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ECONOMIC GROWTH AND FIRES: THE CASE OF JAPAN

Robert EVANS Jr.*

Abstract: Adam Smith's theory of compensating wage differentials implies that out of increased consumption funds generated by economic growth individuals will purchase more safety. However changes in the economy which give rise to economic growth may result in lower levels of safety. Investigation of patterns of fires during 20th century economic growth reveals complex patterns. Only after the oil shock is increased growth associated with increased fire safety. Compared, however, to other advanced countries Japan is a fire safe nation.

In January, 1657, a great fire swept Edo (Tokyo) for two days. The Meireki Fire, also known as the Great Furisode Fire, in combination with a severe blizzard immediately afterward caused the deaths of more than 100,000 people. Whether the cause was, as a fanciful story relates, a fire which leaped out of control due to evil spirts will never be known (Kuroki 1971). Since then Tkyo and Japan have known other great fires, especially those which swept the city following the Great Kanto Earthquake in 1923, but none as lethal as the Meireki fire (Fire Service 1982: 32). More people died in the Earthquake fire, but over a much wider area.

In the years since the Meireki fire the incidence, cause, and location of fires have changed. Fires like occupational and motor vehicle accidents, unlike crimes and pollution which require deliberate action, grow out of everyday activities. Yet fires are unique because, unlike other accidents which occur in the twinkling of an eye and are over, a fire may grow and expand. A single fire in the Kanda section of Tokyo in 1912 destroyed 2,500 buildings (Seidensticker 1983: 262). Fires thus require intervention to limit both human and property damage.

Economic growth, usually praised for its contributions to human welfare, is now recognized as bringing with it certain negative aspects as well. What roles, if any, have the processes of economic growth played? Does growth generate new methods for the prevention and control of fires, or do new modes of living, new patterns of consumption, and mobility lead to an increased incidence of fire and economic losses? Does the answer depend upon whether growth is rapid or stately?

The process of economic growth may result in reduced fire loss even if not

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reduced incidence. These reductions would result from the development of fire-retardent materials and more effective fire-fighting equipment and techniques. The growth in physical assets which can burn, however, may make real losses higher even if the square meters burned are smaller.

Here we examine these questions for Japan for the 88 years, 1900 to 1987. The first section presents the data for Japan. The second discusses the theory. The third relates the fire record to the growth record. The fourth briefly places Japan's experience in an international context. The fifth and final section is a brief summary and conclusion.

I. FIRES IN JAPAN

In 1988 there were 59,653 fires (*Japan Times* Feb. 26, 1989). This was slightly below the average for the preceding ten years. For international and historical comparisons the number of fires should be deflated by some index of burnable objects. No such deflater exists. The square meters burned could not be used, for in 1987 only 62.1 percent of all fires involved buildings. The most appropriate deflater is population which easily allows historical and international comparisons.

The basic pattern of fire incidence in Japan since 1900 is shown in Table I. In

TABLE 1. FIRES AND FIRE LOSS

Year	Fires	Fires per 10,000	Fires Deaths 1,000,000	Real Fire Loss per person*
1900	12,416	3,3	—	—
1905	14,909	3.2	—	—
1910	17,510	3.6	—	—
1915	16,475	3.1	—	7.37
1920	15,123	2.7	5.7	10.72
1925	17,279	3.0	12.7	15.83
1930	17,279	2.7	6.7	15.01
1935	17,069	2.8	5.6	21.78
1940	17,069	2.3	9.5	19.03
1950	19,243	2.3	5.1	2,017.95
1955	29,947	3.4	7.8	1,940.16
1960	43,679	4.7	8.3	1,485.46
1965	54,157	5.5	9.8	1,835.50
1970	63,905	6.2	15.4 (13.2)	2,021.70
1975	62,212	5.6	15.0 (11.6)	1,817.90
1980	59,885	5.1	16.0 (10.6)	1,428.10
1985	59,865	5.0	14.5 (9.0)	1,241.70
1988	59,653	4.6	17.2 (9.5)	—

* This is a three year average centered on the year. The CPI is 1985=100. It is linked to the 1934–36=100 series in 1949–50. ((Excludes suicides by fire.

Source: Japan Statistical Agency, *Historical Statistics of Japan* Vol. V., Tokyo: 1988 pp. 480–481. The 1988 data are from *Shōbō Hakusho 63* (*Fire Service White Paper*) Tokyo: 1988 pp. 284, 286; 309.

the pre-1940 period there were about 3 fires per 10,000 population, with no apparent trend except that fire incidence was less after 1920 than before. In 1952–53 when the Japanese economy had achieved pre-war levels of income and consumption the pre-war level of fire incidence was also reestablished.

After the early 1950's the incidence of fires per capita rose steadily to a peak in 1973 of 6.8 per 10,000 persons. Fire related deaths per million people also rose and have continued to rise. When suicides by fire are removed, however, the 1988 level of 9.5 deaths per million is 28 percent below that of 1970.

The average fire in the postwar years destroyed fewer square meters than those before the war, an average of 74.7 square meters per building fire during the years 1927 to 1936 and 53.5 square meters during 1977 to 1986 (*Shōbō Hakusho 62* (*Fire Service White Paper*) 1987: 278–279; Japan Statistical Agency, Vol. V 1988: 480). This change reflects the greater use of fire-retardent materials and improved fire fighting capacity. In 1955 there were 35 firemen and 2.9 fire engines per 100,000 population. In 1987 these had increased to 106.7 paid firemen and 6.0 fire trucks per 100,000 people. In 1958 there were 22 engines with ladders while in 1987 there were 1,112 (Japan Coordination and Management Agency 1988: 24–25, 743; Japan Statistical Agency Vol. V 1988: 484).

II. THEORETICAL ISSUES

Economists, following Adam Smith, believe that workers accept lower wages in order to work in safer environments. Data from industrial accidents confirm this belief (R. Smith 1979: 346). This means that safety is an ordinary good and individuals can be expected to use some of their higher income achieved through economic growth to purchase more safety, including safety from fires. This expectation that the incidence of and loss from fires should be reduced in periods of economic growth holds with all else being constant. Yet the very process of growth means change. Therefore the process of economic growth may involve new technologies, new modes of living, new patterns of consumption, etc. which may for a time or forever result in higher incidences of fire and loss from fires.

Rapid growth was associated with significant changes in lifestyles, in the nature of the productive process, and in residential location. The first two of these involved vast increases in the use of mechanical, electrical and heat energy. Each use had the potential of becoming uncontrolled, resulting in a fire. During the years of rapid growth energy use per-capita rose from 574,000 kilo calories in 1955 to 3.2 million kilo calories in 1973. The third factor, mobility, could be expected to break down traditional social and community forces stressing and reenforcing fire prevention. Thus, growth in the incidence of fires per-capita would be a result of the increased use of energy and inter-prefectural mobility.

III. THE RELATIONSHIP BETWEEN FIRES AND ECONOMIC GROWTH

The years of rapid postwar growth were also characterized by a steady rise in the incidence of fires and in the real yen loss per-capita from those fires. There is a rank order correlation of .944 and an adjusted moment correlation of .748 between the number of fires per-capita and the GNP per-capita for the years 1955 to 1975. The sources of this relationship are to be found in changed life styles, a rapid increase in the use of energy, and extensive inter-prefectual mobility.

A. Energy and Growth

A variety of life-style changes induced by growth are mirrored in the principal causes of fires, Table II. Ashes and the use of the *kotatsu* as causes have declined while bath furnances and stoves as causes have increased. Some items important before 1950, such as lanterns and candles which caused 6.2 percent of all fires in 1935 (Japan Coordination and Management Agency, 1951: 430) are not even mentioned in recent tabulations. Lighting fires which accounted for between 5.5 percent and 8.5 percent of all fires between 1925 and 1940 now account for only 1 percent. The increasing use and sophistication of electrical products illustrate both the positive and negative aspects of growth as it relates to fires. In 1960 the average availability of electric washing machines, vacuum cleaners, electric fans, and electric refrigerators in Japanese households was 19.4 percent. Thirteen years later in 1973 the average availability was 92.6 percent (Japan Institute of Labour 1974: 160–161). The number and proporation of electrical product fires have

TABLE 2. PRINCIPAL CAUSES OF FIRES 1925–1987 (Percentage)

Year	Arson	Ashes	Bath Furn	Electrical	Kitchen Furnace	Kotatsu*	Stove	Smoking	Hot Plate
1925	5.9	6.7	2.0	1.8	8.9	5.8	—	5.0	1.4
1930	6.9	6.7	2.6	2.8	6.6	5.2	—	5.0	1.4
1935	6.2	7.5	2.6	8.3	6.6	5.7	—	5.1	1.6
1940	3.5	8.9	3.2	3.6	5.9	5.6	1.2	6.0	1.9
1950	3.9	5.7	1.9	5.8	5.8	4.3	1.6	5.0	2.5
1955	2.3	3.5	2.3	9.2	4.4	4.0	2.2	8.1	10.2
1960	2.1	3.1	2.3	7.5	2.9	3.3	2.7	9.9	9.9
1965	2.2	2.3	2.8	6.3	1.6	3.1	5.0	12.8	6.0
1970	3.0	1.3	4.3	7.8	1.0	2.0	4.0	13.8	5.5
1975	3.6	.9	5.2	5.4	.7	1.2	4.0	14.9	6.6
1980	5.6	.8	6.3	6.4	.6	.8	4.5	12.3	8.2
1985	7.8	.9	3.4	6.3	.4	.6	4.4	11.5	9.8
1987	8.5	.8	3.0	6.8	.4	.6	4.3	10.9	—

* Includes electric kotatsu since 1938. Hot plates includes both gas and electric since 1938.

Sources: 1925–1985, Japan Statistical Association, *Historical Statistics of Japan* Vol. V, Tokyo: 1988: 482–483; 1987 *Shōbō Hakusho 63* (Fire Service White Paper) 1988: 290–294.

increased absolutely and proportionately, but these have been dwarfed by the increase in the use of electrical energy. In 1925 these products were the source of 1.8 percent of all fires. The proportion peaked at 9.2 percent in 1955 and in 1987 it was 6.8 percent. Between 1950 and 1986 the number of electrical fires doubled, but electrical energy use increased 14.8 times (Japan Coordination and Management Agency, 1988: 786).

Smoking is a complex issue. The substitution of cigarettes with long burning paper for quick-burning traditional Japanese pipes is one factor. The other is the apparent high income elasticity of cigarettes. In 1960 consumption was 1,868 cigarettes for each Japanese person 15 years of age and older. By 1975, the peak year for tobacco fires, consumption was 83 percent higher, 3,419 per adult. Since 1975 there has been a small decline to 3,265.2 cigarettes and smoking related fires have also declined (Japan Coordination and Management Agency 1988: 38,252).

Arson is both an act against property and an act of violence. During economic downturns business assets decline in value. When the result is insurance values for assets which exceed market values there is a potential for increased arson. This situation has been observed in the United States (Hershbarger and Miller 1978: 286). When economic growth slowed after 1975 more arson fires could have been expected in Japan, and they occured. The proportion of arson induced fires quadrupled to 1987's 8.5 percent. Yet, at least through 1983, Japanese insurance companies reported little evidence of arson being used to defraud them (Kawamura 1980; Ando and Satoh, interview, 1983).

Historically early economic growth was associated with a reduction in the incidence of arson. During early Meiji, the late 1870's and early 1880's, arson was a severe problem. One fourth of all fires were the result of arson. By 1900 arson accounted for only 5 to 7 percent of all fires. The reduction in arson fires followed a marked reduction in the level of violence in Japanese society. Between 1882 and 1890 an annual average of 5,683 individuals were arrested for murder. Between 1900 and 1908 the annual average was less than one thousand (941.4). The other factor in the decline in arson fires was a more efficient police force. In the 1880's 20 persons were arrested for arson for every 100 arson fires. In the fires decade of the 20th century the ratio was 80 out of 100 (Japan Statistical Association Vol. V 1988: 384).

B. Mobility

Japan has had a long experience with frequent and destructive fires, once termed the flowers of Edo. Rutherford Alcock, Great Britain's first minister to Japan wrote. "It is impossible to ride through the streets of Yeddo without noticing one of the most striking and constant features of the city no matter the season of the year, large gaps where charred timber and rubbish mark the scene of a recent fire." (Whaley 1984: xxiv). Partly this reflected the pattern of Japanese housing, tiny wooden dwellings jammed together.

The Tokugawa government did decree death by fire as punishment for arson

and other punishments for accidental fires. And after the Meireki Fire the Tokugawa government did force temples to substitute tile for thatched roofs and to move outside the outer moats of the castle (Seidensticker 1983: 58–66; 262). Wider streets and land for firebreaks also were required and the latter two were tried during the Meiji period. Unfortunately these areas tended to sprout houses with economic growth and development. All of these led to a strong consciousness of fire. As Ronald Dore noted, starting a fire which could bring danger to one's neighbor was felt to bring great shame and the potential for wrath from one's neighbors (1971: 260; 384).

The very high levels of geographical mobility accompanying growth resulted in a lessened sense of community (Fukutake 1982; 131–137) and this in turn may have resulted in a lessened local fire consciousness. Consequently, it is not surprising that Kyoto, now the city with the lowest incidence of fires among major cities, after a doubling of fire incidence between 1950 and 1955, made strenuous efforts to stregthen neighborhood fire consciousness, by establishing fire prevention metings and fire protection associations including a volunteer fire department of 4,550 to supplement a paid department of 1,711 firemen (Iinuma 1982: 2–3). Nationally, too, there have extensive efforts to involve citizens in fire prevention and control. School and factories must have designated and certified fire protection managers and, in larger places of public assembly, a works fire brigade is required. Even statues are pressed into fire protection activities. During fire prevention weeks the 81 foot tall Kannon statue (Goddess of Mercy) at Ofuna, and Hachiko, the famous statue of a faithful dog outside Shibuya Railroad Station in Tokyo wear sashes proclaiming fire protection. Lastly, even within Tokyo, some residential neighborhoods still echo at night, mainly around the New Year period, to the ancient practice of a watchman going around to remind householders to make sure that their fires are out.

The importance of weakened community ties during periods of rapid growth in leading to increased fire incidence seems clear. During the two five year periods 1955 to 1960 and 1965 the national population grew by almost 10 percent, but 26 out of 47 prefectures lost population. Between 1965 and 1970 the six fastest growing prefectures grew at an average rate of 19.5 percent. A decade later their population growth rate had declined 7 percent. Rapid growth during these years induced high levels of prefectural mobility and this in turn induced a weakening in neighborhood fire consciousness. As a result the incidence of fires in the prefectures with rapid in-migration could have been expected to increase.

There are significant positive rank order correlations in the census years 1955, 1960, 1965, and 1970 between the prefectural incidence of fires per 10,000 persons and the prefectural population growth during the preceeding five year period. When rapid growth and mobility became more moderate these relationships ceased to be significant.

The importance of inter-prefectural mobility and increased energy use during the high economic growth can seen in the results of a simple linear regression.

(1) Fires/10,000 = 160.5 + .128E + .679M
(2.51) (8.3) (3.2)

$R^2 = .857$, $DW = 1.744$ and SEE 36.2. The T values are in parenthesis. E was thousands of kilo calories of energy use per person. M was the number of prefectures which lost population with data for five year periods smoothed to yield annual data for the years 1955 to 1973.

IV. INTERNATIONAL COMPARISONS

With 5.2 fires per 10,000 population in 1986 Japan's incidence was 12 percent of the average for seven other advanced industrial nations (Table III). Japan's 11 largest cities had a median fire incidence of 4.4 per 10,000 (*Shōdō Hakusho 63* 1988: 334–335). The median of 15 other world cities was 40.7 while the 10 non-United States cities had a median of 37.5 (Table III). It is only for the number of fire related deaths per one million persons that the Japanese experience begins to be more similar to that of European countries.

Japan's average fire incidence in 1985–1986 of 5.1 per 10,000 population was about 30 percent below its peak of 6.8 in 1973. Fire incidence in the United States,

TABLE 3. INTERNATIONAL INCIDENCE OF FIRE, 1986 AND CITIES 1987

Country/City	Fire per 10,000 population	Fire Deaths per one million people	Per-Fire Loss Millions of ¥
United States	94.0	24.2	498
England	68.4	16.9	291
Australia	30.2	15.3	1,232
Canada	26.5	21.6	1,740
West Germany	24.9	7.6	—
Italy	24.0	3.4	335
Japan	5.2	17.1	3,690
Washington	134.8	15.9	—
Chicago	105.8	35.3	—
San Francisco	83.6	18.7	—
Los Angeles	66.5	14.7	—
Ottawa	63.5	18.8	—
London	58.2	25.6	—
Montreal	40.7	18.6	—
Stockholm	38.0	27.3	—
Melborne	37.9	12.9	—
Hamburg	37.1	5.1	—
Bremin	31.2	15.4	—
Vancouver	29.7	18.6	—
Paris	28.2	13.3	—
Brussels	20.1	4.0	—
Tokyo	6.2	12.2	—

Source: *Shōbō Hakusho 63* (*Fire Service White Paper 1988*) Tokyo, 1988, pp. 93; 334–335.

while absolutely much higher in all three years, also declined about 30 percent, while Australian incidence was cut almost in half. Canadian fire incidence declined modestly. The United Kingdom and Italy both recorded marked increases.

Deaths from fires among these countries moved quite differently. For Japan there was some modest improvement as long as suicides are exluded. The United States cut its rate almost in half while the United Kingdom and Italy which had more fires reported slightly fewer fire related deaths. Australia, which had a marked decline in incidence, witnessed increased deaths by fire. These divergent patterns suggest that the factors controlling fire incidence and deaths from fires are somewhat separate.

V. SUMMARY AND CONCLUSION

The interaction between per-capita growth in income and fires is complex. Between 1900 and 1940 real per-capita consumption grew by 50 percent but there were only slight changes in the incidence of fire. Nor did the distribution of principal causes of fires show much change from 1925 to 1940. After 1955 with rapid growth in per-capita consumption the pattern was for the incidence of fires per-capita to move up with real consumption per-capita. This lasted until the oil shock. Sincethen the rate of economic growth has been slower and the incidence of fires has declined. During rapid growth new products caused an increasing proportion of fires. Then technological improvements and greater familiarity allowed their rate of fire-incidence to decline.

The current situation of a lower incidence of fires than in 1973, a lower fire death rate, less property lost per fire, and more resources devoted to fire fighting are consistent with the idea that fire safety was purchased by the Japanese out of the increased income generated by Japan's economic growth.

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