

The Missing Link—Still Missing

An Economic Analysis of the Relationship between the 1997 Asian Financial Crisis and Japan's 1997-1998 Suicide Boom

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Japan has been relieved to see its overall suicide rate falling steadily since 2009. The 21,897 annual suicide total for 2016 marked a 22-year low. However, Japan's suicide rate is still the sixth highest in the world and the second highest among major industrialized nations. That Japan's 2016 numbers are, in fact, a marked improvement, then, demonstrates how dire Japan's situation has been over the past 22 years.

The suicide epidemic is predominately characterized by the skyrocketing in annual suicides that took place between 1997 and 1998. In 1997, total suicides came to 24,391, a figure that is representative of the early and mid-1990s. In 1998, that figure rose to 32,863 for an unprecedented one-year increase, in peacetime, of 35 percent. Equally shocking, perhaps, is that annual suicides plateaued for a decade in the mid-30,000s before finally beginning to come back down. Japan's suicide problem has brought with it a barrage of negative publicity that is becoming an issue for its "soft power" international relations strategy. Articles are frequently written on "overwork suicide" in Japan and major newspapers and independent journalists alike have taken a "shock value" approach to Japan's suicide problem in hope of drawing readership.

The Asian Financial Crisis of 1997, precipitated by a collapse of the Thai currency (Baht), was a major economic setback for much of Southeast Asia. Hardest hit were the Association of Southeast Asian Nations (ASEAN) economies and South Korea. Though Japan

was able to avoid the brunt of the impact, the fallout had a significant negative impact on the Japanese financial sector. In late 1997, some of the largest Japanese financial firms were forced into bankruptcy. Many others suffered losses and reductions in operational scale. The crisis aftermath saw multiple Japanese banks forced into painful mergers in order to stay alive.

The congruous timing of the financial crisis and the sharp increase in Japanese suicides is striking. It could be hypothesized that the hardships brought on by the financial crisis were a causal factor in the suicide increase. Even so, evidence for such a causal relationship has not been found. The purpose of this paper is to work through one method of uncovering evidence for this relationship, should it exist.

Related Literature

This paper relies on the work of Chen, Choi, Mori, Sawada, and Sugano (2012, 2014) who in their 2012 paper establish that socioeconomic variables and suicide rate varies by gender and age group; economic conditions and suicide rates are negatively correlated across countries; and in Japan, suicide rates and economic conditions have a stronger correlation than is found in other countries. They accomplish this with two main panel studies, one that uses quarterly panel data across 1997-1998 and one that uses annual panel data from 1997-2005 (no control for 1997-1998 shift). The conclusion that suicide rates in Japan having a strong correlation with economic conditions supports the idea that the 1997 financial crisis could have had a causal effect on the suicide increase. They are also able to establish that unemployment and bankruptcy prevalence have significant effects on suicide rates. In 2014, they decompose the 1997-1998 suicide increase, finding that the most dramatic increase in suicides occurred in the 40-59 age group and that 78% of the growth can be attributed to males. In an analysis of the ensuing decade-long

plateau, they find that the high rate was sustained by increasing suicide prevalence among younger generations, age 20-39. The observed redistribution of suicides to the younger generation may be due in part to dwindling job prospects for young people and reclassification of many full-time jobs to part-time positions.

Hamermesh and Soss' 1974 paper, "An Economic Theory of Suicide," continues to serve as the foundation of economic research on suicide. Prior to this paper, suicide was considered an inherently irrational decision, and therefore excluded from the field of economics. Hamermesh and Soss create a basic theory that rationalizes suicide as a spontaneous decision made when expected remaining lifetime utility falls below the costs of keeping oneself alive over the remaining period. As remaining utility decreases with age, and costs of keeping oneself alive increase with age (per unit time), their paper establishes, in economic terms, that age is an important factor in suicide risk. Thus, age will become a variable in regressions later in this paper. This paper is frequently cited in economic studies concerning suicide, but it has also faced substantial criticism including challenges to the theory behind the model. This paper will investigate the effect of aging on suicide rate and will provide empirical results that will either support or contradict the Hamermesh and Soss model.

Chang, Gunnell, Sterne, Lu, and Cheng perhaps come closest to linking the financial crisis with suicide rate changes in Asia. Using joinpoint regression models and time series suicide data at the national level, their 2009 paper is able to establish that the upturn in suicide in Japan followed the onset of financial crisis conditions so immediately that one could conclude that the suicide rate change had been caused by the crisis. However, they are unable to establish causality or conclude a theoretical explanation for their results. This paper will build on this

work by proposing a variable that will map the magnitude of the crisis' effect on each prefecture¹ to see if these cross-section data predict the magnitude of suicide rate increase.

Methods and Data

This study disaggregates Japan into its 47 prefectures and attempts to explain the variation in increases of prefectural suicide rates between 1997 and 1998 with the hypothesis that the 1997 Asian Financial Crisis was a causal factor of the overall increase in suicides. To approximate the extent of the effect on each prefecture, this paper looks at the degree to which the financial sector is integrated into each prefecture. Economic integration will be represented by the proportion of the population employed in the financial services sector, assuming that individuals are employed in the same prefecture in which they live.

This assumption is supported by additional research that focuses on the financial sector, the sector hit most-directly by the 1997 crisis. First, an article published by Japan's leading housing website, Suumo, claims that over 84.6% of singles working in the area near Tokyo Station (the area in which the financial district is located) have less than a 60-minute daily door-to-door commute. Even under perfect commuting conditions, living on the outskirts of Tokyo could reasonably leave a 1hr30mins to 1hr40min commute to the Tokyo Station area. The shortest possible route out of Tokyo would entail a commute of no less than 30 minutes. This supports the argument that those employed in finance in Tokyo live mainly in Tokyo. The assumption is more restrictive for Tokyo than any other Japanese prefecture as it is one of the

¹ The prefecture is the first level of administration division in Japan. Japan's 47 prefectures are divided into four types, *to*, *dō*, *fu*, and *ken*, but the differentiation is largely historical and irrelevant to this study.

three smallest prefectures (similar size as Osaka and Kagawa prefectures) and has the highest cost of living of all prefectures as measured by average rent for any given apartment type.

The strength of the assumption is further substantiated by the finding that the proportion of businesses located in a Tokyo ward² that are classified as engaging in finance or insurance services has a significant ability to predict the per capita taxable income of residents of that ward. *See Table 1.* According to 2014 data, the two quantities are positively correlated in that the highest-earning Tokyo residents generally live in the areas with the highest proportions of financial or insurance service businesses relative to all businesses in the ward. This correlation, combined with the fact that finance and insurance service jobs yield high salaries, suggests that Tokyo residents will pay to be close to their place of work according to their ability to do so. The relevant finding comes from an OLS regression of per capita taxable income on proportion of a ward's businesses in the finance or insurance sector, with controls for median age and population density. Data were retrieved from the Japan Central Statistics Bureau's Economic Census for Business Frame, Economic Census for Business Activity, and Establishment and Enterprise Census as well as the Tokyo Metropolitan Government's annual statistics publication.

Though any number of sectors could have been negatively impacted by the crisis, the financial sector took the most severe and direct hit, as demonstrated by the 1997 failings of several large financial firms and the existential peril faced by Japan's "too big to fail" banks. The 1997 Asian Financial Crisis was characterized by widespread currency failures and the subsequent realization that many countries could no longer afford to continue paying off their ballooning debts. Any Japanese financial institution that had large holdings in any of the collapsing currencies or had been a financier of the region's numerous bankrupted high-leverage

² The "ward" is the main administrative division of Tokyo City.

ventures was unlikely to recoup any of its investment, thus placing its own existence into question. Other sectors were certainly injured by the crisis, however, effects on other sectors are likely to be a result of the financial sector's lending policies that were changed as a result of the crisis. It can be said that injury to non-financial sectors is a sub-effect injury to the financial sector and is likely to temporally lag behind impact to the financial sector. For these reasons, the economic integration of the financial sector into a prefecture should be an adequate proxy for magnitude of impact of the financial crisis.

The study controls for two possible confounding factors that have been identified in related literature. One controlled factor is the change in unemployment rate over 1997-1998 as unemployment is identified in the works of Chen, Choi, Mori, Sawada, and Sugano as having a relationship with suicide rates. The chosen control variable is percentage change in prefecture-level unemployment rate over 1997-1998. The second controlled factor is age, as identified in the Hamermesh and Soss paper. Aging over the 1997-1998 period is represented by the percent change in prefecture-level "ageing index," the ratio of individuals 65 and older to those under 14.

First-differentiation of all quantities over a single year should sufficiently control for most prefecture-level effects. However, one quantity that can affect economic outcomes at the prefecture-level and may vary significantly by prefecture is variation in population density. Japan has recently experienced large-scale population shifts from rural to urban areas, which may be systematically depressing rural economies. Thus, change in population density will also be entered as a control.

All data for this paper are taken from surveys conducted by the government of Japan. The information is made available through the websites of various government agencies³. Prefecture level values for aging index and population were obtained through the Central Statistics Bureau. The data are reported in the 1997 and 1998 “Annual October Current Population Survey⁴” under page title “prefecture level age structure indices, sex-separated⁵.” Unemployment numbers are reported by the same agency under “Labor Force Survey Reference Data⁶” for the post 1997⁷ time period under page title “Complete Prefecture Level Unemployment Rate (Model Inference)⁸.” Data for prefectural level suicide rates was found in a report hosted on the website of Aomori prefecture. The report, entitled “Suicide Death Trends by City, Town, and Village⁹” reports suicide rates for all prefectures in both 1997 and 1998. As all data is collected by high-capacity government agencies, the data is likely to be trustworthy and without significant bias. Regarding suicide statistics, it is important to note that is often difficult to say definitively whether a death should be ruled a suicide, especially in cases where the suicide means could have been an accident such as gas poisoning or drug overdose. However, as there is likely to be misclassification in both directions, this measurement error is unlikely to introduce significant skew to the data.

³ There are both Japanese and English versions of all websites, but the data only seems to be accessible through the Japanese language site maps.

⁴ 各年 10 月 1 日現在人口

⁵ 都道府県, 男女別年齢構成指数－総人口

⁶ 労働力調査参考資料

⁷ All statistics are listed under the Japanese calendar, the years of interest are Heisei 9 and Heisei 10

⁸ 都道府県別完全失業率 (モデル推計値)

⁹ 市町村別自殺死亡の動向

Relevant data were available for every prefecture for both years, 1997 and 1998. No prefectures were excluded as outliers, leaving 47 data points over the cross-section.

Results

An OLS regression was run across a cross section of all 47 Japanese prefectures with percent change in prefecture-level suicide rate 1997-1998 as the dependent variable and proportion of population employed in the financial services sector, percent change in aging index 1997-1998, and percent change in unemployment rate 1997-1998 as explanatory variables. No explanatory variable had a significantly nonzero effect on the dependent variable at a 10% alpha. *See Table 2.* There was also no significant correlation between proportion employed in the financial sector and percent change in the unemployment rate 1997-1998. *See Table 3.*

As no coefficients were found to be significant, and the unemployment effect yielded a sign opposite that predicted, the regression failed to support the working hypothesis that the Asian Financial Crisis caused Japan's spike in suicides in 1997-1998. If this is a power issue, a higher level of power could be obtained by further disaggregating into municipalities, however, the necessary data cannot be collected at this level. Over-disaggregation also increases the chance that an individual's workplace and place of death are in different geographic divisions, thereby introducing greater potential for bias. In any case, power does not seem to be the issue here. With a negative adjusted R^2 value, no P-values under 0.5, and an unexpected negative coefficient on percent change in unemployment rate 1997-1998, this regression likely points to a lack of ability to explain the dependent variable rather than the lack of power to identify correlation.

Discussion

The regression results do not necessarily refute Chang, Gunnell, Sterne, Lu, and Cheng's assertion of a linkage between the 1997 Asian Financial Crisis and the subsequent sharp increase in suicide rates in Japan. The results do, however, contradict the guidance of Hamermesh and Soss and Chen, Choi, Mori, Sawada, and Sugano. Chen, Choi, Mori, Sawada, and Sugano note that suicide rates in Japan are particularly affected by changes in economic conditions, particularly unemployment. One would expect there to be some correlation between rising unemployment and suicide rates evident in the regression results of this study, but no such correlation exists. The findings do not substantiate the findings of Chen et al. but also fail to provide sufficient evidence to challenge the claim as the unemployment factor could have been overwhelmed by some powerful, unseen factor.

The lack of positive correlation between aging and change in suicide rate is counter to the claim of Hamermesh and Soss in "An Economic Theory of Suicide." This finding was initially quite surprising but is perhaps more understandable in light of recent criticism of Hamermesh and Soss' paper. Smith, in a 2018 study of California suicide statistics, reveals an age-suicide distribution that poses a serious challenge to the Hamermesh and Soss model¹⁰. *See Figure 1*. He also identifies a number of theoretical issues that call the "rationality" of suicide into question. It should be noted that "An Economic Theory of Suicide" was published before it became acceptable to assume that actors make decisions under "bounded rationality," but Smith is correct to note that, especially in regards to such an emotionally charged topic, that it is incorrect to assume actors have full access to information or even that they are fully considering

¹⁰ The distribution demonstrates that there is no increase over time for women and that the distribution for men is bimodal (no monotonic increase).

all information available. Those considering suicide have no way of knowing for certain what their incomes or health outcomes will be in the future, thus inviting potential for emotional bias in decision making. The Hamermesh and Soss paper is also potentially flawed in that it groups “the future” without regard to the ordering of future events. Smith gives the example of “a 30-year-old male [] looking forward to 50 years of positive utility followed by 10 years of misery so extreme that the present value of lifetime utility is negative.” It would certainly not make sense for the male to commit suicide at the present moment, but that is exactly what the Mamermesh and Soss model predicts.

The degree to which the results of this study refute the idea that there is a causal link between the 1997 Asian Financial Crisis and the severe rise in Japanese suicides in 1998 rests on the appropriateness of financial sector employment as a proxy variable for the magnitude of the impact of the crisis on a prefecture. If this is indeed appropriate, these results can be considered a strong challenge to the idea that the financial crisis was a causal factor of the suicide rate increase. Further investigation is required to determine the degree of adequacy of the proposed proxy variable.

As an initial investigation measure, percent GDP growth 1997-1998 for each prefecture is regressed on financial sector employment percentage with controls for population density and median age. *See Table 4, see figure 2.* Though there may be confounding factors, the coefficient came in strongly positive with significance at an 0.05 alpha, suggesting that GDP change in the relevant period is associated with the proposed proxy variable. However, the result is surprising as the positive significant coefficient suggests that high financial sector employment actually acts as a buffer to GDP loss in response to the 1997 Asian Financial Crisis. While this finding is

initially counterintuitive, it does provide evidence for the proposed proxy variable being able to represent the relative economic burden of the financial crisis on a prefecture.

To explore this result further, the effect of finance employment proportion on prefectural GDP growth is examined over a longer period of time using data from 1998 to 2014, excluding 2001 due to a missing data point. This increases the level of power and allows one to see if the effect differs significantly in the post-crisis period from the relatively stable period that follows. An OLS regression is run on prefecture-level annual GDP growth (1998-2014) against the proportion of population employed in financial services sector and a dummy variable product that represents a change in behavior of the finance employment proportion during the 1998-1999 crisis recovery period. The regression includes controls for population density and annual GDP growth for all of Japan, allowing the regression to evaluate the relative performance of each prefecture in a given year without being confounded by overall national growth. As one would expect the coefficient for national annual growth comes in strongly positive and significant at any alpha. The coefficient expressing a change in the effect of finance employment proportion in the crisis recovery years also comes in positive and statistically significant at any alpha, reaffirming the previous finding and suggesting that having a higher proportion of people employed in the financial sector actually acted as an economic shock resistor in response to the crisis. Also, higher employment in the finance sector signals, and can help to build, higher levels of wealth in a region. Additional wealth can act as a buffer against external shocks, in this instance guarding against growth loss in crisis conditions.

What this likely means is that the secondary damage to Japan was more impactful than the initial shock to the finance sector. In other words, although there were bankruptcies, finance institutions were mostly able to recover through internal restructuring, mergers, and government

assistance, and the damage was passed on to customers through worsened lender attitudes and increased cost and impediments to obtaining capital. Thus, businesses in areas where there was an abundance of institutions from which to access capital were better off in the post-crisis years than those with more limited capital options. This is reflected in that prefectures with higher finance sector employment proportions suffered less GDP loss in the post-crisis years than did prefectures with lower employment proportions.

Considering the empirical evidence supporting the proposed proxy variable's ability to represent the relative economic impact of the 1997 Asian Financial Crisis on the Japanese prefectures, the study concludes that the proxy variable's inability to explain the variation in suicide rate growth between the prefectures constitutes evidence against the idea that the financial crisis was a causal factor of the remarkable increase in the Japanese suicide rate in 1998. As such, this paper is in some ways contradictory to the findings of Chen, Choi, Mori, Sawada, and Sugano and Chang, Gunnell, Sterne, Lu, and Cheng. Chang et al. use joinpoint models to suggest that the crisis may have been a causal factor of Japan's suicide upsurge due to the temporal relationship of the two events, but they are unable to identify a mechanism. Chen et al. suggest that in Japan, more so than in other countries, the suicide rate is influenced by economic factors. If this is the case, one would expect the 1997 crisis to have a significant effect on the Japanese suicide rate, but this paper finds evidence to refute such an effect.

Further research on the topic may be able to find more nuanced results by disaggregating the suicide data by sex and age group, as Chen et al. do in their later study. Due to a lack of data availability, this paper does not attempt to significantly disaggregate. It is possible that the 1997 crisis had a causal effect on the suicide rate for one or more subgroups of the Japanese

population, but this effect is not strong enough, or the subgroup not large enough, for this to have made any difference in the aggregated data.

APPENDIX

Pctdeltarate = percent increase in suicide rate

Financeprop = proportion of population employed in financial services sector

UmpChange = percent increase in unemployment rate

AgeCngProp = percent increase in aging index

FinanceBusiness = proportion of a ward's businesses in the finance or insurance sector

PopDensity = population density

CrisisEffect = the product of proportion of population employed in financial services sector and a dummy variable displaying one if year is 1998 or 1999 and 0 otherwise

TABLE 1

Regress ward per capita taxable income on proportion of a ward's businesses in the finance or insurance sector, ward median age, and ward population density.

Title	Coefficient	Std. Err.	t	P> t	R ² = 0.6088
FinanceBusiness	.0045142	0.0010745	4.20	0.000	
Population Density	4.21e-9	1.85e-9	2.27	0.035	
Median Age	5.94e-6	6.29e-6	0.94	0.357	
Constant	-0.000352	0.0003033	-1.16	0.261	

TABLE 2

Regress percent increase in suicide rate on proportion of population employed in financial services sector, percent increase in unemployment rate, and percent increase in aging index.

Title	Coefficient	Std. Err.	t	P> t	R ² = 0.0161
Financeprop	0.0025642	0.0045577	0.56	0.577	
UmpChange	-0.13082	0.21502	-0.61	0.546	
AgeCngProp	1.8706	2.4867	0.75	0.456	
Pct Density Change	6.8881	6.0606	1.14	0.262	
Constant	0.19956	0.18526	1.08	0.288	

TABLE 3

Regress percent increase in unemployment rate on proportion of population employed in financial services sector.

Title	Coefficient	Std. Err.	t	P> t	$R^2 = 0.0146$
Financeprop	-0.00246	0.0030123	-0.82	0.418	
Constant	0.25332	0.042852	5.91	0.000	

TABLE 4

Regress percent GDP change (prefecture, 1997-1998) on proportion of population employed in financial services sector, population density, and median age.

Title	Coefficient	Std. Err.	t	P> t	$R^2 = 0.1958$
Financeprop	0.14931	0.073427	2.03	0.048	
PopDensity	-0.0000527	0.0003354	-0.17	0.866	
Median Age	0.18702	0.010269	1.82	0.076	
Constant	-10.578	4.7304	-2.24	0.031	

TABLE 5

Regress percent GDP change (prefecture, 1998-2014) on proportion of population employed in financial services sector, the product of proportion of population employed in financial services sector and a dummy variable displaying one if year is 1998 or 1999 and 0 otherwise, population density, and GDP growth for the whole country.

Title	Coefficient	Std. Err.	t	P> t	$R^2 = 0.3749$
Financeprop	-0.021792	0.025354	-0.86	0.390	
CrisisEffect	0.063062	0.01699	3.71	0.000	
Population Density	-8.01e-6	0.0000941	-0.09	0.932	
Japan Growth	0.8054839	0.038175	21.1	0.000	
Constant	0.51678	0.31516	1.64	0.101	

FIGURE 1

California suicide mortality 1970-2004, whites, separated by sex, averaged for ages 81-85, 86-90, 91-100 (Smith 2018)

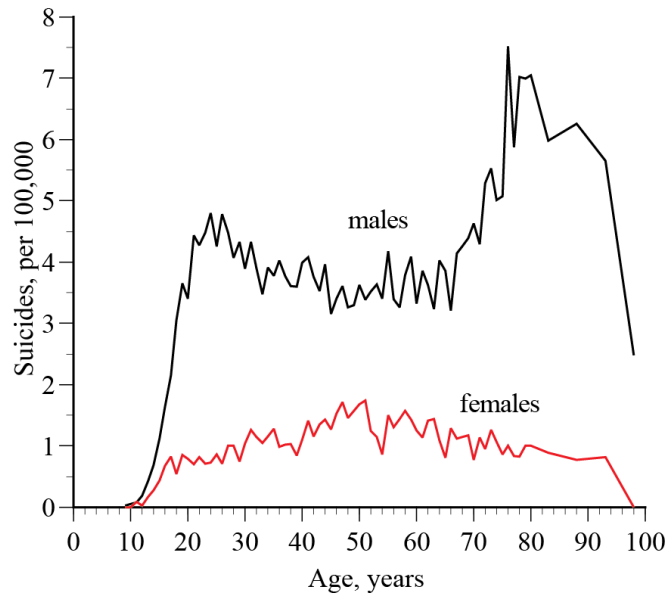
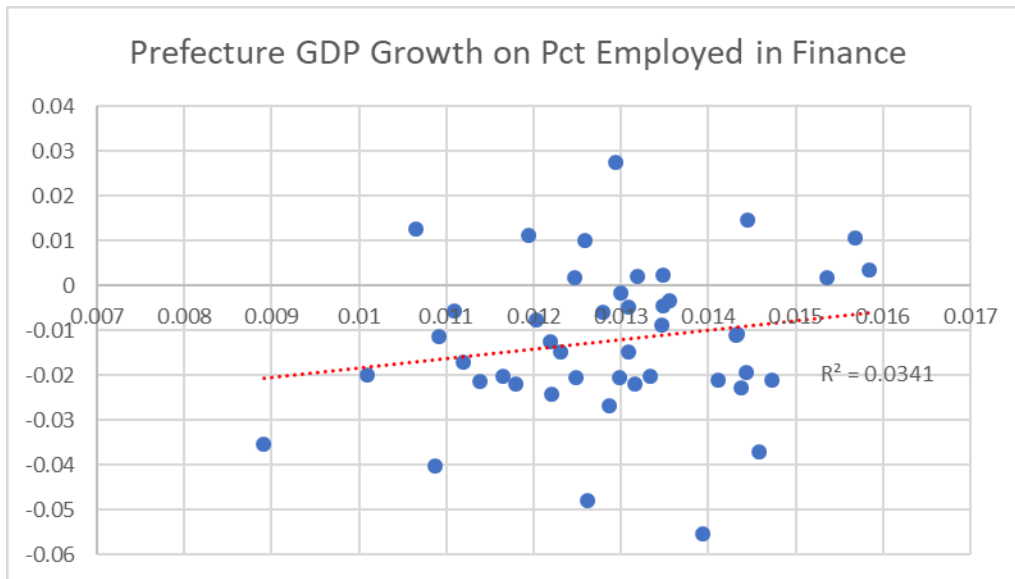


FIGURE 2



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