

## SOCIO-ECONOMIC CORRELATES OF SUICIDALITY IN HONG KONG

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### ABSTRACT

*This study explores the correlates of the suicidality in Hong Kong with its socio-economic predictors. Hong Kong witnessed its economic decline and its improvement in the last decade with 2003 as the turning point. After applying Poisson regression models on the data, it was found that individual payroll and property price indices were closely associated with the monthly suicide counts in Hong Kong, whereas unemployment rate and average rent index were not observed statistically significant. The results reinforce the findings that structural socio-economic conditions generally have a substantial impact on suicidality and that unemployment rates may not always be correlated with suicide. This study recommends taking into account of some alternative macroeconomic variables, namely property price and individual payroll, to predict suicide rates.*

**Keywords:** suicides, suicides in Hong Kong, unemployment studies, Poisson regression models, socio-economics in Hong Kong

### INTRODUCTION

The World Health Organization (WHO) estimated that suicide claimed one million lives every year, which exceeded the number of deaths by homicide and war combined (WHO 2004). Since Emile Durkheim published *Le suicide* (Durkheim 1897), it is postulated that suicide rate would increase during financial crashes and financial booms due to *anomie*, an unlimited and insatiable change in desires associated with the breakdown of the external restraints present during period of economic stability (Lester 2001). Contemporary research on suicide also yields that macroeconomic variables are significantly associated with suicide (e.g., Brainerd 2001; Hung 1996; Yang 1992). The unemployment rate, in particular, has been one

of the most commonly used predictors of the economic well-being of a geographic area and is most often adopted as a socio-economic predictor of suicide rates (e.g., Liu et al. 2006; Yip et al. 2005, 2010). However, recent research has increasingly indicated that the effect of unemployment rate was not always shown to be significantly correlated with suicide as improving employment is neither a sufficient nor a necessary condition for suicide rates to fall (Hintikka et al. 1999). Especially in Hong Kong and Taiwan, suicide rates though tend to respond to unemployment rates have not been shown directly proportional to improvement in unemployment conditions (Chen et al. 2010). A better understanding of how unemployment rate and other macroeconomic factors correlate with suicide rates is thus necessary and will help to improve intervention and prevention efforts, especially in major East/South-east Asian cities.

The aim of the present study is to explore alternative socio-economic factors for explaining suicidality during rapid social and economic changes, with the case of Hong Kong. While previous studies have shown that macroeconomic factors can have a general impact on suicidal behaviours as suicide tends to increase under unfavourable economic conditions (e.g., Chan et al. 2007; Chang et al. 2009; Chen et al. 2010; Kang et al. 2005; Yu et al. 2007), this study includes and examines a suite of overlooked structural socio-economic variables, namely property price, individual payroll and rent, together with unemployment rate for predicting suicide rates. These explanatory variables are suggested by the present study to be potentially effective predictors and yet, to the best knowledge of the author, have been neglected in the existing literature as prior research tended to focus on the socio-economic factors such as income inequality, cost of living, and per capita GDP (e.g., Andrés et al. 2011; Yang et al. 1992) and related socio-demographic factors like socio-economic status (e.g., Kjoller and Helweg-Larsen 2000) that were primarily tested in western societies. In particular, Hong Kong with a land area of only 1 108 square kilometres but a population of over six millions (as in 2002–2006) is certainly one of the most densely populated places in the world. According to the Hong Kong SAR Government, housing expenditures with utilities were account for an average of 34 percent of the average monthly household expenditures (Census and Statistics Department [CSD] 2005). At the same time, more young adults seek to move out of the family once they are financially independent as Hong Kong has become modernised (Yip et al. 2010: 90). Small family size has nowadays become the norm as the average household size dropped from 4 in the 1980s to 3 in 2006 (CSD 2007b). About half of the applicants for the public housing in Hong Kong were single individuals in 2011. Socio-economic factors in relation to housing and

individual well-beings are therefore expected to exercise more influence on the suicide rates in Hong Kong.

In the following, this study demonstrates how above-mentioned macroeconomic variables correlate with suicide rates in the Hong Kong Special Administrative Region (Hong Kong SAR) during the study period of 2002–2006. In the last decade, Hong Kong experienced its critical economic decline and expansion. The Asian financial crisis, which started in late 1997, hit its greatest economic slump in 2003 due to the outbreak of Severe Acute Respiratory Syndrome (SARS) epidemic. The unemployment rate was 7.9 percent in 2003 on average, which was a historically high figure in Hong Kong. There were 25,620 documented orders by the High Court of the Hong Kong SAR for compulsory bankruptcy in 2002. The economy of Hong Kong improved from the second half of 2003 and entered a stage of economic expansion towards 2007 (IMF 2009). During the same period of time, with a total population of over six million, Hong Kong had an increase of suicide rate from 12.6 per 100,000 in 1997 to its peak of 18.6 per 100,000 in 2003, which was well above the world average of 14.8 per 100,000 (WHO 2001). The suicide rate then returned to 14.5 per 100,000 in 2007. Overall the year of 2003 can be considered as a turning point for both the economy as well as the suicide rate in Hong Kong. Dramatic changes in both of them thus provide an opportunity to study the socio-economic correlates of suicidality in one of the most developed financial centres in the world.

## **METHODS**

### **Suicide Data**

The dependent variable of this study is the monthly suicide counts in Hong Kong. The official monthly suicide mortality data of Hong Kong between 2002 and 2006 were available from the Coroner's Court of Hong Kong SAR. This study sourced the data from the annual reports of the Hong Kong Jockey Club Centre for Suicide Research and Prevention (Yip and Law 2008a; 2008b), which was granted the permission of the Coroner's Court to access the suicide death files, where the external cause code ranged from X60 to X84 under the Tenth Revision of the International Classification of Diseases (ICD-10).<sup>\*</sup> Hong Kong has a well-developed reporting system to record all vital life events including births and deaths; and the coverage rate of the data is almost complete and the quality of the data is high (Yip et al. 2005: 157; Yip and Law 2008a: 6, 2008b: 5).

Figure 1 presents the monthly suicide counts and their fluctuations in Hong Kong between 2002 and 2006. Suicides are highly random and relatively rare count events. The suicide counts in Hong Kong were low in general in 2002; and the lowest count of the year was at 59 in June. The suicide counts appeared to increase and reached the peak of the study period in April 2003 at 134. Starting from the second half of 2003, the suicide counts started to drop and met the bottom at 57 in February 2006.

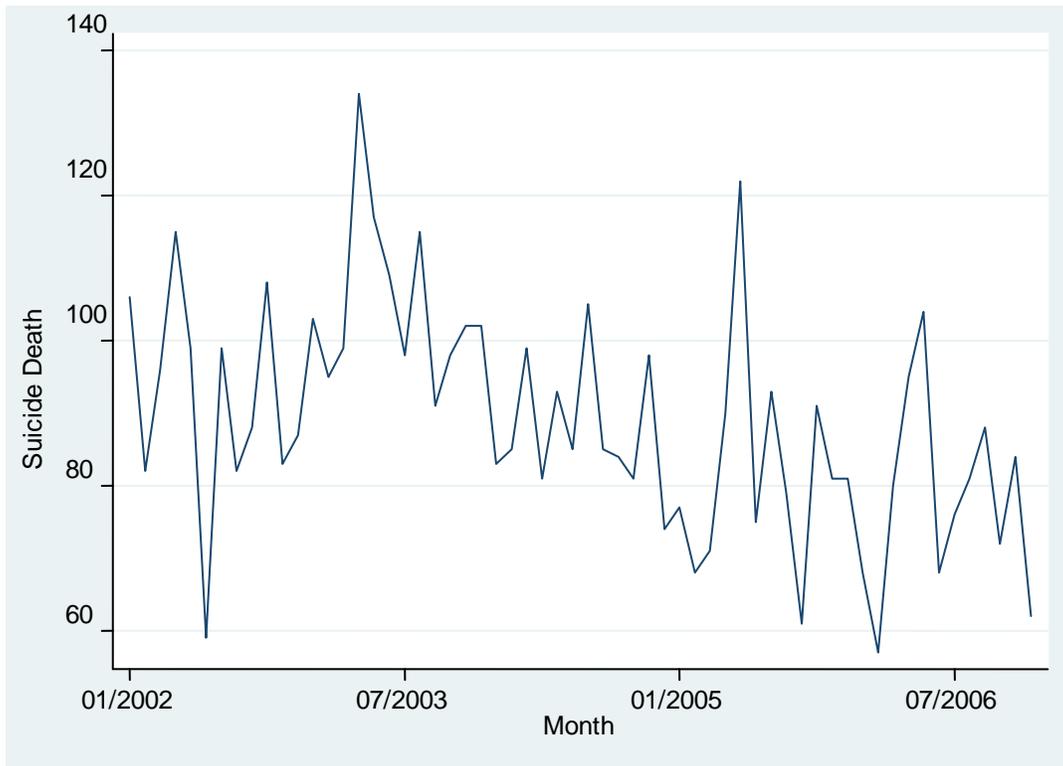


Figure 1: Suicide cases between 2002 and 2006.

### Socio-Economic Predictors

The monthly unemployment rate data for Hong Kong during 2002–2006 were derived from the *Hong Kong Monthly Digest of Statistics* (Census and Statistics Department [CSD] 2002, 2003, 2004, 2005, 2006, 2007a) surveyed and published by the CSD of the Hong Kong SAR Government. Between 2002 and 2006, the unemployment rate increased from 6.7 percent in January 2002 to its historically high figure of 8.7 percent in July 2003. It then gradually decreased to 4.4 percent in December 2006 at the end of the study period.

The individual payroll, property price, and average rent data in Hong Kong were included and controlled in the models as these factors were possible predictors of suicide rates. All of these data for the period of 2002–2006 came from the *Hong Kong Monthly Digest of Statistics* (ibid). The individual payroll data mean the real indices of payroll per person engaged by all industry sectors in Hong Kong, where the index for 1999 was to be 100. Since only quarterly data were available in Hong Kong, each quarterly index was used for and assumed to represent the average individual payrolls for all three months of the same quarter.

As for property price and average rent, the monthly data were available and complete in the government's reports; and therefore no data modifications were required. The property price and average rent data stand for the average prices and average rents of fresh lettings of private domestic premises in Hong Kong. Both variables were expressed in terms of the price/rental indices, where the indices for 1999 were to be 100. Following the general economic trend of Hong Kong, the property price index dropped from 74.1 in January 2002 to its lowest points of 58.4 in the middle of 2003. As for the average rent index, it dropped from 88.3 to 71.3 during the same period of time. Both indices improved from the second half of 2003 and went up to approximately 94 in December 2006 at the end of the study period. Table 1 shows the correlation matrix of the predictors. Collinearity diagnostics were employed to perform multicollinearity analysis on the explanatory variables. Using mean-centering method, no problem with multicollinearity was found as all the condition indices were shown to be low in the analysis (the highest was 6.797) indicating that predictors were not highly intercorrelated.

Table 1: Correlation matrix of predictors.

	<b>Unemployed</b>	<b>House</b>	<b>Payroll</b>	<b>Rent</b>
Unemployed	1.0000			
House	-0.9227	1.0000		
Payroll	-0.2535	0.1833	1.0000	
Rent	-0.8930	0.8191	0.1335	1.0000

### **Control Covariate: Population Growth**

In Poisson regression model, the dependent variable is the number of occurrences in a population during a given period of time and thus involves the issue of exposure. As the total population of Hong Kong grew from 6.7 to 6.9 million

between 2002 and 2006, the event counts of suicide were possibly to be affected across the period of time.

To tackle this problem, this study included and controlled the exposure variable of demographic change in order to capture its possible effect. The data of the total population of Hong Kong were again derived from CSD (*ibid*). However, the data for the total population of Hong Kong were only available on a half-yearly basis accordingly to its population by-censuses. This study therefore had to divide the half-yearly population increase by six and distribute the growth of population evenly to each month assuming that the six months share the same positive demographic change for the given half-year. The formal definitions of all the variables are presented in Table 2.

Table 2: Variable definitions.

Variables	Definitions
Suicide	Suicide count per month
Suicide1	Suicide count per month lagged by 1 month
Unemployed	Percentage of unemployment for each month
Payroll	Modified individual payroll index for each month (100 = 1999) (originally = quarterly)
House	Monthly property price index of private domestic premises on average (100 = 1999)
Rent	Monthly rental index of fresh letting private domestic premises on average (100 = 1999)
Pop	Modified total population for each month (originally = half-yearly)

### Statistical Analysis: Poisson Regression

In this study, the dependent variable of suicide is a count variable that appears to be continuous. Suicide counts are measured by a non-negative integer and are relatively rare. These rare event counts are desirable to be modeled by a Poisson distribution. Compared to other ordinary or generalised least squares regression models, the more sophisticated model of Poisson regression can make use of the integer nature of the data and provide more precise estimates (Liao 1994: 70). Especially the implied mean-variance restriction of Poisson regression model

makes it an efficient technique (Michener and Tighe 1992: 452). In earlier empirical studies, the Poisson regression model has also been used for examining the suicide rate in Hong Kong. For instance, using Poisson regression models, Yip et al. (2010) found that the suicide motives among SARS-related older adult suicide victims were closely associated with stress over fears of being a burden to their families during the epidemic.

## RESULTS

### Regular Model

Results of the models addressing the study hypotheses are presented in Table 3. The two regression models showed statistical significance with  $p < 0.01$ . Model (1) presents the main Poisson regression estimates of this study. Taking into account the effects of all four explanatory variables, property price and individual payroll indices were shown to be statistically significant at the one-percent level and negatively associated with the suicide counts, while unemployment rate and rental index were not found statistically significant.

Table 3: Statistical results.

	Estimate	Standard error	<i>p</i> -value
Model (1)			
Constant	-2.5507	0.8069	< 0.01
Unemployed	-0.0215	0.0409	0.60
House	-0.0079	0.0029	< 0.01
Payroll	-0.0073	0.0024	< 0.01
Rent	-0.0032	0.0045	0.48
Model (2)			
Constant	-2.2107	0.8363	< 0.01
Unemployed	-0.0310	0.0415	0.46
House	-0.0075	0.0029	< 0.01
Payroll	-0.0087	0.0025	< 0.01
Rent	-0.0050	0.0047	0.29

Poisson regression assumes that the marginal effect of  $X_k$  on expected  $y$  is calculated by  $\theta\beta_k$ . Given that the average monthly suicide counts in Hong Kong were 105.3, 77.9, and 89.3 in 2003, 2006, and 2002–2006 respectively (Yip and Law 2008a, 2008b), the point estimates in the result table suggest that property

price index increased by one would have lowered the suicide counts monthly by 0.83 in 2003, 0.61 in 2006, and 0.70 in 2002–2006. Individual payroll index increased by one would have lowered the counts monthly by 0.76 in 2003, 0.56 in 2006, and 0.65 in 2002–2006.

Poisson regression models were generated to examine the generational difference in suicides. Age-groups were defined in the present study as working-age (age15–64) and retired-age populations (age > 65). Property price index was found statistically significant ( $p < 0.01$ ) for the working-age population, while individual payroll and rental indices were shown to be statistically significant ( $p < 0.01$ ) and negatively associated with the suicide counts for the retired-age population. However, unemployment rate remains statistically insignificant when the effects of other explanatory variables were controlled in the statistical models.

### **Time-Lagged Model**

Failure to account properly for the dynamics of time series models may have consequences for event count data (Brant and Williams 2001). Previous research showed that there was no evidence of significant difference in seasonal distribution among the suicide deaths for both males and females in Hong Kong (Chiu 1988; Yip and Yang 2004) and some other country (Barker et al. 1994; Dixon and Shulman 1983; Tsai 2010). This study applied a time-lagged Poisson regression model on the data in order to capture the nature of autoregression in the data. In the time-lagged model, all monthly suicide count data were lagged by one month. The data of all four explanatory variables in February 2002, for instance, were analysed in relation to the data of the dependent variable of suicide in January 2002, and so on and so forth.

Model (2) presents the result of the one-month time-lagged model. Just like in the regular model, unemployment rate and average rental index were not found statistically significant, while property price and individual payroll indices stayed statistically significant ( $p < 0.01$ ). As expected, the point estimates were shown slightly different from those in the previous model. The new point estimates suggest that the property price index increased by one would have lowered the suicide counts per month by 0.79 in 2003, 0.59 in 2006, and 0.67 in 2002–2006 (they were 0.83 in 2003, 0.61 in 2006, and 0.70 in 2002–2006 in the regular model), whereas individual payroll index increased by one would have lowered the counts monthly by 0.92 in 2003, 0.68 in 2006, and 0.78 in 2002–2006 (they were 0.76 in

2003, 0.56 in 2006, and 0.65 in 2002–2006 in the previous model) according to their marginal effects.

## **DISCUSSION**

In this study, the socio-economic correlates of suicidality in Hong Kong between 2002 and 2006 were examined. Overall this study finds an upward trend in suicide rates under adverse economic conditions. More people killed themselves in 2003 (1264 in total) during the economic downturn than in 2002 (1111 in total). The suicide counts decreased from 1264 in 2003 to 935 in 2006 as the economy improved. These figures generally support the conclusions of previous studies, which showed that macroeconomic factors have an impact on suicidal behaviour as suicide tends to increase in unfavourable economic environments, especially in East/South-East Asian cities, such as Hong Kong, Seoul, Singapore and Taipei (e.g., Chan et al. 2007; Chang et al. 2009; Chen et al. 2010; Kang et al. 2005; Yu et al. 2007).

This study found that unemployment rate was not significantly correlated to suicide rates in the statistical models. The results are consistent with prior research which shows that the effect of unemployment rate was not always shown to be significantly correlated with suicide (Hintikka et al. 1999), especially in the context of Hong Kong (Chen et al. 2010). Other studies also suspect the unemployment-suicide relationship at the personal level to be confounded by health selection as poorer health or mental health may lead to suicide as well as unemployment (Agerbo 2003; Preti 2008). Barraclough and Hughes (1987), for instance, conducted case studies of unemployed suicide in England and found that all of them lost their jobs because of alcoholism or mental illness. It is therefore debatable whether unemployment leads to suicide as unemployment and suicide may arise from similar causes. Average rental index was not shown statistically significant either, except for the retired-age population. But this does not exclude the possibility that the change of rent can cause minor fluctuation in mood, but only implies that the resulting mood fluctuation, if any, is not severe enough to lead to suicide.

At the same time, the findings of this study suggest property price and individual payroll to be effective explanatory variables for predicting suicide rates in Hong Kong. Hong Kong is known for having the third most expensive real estate only behind London and Monaco. It has one of the most developed mortgage market in Asia as mortgage loans account for 25–30 percent of its bank loans (Zhu

2006). After the Asian financial crisis in 1997, there was a serious property price collapse. From 1997 to 2003, the residential property prices in Hong Kong fell by 61 percent (Global Property Guide 2008). As property value dropped, the tendency with Hong Kong's property owners was to suffer high mortgage payment as well as property vacant, both of which can translate into heavy financial burden and psychological distress. Especially for the working-age population, the dramatic devaluation of property can lead to the increase in suicide counts, as it can create severe financial difficulties for individuals. Previous studies also found that major change in mortgage or loan was shown to be a significant stressor in suicide attempters (Chan et al. 2011).

As for the individual payroll index, the relationship of it with suicide can be twofold. First, within the framework of lifetime utility maximisation models (Hamermesh and Soss 1974), diminishing income can reduce individual's expected utility making them more likely to commit suicide. The essence of these models is that an individual's utility depends upon their own income and that the individual commits suicide when the present value of their lifetime utility falls to a certain values, presenting an assumption of that an individual commits suicide as a consequence of rational choice (Suzuki 2008). Second, suicide tends to reflect how individuals relate to society and is strongly associated with individual disadvantages like low income (Burrow et al. 2011). Low levels of income may limit an individual's strategies or choices for managing stressful situations, and may lead to life situations less likely to promote marriage, employment and social capital, which account for further social and economic deprivation and influence suicide risk (Denney et al. 2009). Hence, the explanatory variable of individual payroll, which indicates the financial burden, social status and self-esteem of individuals, can become significant in predicting suicide rates. However, as explained earlier, only quarterly data were available for the analysis of this study. Future research projects may examine the effect of individual income on suicide by using more sophisticated data.

## **CONCLUSION**

This study contributes to the existing suicide research by extending our knowledge of the association between macroeconomic factors and suicide. The results of this study reinforce the findings that structural socio-economic conditions have a substantial impact on suicidality and that unemployment rates may not always be correlated with suicide. Moreover, this study suggests that property price and

individual payroll are effective explanatory variables for predicting suicide rates in Hong Kong. It therefore recommends taking into account of alternative macroeconomic variables.

Limitations of this study included the small sample size ( $n = 60$ ), relatively short duration (5 years), lack of gender data, as well as the fact that no individual events were considered. Low values for  $R^2$  ( $R^2 = 0.12$  and  $0.13$  for the regular and time-lagged models respectively) and  $\beta$  for variables suggest that the relationship between suicide and macroeconomic indices is, unsurprisingly, only one of many interacting factors. As economic impact may vary across age strata and between genders, the examined explanatory variables may also exert an influence on the suicide rate by acting at different levels.

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\* ICD-10 was endorsed by the 43rd World Health Assembly in May 1990 and has been widely used by WHO member states since 1994. Based on the assigned external cause code, the external cause and the location of occurrence, every suicide death can be immediately identified from the death investigation file (Yip and Law 2008a: 6, 2008b: 5).