CARLETON UNIVERSITY

ANALYSIS OF ARREARS RATES IN CANADA'S HOUSING MARKET

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ECON 3856 HOUSING ECONOMICS

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The goal of this analysis is to examine trends in Canada's arrears rates, identified as households that are behind on a payment for a given payment method by three months or more. In this context, we will be focussing on loans of all types, as is defined by the dataset. The selected data analyzed comes from the Canadian Mortgage and Housing Corporation (CMHC)'s public data arrears and foreclosure rates for Canada and the U.S. For this text we will focus purely on analyzing trends in the Canadian market, and their impacts.

Basic Analysis of Arrears rates in Four Canadian Provinces

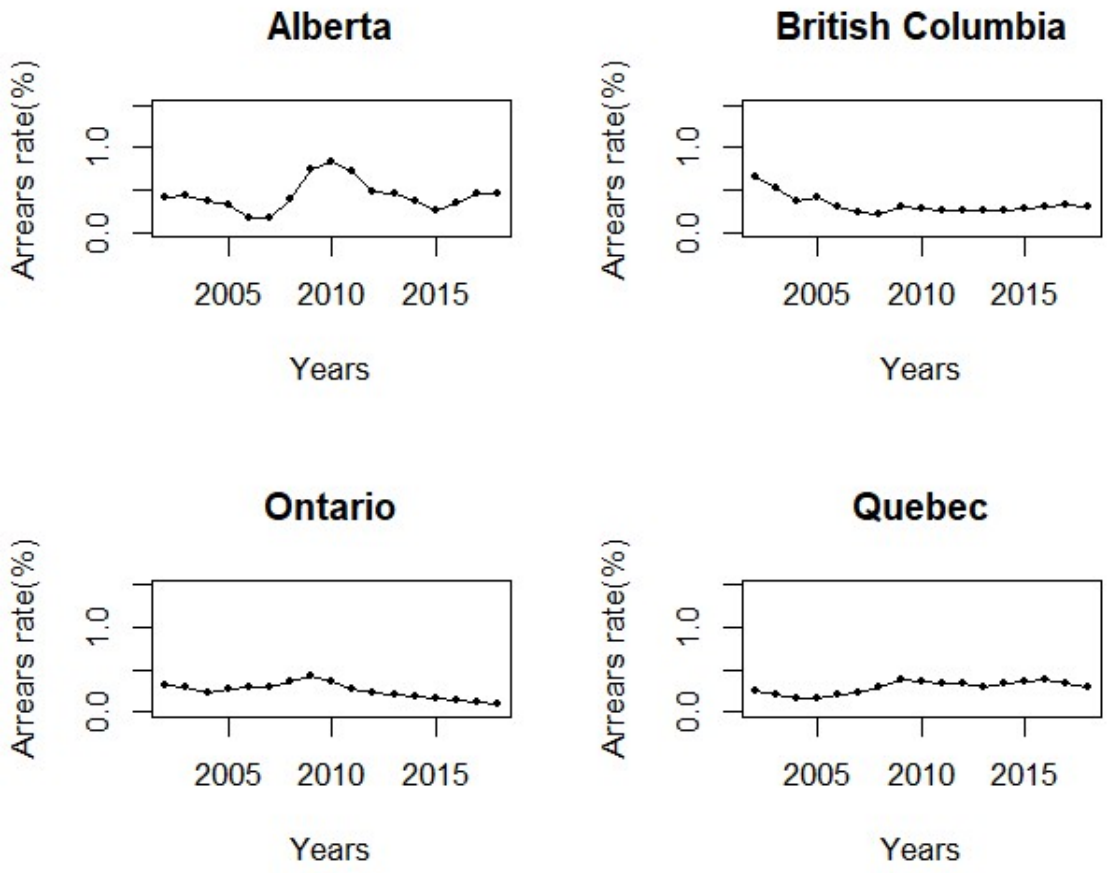

Figure 1: The Arrears rate in (%) in four provinces from the years 2002 to 2018.

We will begin with this graph generated from the CMHC's dataset on arrears rates by province from 2002 to 2018, taking a sample from the four listed provinces, we observe that there is a significant spike in the arrears rate in all four provinces during the period of the financial crisis.

from 2008 to 2011. Alberta exhibits the most change, going from a rate of 0.18% in 2007 to 0.83% in 2010, a 361% increase in the arrears rate at the peak of the financial crisis. Other provinces also exhibited increases, though not nearly as significant as that of Alberta. They all exhibit a gradual decrease as time progresses until the year 2018.

Comparing the Arrears Rates of Ontario, Quebec, Alberta & British Columbia to all of Canada

Looking at the graphs below, we can further observe the trends in the rates overtime.

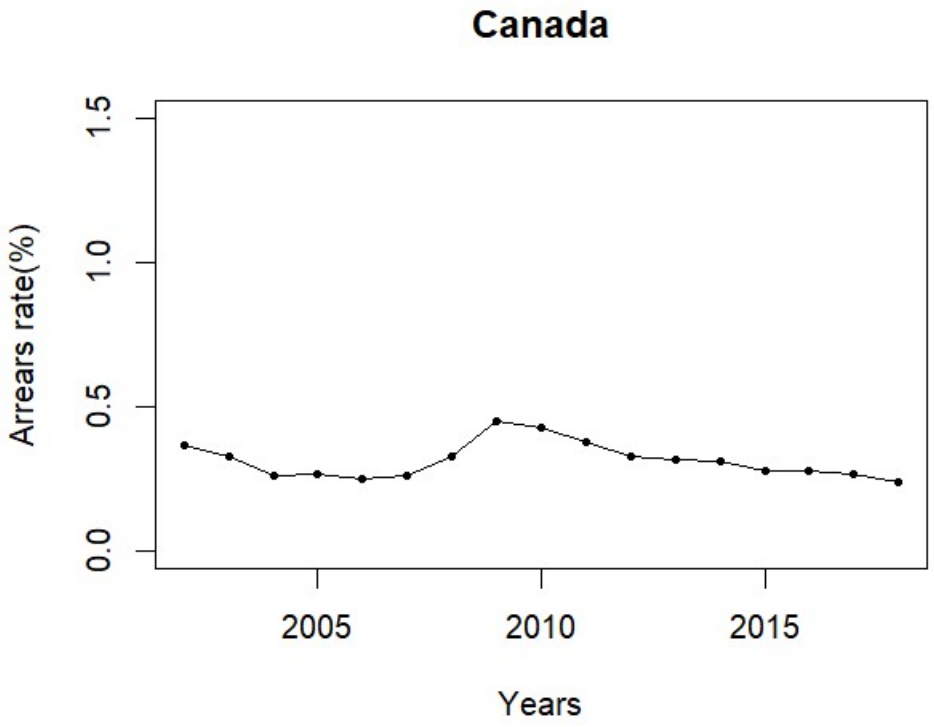

Figure 2: The Arrears rate of Canada on all mortgage loans from 2002 to 2018.

As We can observe from the plot above, the trend for Canada exhibits a similar pattern to that of its provinces, having a peak in arrears rates around the time of the financial crisis in 2009, and falling in the years after. Noteworthy, we can observe that the arrears rate was climbing from the years 2006 until 2009, a four-year climb before it started to drop, and only reached levels below where it started by the year 2017, when the rates are equal at 0.24%. The man arrears rate

is ~0.32%. The peak was reached in 2009 at an arrears rate of 0.45% of homeowners were 3 months or more behind on their mortgage payments.

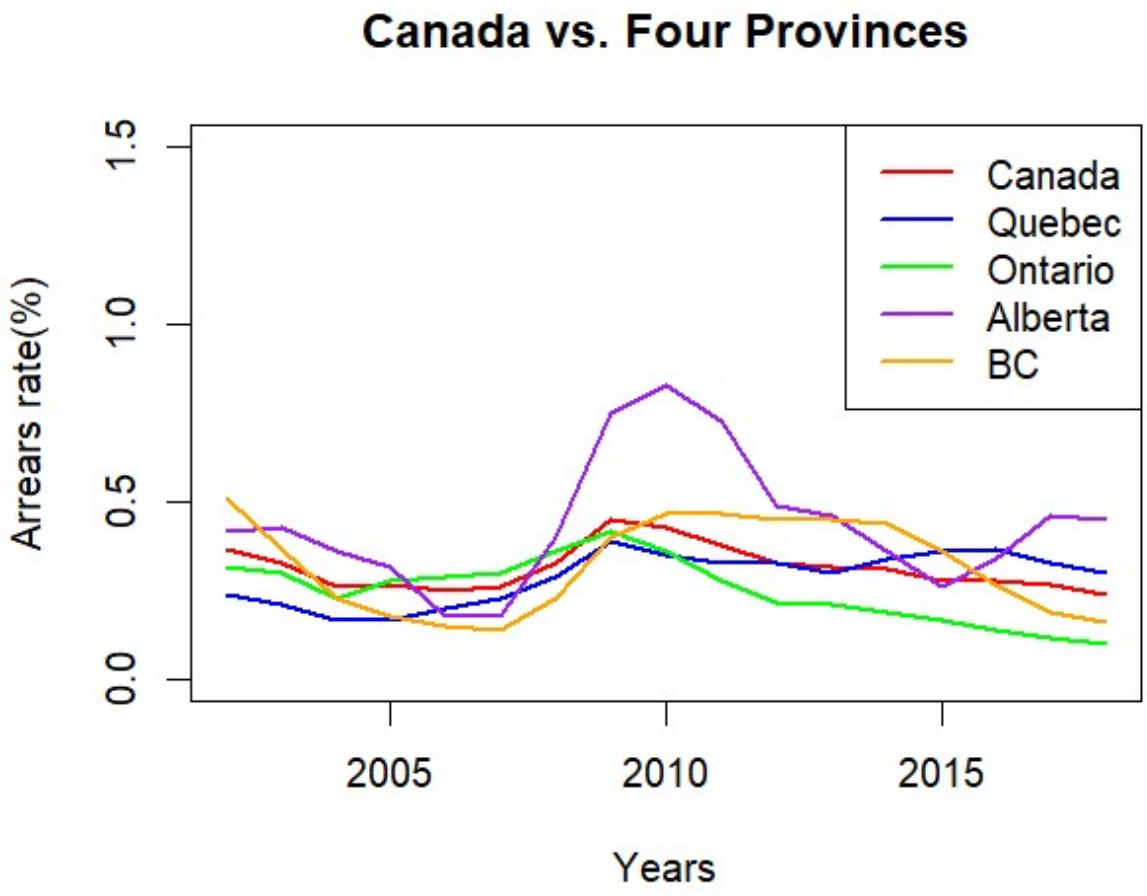

Figure 3: Arrears rates (%) in Canada and four provinces listed in the legend.

In the plot above we can observe how Canada's provinces compare to its overall arrears rate, and we see that overall, Alberta remains the highest, being above Canada's average arrears rate for all but 3 years, while provinces like Quebec, remain mostly under the arrears rate. Notably, British Columbia starts off higher than all provinces at 0.51%, which is approaching the heights seem in Alberta during the financial crises, though drops rapidly and remains below the national average until the year 2015, when it begins to rise above the national average. It may be reasonable to assume that Alberta has an impact that may be drawing up the national average, as it sees a consistently higher percent of homeowners who cannot afford to pay their mortgage, we

can run a simple linear model to test this hypothesis, from the point of view of hedonic price analysis, the null hypothesis Ho: Alberta has no impact on the national average, and Ha: it is not no impact.

```
Call:
lm(formula = ArrearsRateC ~ ArrearsRateA + ArrearsRateB + ArrearsRateO +
    ArrearsRateQ, data = datAll)

Residuals:
       Min         1Q     Median         3Q        Max
-0.0191992 -0.0074420 -0.0001499  0.0042773  0.0229125

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.001791   0.025800   0.069  0.94581
ArrearsRateA 0.142566   0.024692   5.774 8.83e-05 ***
ArrearsRateB 0.127655   0.032509   3.927  0.00201 **
ArrearsRateO 0.389503   0.042454   9.175 9.01e-07 ***
ArrearsRateQ 0.386691   0.067165   5.757 9.06e-05 ***
```

Figure 4: T-test using on a model using the summary() function of a linear model in R.

In this analysis, we take Canada's Arrears rate as the response, and the provinces as our predictors. From looking at the p-values in the furthest right column, we observe that Alberta has a p-value 8.83e-05 < 0.05, so we reject the null hypothesis, which means that there is evidence to suggest that the Arrears rates in Alberta have an impact on the national average, the same can be said about other values too, as all the p-values are below the threshold of 0.05, and so the null hypothesis of this T-test is rejected, and we can conclude that they are all statistically significant predictors.

Furthermore, we observe that given the intercept, Ontario has the largest impact on Canada's overall values, this may be because Ontario's values for Arrears rates follow that of Canada's most closely, and dominate the trend, Quebec is also very close behind, also following the trend closely. To clarify, for every unit increase in Ontario's arrears rate, the national arrears rate will increase by 0.3895. Of course these are not official numbers, and these would likely change given more provinces added to the model, but it gives us an idea of which provinces contribute most to Canada's arrears rate overall. Though given the trend, could we reasonably guess that as this is time series data, there may be autocorrelation in the model, which happens when the residuals, computed y-yhat, are correlated. We can test for this in our model using a Durbin-Watson test.

```
        Durbin-Watson test

data:  mod1
DW = 0.48006, p-value = 1.258e-07
alternative hypothesis: true autocorrelation is greater than 0
```

Figure 5: Durbin Watson test on our model using the function dwtest().

Given the null hypothesis Ho: there is no autocorrelation, we reject the null hypothesis, meaning there is evidence to suggest that there is autocorrelation present in them model.

What this means is that the trend that we analyzed in our data suggests that the arrears rates are likely to continue to follow their trend, and are not random, as autocorrelation means that the difference in the predicted value of the model, to the true value, is correlated with the previous years residual value.

Moving on: Comparing the Prairie Provinces to Canada's Atlantic Provinces

One of the components that can affect arrears rate is geography, we will next conduct an analysis on the arrears rates in the provinces of Alberta, British Columbia, Saskatchewan and Manitoba, and how they compare to the Atlantic provinces.

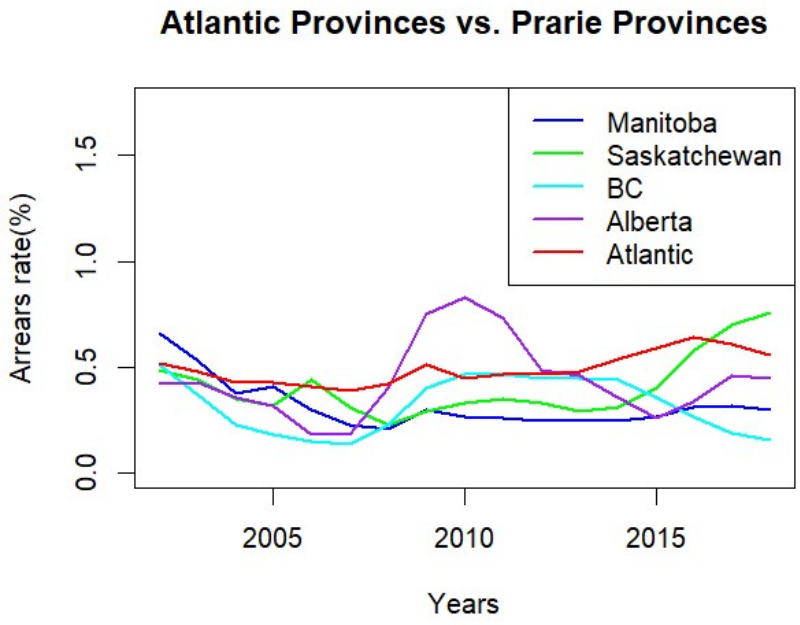

Figure 6: Arrears rate (%) in prairie and Atlantic provinces.

In this plot, we observe that the arrears rate for the Atlantic provinces is higher than all provinces throughout almost the whole timeframe of 2002 to 2018, apart from the ends. Only surpassed marginally by a few provinces and substantially by Alberta during the period of the financial crisis. Something to note, while the arrears rate in the Atlantic provinces is higher on average at 0.49%, the increase following the financial crisis was minor, as all other provinces exhibited greater increases from 2008 to 2009 in arrears rates, increasing by 0.9% during that time, with only Saskatchewan exhibiting a smaller increase of 0.6%.

Furthermore, while the Atlantic provinces and Saskatchewan exhibited minor change in arrears rates, suggesting a more inelastic arrears rate in the short term than other provinces, we can observe that as in economic terms, everything is elastic overtime, and as we approach 2018 on the graph, the Atlantic provinces, and Saskatchewan now have the highest arrears rates in the nation, at 0.56 and 0.76, which is much higher than the national average at just 0.24, which is substantially higher, and may suggest a more unsustainable cost of living in these areas, as more people on average are unable to afford to pay their mortgage, and are refusing to pay for 3 months or more, contributing to the statistic.

Analysis of Arrears Rates Against the US Market

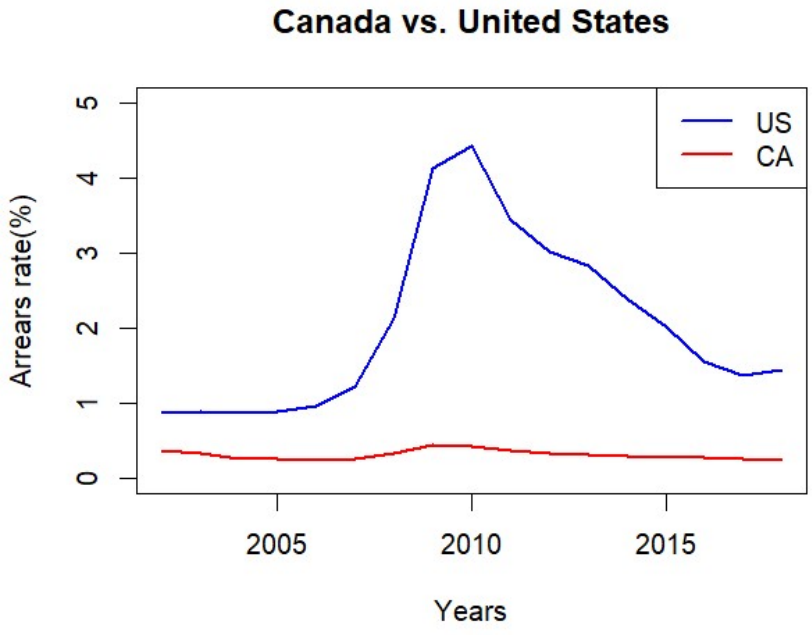

Figure 7: Arrears Rates (%) in Canada and the United States.

Canada's arrears rates have consistently fallen significantly below that of the us, with the lowest arrears rate in the us at 0.87 in 2004, significantly higher than any year in Canada's observed range of this dataset. The Canada and the United States achieved their peaks in arrears rates of 0.45% and 4.43% in 2009 and 2010 respectively. We can observe that these trends are significantly different, so while the Canadian market was hit by the financial crisis, the housing sector did not see near as dramatic an increase in arrears as did the United States.

Using hedonic price analysis by running a linear model with Canadian arrears rates as the response, and United States as the predictor, we can observe that the predictor, while statistically significant, has a poor model fit, with an r-squared value of just 0.6074. While log and square root transformations can be applied to enhance the r-squared metric, they on

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.231468   0.019948  11.603 6.83e-09 ***
ArrearsRateUS 0.041306   0.008574   4.818 0.000226 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04022 on 15 degrees of freedom
Multiple R-squared:  0.6074,    Adjusted R-squared:  0.5813
F-statistic: 23.21 on 1 and 15 DF,  p-value: 0.0002259
```

Figure 8: T-test on a model to predict Canadian arrears rate using US arrears rate.

R-squared is a metric used to measure how well a model fits to the data, and as this value is relatively low, while we can say there is a relationship between the markets due to the rejected null hypothesis of no relationship, it is a poor positive relationship, as observed by the graph, a much larger change in US arrears rates must occur for Canadian arrears rates to feel a significant impact.

Drawing conclusions from this chart, and assuming all other predictors constant, that housing was least affordable during the 2009 financial crisis, as the higher percent of individuals who were unable to pay for their mortgage. As houses generally take a long time to leave the market, the market conditions of arrears rates are likely based off of affordability of the same properties overtime, with some leaving and some entering the market.

Many conditions can cause arrears rates to rise; extreme events, hikes in inflation rates which drive the cost of the mortgage up, changes in law may all influence homeowners and their ability to pay for their mortgage. Notably, observing provincial arrears rates (*See Figure 6*), we can see that many of the provinces are seeing consistently increasing arrears rates following 2015, which may serve as an indicator that housing is becoming more unaffordable, though we would need to conduct more tests with different datasets to draw proper conclusions.

To elaborate on the conditions observed during the financial crisis, which began in the year 2007, and had affects on arrears rates lasting through the 2010's, our dataset indicates that the increase in arrears rates would result in a decreasing in demand for housing, as many people were barely able to afford their home, the demand for houses in Canada would be lower among Canadian consumers due to budget constraints of an increased number of Canadians spending a larger portion of their income on housing products.

Conclusion Fast Facts

- Alberta had the highest arrears rate in a year, at 0.83% in 2010.
- Canada has a mean arrears rate of 0.315%, while the US has a mean of 2.03%.
- The Atlantic provinces have the highest mean arrears rate of 0.494%.
- The arrears rate for most provinces have begun to climb since hitting a low in the period after the financial crisis around 2010-2013.
- Arrears rates for all provinces were decreasing prior to the financial crisis of 2007.
- The US has a consistently higher arrears rate than that of Canada, with the minimum distance being a 0.51% between Canada and the United States.
- T-tests suggest a weak positive relationship between the arrears rates in the US and Canada for all mortgage loans.

Bibliography

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