

Mental Health in Turbulent Times

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*Abstract.* Using data from the Hospital Mental Health Database (HMHDB), I test the hypothesis that decreases in stock market indexes are correlated with increases in the hospital admission rate for mental illness in Canada. I follow the empirical approach of Lin, Chen and Liu (2014), who conducted a similar study in Taiwan and found a statistically significant negative relationship between market upswings and the number of hospitalizations for mental illness. Using a Poisson regression to model time series count data on daily hospitalizations between 2006 and 2012, my results display a less robust relationship between the stock market and hospitalizations in Canada. For individuals 60 and over—those found previously to be the most affected by fluctuations in the stock market—my results indicate that the stock market has only a very small effect on their hospitalizations for mental health disorders.

# Introduction

As Canadians, we consider ourselves very lucky to be covered under our national comprehensive health care plan. Most citizens would lament the United States' slow crawl towards universal coverage and researchers point out our similar (and in many cases superior) health care outcomes at a much lower cost as a percentage of GDP (Folland et al. 2009). The overall success of the Canadian health care system has allowed us to enjoy better health outcomes and a high level of health care services.

However, the Canadian health care system faces various challenges, including the treatment and prevention of mental health problems in all age groups. For example, Canada's youth suicide rate is the third highest in the developed world, suggesting that Canada has a long way to go in ~~combating~~[combating](#) depression, anxiety, schizophrenia and other mental health illness (CMHA 2014).

In 2002, the Romanow report stated that mental health remains one of the least integrated aspects of health care. It describes mental health as "one of the orphan children" of Medicare (Romanow 2002 page 178). The Commission consistently heard that it is time to deal with this issue and bring mental health into the mainstream of public health care. The reality is that mental health care has changed and it is now largely a home- and community-based service with only a small number of people needing hospital or institutional care and even then, only for shorter periods of time. This is largely due to innovations in drug therapies. However, the report advises that Canada still needs to vastly improve on its support and monitoring policies (Romanow 2002).

Lately, the World Health Organization (WHO) has taken an increased interest in the relationship between the economy and mental health. In 2014, the WHO released a report detailing policy recommendations in regards to mental health illnesses in light of the recent financial crisis and its impact on mental health in Europe. In their paper, the authors build the case for governments and policymakers to invest in mental health. They stress that there exists a strong interconnectedness between economic activity and mental health and that good mental health is not simply the absence of mental illness—that positive mental health is a resource that supports overall well-being and productivity in the economy. As figure 1 shows, people with high levels of debt are more likely to experience mental health issues. The WHO European authority further asserts that governments should take measures to improve conditions associated with economic and social hardships that impact mental health. “Targeted investment in public services that are crucial for many people’s well-being can ameliorate the social and economic determinants of health and the associated health disparities.” (WHO 2014 page 1).

When an individual suffers from poor mental health, it can have a devastating effect on his or her own quality of life, as well as affecting the people around them. And mental health problems are common in the Canadian population. Almost 7 million Canadians are living with mental health illness, amounting to approximately one in five individuals (Smetanin et al. 2011). If the effects on family and friends are taken into account, mental illness affects almost everyone in Canada.

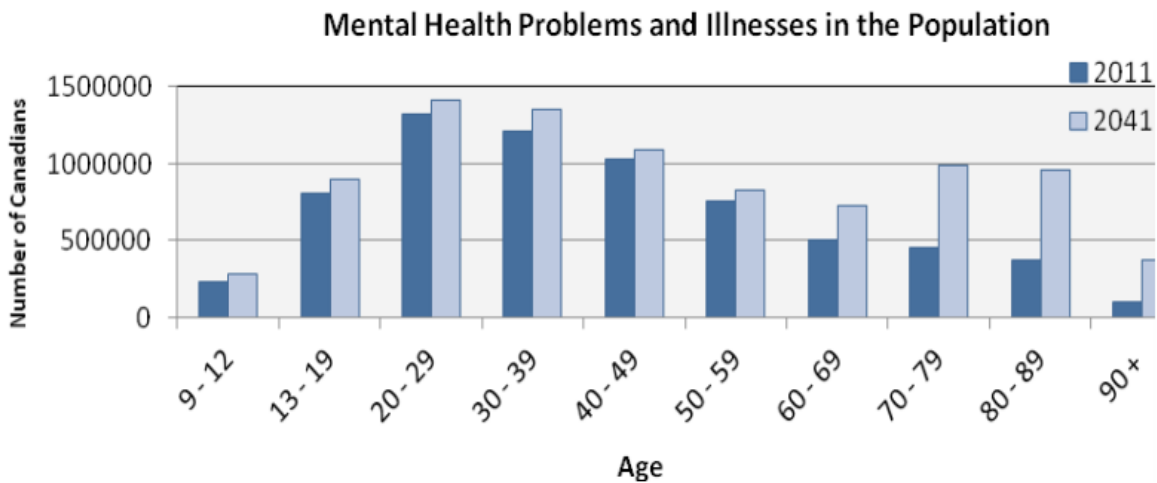
Mental illness also has significant economic costs to society. It is estimated to cost the Canadian government \$50 billion per year.<sup>1</sup> The costs have increased over time and the Mental Health Commission of Canada predicts that they will continue to rise, partly as a consequence of

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<sup>1</sup> Canadian studies have estimated the cost to be between \$48.5B (Smetanin, et al. 2011) and \$51B per year (Lim et al. 2008)

an aging population. Figure 1 shows the distribution of mental illness by age group for 2011 and projected levels for 2041. According to the Public Service Alliance of Canada (PSAC), about half of all disability claims in the public service in 2010 were due to mental health illness, a 20% increase from 1990 (Butler 2011). In particular, as the baby boomer generation heads toward retirement, Canadians need to be concerned with mental illnesses, such as dementia, associated with an older population (Alzheimer Society 2010).

**Figure 1** Mental health problems and illnesses in the population, by age, 2011(actual) and 2041(forecast)



**Source:** Mental Health Commission of Canada (2014 page 3)

While there is certainly a random element to mental illness, the key to mitigating its costs is prevention. Recent research has provided evidence that “promotion, prevention and early intervention targeted at children and families can produce significant net cost benefits.” (Mental Health Commission of Canada 2014 page 3). For example, a Canadian study of the Triple P parenting program found that the Triple P program could reduce the incidence of conduct disorders by 26%, whereas the breakeven cost point on the program was a reduction of only

1.6% (Doran et al. 2011).<sup>2</sup> Another study estimated that by improving a single child's mental health from 'moderate' to 'high' results in a lifetime savings of \$140,000 (Smith and Smith 2010). These findings underline the importance of designing programs and policies that focus on prevention.

Factors that affect mental health have been researched extensively, from substance abuse to relationship status to television watching. I propose to analyze another potential factor: the stock market.

The goal of my research is to link stock market outcomes on the Toronto Stock Exchange to the daily number of Canadians admitted for mental illness across the country using data from the Hospital Mental Health Database (HMHDB) for the years 2006–2012.<sup>3</sup> There is only one comparable study of this type. Provocatively titled, "Do stock prices drive people crazy?" (Lin Chen and Liu 2014 henceforth LCL), the econometric study looked at correlations between the number of hospitalizations per day and stock market outcomes over 4,000 days between 1998 and 2009 in Taiwan. This paper uses the methodology of LCL to link stock market outcomes to Canadian national level hospital admission rates.

There are two key ways that stock market fluctuations could affect mental illness. The most obvious mechanism is by creating stress associated with losing money on the market. A second mechanism pertains to the influence of the media. The media tends to exacerbate the effect of low markets on perceived employment and economic conditions by spreading fear and uncertainty of the future.

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<sup>2</sup> The Triple P stands for Positive Parenting Program and provides parents with information and support to foster better relationships with their children and improve their children's behaviour. It is used in 25 countries and has been proven effective across all regions and demographic groups.

<sup>3</sup> Originally, I requested earlier years as well, but it was the recommendation of Canadian Institute for Health Information (CIHI) to use these years in order to have robust and comparable data.

The stock market is expected to have heterogeneous effects across the population. For example, older individuals should be affected more than younger adults because people with more money invested in the market have more to lose and would be more concerned with falling prices. In general, older individuals close to retirement would be most concerned with consecutive days of falling prices as they are the most likely to have money invested. Further, men should be more affected than women, as they generally have riskier investment profiles and stand to benefit/lose more from market upswings/downturns (Bonte and Jarosch 2011).

There is substantial literature supporting the idea that women are more risk averse and would therefore hold fewer volatile assets. Research has found that single women hold less of their wealth in risky assets compared to men in equal positions (Bernasek and Jianakoplos 1998, Sunden and Surette 1998) and generally have a lower propensity to risk (Bernasek and Shwiff 2001, Borghans et al. 2009, Croson and Gneezy 2009, Arano, Parker et al. 2010). However, other research has concluded that this assumption is not necessarily true in all investment contexts or, at minimum, the label that women are more risk averse has been greatly exaggerated in literature (Nelson 2012). There is also the caveat that males may react less stressfully to a market downswing, counteracting their relatively high risk propensity and, therefore, men may be no more prone to mental illness in downturns. The overall effect on men and women is evaluated as a part of this study.

The researchers in the LCL paper used daily hospitalization rates for mental disorders in Taiwan. The daily hospitalization rate in the LCL paper refers to the number of people currently admitted to a general or psychiatric hospital for mental illness. They found evidence that falling stock markets were correlated with higher hospitalization rates for mental disorders for both genders. In particular, they found that a 1,000 point fall in the TAIEX was correlated with a

4.7% increase in daily hospitalizations for mental illness. A 1% daily drop was correlated with a 0.36% increase in hospitalizations for the same day. Any declines in stock prices over two consecutive days were associated with a 0.32% daily increase in hospitalizations. And when the stock market declined for 5 days in a row there was a 1.6% increase in hospitalizations on the last day. These results were significant and they found that for daily and consecutive drops in prices, there was a greater effect on men's as compared to women's mental health. They also discovered heterogeneous effects by age, with stock market volatility having the greatest effect of older individuals.<sup>4</sup>

Instead of using the total number of patients in hospital on a given day, this paper uses the daily number of admissions as the dependant variable. Following the LCL methodology (described in detail in Empirical Approach), I find no relationship between three measures of stock market performance and national level admissions for mental illness. When hospitalizations are considered for different age groups and genders separately, some significant results emerge. In particular, the index price variable proved not to have a significant effect for most age groups or genders, except for people aged over 60 and females aged 35–60. The model predicts that a 1,000 point increase in the TSE results in 0.8% fewer hospitalizations per day for people over 60 and 0.9% fewer for women over 60. These results, though limited, should still be pertinent to public policy as they may help mental health hospital administrators anticipate fluctuations in the demand for mental health services and assist policymakers to design programs to help Canadians cope with stress in turbulent times.

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<sup>4</sup> For the 25–34 and above 65 age groups, they found a significant impact on the incidences of mental disorder hospitalizations only for the stock price index, and not for the daily change. At the same time, they also found that the stock price index and accumulated change had a significant effect for the 55–64 age group.

# Data Description

Using Google Finance, daily closing data from the Toronto Stock Exchange (TSE) were downloaded. Following the approach of LCL, I incorporate three measures of stock market fluctuations in my analysis: the price of the stock market index, divided by 1,000, the daily percentage change, and the monthly percentage change – all based on closing prices.<sup>5</sup> It is not a perfectly concurrent experiment in that it assumes that afterhours declines in prices are mostly reflected in the next day's opening price and not in the afterhours tracker. It is also assumed that following an afterhours decline, most individuals would be subject to the corresponding negative health shock on the following day as well.

Data on hospitalization rates were accessed from the Canadian Institute for Health Information (CIHI). Data comes from the Hospital Mental Health Database (MHDB). Launched in 1994–1995, the MHDB contains data from across Canada on hospitalizations for mental illness. The database is made available without charge to graduate students upon request through the Graduate Student Data Access Program (GSDAP). The data are gathered from administrative separation records of psychiatric and general hospitals from four different sources:

1. Psychiatric hospitals: selected extracts of the Discharge Abstract Database (DAD) for all provinces and territories, except Quebec.

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<sup>5</sup> In the paper by LCL, they include a variable for the accumulated return of the market. This variable represents the accumulated percentage return of the market after consecutive days of positive or negative daily returns. I was unable to include this variable due to multicollinearity with daily returns, but replaced it with a monthly return variable as another measure of accumulated returns.

2. General and psychiatric hospitals in Quebec: the Hospital Morbidity Database (HMDB). These were not included in this case as access was subject to additional approval.
3. Some psychiatric hospitals: data submitted by a small number of hospitals and ministries of health through the Hospital Mental Health Survey (HMHS), an annual collection of data on separations.
4. Designated adult beds in Ontario: clinical and administrative records through the Ontario Mental Health Reporting System (OMHRS) (CIHI 2014).

For the years 2006–2012, the HMHDB contained data on 887,931 separations from 764 general hospitals and 45 psychiatric hospitals across Canada, excluding Quebec, over 2,204 days.<sup>6</sup> The dataset included the date of admission, the age of the patient, the primary diagnosis category, and gender. I removed observations where the primary diagnosis was either “non-mental health disorders” or “other mental health disorders” from the sample to simplify the interpretation of key coefficients. The number of observations removed amounted to fewer than 0.1% of total hospitalizations. Three separate age groups were created, denoting individuals under 35, between 35 and 60, and over 60. In each regression, every observation represents a day with a corresponding number of hospitalizations from across Canada. Separate regressions were run for only women, only men, and men and women in the three different age groups. A tabulation of total hospitalizations by province/territory is provided in table 1. A large portion of the data comes from Ontario, representing 47.32% of total mental health hospitalizations in Canada.

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<sup>6</sup> In some cases, individuals may have more than one separation. Since this study does not make use of the unique patient identifiers, in these cases each separation is treated as a unique observation.

The financial crisis that began in 2008 provides an opportunity to examine the effects of a rapidly declining stock market on mental health. May 20, 2008, marked the beginning of a period of rapidly falling stock prices. The market had just peaked over 15,000 and was about to collapse. Over the next month, the market began to slide, losing 3% before freefalling 43% over the next nine months to 8,596 on March 30, 2009. An indicator variable, CRASH, was created to identify this period of stock market decline, equalling one if the day is during this period and zero otherwise.

## Econometric Approach

Daily hospitalizations in both Ontario and the rest of Canada exhibit a bimodal distribution as shown in figures A.3.1 and A.3.3. This bimodal distribution is caused by a much lower average number of daily hospitalizations on non-trading days (weekends and holidays).<sup>7</sup> The distribution of hospitalizations is much more normal appearing if only trading days are considered as shown in figure A.3.4, implying that hospitalizations on non-trading days also follow a more normal distribution. As in LCL, this trading day effect is controlled for in the regression with the trading day indicator variable.

Underlying econometric theory suggests that OLS is inappropriate given that the dependant variable is time series count data and given the non-normal distribution of the error

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<sup>7</sup> It is difficult to speculate why there are fewer admissions on the weekends, but it is likely not linked to market trading. It is more likely due to other factors, such as the presence of family support on weekends or the preference of doctors to book appointments on weekdays.

term. For modelling health care utilization, the Poisson and Negative Binomial models are most commonly used in literature.<sup>8</sup>

For the Poisson regression, the dependant variable,  $y_i$ , is assumed to follow a Poisson distribution with mean  $\mu$ , defined as a function of the covariates,  $x_i$ . Therefore, the model is defined by:

$$P(y) = \frac{e^{-\mu} \mu^y}{y!}$$

Where the conditional mean is defined as  $\mu = E(y_i|x_i) = \exp(x_i\beta)$

The Poisson model implies equality of the conditional mean and conditional variance, known as the equidispersion property. In situations of over- and under-dispersion, the estimator will still give consistent estimates, but the resulting standard errors will be larger and biased. We can correct for this by including robust standard errors in the Poisson regression, specifying that the covariance matrix should be estimated using the Hubert-White sandwich estimator (Jones 2007).

The dependant variable is a count variable and the Poisson regression models the log of the expected count, so the estimated coefficients in the Poisson model represent the expected change in the difference in the logs of the expected counts given a one unit change in the explanatory variable while holding other explanatory variables constant. The interpretation can be simplified by taking the anti-log of the estimated regression coefficient, which gives the multiplicative effect of a one unit change in the explanatory variable. For example, if the antilog of the daily percentage change coefficient is 1.15, then there are 115% or 1.15 times more

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<sup>8</sup> For examples, see Mendoza et al. (2003), and Diehr et al. (1999)

hospitalizations given a one percent increase in the daily closing price. Negative values imply a negative trend since the antilog is between 0 and 1.

The Negative Binomial model is another model often used to model time series count data. The Negative Binomial is a mixed Poisson model where the error is assumed to follow a Gamma distribution. The estimation results for the full sample of hospitalizations are shown for the Poisson and Negative Binomial models in table 2. The conditional mean is defined in the same way, so the coefficients can be interpreted in the same way. Included in the list of covariates are the three measures of stock price change, a trading day indicator, a stock market crash indicator, and month and year dummies to control for time trends.

The main difference in empirical approach between this project and that of LCL is that they use the Integer Valued Autoregressive (INAR) model to model hospitalizations as time series count data. The method used in LCL's paper is appropriate because they chose to use the number of hospitalizations as the dependant variable as opposed to the number of admissions. While they also assume a Poisson distribution, they incorporate lags of the dependent variable (the number of lags determined by the Autocorrelation Function (ACF) and the Ljung Box statistic) to account for serial correlation in the dependant variable. There is serial correlation stemming from the fact that if an individual is hospitalized on a given day for mental illness, the individual would subsequently continue to be counted in the number of people hospitalized in the following days until separation. The count on any given day is therefore highly correlated with the previous days' counts. In this paper I do not model daily hospitalizations as following an autoregressive process since that there is no reason to suspect such a serial relationship when using admissions as opposed to total number of hospitalizations. Again borrowing the approach of LCL, I attempted to use lags of the change in the stock price index as the impact on mental

health conditions may be subject to a time lag. Similar to the findings of LCL, I discovered no significant relationship when using lags of the stock price, so they are not included in the regressions.

## Results

Table 3 provides descriptive statistics and characteristics of the sample. The average number of mental illness hospitalizations per day in Canada was 392.51. It is roughly divided evenly between men and women, with men representing 50.13% of the sample. 37.12% of the sample was under 35, 41.13% between 35 and 60, and 21.75% over 60. The average price of the stock market index was \$12,240 and the average daily and monthly returns were 0.0413% and 0.22%. Over the sample period, the stock market rose to a peak of \$15,070 prior to the financial crisis and bottomed out at \$7,560 in its wake.

Figures A.2.1 and A.2.2 plot the stock exchange closing prices against daily mental health hospitalization rates with and without non-trading days. Upon inspection, there is no obvious trend in either case to imply a strong relationship between closing prices and hospitalizations rates. There appears to be an upward trend in hospitalizations and it also appears that the stock market was subject to considerable variance over the sample, in a large part because of the recent financial crisis.

I first compare the appropriateness of using the Poisson and Negative Binomial models. The estimate for the over-dispersion parameter in the Negative Binomial model,  $\alpha$ , is .0087, indicating that there is no problem with over-dispersion that would negatively affect the

preciseness of the Poisson estimates. When using robust standard errors, the estimated coefficients exhibit only small differences between models.

The Hausman specification test comparing the coefficient estimates produced by the Negative Binomial and Poisson regressions did not reject the null hypothesis that the difference in coefficients was not systemic and therefore failed to select one model over the other at the 1% level of significance. In further comparing the models, it was found that the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) were lower on the Negative Binomial regressions. The AIC and BIC are used to assess model fit by penalizing extra estimated parameters. A lower number is better under both criterion, which in this case suggests that the Negative Binomial model may fit the data slightly better.

Although the AIC and BIC were lower for the Negative Binomial model, these results imply that there is not much difference between using the Poisson and Negative Binomial models. Since the dependant variable is not over dispersed and does not contain an excessive number of zeroes, and given that there is not much difference in how the models fit the data, I follow the approach of LCL in assuming a Poisson distribution of daily hospitalizations. They also argue that this approach is appropriate because the data-generating process creating hospitalization counts cannot possibly follow a normal distribution.

The main results of the Poisson regressions are presented in tables 4–6. Columns 1–3 present estimated coefficients of the effect of stock market volatility on daily hospital admissions using the three measures of variation. Table 4 shows the stock market effect for men and women together as well as for men and women separately. I find no significant effects for the closing price variable, SCLOSE, for any of the three groups. This indicates that there is no relationship between the price of the index and the number of daily hospitalizations. The daily percentage

return variable, DAILY, is also shown to be insignificant for the three groups. The monthly percentage return variable, MONTHLY, is positive and significant at the 5% level. Taking the antilog implies that there are 1.001 or 0.1% times more hospitalizations given a 1% monthly increase in the stock market. TRADINGDAY, an indicator for not being a weekend or holiday, is positive and highly significant, which is to be expected given the different distribution of hospitalizations on non-trading days (figure A.3.1 and A.3.4). Again taking the antilog of the regression coefficients, it shows that on trading days there are 75% more hospitalizations per day for women, 64% for men, and 69% for the entire sample relative to non-trading days.

Using January as the base month, dummy variables show the seasonal trend for mental health hospitalizations. One of the most notable effects is the marked decrease in hospitalizations in winter months. This relationship holds across all age groups and genders and is consistent with what was found by LCL as well as other previous researchers. As noted in LCL, summer has been consistently recognized as the peak season for mental illness across various populations (Hare and Walter 1978, Takei and Murray 1993, Clarke et al. 1999, Shiloh et al. 2005). Significant at the 5% level, there are 2.5% fewer hospitalizations per day for men and 2.3% fewer hospitalizations per day for the full sample in February relative to January. The February effect for women is not significant. March and December have significant effects for all three groups. In March, the effect is close to 10% fewer hospitalizations for all three groups relative to January, but in December the effect is more variable. In December, there are 4.4% fewer hospitalizations per day for men, about 10% fewer for women, and about 7.4% fewer overall relative to January. The annual trend dummy variable was significant in almost all regressions as well, as hospitalizations have naturally trended slightly upwards since 2006. This could be due to population growth as well as an increasing dispersion of information related to mental health

treatment options in Canada. Using 2006 as the base year, table 4 also displays the annual trend. Hospitalizations increased for all age groups every year except for 2012, where only part of the year was included in the data. The variable CRASH, indicating that the day is during the market crash, is not significant for any of the three groups.

Table 5 shows regression results stratified by age groups. SCLOSE has a negative and significant effect on daily hospitalizations only for individuals over 60, reducing daily hospitalizations by 0.8% for a 1,000 point increase in the closing price of the Toronto Stock Exchange. For the two younger age groups, SCLOSE is not significant. The daily percentage change in the closing price is significant for individuals under 35 and reduces the number of daily hospitalizations by 0.4% for a one percent daily increase, but is not significant for the other two groups. The effect of a one percentage increase in the monthly return is significant for all three age groups and indicates a near zero effect. The trading day variable is significant for all three groups and tends to increase the number of hospitalizations by 67% for individuals under 35, 69% for individuals between 35 and 60, and 71% for individuals over 60 relative to non-trading days.

Monthly trend effects are similar to those found in the full sample regression, with March reducing the number of daily hospitalizations by 7.5% for those under 35, 10.3% for those between 35 and 60, and 13.6% for those over 60. February also reduces the number of hospitalizations by 2.5% for those between 35 and 60, and by 5% for those over 60, but is not significant for those under 35. The coefficient for the December variable is negative and significant for the lower age groups, but not significant for those over 60. Once again, a significant annual trend indicator was found to increase the number of daily hospitalizations for each year except 2012, but was not significant in 2007 for the two older age groups. The stock

market crash indicator was found to be significant at the 5% level for those under 35 and indicates that the crash increased daily hospitalizations by 2.3%.

When the regressions are stratified by both age and gender, as in table 6, the results exhibit further heterogeneity. For women aged over 60, a 1,000 point increase in the closing price results in 1% fewer hospitalizations per day. For women under 35, a one percent increase in the daily return results in 0.5% fewer hospitalizations per day. The SCLOSE and DAILY variables are not significant for the other age groups and are not significant for men in any age group. The trading day variable is again highly significant and increases the number of daily hospitalizations by around 64% for all age groups.

## Conclusion

Tackling rising mental health illness is fast becoming a focus of the Canadian health care system. Canadian population dynamics are changing as the baby-boomer generation ages and the incidence of mental health illness is projected to increase. Understanding the factors that lead to mental health disorders is crucial to developing effective preventative strategies. In this paper, stock market turbulence was analyzed as a potential factor affecting the mental well-being of Canadians.

Using a Poisson model, I evaluated the response of daily hospitalizations for mental disorders to three different measures of stock market volatility in Canada. With Toronto Stock Exchange closing prices and data from the HMHDB, I regressed the daily number of hospitalizations on the change of the price of the stock index, the daily percentage return, and the monthly percentage return, controlling for annual and seasonal effects. I also evaluated whether

the stock market crash affected mental health by including an indicator for the period in regressions. I followed the approach of Lin, Chen, and Liu (2014), who conducted a similar empirical study in Taiwan.

LCL found a robust negative relationship between an increase in the price of the stock index and mental health hospitalizations for all genders and age groups in Taiwan, but the same relationship was not found in Canada. For the full sample and men and women separately, the estimated effects of stock market performance were not significant, suggesting the stock market does not seem to have a noticeable effect on hospitalizations for mental health disorders in Canada.

More significant results were found when the sample was split into different age groups. The results demonstrate that declines in the stock market tend to increase the number of daily hospitalizations slightly for individuals over 60, but do not have much of an effect on younger individuals. And even for individuals older than 60, the effect of stock market turbulence is predicted to be almost zero.

While the effects of the index price and the daily and monthly returns are insignificant in most regressions, there is evidence of significant month and year effects. Consistent with previous literature, spring and summer months are shown to be the peak seasons for mental health disorders.

Stock market turbulence does not seem to have a very significant effect on the mental health of Canadians. Younger individuals with less money invested in the market are shown to be unaffected and even for those over 60, the effect is negligible. While Canadians certainly care

about their wealth, fluctuations in the stock market do not seem to cause enough stress to drastically impact their mental health.

However, this paper's research question could prompt further investigation. Data quality could be improved in several ways. While the LCL paper analyzed data on the number of individuals hospitalized, this paper regarded total daily admissions. Using data on the number of hospitalizations in Canada could produce very different results that might be more comparable to those of LCL. It would also be preferable to have data on the impact of stock market fluctuations on the wealth of different demographic groups, perhaps with data indicating how much each group invests in stocks, or the relationship between stock market returns and income for each group. Ignoring non-trading days or analyzing them separately would eliminate the bimodal distribution of hospital admissions and allow analysis under the assumption of a normal distribution.

Taiwan and Canada are also very different countries with heterogeneous demographics. There is some reason to believe that individuals in the two nations have different propensities to report mental issues. The decision to seek professional mental health services could be based on factors such as the level of stigma surrounding mental health hospitalization in each country. In Canada, there is a growing movement to eliminating the stigma surrounding mental health. Such a movement may not be present in Taiwan. Other cultural and social norms, as well as differing attitudes towards saving and risk, can cause potentially significant differences in how income and wealth are connected to the stock market and how individuals respond to a loss of wealth. And differences in government services, such as better funded and more accessible social support programs, can help offset the stress caused by fluctuations in wealth. While it is difficult to control for such social aspects, they may help to explain the differences in how stock market

turbulence affects the mental health of people in Canada compared with their counterparts in Taiwan.

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**Table 1:** Frequency of hospitalizations by province

<b>PROV</b>	<b>FREQ.</b>	<b>PERCENT</b>	<b>CUM.</b>
<b>NEWFOUNDLAND AND LABRADOR</b>	19,132	2.15	2.15
<b>PRINCE EDWARD ISLAND</b>	9,583	1.08	3.23
<b>NOVA SCOTIA</b>	25,696	2.89	6.13
<b>NEW BRUNSWICK</b>	33,205	3.74	9.87
<b>ONTARIO</b>	420,210	47.32	57.19
<b>MANITOBA</b>	43,087	4.85	62.04
<b>SASKATCHEWAN</b>	38,453	4.33	66.38
<b>ALBERTA</b>	123,583	13.92	80.29
<b>BRITISH COLUMBIA</b>	169,503	19.09	99.38
<b>YUKON TERRITORY</b>	1,412	0.16	99.54
<b>NORTHWEST TERRITORIES</b>	3,253	0.37	99.91
<b>NUNAVUT</b>	814	0.09	100.00
<b>TOTAL</b>	887,931	100.00	

Source: Author's calculations from hospital data using Stata

**Table 2:** Estimated coefficients for relationship between stock market volatility and mental disorder hospitalizations from Poisson and Negative Binomial regressions for full sample

	<b>POISSON</b>	<b>NEGATIVE BINOMIAL</b>
<b>SCLOSE</b>	-0.004 (1.44)	-0.003 (1.29)
<b>DAILY</b>	-0.002 (1.41)	-0.002 (1.60)
<b>MONTHLY</b>	0.001 (2.54)*	0.001 (2.60)**
<b>TRADINGDAY</b>	0.528 (111.68)**	0.528 (109.93)**
<b>JANUARY</b>	-	-
<b>FEBRUARY</b>	-0.023 (2.30)*	-0.022 (2.19)*
<b>MARCH</b>	-0.105 (6.95)**	-0.106 (6.72)**
<b>APRIL</b>	0.005 (0.42)	0.006 (0.51)
<b>MAY</b>	0.017 (1.79)	0.016 (1.64)
<b>JUNE</b>	0.017 (1.73)	0.017 (1.68)
<b>JULY</b>	-0.007 (0.67)	-0.004 (0.39)
<b>AUGUST</b>	-0.011 (1.13)	-0.007 (0.70)
<b>SEPTEMBER</b>	0.002 (0.20)	0.002 (0.24)
<b>OCTOBER</b>	-0.009 (0.95)	-0.010 (1.00)
<b>NOVEMBER</b>	-0.013 (1.27)	-0.013 (1.28)
<b>DECEMBER</b>	-0.074 (5.95)**	-0.072 (5.63)**
<b>2006</b>	-	-
<b>2007</b>	0.030 (3.09)**	0.032 (3.20)**
<b>2008</b>	0.065 (6.06)**	0.068 (6.10)**
<b>2009</b>	0.070 (6.92)**	0.075 (7.30)**
<b>2010</b>	0.097 (11.20)**	0.104 (11.55)**
<b>2011</b>	0.166 (18.53)**	0.174 (18.55)**

<b>2012</b>	0.047 (1.82)	0.054 (2.01)*
<b>CRASH</b>	0.011 (1.45)	0.013 (1.74)
<b>_CONS</b>	5.566 (177.19)**	5.556 (173.71)**
<b>N</b>	2,204	2,204
<b>_alpha</b>		0.0087
<b>AIC</b>	26350.45	22755.12
<b>BIC</b>	26481.51	22891.87

Notes: \* indicates significance at the 5% level \*\* indicates significance at the 1% level. Models are estimated using a Poisson regression with robust standard errors. t-statistics in parentheses.

#### Hausman Specification Test

Test:	Ho: Difference in coefficients not systematic
	$\chi^2(22) = (b-B)'[(V_b-V_B)^{-1}](b-B)$
	= 2.08
	Prob>chi2 = 1.0000

**Table 3:** Sample characteristics and descriptive statistics for hospitalizations and explanatory variables of interest

<b>HOSPITALIZATIONS</b>	<b>MEAN</b>	<b>SD</b>	<b>MAX</b>	<b>MIN</b>
<b>ALL</b>	392.51	96.55	590	24
<b>MALE</b>	196.76	47.63	303	11
<b>FEMALE</b>	195.82	51.24	312	13
<b>UNDER 35</b>	141.78	37.18	229	11
<b>35-60</b>	161.382	40.83	243	12
<b>OVER 60</b>	85.40	23.23	143	1
<b>EXPLANATORY VARIABLES</b>	<b>MEAN</b>	<b>SD</b>	<b>MAX</b>	<b>MIN</b>
<b>SCLOSE</b>	12.24	1.52	15.07	7.56
<b>DAILY</b>	0.0413	1.34	9.82	-9.32
<b>MONTHLY</b>	0.22	5.18	19.80	-26.18

Source: Author's calculations from stock market and hospital data using Stata

**Table 4:** Estimated coefficients for relationship between stock market volatility and mental disorder hospitalizations for full sample and stratified by gender using Poisson regression

	ALL	MEN	WOMEN
<b>SCLOSE</b>	-0.004 (1.44)	-0.002 (0.62)	-0.006 (1.88)
<b>DAILY</b>	-0.002 (1.41)	-0.002 (1.00)	-0.002 (1.35)
<b>MONTHLY</b>	0.001 (2.54)*	0.001 (2.28)*	0.001 (2.16)*
<b>TRADINGDAY</b>	0.528 (111.68)**	0.495 (90.22)**	0.561 (103.88)**
<b>JANUARY</b>	-	-	-
<b>FEBRUARY</b>	-0.023 (2.30)*	-0.025 (2.14)*	-0.021 (1.88)
<b>MARCH</b>	-0.105 (6.95)**	-0.109 (6.72)**	-0.102 (6.39)**
<b>APRIL</b>	0.005 (0.42)	-0.005 (0.41)	0.015 (1.18)
<b>MAY</b>	0.017 (1.79)	0.011 (0.96)	0.024 (2.23)*
<b>JUNE</b>	0.017 (1.73)	0.014 (1.23)	0.019 (1.81)
<b>JULY</b>	-0.007 (0.67)	0.010 (0.87)	-0.023 (2.11)*
<b>AUGUST</b>	-0.011 (1.13)	0.009 (0.81)	-0.031 (2.87)**
<b>SEPTEMBER</b>	0.002 (0.20)	0.015 (1.30)	-0.011 (0.99)
<b>OCTOBER</b>	-0.009 (0.95)	-0.005 (0.42)	-0.014 (1.26)
<b>NOVEMBER</b>	-0.013 (1.27)	-0.014 (1.17)	-0.012 (1.05)
<b>DECEMBER</b>	-0.074 (5.95)**	-0.044 (3.44)**	-0.106 (7.28)**
<b>2006</b>	-	-	-
<b>2007</b>	0.030 (3.09)**	0.032 (2.93)**	0.027 (2.57)*
<b>2008</b>	0.065 (6.06)**	0.071 (5.73)**	0.060 (5.11)**
<b>2009</b>	0.070 (6.92)**	0.087 (7.71)**	0.052 (4.72)**
<b>2010</b>	0.097 (11.20)**	0.120 (12.12)**	0.075 (7.95)**
<b>2011</b>	0.166 (18.53)**	0.182 (17.66)**	0.151 (15.46)**
<b>2012</b>	0.047	0.053	0.042

	(1.82)	(2.04)*	(1.53)
<b>CRASH</b>	0.011	0.013	0.009
	(1.45)	(1.43)	(1.03)
<b>_CONS</b>	5.566	4.861	4.884
	(177.19)**	(142.61)**	(134.13)**
<i>N</i>	2,204	2,204	2,204

Notes: \* indicates significance at the 5% level \*\* indicates significance at the 1% level. Models are estimated using a Poisson regression with robust standard errors. t-statistics in parentheses.

**Table 5:** Estimated coefficients for relationship between stock market volatility and mental disorder hospitalizations stratified by age using Poisson regression

	<b>UNDER 35</b>	<b>35-60</b>	<b>ABOVE 60</b>
<b>SCLOSE</b>	-0.002 (0.74)	0.000 (0.06)	-0.008 (2.64)**
<b>DAILY</b>	-0.004 (2.13)*	-0.002 (0.97)	0.002 (0.98)
<b>MONTHLY</b>	0.001 (1.94)	0.001 (1.89)	0.001 (2.09)*
<b>TRADINGDAY</b>	0.517 (82.45)**	0.530 (91.90)**	0.538 (76.69)**
<b>JANUARY</b>	-	-	-
<b>FEBRUARY</b>	-0.003 (0.26)	-0.025 (2.14)*	-0.051 (3.55)**
<b>MARCH</b>	-0.078 (4.48)**	-0.108 (6.74)**	-0.146 (8.14)**
<b>APRIL</b>	0.017 (1.17)	0.004 (0.32)	-0.010 (0.64)
<b>MAY</b>	0.015 (1.16)	0.018 (1.54)	0.017 (1.24)
<b>JUNE</b>	0.002 (0.16)	0.016 (1.31)	0.038 (2.85)**
<b>JULY</b>	-0.057 (4.36)**	0.007 (0.62)	0.038 (2.74)**
<b>AUGUST</b>	-0.067 (5.20)**	0.013 (1.06)	0.026 (1.91)
<b>SEPTEMBER</b>	-0.020 (1.60)	0.011 (0.95)	0.016 (1.19)
<b>OCTOBER</b>	-0.010 (0.72)	-0.022 (1.92)	0.008 (0.57)
<b>NOVEMBER</b>	0.025 (1.83)	-0.044 (3.66)**	-0.023 (1.71)
<b>DECEMBER</b>	-0.095 (5.64)**	-0.088 (6.38)**	-0.020 (1.35)
<b>2006</b>	-	-	-
<b>2007</b>	0.049 (3.80)**	0.015 (1.32)	0.015 (1.28)
<b>2008</b>	0.091 (6.30)**	0.042 (3.42)**	0.051 (3.75)**
<b>2009</b>	0.097 (7.32)**	0.059 (5.29)**	0.053 (4.30)**
<b>2010</b>	0.148 (12.85)**	0.053 (5.17)**	0.094 (8.90)**
<b>2011</b>	0.224	0.075	0.226

	(18.75)**	(7.15)**	(20.98)**
<b>2012.YEAR</b>	0.186	-0.051	-0.021
	(6.95)**	(1.90)	(0.65)
<b>CRASH</b>	0.023	0.026	-0.008
	(2.06)*	(2.31)*	(0.71)
<b>_CONS</b>	4.509	4.666	4.082
	(107.03)**	(141.40)**	(104.53)**
<b>N</b>	2,204	2,204	2,204

Notes: \* indicates significance at the 5% level \*\* indicates significance at the 1% level. Models are estimated using a Poisson regression with robust standard errors. t-statistics in parentheses.

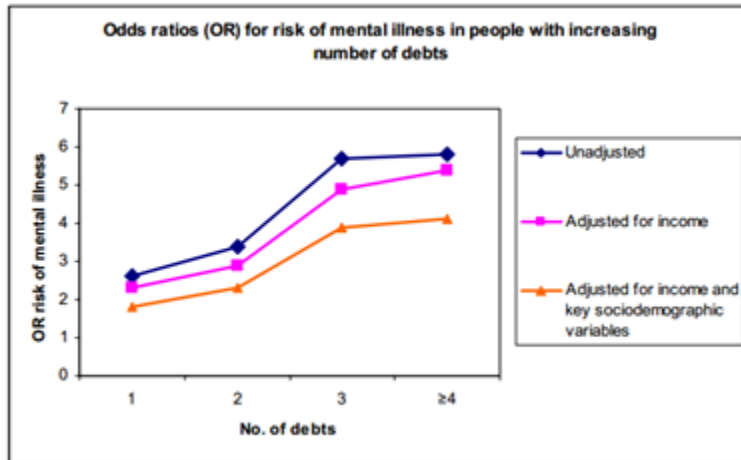
**Table 6:** Estimated coefficients for relationship between stock market volatility and mental disorder hospitalizations stratified by age and gender using Poisson regression

<b>WOMEN</b>	<b>UNDER 35</b>	<b>35-60</b>	<b>OVER 60</b>
<b>SCLOSE</b>	-0.005 (1.16)	-0.003 (0.90)	-0.009 (2.34)*
<b>DAILY</b>	-0.005 (2.24)*	-0.002 (0.97)	0.001 (0.60)
<b>MONTHLY</b>	0.001 (0.95)	0.001 (1.82)	0.002 (2.11)*
<b>TRADINGDAY</b>	0.536 (66.71)**	0.576 (79.17)**	0.568 (66.18)**
<b>MEN</b>	<b>UNDER 35</b>	<b>35-60</b>	<b>OVER 60</b>
<b>SCLOSE</b>	-0.000 (0.10)	-0.000 (0.13)	-0.007 (1.74)
<b>DAILY</b>	-0.003 (1.33)	-0.002 (1.19)	0.003 (0.95)
<b>MONTHLY</b>	0.002 (2.28)*	0.001 (1.36)	0.001 (1.03)
<b>TRADINGDAY</b>	0.501 (68.39)**	0.486 (67.90)**	0.499 (53.67)**

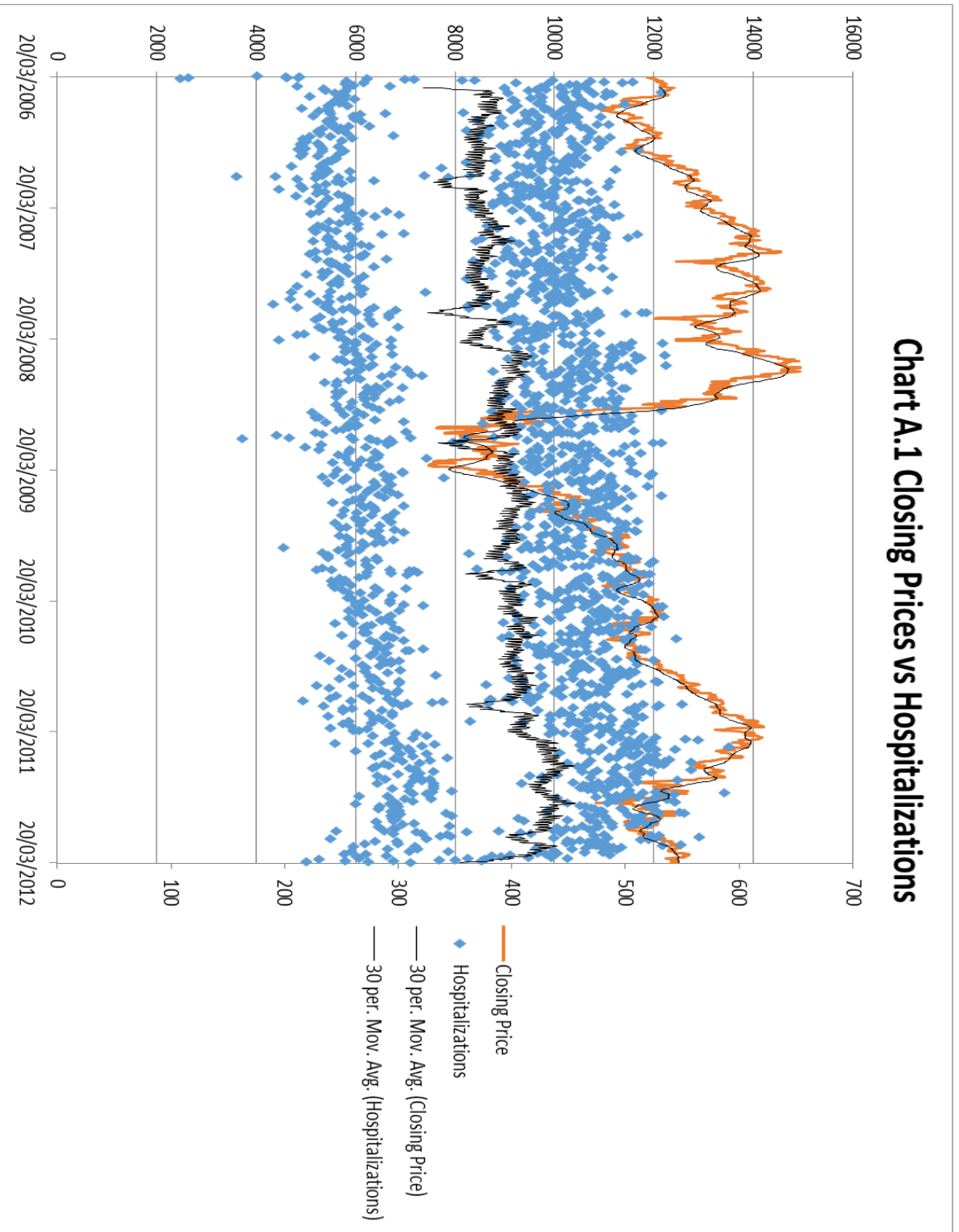
Notes: \* indicates significance at the 5% level \*\* indicates significance at the 1% level. Models are estimated using a Poisson regression with robust standard errors. t-statistics in parentheses.

## Appendix

**Figure A.1:** Relationship between probability of mental illness and number of debts



(Jenkins et al. 2011 page 51)

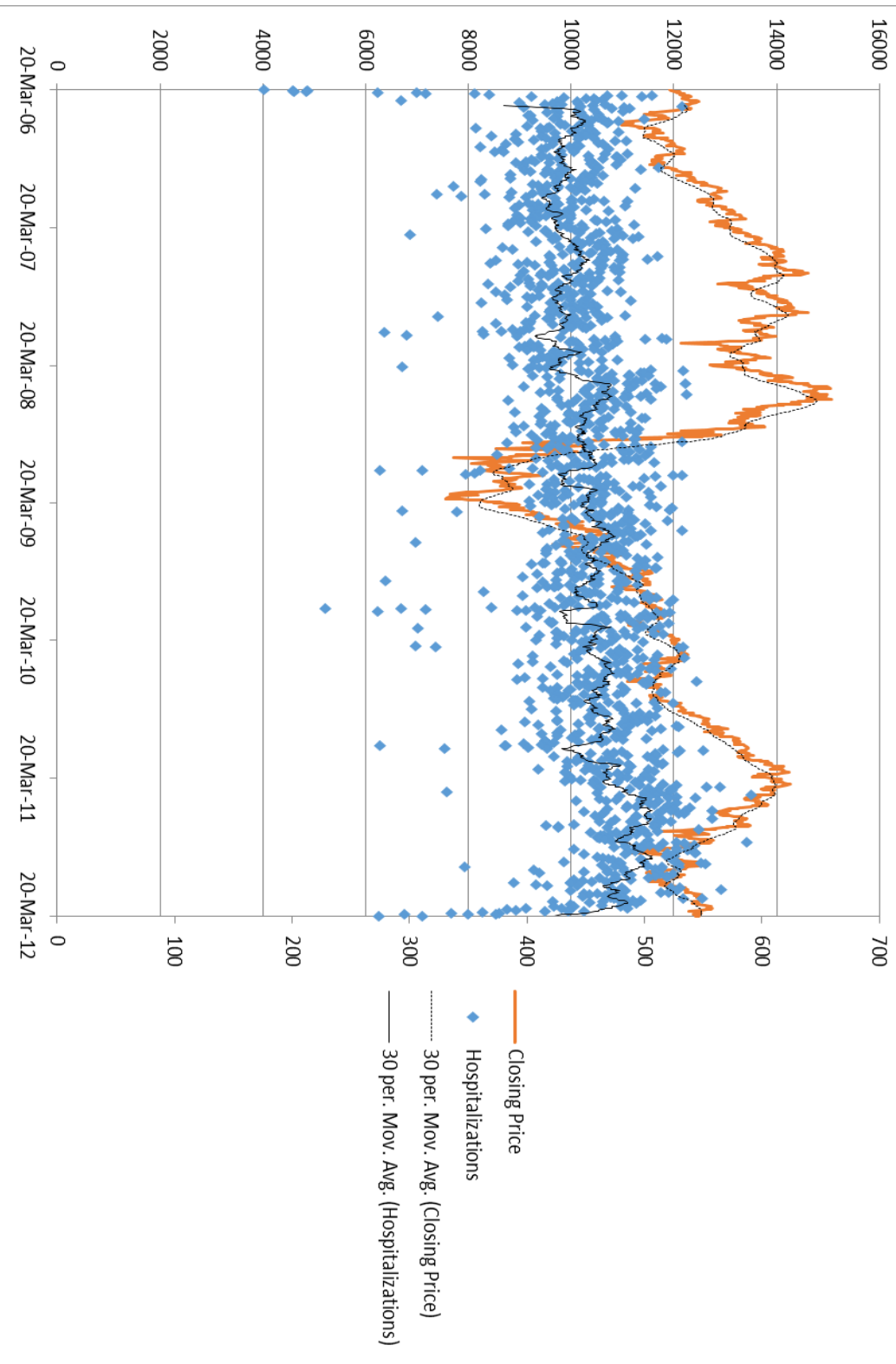


**Figure A.**

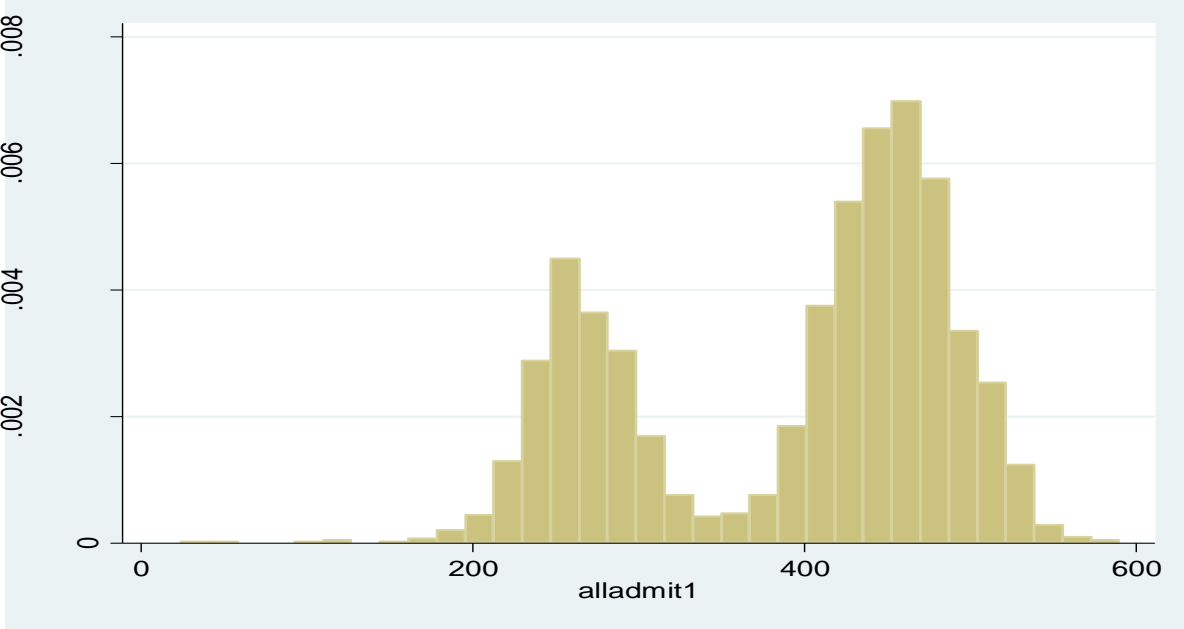
Source: Created by author using stock market and hospital data in Excel

Source: Created by author using stock market and hospital data in Excel  
Distributions of Daily Hospitalizations

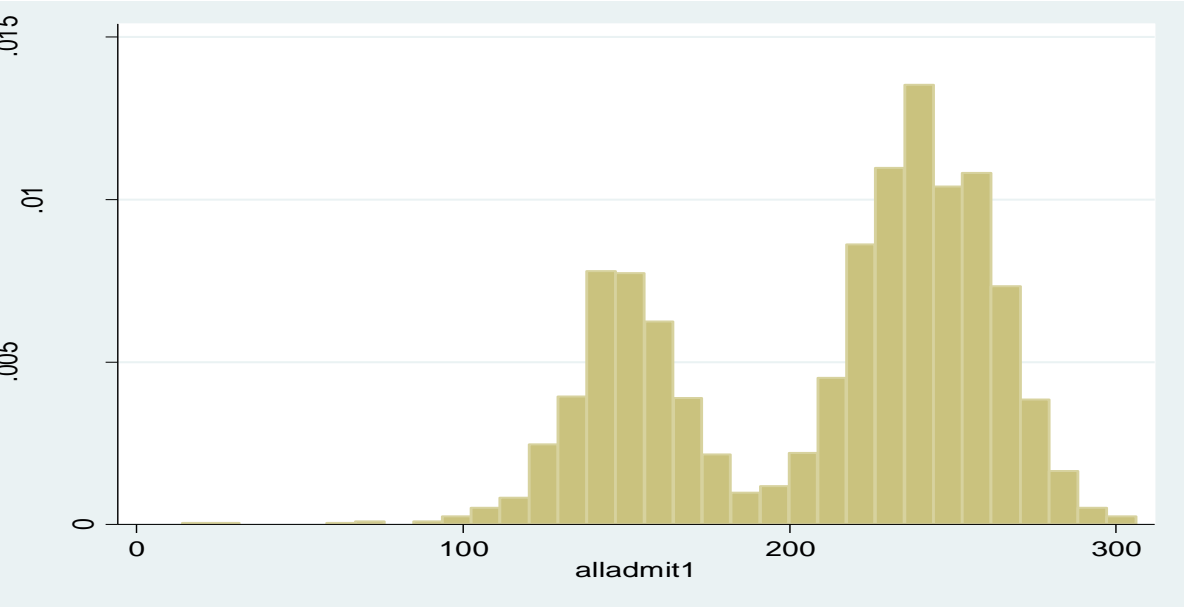
### Chart A.2 Closing Prices vs Hospitalizations (Trading Days only)



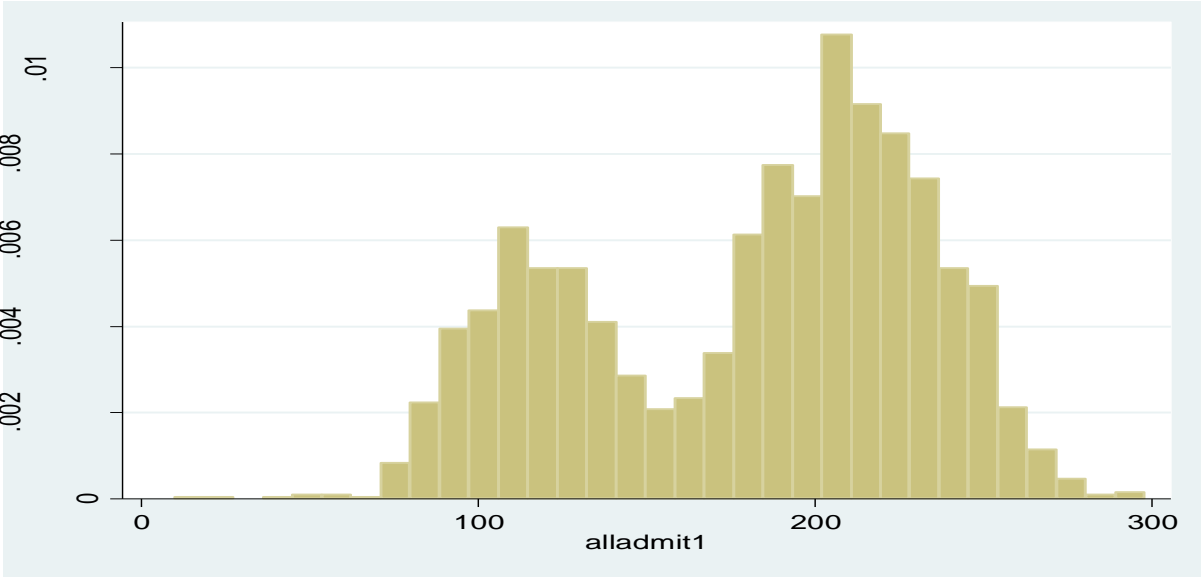
**Figure A.3.1:** All of Canada



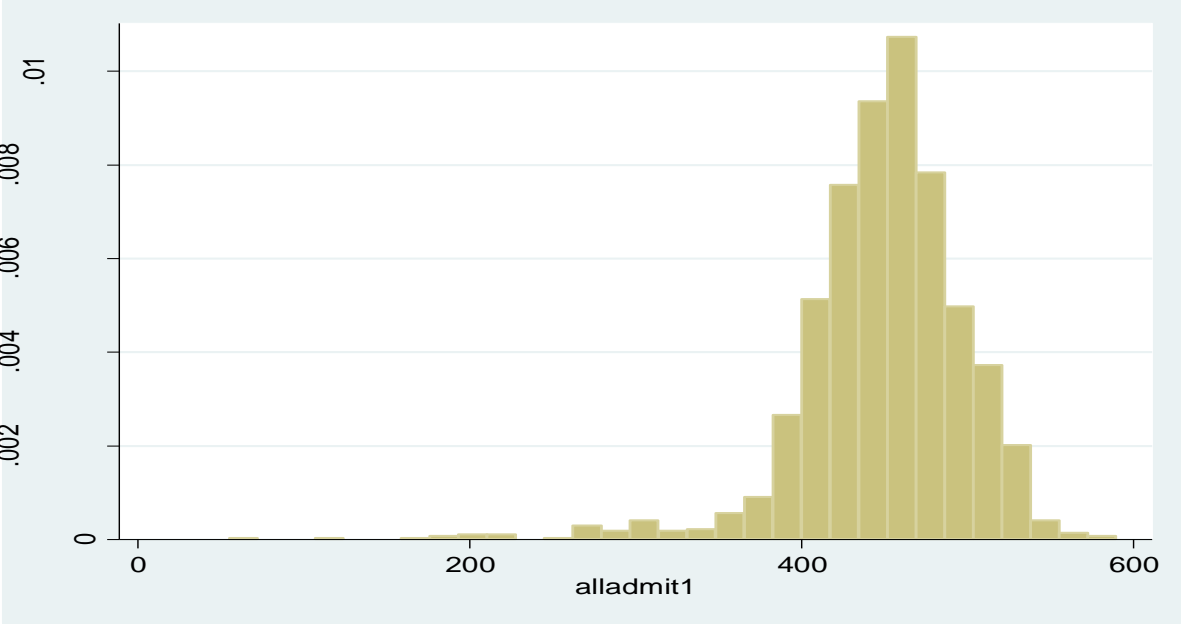
**Figure A.3.2:** Ontario



**Figure A.3.3:** All provinces/territories excluding Ontario



**Figure A.3.4:** All of Canada (trading days only)



Source: All histograms were created by author using Stata