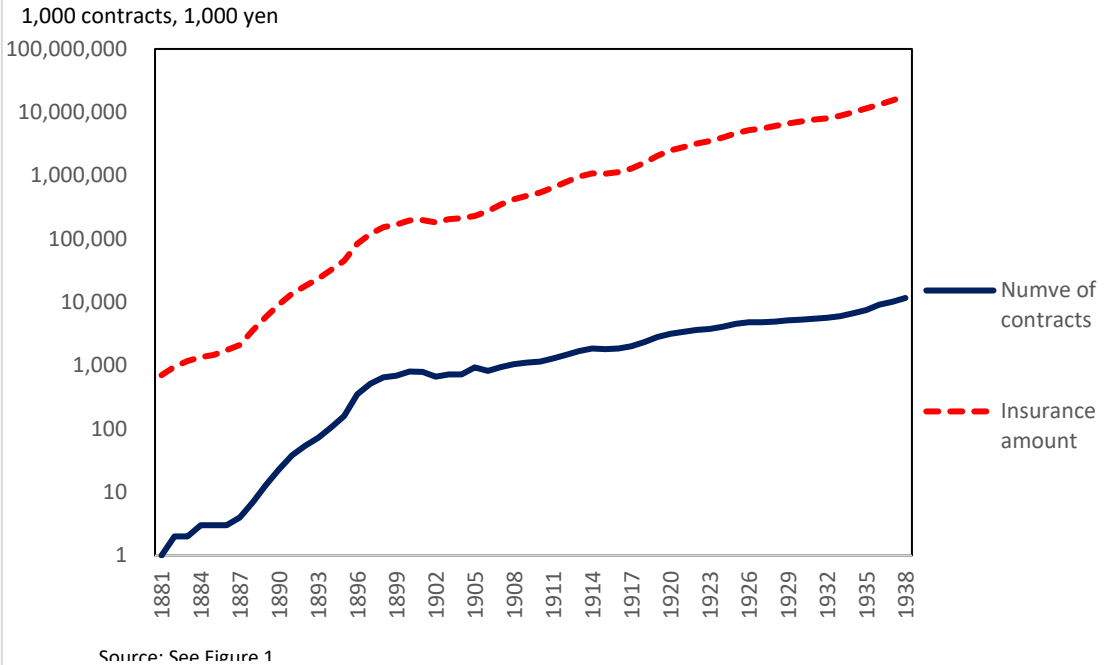
The founding of the aforementioned companies stimulated a flurry of new entries into the industry. Figure 1 illustrates the number of life insurance companies and their policy reserves. Especially, during the economic boom after the First Sino-Japanese War many life insurance companies sprung up. At the same time the number of life insurance contracts and the insurance amount also sharply increased (Figure 2).

Figure 1: Number of life insurance companies and amout of policy



Source: Toyo Keizai Shinpo-sha (1927); *Statistical Yearbook of Japan Empire*,

Figure 2 Number of life insurance contracts and insurance



Source: See Figure 1

The main reason for the sharp increase in life insurance companies was a de facto absence of regulation. More specifically, the foundation of a life insurance company was licensed by local government until 1893 when under the Corporate Law (a part of the Commercial Code) this fell under the responsibility of the central government. However, there was no regulation specific to life insurance companies. In 1898, due to the full enactment of the Commercial Code, regulations specific to life insurance companies (and property insurance companies) were introduced, such as the government's authority to issue orders, request reports, suspend business, etc.. Then, in 1900, the Insurance Law was enacted, which added government supervision, the prohibition of a secondary business, and regulations on insurance policy terms etc. to the regulations covered under the Commercial Code (ibid, pp.64-65; Ministry of International Trade and Industry 1980, pp.50-55).

According to the Insurance Law, enacted 1900, the Ministry of Agriculture and Commerce took charge of the insurance industry, inspected life insurance companies with respect to compliance, knowledge of insurance operations, internal governance, asset management, and financial balance. After

inspection the Ministry ordered more than ten companies to suspend business and be dissolved. Importantly, the inspection and supervision by the government restrained new entries, which is reflected in the decline in the number of life insurance companies in the 1900s (Figure 1).

2-2 Development of the life insurance industry after the World War I

By the 1900s the basis and the regulatory framework of the life insurance industry in Japan was formed. Since then, several events affected the industry and resulted in its further development. First, World War I caused a huge economic boom, which expanded the life insurance market and induced new entries of life insurance firms. Second, Japan experienced a serious pandemic and natural disaster. More specifically, the pandemic of the Spanish Flu hit Japan from 1918 to 1921 (Ilan et al. 2023), with the number of deaths estimated to be 389 thousand (Hygiene Bureau of the Ministry of Home Affairs 1922, p.85). The impact of the pandemic is reflected in the mortality statistics (Figure 3). The sharp twin spikes in 1918 and 1920 in Panel A are due to the Spanish Flu pandemic, which is consistent with the graphs in Panel B. The pandemic also affected the death rate of the insured persons of life insurance policies. For instance, the death rates of policy holders of the major five life insurance companies (Meiji, Teikoku, Nippon, Daiichi, and Chiyoda) increased by 12-13%, which inflicted large financial damages on these companies (Nippon Mutual Life Insurance Co. 1992, p.434).

In addition, on September 1st in 1923 the Great Kanto Earthquake hit Tokyo, Kanagawa and neighboring prefectures, and more than 100 thousand persons died (Imaizumi, Ito, and Okazaki 2016). The relatively small spike in Panel A of Figure 3 is due to the Great Kanto Earthquake. Panel B indicates that this spike was due to deaths classified as “accidents”. From September 1st in 1923 to August 31st in 1924 the life insurance companies paid 7,061 thousand yen as death benefits, although this was much smaller than that due to the Spanish Flu (Innan ed., p.79). Whereas the pandemic and the natural disaster caused

financial damages to life insurance companies in the short-run, it is notable that there was a positive effect on the development of the life insurance (and property insurance) industry in that they impressed on people the importance of insurance (Innan ed. 1966, p.80).

Third, in the 1920s the financial system, in particular the banking industry, became unstable because of an increase in non-performing loans, which in turn was due to the collapse of the economic boom of World War I and the damage from the Great Kanto Earthquake (Okazaki, Okubo and Strobl, 2024). The instability finally resulted in the Showa Financial Crisis of 1927, where 45 banks facing bank runs were closed (Okazaki, Sawada, and Yokoyama 2005; Okazaki and Sawada 2007). The instability of the banking sector contributed to a rise of the status of life insurance companies in the financial system (Nippon Mutual Life Insurance 1992, p.424). Indeed, the ratio of the policy reserve of life insurance to bank deposits increased sharply in the 1920s (Figure 4).

Figure 3-A: Mortality Rate in Japan (Total Mortality Rate)

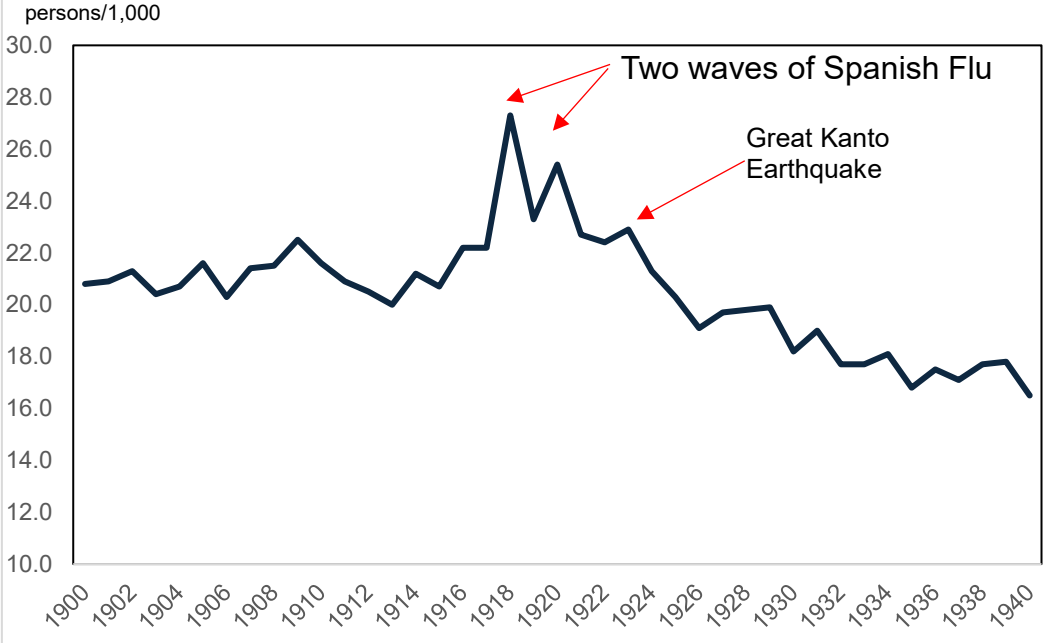


Figure 3-B: Mortality Rate in Japan (Mortality Rate by Cause)

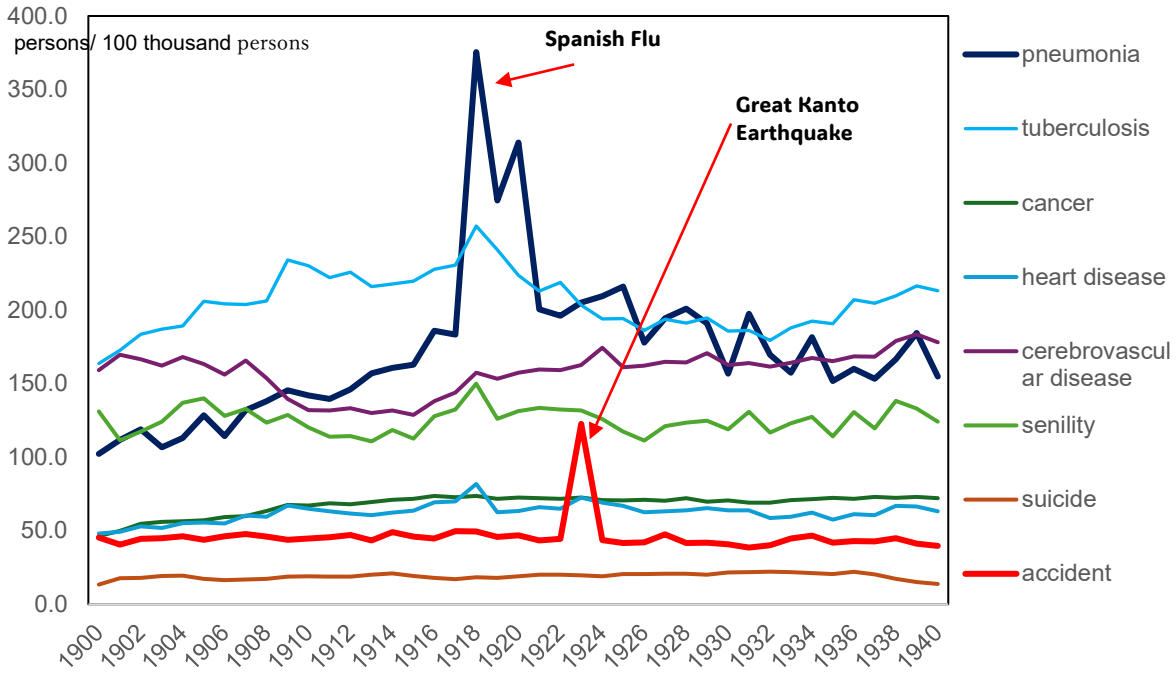
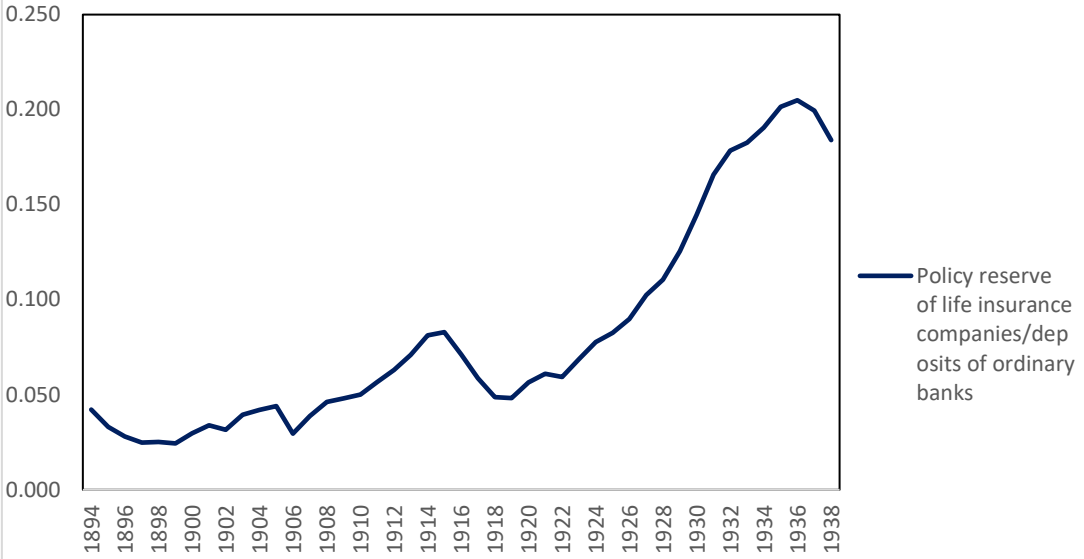


Figure 4: Relative growth of life insurance compared with banking



Source: Toyo Keizai Shinpo-sha (1927); Statistical Yearbook of the Japan

Finally, the Insurance Law was revised in December 1927, motivated by the Financial Crisis in 1927. Through this revision the procedure of mergers and acquisitions of insurance companies was simplified, and subsequently several mergers and acquisitions of large life insurance companies were carried out (Nippon Mutual Life Insurance 1992, pp.439-440). This is reflected in the decline in the number of life insurance companies in the late 1920s and the early 1930s (Figure 1).

2-3 Major insurance products and their expected virtues

The insurance products that life insurance companies offered in prewar Japan were death insurance, survival insurance, and conscription insurance (Table 1). Death insurance is a class of life insurance that pays insurance benefits in the case that the insured person dies, while survival insurance is a class of life insurance that provides insurance payouts when the insured person survives until a specified period. Death insurance, in turn, is classified into whole life insurance,

endowment insurance, and term insurance. Whole life insurance covers literally the entire life of the insured person, while term insurance covers a certain term specified by the contract. Meanwhile, endowment insurance is a class of life insurance between death insurance and survival insurance, where in case the insured person dies before the contract term, death insurance benefit is paid, and in case the insured person survives until the end of contract term, a survival insurance benefit payment is made (Awazu 1910, pp.233-244). Since 1910, the largest category of life insurance contracts had been death insurance, both in terms of the number and the amount. Meanwhile, the largest category of death insurance was endowment insurance (Table 1), although by the late nineteenth century whole life insurance was the most important (Nippon Mutual Life Insurance Co. 1992, pp.171-172; Asahi Mutual Life Insurance Co., 1990, pp.126-128).

Table 1

Table 1: Composition of life insurance contracts

		Death insurance						Survival insurance	
		Whole life insurance		Endowment insurance		Term insurance			
Number of contracts	1910	339,909	(29.0)	755,635	(64.6)	6,368	(0.5)	68,303	(5.8)
	1915	372,931	(20.5)	1,359,568	(74.9)	3,830	(0.2)	79,910	(4.4)
	1920	373,596	(11.7)	2,660,728	(83.4)	44,507	(1.4)	109,821	(3.4)
	1925	362,644	(8.0)	3,834,925	(84.4)	44,336	(1.0)	302,037	(6.6)
	1930	370,865	(7.0)	4,699,457	(88.5)	33,662	(0.6)	205,894	(3.9)
	1935	410,733	(5.5)	6,624,824	(88.5)	38,214	(0.5)	413,166	(5.5)
	1940	588,169	(3.6)	14,480,670	(88.0)	47,383	(0.3)	1,345,975	(8.6)
Insurance amount	1910	155,514	(28.9)	361,684	(67.3)	2,550	(0.5)	17,435	(3.2)
(1,000 yen)	1915	214,402	(20.0)	834,478	(77.8)	2,187	(0.2)	21,158	(2.0)
	1920	277,648	(11.1)	2,145,236	(85.9)	35,325	(1.4)	39,508	(1.6)
	1925	384,219	(8.3)	3,989,254	(85.7)	40,714	(0.9)	242,950	(5.2)
	1930	586,618	(8.2)	6,330,103	(89.0)	35,444	(0.5)	161,664	(2.3)
	1935	787,212	(6.8)	10,302,369	(89.6)	89,204	(0.8)	316,826	(2.8)
	1940	1,200,434	(4.4)	24,601,540	(89.7)	460,639	(1.7)	1,149,521	(4.2)

Source: *Insurance Yearbook*, various issues.

Note: Percentages in parentheses.

As described above, life insurance, in particular death insurance, rapidly spread in prewar Japan, begging the question as to the motivation of the persons who purchased these policies. In this regard, a manual for insurance agents to promote life insurance, titled *Seimei Hoken Gaimu Tokuhon* (*Life Insurance Field Manual*) by the Training and Education Section of Nippon Mutual Life Insurance Co., provides useful insight (Training and Education Section of Nippon Mutual Life Insurance Co. 1934). This book was written for training agents on the techniques to persuade potential customers to purchase life insurance, and lists the general virtues of life insurance as insurance, savings vehicle, health promotion, tax saving, enhancing creditworthiness, preparing children's weddings and startup funds, donations, and preparing for medical expenses. Concerning the insurance function, it states that "to secure the family's livelihood in case of an emergency and to remove future concern is the original direct virtue of life insurance, and this is the basis of the life insurance industry" (ibid, pp.50-56).

In the context of the current paper, securing fund for the education of children was essential. The book explicitly states how to explain the virtues of death insurance for this purpose. First, it stresses the importance of education in that higher education increases the likelihood of economic success. Second, it outlines the amount of educational expenses until a child graduates from middle school, vocational school, and a university, respectively. It also stresses the risk of death of the father or elder brother, i.e., the breadwinner of the family:

> *We have witnessed for many cases of our friends, that children of not so wealthy families who would have gone on to higher schools, but unfortunately their fathers or brothers whom they relied on, passed away, and they had to withdraw from school… How can we avoid this risk? It is quite easy. A modern device, life insurance, will completely address this risk* (ibid, pp.45-46, authors' translation).

Another book titled *Boshu Waho* (*Promotion Speech*) (Institute of Life Insurance management 1933) stressed that “life insurance is a device that secures education of children, regardless of any accidents” (p.9). These explanations indicate that covering the risk of death of a family’s bread winner on continuing education was understood as a significant virtue of life insurance.

2-4 Education System in prewar Japan

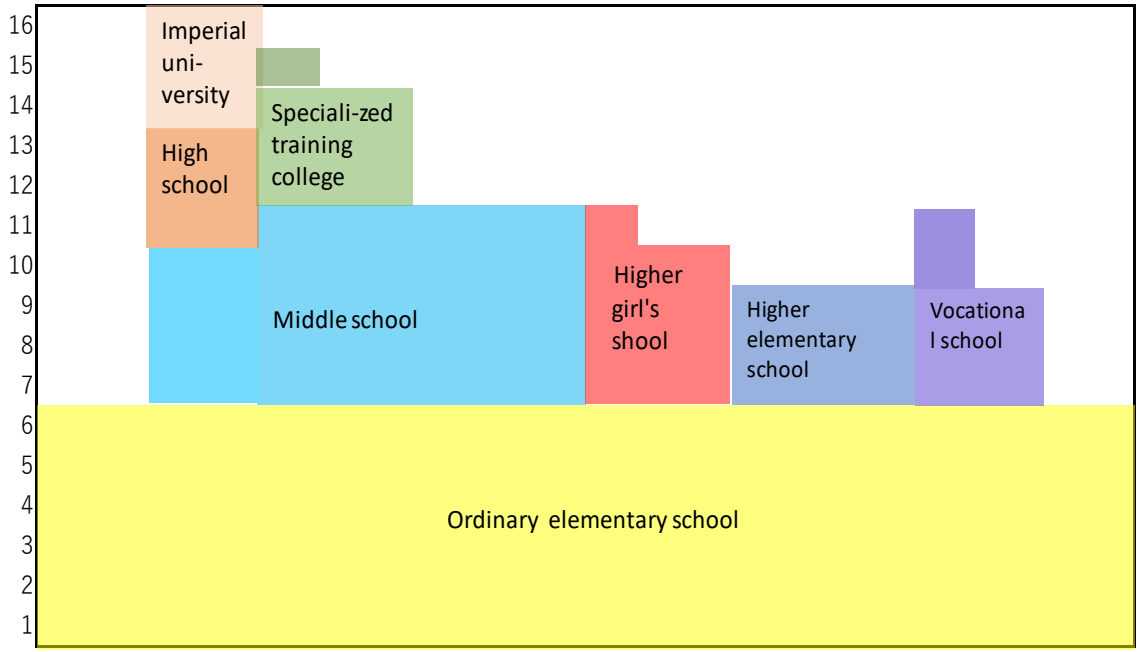
In the late 19th century after the Meiji Restoration, in 1868 the Japanese government established a nation-wide public educational system for all people as part of its modernization policy. The Ministry of Education was founded to administer in 1871, which prepared the Education Order, promulgated in 1872. The Education Order drew up a grand design of the modern education system with three levels, primary, secondary, and tertiary. The idea was that all the children aged 6 and older should go to primary school, selected primary school graduates would proceed to secondary school, and then selected graduates of secondary school graduates would go to tertiary school (Ministry of Education, 1954, pp.7-8, p.27). A more detailed legal framework was established by four imperial ordinances on individual level schools in 1886, i.e., the Elementary School Order (*Shogakko-rei*), the Middle School Order (*Chugakko-rei*), the Normal School Order (*Shihangakko-rei*), and the Imperial University Order (*Teikoku Daigaku-rei*). Although these orders were revised afterwards, they remained the basis of the prewar education system (Ministry of Education 1972, pp.274-275).

Secondary level education was prescribed as follows. The middle school refers to the secondary level ordinary school for male students, whose schooling duration was five years in principle. By the revision of the Middle School Order in 1891, higher girl’s school (*Koto Jogakko*) was prescribed, which provided secondary level education to female. The schooling duration was four years in principle (ibid pp.341-349). Besides these two types of schools for ordinary education, vocational schools were established at the secondary level, whose

schooling duration was three years in principle (ibid p.399; Naka ed.1979, p.11). Then, in 1899, the Middle School Order was revised, and the Higher Girl's School Order became independent from it (Naka ed. 1979, pp.18-19). Middle schools and higher girl's schools admitted the children aged 12 who finished six years of education at elementary schools[2]. In 1918, selected students of middle schools became able to enter high schools (*koto gakko*) after four years of education (ibid, p.56), and in 1920 schooling duration of higher girl's schools was altered to five years in principle. Figure 5 illustrates the school system in Japan as of 1919.

Figure 5: School system in Japan as of 1919

Years from entrance in ordinary elementary school



Note: Teacher traning schools are omiited to avoid complexity.

Source: Ministry of Education (1962), p.27.

Under the legal framework described above, schools at three levels were

[2] Until 1907, when the mandatory school years were 4 at ordinary elementary schools, middle schools and higher girl's schools admitted graduates of higher elementary schools (*koto shogakko*), whose education years were 2. In 1907, the mandatory school years were altered to be 6 at ordinary elementary schools, and from that year middle schools and higher girl's schools admitted graduates of ordinary elementary schools.

established (Table 2). At first elementary school diffused rapidly, followed by secondary schools. Sharp increase in secondary schools from the late 1890s is due to the policy change. That is, originally the Ministry of Education allowed just one middle school in each prefecture, but it allowed towns and villages to establish middle schools (Ministry of Education, 1972, p.361). The diffusion of primary and secondary schools is reflected in the enrollment rate. As shown in Panel A of Figure 6, the enrollment rate of elementary school became close to 100% for both male and female in the 1910s. Also, Panel B of Figure 6 indicates, the enrollment rate of secondary school began to increase in the 1910s and in the 1930s, exceeding 40% for male and 30% for female.

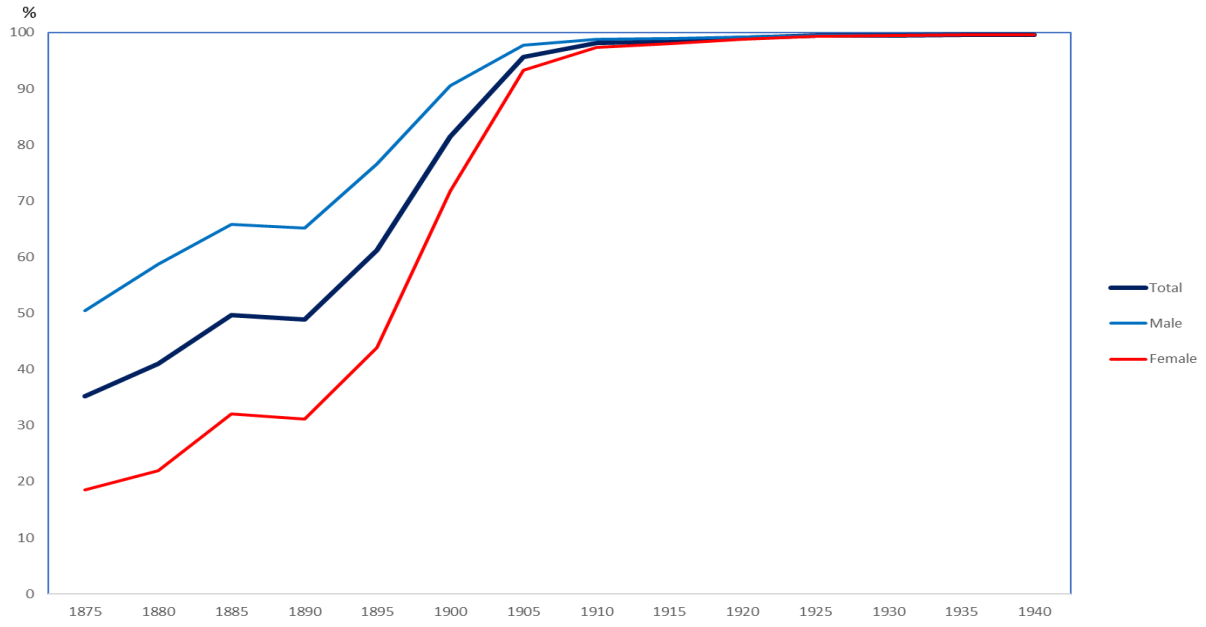
Table 2 Development of the school system in Japan (Number of schools)

	Primary	Secondary			Tirtiary				
	Elemenrary school	Middle school	Higher girls school	Vocational school	High school	Normal school	Specialized training college	Higher normal school	University
1875	24,303	116	0	1	0	82	110	8	0
1880	28,410	187	0	15	0	74	74	2	1
1885	28,283	106	9	26	0	56	75	1	1
1890	26,017	55	31	23	7	47	36	2	2
1895	26,631	96	15	55	7	47	52	2	1
1900	26,857	218	52	121	7	52	52	2	2
1905	27,407	271	100	272	8	66	63	3	2
1910	25,910	311	193	481	8	80	79	4	3
1915	25,578	321	378	541	8	92	88	4	4
1920	25,639	368	514	676	15	94	101	4	16
1925	25,459	502	805	797	29	99	135	4	34
1930	25,673	557	975	976	32	105	162	4	46
1935	25,799	557	1,253	1,253	32	102	177	4	45
1940	25,860	600	1,422	1,479	32	103	193	4	47

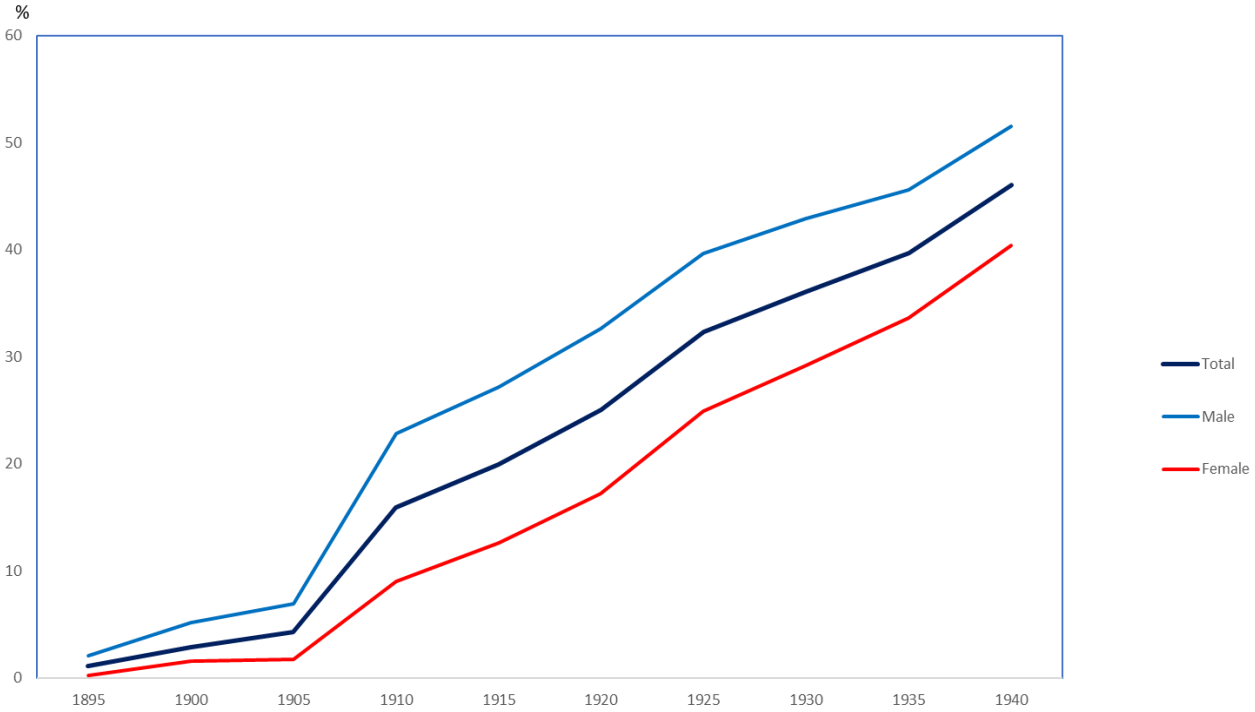
Source: Ministry of Education (1962), pp.170-173.

Figure 6: Enrollment rate of elementary and secomdary

A. Elementary school



B. Secondary school



Source: Ministry of Education (1962), p.181.
Note: The parcentage of the students in secondary schools in the population aged 12-16.

Evolution of enrollment rates in Japan have been studied in the literature on education and on the history of education. Amano (1992) pointed out two constraints on the enrollment rates, namely the affordability of education costs of a family and the motivation of parents to finance higher education for their children. For a family to have a child enter a secondary or higher school, it needed to shoulder the accommodation cost of studying away from home in addition to the tuition. Also, although the situation changed overtime, at least in the early twentieth century the jobs where a strong educational background was highly valued were limited (ibid, pp.123-124, pp.141-157). This is especially the case for girls. According to the survey by the Ministry of Education for 1929, while 54.6% of the boys who graduated from middle schools in the previous year advanced to the next level of education (29.2%) or got jobs (24.7%), just 27.8% of the girls who graduated from higher girl's schools advanced to the next level of education (22.8%) or acquired jobs (4.9%) (Bureau of Ordinary Education, Ministry of Education, 1930a, 1930b). This indicates that the effect of secondary education as an investment in human capital was substantially smaller for girls than for boys, which is reflected in the estimation results of the impact of life insurance presented in section 4.

Moreover, once children entered school a significant number of them dropped out before graduation (Naka, Uchida, and Mori ed. 1979). The Yearbook of the Ministry of Education provides detailed data on dropouts from middle schools by reason for the period from 1904 to 1909 (Table 3). As shown in the Table 3, 15-20% of students dropped out every year, and notably the sum of "family obligations" and "non-payment of tuition fees" accounted for around two thirds of total dropouts. The economic condition of the family of a student substantially influenced on continuation of studies. Even in 1932, the survey by the Education Section of Fukuoka Prefecture Office reported that the number of drop outs from middle schools in Fukuoka Prefecture was 2700, of which 1321 were because of family reasons, and stated that "most of them are due to the

serious economic depression and we are sympathetic to those who dropped out in 3rd and 4th grade just before graduation". (Teikoku Kyoiku-kai 1933, p.47).

Table 3: Dropouts of students from middle schools

Year	Number of middle school students	Total dropouts (%)	Dropouts by reason (%)				
			Family obligations (%)	Non-payment of tuition fees (%)	Illness (%)	Inappropriate behavior (%)	School transfer (%)
1904	99,024	18.0	10.0	1.2	2.1	1.0	3.4
1905	103,231	16.7	9.3	2.1	2.0	0.5	2.8
1906	107,077	17.7	9.7	2.4	2.1	0.4	3.1
1907	110,260	16.9	9.6	2.2	2.0	0.2	2.9
1908	114,055	16.5	9.4	1.9	2.0	0.2	3.0
1909	117,104	15.9	9.3	1.6	2.0	0.2	2.8

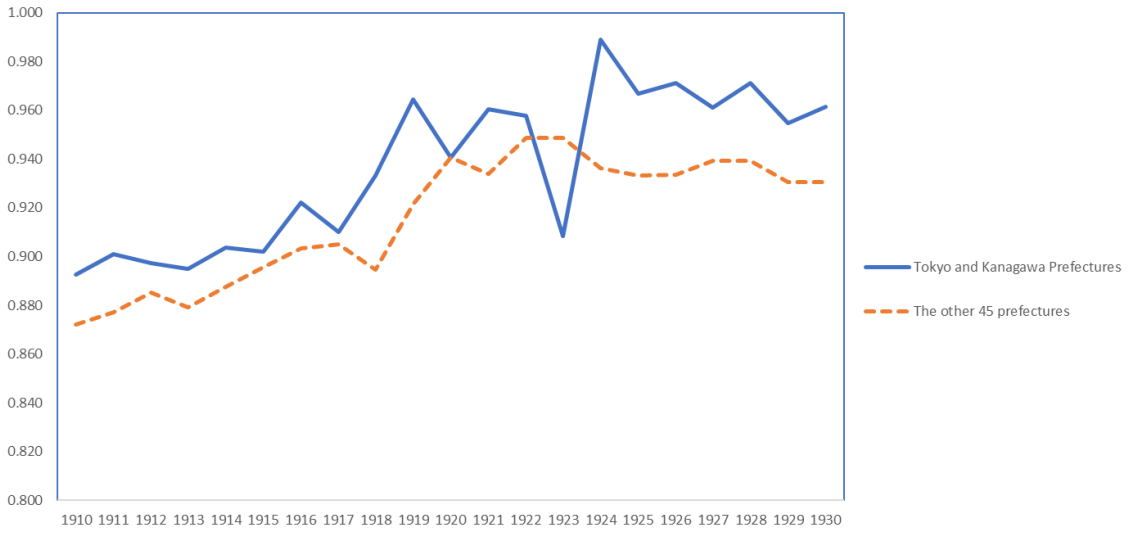
Source: Yearbook of the Ministry of Education, Japan Empire, 36th and 37th editions.

2-5 Natural disaster, life insurance, and secondary education

As just stated, because continuation of education of a student hinged on the economic condition of her/his family, we suspect that a large natural disaster with huge human and physical damage had a negative impact on it. Based on this idea, we observe the promotion rate of middle school students. The promotion rate here means the ratio of the number of students in grade G in year t to the number of students in grade G-1 in year t-1. We calculated this ratio for each prefecture for each year, and calculated the average of the ratios for grade 1 to grade 2, grade 2 to grade 3, grade 3 to grade 4 and grade 4 to grade 5. In order to see the impact of the Great Kanto Earthquake, 1923 on the promotion rate, we compare the rates between the average of Tokyo and Kanagawa Prefectures and the other 45 prefectures, because 97.8% of the total deaths and missing persons concentrated in these two prefectures (Imaizumi, Ito, and Okazaki 2016). As shown in Figure 7, the promotion rate in Tokyo and Kanagawa Prefectures declined sharply, while the average of the other 45 prefectures was stable, which indicates how substantial the negative impact of the Great Kanto Earthquake was

on the promotion rate.

Figure 7 Impact of the Great Kanto Earthquake on the promotion rate of male students



Source: Nihon Teikoku Monbu-sho Nenpo (Yearbook of the Ministry of Education, Japan Empire), various issues.
Note: The average of the promotion rates from 1st grade to 2nd grade, 2nd grade to 3rd grade, and 3rd

Meanwhile, there is also anecdotal evidence that life insurance mitigated the negative impact. From September 1, 1923, when the Great Kanto Earthquake occurred to January 31, 1924, 36 member companies of the Life Insurance Association pay outed 6,557 thousand yen to 5,715 life insurance contracts (Oda 1924, p.3). Oda (1924) collected the anecdotes on the role of life insurance in aiding the victims of the Great Kanto Earthquake. One of the anecdotes is on a family who lived in the downtown of Tokyo City, when the Earthquake occurred. The father, the breadwinner of the family, died by the Earthquake. However, as he had purchased life insurance, his wife received the payout. She talked:

> My family who missed the breadwinner could not expect happiness like before, but thanks to my husband's kindness, my son would not drop out from the commercial school (pp.33-34, the authors' translation)

As this is just an anecdote, in the next section, we quantitatively examine the effect of life insurance in mitigating the negative impact of natural disasters on continuation of education.

3. Data and summary statistics

Our paper uses several data sources. To calculate the educational promotion rates we use the number of enrolled students in each grade of middle schools (*chuggako*) at prefecture level, as taken from the *Annual Report of the Ministry of Education, the Japan Empire (Nihon Teikoku Monbusho Nenpo)*. The promotion rates are the difference between the number of students in grade G-1 at t-1 and the number in grade G at t divided by the number of G-1 at t-1. T. Note that the number of enrolled students are those in regular course (*honka*) at all the public and private middle schools. Insurance claims are measured by the number of claims for death insurance and life insurance, expressed in log (ln_cl_n0). The data are available in various issues of *Insurance Yearbook (Hoken Nenkan)* at the prefecture-level from 1910 to 1940. We do not include promotion from 4th to 5th grade in our observations, because excellent 4th grade boys became able to enter high schools directly from 4th grade of middle schools from 1919, and higher girl's school started to have 5th grade only from 1919, as we stated in the previous section[3]. (see Appendix Figure A, B).

Our earthquake damage variable is the number of deaths. The data is taken from Usami et al. (2013) "Materials for Comprehensive List of Destructive Earthquakes in Japan, 599-1012". The data cover the number of deaths in all earthquakes in each prefecture. Since prefecture-level GDP is not available for

[3] Appendix Figure A and B show the percentage of boys in the fifth grade of middle schools in the total middle school students and that of girls in the fifth grade of higher girl's schools. As indicated in these figures, the percentage of 5th grade boys declined significantly from 1919, while the percentage of girls in the fifth grade was very low.

pre-war Japan, we instead use prefecture level bank deposits as proxy for regional GDP, economic activity and wealth. Deposit data are taken from various issues of *Annual Report of the Bank Bureau, the Ministry of Finance* (*Ginko-kyoku Nenpo*). Bank deposit here is defined as the sum of all categories of deposits at ordinary banks and savings banks in each prefecture at the end of year. The deposit values are deflated by the national-level wholesale price index of the Bank of Japan. We take one year lag of deposits in our estimations, given that deposits may be directly affected by earthquakes when they occurred. Our sample period is from 1910 to 1940. For the savings rate we simply linearly interpolate to obtain the missing number in 1922. For claims we calculated the growth rate of claims of the five largest insurance companies in each prefecture as available from their company reports and then multiplied this by the prefecture-level number of claims in 1922 to obtain an estimate for 1923.

We note that our paper focuses only on male education for the following reason. During the period of our study that the general view was that education was particularly important for males in order to get better jobs and higher income to support a family, while married women were to be responsible for housekeeping and young unmarried women tended to work outside (textile factories) as unskilled cheap labor (Hunter, 1993). Many parents thus thought that investment in higher education level was much more valuable for males and felt this as contribution to the nation.

Summary statistics for our main variables are provided in Table 4. As can be seen, overall promotion rates vary between 79.3 and 115.4 per cent, with an average of 92.6 per cent. As would be expected, the promotion to a higher grade is highest for the lowest grade (92.9 per cent) and then gradually falls as one considers higher grades. We note that there are a number of reasons for the more than 100 percent of promotion rates: (i) family moved from other prefectures, (ii) some students dropped out or left absence came back to schools, and (iii) the average promotion rates are around 93% and thus such high average values tend to exceed 100% by even a small increase. For girls the promotion rate to all levels,

except to the highest, are slightly higher. One may note that the reasons for the maximum promotion rates being above 100 per cent are similar for females. In terms of earthquakes, the number of deaths, when it occurs and is deadly, is 2280, but with considerable variation. The number of insurance claims is a little over 1100 per year on average, but with a large standard deviation.

Table 4: Basic Statistics

	Mean	sd	min	Max
All Boys	0.926	0.033	0.793	1.154
Boys 1→2 Grade	0.931	0.043	0.745	1.166
Boys 2→3 Grade	0.928	0.038	0.721	1.151
Boys 3→4 Grade	0.925	0.035	0.743	1.143
All Girls	0.994	0.096	0.491	2.032
Girls 1→2 Grade	1.004	0.105	0.487	2.154
Girls 2→3 Grade	0.987	0.109	0.476	2.055
Girls 3→4 Grade	0.991	0.096	0.512	1.98
Earthquake	0	1711	0	68221
Earthquake≠0	2280	10824	1	68221
N. Claims	1140	1418	6	15096

Notes: Summary statistics are based on the sample used for the estimation, i.e., 1,457 observations.

4. Methodology: Mediation Analysis

The impact of earthquakes on promotion rates of pupils can work through a number of channels within the context of life insurance. Firstly, there may be a direct effect on promotion independently of any claims, whether related to the earthquake or otherwise. However, given that claims, even unrelated to an earthquake, provide income to households it may this direct effect may depend on the claims made during any period (as will the effect of other explanatory variables potentially). Secondly, if households affected by the earthquake are

insured then the event may result in policy payouts that provide additional income and hence influence a household's decision to allow their boys to be promoted to a subsequent grade.

An ideal econometric framework to capture these different effects is a mediation analysis, which considers a treatment, a mediating variable, and their interaction, and their impacts on an outcome variable. Within our context the outcome, treatment, mediator would be pupil promotion, an earthquake, and insurance claims, respectively. Valeri and Vander Weele (2013) develop a simple estimation strategy to try to disentangle the various channels through which a treatment and mediator can affect an outcome variable. Within our setting this first involves estimating the following:

$$PR_{it} = \beta_0 + \beta_{EQ} EQ_{it} + \beta_{\log(CLAIMS)} \log(CLAIMS)_{it} + \beta_{\log(CLAIMS)*EQ} \log(CLAIMS)_{it} * EQ_{it} + \boldsymbol{\beta_X X}_{it} + \gamma_t + \mu_i + \varepsilon_{it} \quad (1)$$

$$\log(CLAIMS)_{it} = \alpha_0 + \alpha_{EQ} EQ_{it} + \boldsymbol{\alpha_X X}_{it} + \gamma_t + \mu_i + \tau_{it} \quad (2)$$

where *PR* is the promotion rate, *EQ* is an indicator for earthquake occurrence, and *log(CLAIMS)* are the logged number of claims, *μ* are prefecture fixed effects, *γ* are year fixed effects, and *ε* and *τ* are error terms. For additional controls ***X*** we include the logged real savings rate and logged population to capture time varying prefecture differences in income and population sizes. One should note that these latter two controls are included as lagged values since they may be affected by an earthquake as well. We include *μ* and *γ* to capture any unobservable time invariant prefecture specific and time varying prefecture common factors that might be correlated with claims and promotion rates.

Arguably, earthquake incidences are unanticipated and hence can be considered exogenous shocks.

Using the estimated coefficients from (1) and (2) above we can assess the role of the treatment, the mediator, and the dependence of these on each other with the following identities:

$$NDE = (\beta_{EQ} + \beta_{\log(CLAIMS)*EQ}\alpha_0 + \beta_{\log(CLAIMS)*EQ}(\boldsymbol{\beta_X} + \gamma_t + \mu_i)) \quad (3)$$

$$NIE = (\beta_{\log(CLAIMS)}\alpha_{EQ} + \beta_{\log(CLAIMS)*EQ}\alpha_{EQ}\beta_{EQ}) \quad (4)$$

$$MTE = NDE + NIE \quad (5)$$

The natural direct effect (*NDE*) represents the impact of earthquakes on promotion that does not operate through claims. In other words the *NDE* assumes claims to be at the level in which no earthquake occurred. The natural indirect effect (*NIE*) is the impact of earthquakes on promotion that works only through changes in claims induced by the earthquake. Finally, the marginal total effect (MTE) of earthquakes simply is the sum of *NDE* and *NIE*, and captures the total effect of earthquake as it works directly, depends on the level of claims, and works indirectly through claims. In order to assess the statistical significance of these four decomposition measures we generate bootstrapped standard errors as suggested by Valeri and Vander Weele (2013).

5. Estimation Results

We first estimated (1), (2) and (3) for total boys rate at the median number of deaths of a damaging earthquake, i.e., the median at which *EQ*≠0. One should note that for the NIE one also needs to set a level of claims. We use the median logged number of claims throughout our analysis since our estimates are never sensitive to this choice qualitatively and only sometimes, and then only to a small extent, quantitatively.[4] The estimates for all promotions for the median number

[4] Detailed results available from the authors upon request.

of earthquake deaths is provided in Panel A of Table 5. As can be seen, there is a total net negative effect of earthquakes (MTE) on male promotion rates, albeit this is very small for the median deadly earthquake, where the estimated coefficient implies a 1.5 percentage point reduction for the median deadly earthquakes. This negative effect is mainly driven by a direct from the earthquake (NDE),.

Importantly, however, the NIE is positive and reduces the net impact of the direct impact. In other words, life insurance claims arising from the earthquake induces boys to get promoted to higher grades on average. In terms of its quantitative role in doing so, the NIE reduces the impact of NDE by 4,2per cent. Assuming a more damaging earthquake (75^{th} percentile) – as depicted in Panel B – produces the same qualitative results for all boys, but the quantitative impact increases multiple folds. More precisely, the total net reduction in the rate of promotion is 2.8 percentage points. This driven by a direct reduction of 2.9 percentage points, buffered by 0.1 percentage point impact of insurance claims. The mediation analysis decomposition for the largest observed number deaths, i.e., arising from the 1923 Kanto earthquake in Tokyo for all promotions is provided in Panel C. As can be seen, it is for this case that the buffering effect of insurance claims plays a much larger role. More precisely, insurance claims after an earthquake of this size reduces the direct negative impact by 36.6 per cent.

The mediation analysis for the different grades for different earthquake death levels are shown in columns 2 through 4. As is apparent, the results are qualitatively the same for all promotions. Regardless of the grade for these, the total net marginal negative effect becomes larger as boys move through the grades. While this increase is relatively marginal comparing promotion from the 1^{st} to promotion from the 2^{nd} grade (ranging from 7.1 to 8.1 per cent), it is relatively large in comparing promotions from the 2^{nd} grade to that from the 3^{rd} grade, ranging from 41.4 to 48.6 per cent increases depending on the deadliness of the earthquake. The absolute values of the NDE and NIE increase as one moves up

the grades, regardless which earthquake intensity one examines.

In contrast to the lower grades, earthquakes only have a significant impact in terms of the positive indirect of the events through life insurance claims, and only for the median and the 75th per centile event sizes.

Table 5: Mediation Analysis Decomposition for Boys

	(1)	(2)	(3)	(4)
	All	1→2	2→3	3→4
PANEL A: Median EQ≠0				
NDE	-0.000120***	-0.000100**	-0.000109**	-0.000163***
	(0.000033)	(0.000044)	(0.000044)	(0.000045)
NIE	0.000004***	0.000003**	0.000003***	0.000007***
	(0.000001)	(0.000001)	(0.000001)	(0.000001)
MTE	-0.000120***	-0.000098**	-0.000105**	-0.000156***
	(0.000033)	(0.000044)	(0.000044)	(0.000044)
PANEL A: 75th Percentile EQ≠0				
NDE	-0.000520***	-0.000431**	-0.000468**	-0.000701***
	(0.000141)	(0.000188)	(0.000190)	(0.000192)
NIE	0.000017***	0.000011**	0.000014***	0.000028***
	(0.000004)	(0.000004)	(0.000005)	(0.000006)
MTE	-0.000499***	-0.000420**	-0.000454**	-0.000672***
	(0.000141)	(0.000188)	(0.000189)	(0.000191)
PANEL A: Maximum EQ≠0				
NDE	-0.629300***	-0.525625**	-0.569990**	-0.853795***
	(0.171253)	(0.229521)	(0.231125)	(0.233932)
NIE	0.230567***	0.183222**	0.202601**	0.334111***

	(0.073368)	(0.091422)	(0.092793)	(0.100820)
MTE	-0.398817***	-0.342403**	-0.367389**	-0.519685***
	(0.111920)	(0.144916)	(0.146391)	(0.152635)

Notes: (a) ***, **, and * indicate 1, 5, and 10 per cent significance levels; (b) Bootstrapped standard errors in parentheses.

In Table 6 we show the decomposition for girls. Accordingly, the overall total net effect is about double for girls regardless of earthquake deadliness considered. Importantly, and in contrast to boys, for all grades considered together there is negative direct impact of earthquakes on their promotion, but no indirect role of insurance claims. The earthquake has no direct, indirect or total net impact on the lowest grade (1→2) for girls. For being upgraded from 2nd to 3rd grade, there is, as there is for boys, a negative direct effect and a positive indirect effect through insurance claims. Both of these are again larger for girls, ranging between double and triple the size. These also translate into about twice as large net negative impact of the earthquake on girls compared to boys in terms of moving from the 2nd to the 3rd grade. As for the lowest grade, when moving from the 3rd to the 4th grade, there is only a direct negative impact of the earthquake for girls, and this is also larger than that for boys. The only exception is for the Kanto 1923 event where subsequent claims buffered the direct effect by 63.6 per cent.

The findings that for girls the negative direct impact of an earthquake was larger and that the positive buffering impact of life insurance was mostly insignificant compared with boys, are meaningful in the context of this paper. As stated in Section 2, the effect of secondary education as an investment in human capital was smaller for girls than for boys. This suggests, as would be expected given the context of the time, that spending on girls' education was reduced first when a family lost its breadwinner, and that spending on boys' education was

given priority when the family received insurance benefits.

Table 6: Mediation Analysis Decomposition for Girls

	(1)	(2)	(3)	(4)
	All	**1→2**	**2→3**	**3→4**
PANEL A: Median EQ≠0				
NDE	-0.000210*	-0.000169	-0.000285*	-0.000289**
	(0.000121)	(0.000158)	(0.000151)	(0.000145)
NIE	0.000003	0.000001	0.000006*	0.000001
	(0.000003)	(0.000003)	(0.000003)	(0.000003)
MTE	-0.000239*	-0.000168	-0.000279*	-0.000288**
	(0.000141)	(0.000158)	(0.000151)	(0.000145)
PANEL A: 75th Percentile EQ≠0				
NDE	-0.001043*	-0.000728	-0.001227*	-0.001244**
	(0.000610)	(0.000682)	(0.000652)	(0.000626)
NIE	0.000012	0.000003	0.000026*	0.000006
	(0.000014)	(0.000015)	(0.000015)	(0.000014)
MTE	-0.001031*	-0.000725	-0.001201*	-0.001238**
	(0.000606)	(0.000679)	(0.000649)	(0.000624)
PANEL A: Maximum EQ≠0				
NDE	-1.2705381*	-0.887083	-1.4951725 *	-1.516031**
	(0.741697)	(0.830583)	(0.794441)	(0.763067)
NIE	0.460940	0.309567	0.553448*	0.551603*
	(0.290881)	(0.320644)	(0.313499)	(0.301813)
MTE	-0.809598*	-0.577517	-0.941724*	-0.964429**
	(0.465440)	(0.518049)	(0.499749)	(0.480448)

Notes: (a) ***, **, and * indicate 1, 5, and 10 per cent significance levels; (b) Bootstrapped standard errors in parentheses.

6. Conclusion

Theoretical literature claims that life insurance transfers risk and thereby improves resource allocation, but the channels through which life insurance in this sense would affect the real economy has not yet been explored empirically. In this paper we examine the role of life insurance in buffering the effects of large negative income shocks on the acquisition of human capital by focusing on boys' and girls' middle school grade promotion rates after deadly earthquake disasters in early 20th century Japan. To this end we constructed a prefecture level dataset of grade promotions by gender, life insurance claims, and the deadliness of earthquakes. Our results using mediation analysis indicate that life insurance was consistently able to buffer the negative impact of earthquakes on the promotion of boys to higher grades, where this effect becomes larger the more deadly an earthquake was. In contrast, for girls insurance acts to reduce the fall in middle school promotion only for some grades or only for very large earthquakes. These findings indicate that life insurance indeed helped to promote human capital investment by buffering negative shocks on a family, as predicted by theoretical studies.

References

Andersson, L. F., Eriksson, L., & Lindmark, M. (2010). Life insurance and income growth: the case of Sweden 1830–1950. *Scandinavian Economic History Review*, *58*(3), 203-219.

Amano, I. 1997, *Kyoiku to Kindaika: Nihon no Keiken (Education and Modernization: Experience of Japan)*, Tokyo: Tamagawa Daigaku Shuppan-bu (in Japanese).

Asahi Mutual Life Insurance Co., 1990, *Asahi Seimei Hoken Sogo Gaisha 100-nen-shi (100 Year History of Asahi Mutual Life Insurance Co., Tokyo: Asahi Mutual Life Insurance Co.* (in Japanese).

Awazu, K. 1910. *Hokengaku Koyo (Outline of Insurance Studies)*, Tokyo: Sanshoro (in Japanese).

Barro, R. J., & Friedman, J. W. (1977). On uncertain lifetimes. *Journal of Political Economy*, *85*(4), 843-849.

Bureau of Ordinary Education, the Ministry of Education, 1930a, *Zenkoku Koritsu Shiritsu Chugakko ni kansuru Shochosa (Surveys on Public and Private Middle Schools in Japan)*, (in Japanese).

Bureau of Ordinary Education, the Ministry of Education, 1930b, *Zenkoku Koto Jogakko Jikka Koto Jogakko ni kansuru Shochosa (Surveys on Higher Girl's School and Vocational Higher Girls School in Japan)*, (in Japanese).

Chen, Pei-Fen, Chien-Chiang Lee, and Chi-Feng Lee, 2012, "How does the development of the life insurance market affect economic growth? some international evidence", *Journal of International Development* 24: 865-893

Imaizumi, Asuka, Kaori Ito, and Tetsuji Okazaki, 2016, "Impact of natural disasters on industrial agglomeration: The case of the Great Kanto Earthquake in 1923," *Explorations in Economic History* 60: 52-68.

Innnan, Hirokichi. ed. *Gendai Nihon Sangyo Hattatsu-shi: 27 Hoken* (History of Industries in Modern Japan, 27, Insurance), Gendai Nihon Snagyo Hatten-shi Kenkyu-kai, Tokyo, 1966.

Nippon Mutual Life Insurance Co. 1992, *Nippon Seimei 100-nen-shi (100 Year History of Nippon Mutual Life Insurance Co.)*, Osaka: Nippon Mutual Life Insurance Co. (in Japanese).

Noy, I., Okubo, T., & Strobl, E. (2023). The Japanese textile sector and the influenza pandemic of 1918–1920. *Journal of Regional Science*, *63*(5), 1192-1227.

Lewis, F. D. (1989). Dependents and the demand for life insurance. *The American economic review*, *79*(3), 452-467.

Ministry of Education, 1954, *Gakusei 80-nen-shi (80 Year History of the Education System)*, Tokyo: Printing Bureau of the Ministry of Finance (in Japanese).

Ministry of Education, 1962, *Nihon no Seicho to Kyoiku (Growth of the Japanese Economy and Education)*, Tokyo: Ministry of Education

Ministry of Education, 1972, *Gakusei 100-nen (100 Year History of the Education System), Tokyo: Teikoku Chiho Gyosei Gakkai (in Japanese)*.

Ministry of International Trade and Industry 1980, *Shoko Seisaku-shi (History of Commercial and Industrial Policy)*, vol.7, Tokyo: Shoko Seisaku-shi Kanko-kai (in Japanese).

Hygiene Bureau of the Ministry of Home Affairs,1922, *Ryukosei Kanbo (Influenza)*, Tokyo: Hygiene Bureau of the Ministry of Home Affairs (in Japanese).

Naka, A., T., Uchida, and T. Mori, eds., (1979) *Gakko no Rekishi (History of Schools)*, vol.3, Tokyo: Daiichi Hoki Shuppan (in Japanese).

Okazaki, T. Okubo, T. and Strobl,E. 2019, “Creative destruction of industries: Yokohama City in the Great Kanto Earthquake, 1923, *Journal of Economic History* 79(1): 1-31

Okazaki, T., Okubo, T., & Strobl, E. (2024). The bright and dark sides of a central bank's financial support to local banks after a natural disaster: Evidence from the Great Kanto Earthquake, 1923 Japan. *Journal of Money, Credit and Banking*, *56*(6), 1439-1477.

Okazaki, T., Okubo, T., & Strobl, E. (2025). *Large Fires and the Rise of Fire Insurance in Pre-war Japan* Journal of Economic History, forthcoming.

Okazaki, Tetsuji, and Michiru Sawada, and Kazuki Yokoyama (2005). “Measuring the extent and implications of director interlocking in the pre-war Japanese banking industry” *Journal of Economic History* 65-4, 1082-1115

Okazaki, Tetsuji, and Michiru Sawada.(2007) “Effects of Bank Merger Promotion Policy: Evaluating Bank Law in 1927, Japan”, *Financial History Review* 14-1, 29-61, 2007.

Orofuke, P. and Maku, O. 2023, “Insurance economic growth nexus: Evidence from a small open economy,” *Oeconomica* 19(3): 233-248

Outreveill, J. Francois, 1996, “Life insurance markets in developing countries,” *Journal of Risk and Insurance* 63(2): 263-278

Shindo, Yuko, 2023, “The impact of life insurance on human capital investment during the steady growth period in Japan: Simulation analysis in an overlapping generations model with endogenous growth,” in Shuhei Takahashi, Mitsuyoshi Yanagihara, Kei Hosoya, and Tsuyoshi Shinozaki eds., *Modern Macro Economics with Historical Perspectives*: 71-85, Singapore: Springer

Teikoku Kyoiku-kai 1933, “Fukuoka-ken-ka chuto-taigakusha 2,000-mei” (2,000 students withdrew in Fukuoka Prefecture), *Teikoku Kyoiku (Imperial Education)*, September 15, 1933: 47 (in Japanese).

Usami, R. H. Ishii. T. Imamura, M. Takemura, R. Matsuura. (2013), Nihon Higai Jishin Soran, 599-1012 (“Materials for Comprehensive List of Destructive Earthquakes in Japan, 599-1012”) University of Tokyo Press

Valeri, L. and VanderWeele, T.J., 2013. Mediation analysis allowing for exposure–mediator interactions and causal interpretation: theoretical assumptions and implementation with SAS and SPSS macros. *Psychological methods*, 18(2), p.137.

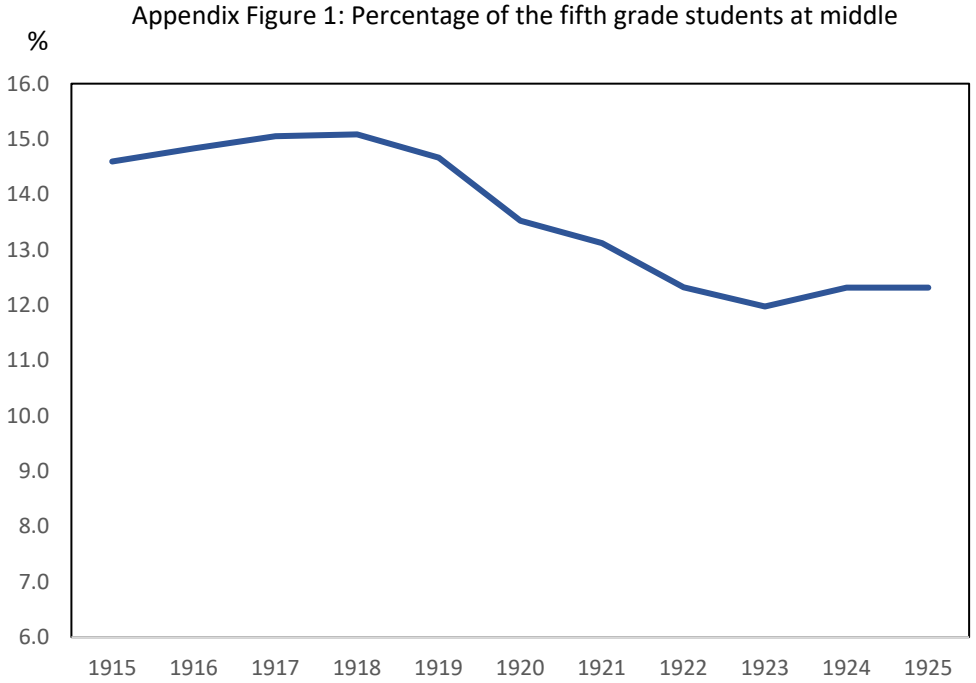
Ward, Damian, and Ralf Zurbuegg, 2000, “Does insurance promote economic growth ?” Evidence from OECD countries,” *Journal of Risk and Insurance* 67(4): 489-506

Yaar, Menahem E., 1965, “Uncertain lifetime, life insurance, and the theory of the consumer,” *Review of Economic Studies*, 32(2): 137-150

Yinusa, Olalekan, and Taiwo Akinlo, 2013, “Insurance development and economic growth in Nigeria, 1986-2010,” *Journal of Economics and International Finance* 5(5): 218-224

Zweifel, Eisen, and Eckles, 2021. *Insurance Economics*, second edition, Berlin: Springer

Appendix Figure 1: Percentage of the fifth grade students at middle



Appendix Figure 2: Percentage of 5th grade stidents at higeher girls schools