Determining the Role of Government Investment in Housing on Educational Success

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Abstract

Education is a powerful tool that allows one to develop their full potential and achieve financial stability. In society, housing plays a great role in a student's academic success; however, housing insecurity is a major issue that many Canadians face today. The goal of our study was to determine the impact of government investment in housing on education and quality of life in Canada. More specifically, we compared the investment in housing of several Canadian provinces to their Human Development Index (HDI) and average literacy and numeracy scores. We collected data on literacy, numeracy, and housing investment from Statistics Canada and data on HDI from Global Data Lab. Python language was used to sort and visualize the data in addition to identifying significant statistical correlations between our variables. We saw positive correlations between investment in housing and HDI, average literacy scores, and average numeracy scores. As housing investment increased, so did HDI, literacy, and numeracy. Unlike other papers, this paper stays within the scope of Canada, investigating housing investment and educational success in the country based on those three factors. Overall, this research paper offers compelling evidence that housing investment is an important factor in promoting educational success, highlighting the need for the government's continued attention to this issue.

Keywords housing investment, literacy, numeracy, education, Human Development Index

1 Introduction

The rising issue of housing insecurity affects the educational aspects of students' lives, which is alarming as education is one of the greatest indicators of individual success [1]. Instability places stress on students and decreases their attendance in school, cognitive ability, and other factors that all lead to decreased academic performance [2]. Housing insecurity, coupled with income insecurity, has a negative effect on education, and the gap between poor and wealthy students has remained consistent if not grown since the 1950s. Especially in light of the recent COVID-19 pandemic, job loss and decreases in income have only resulted in a greater socioeconomic gap. This is concerning when considering that schools near lower-income neighborhoods often have lower standardized test scores than the schools near high-income neighborhoods [3], where there is limited development of affordable housing.

Housing investment allows us to measure contributions to the issue of housing insecurity. As a society, our investments must be carefully planned and strategized. In this paper, we hope to determine the significance of housing investment on education, specifically within the region of Canada, while diving into its impacts on factors such as literacy, numeracy, and overall well-being through the Human Development Index (HDI). We also hope to combine our results with our background knowledge on the topic of housing insecurity affordable housing to suggest reasonable methods to use housing investment to improve educational success in Canada.

2 Hypothesis

Based on our knowledge of the relationship between housing insecurity and education, we hypothesize that housing investment from the government will have a positive correlation with our three factors of numeracy, literacy, and HDI.

3 Materials & Methods

3.1 Getting Data

To start, we obtained data for our project from three databases: Subnational HDI from Global Data Lab, Investment in Building Construction from Statistics Canada, and Literacy, numeracy from Statistics Canada. We downloaded the data as csv files and uploaded them onto GitHub, a cloud software that can be used to stored large files. Google Colab was used to code in the Python language, which is popular for data analysis. The module Pandas from Python was used to import the csv files from Github as dataframes, sort the data, and finally visualize it. Scipy was used to analyze significant statistical values and Matplotlib was used for extra data visualizations.

3.2 Sorting the Data

The database related to investment in housing showed the total housing investment value monthly for Canada and its provinces over several years while the HDI database displayed the yearly HDI from Canadian provinces and Canada over several years. Literacy and numeracy from Statistics Canada showed the average literacy and numeracy scores for Canada and its provinces in the year 2012.

The dataset on literacy and numeracy was divided into two distinct datasets. We used Python coding to create a separate dataset that combined the yearly sum of the monthly housing investment values from 2010 to 2019 and Canada's subnational and national HDI from 2010 to 2019. We took the total investment values from 2012 from this dataset and combined it with the numeracy and literacy scores of each province and Canada to make a different dataset.

3.3 Data Analysis

To determine the role of investment in housing on education, we used three indexes to measure education: literacy, numeracy, and Human Development Index (HDI).

The Human Development Index is a measure of a country's (or regions) overall well being. The Index takes multiple factors into account, such as life expectancy, literacy, and gross domestic product (GDP). A compilation of all the indicators is calculated into a number ranging from 0-1.0, with a score of 0 indicated the an underdeveloped country that faces poverty, a corrupt government, poor education and low incomes. In addition, such a country would have low life expectancies despite high birthrates. An HDI with a score close to 1.0 would be suggest a highly developed country with a stable government, access to health care, good quality of life, and a consistently growing economy. This quantification of a nation's development is important in viewing its monetary and social improvements and conditions.

Our independent variable, investment in housing, was plotted against these three indexes using scatter plots. Here we used linear regression — a statistical way of measuring and predicting the relationship between two variables. In this case, a linear equation was used relate the dependent variable to the independent variable. Specifically, a simple linear regression was utilized using the model function of

$$y = mx + b \qquad (1)$$

. The goal was to find values of m and b that would yield in a best-fit line using a "least squares" method for a dataset. In doing so, this straight line minimizes inconsistencies between predicted and actual data because it is the smallest sum of squares of errors derived using the following equation:

$$S = \sum_{i=1}^{n} d_i^2$$

$$S = \sum_{i=1}^{n} [y_i - f_{x_i}]^2$$

$$S = d_1^2 + d_2^2 + d_3^2 + \cdots + d_n^2$$

. When plotting out each data point on a simple Cartesian plane, each point has a certain distance from the original linear slope called residual. The sum of the squared errors between the data points and the line of best fit are used to calculate the optimal slope and intercept that minimizes this error. Lastly, we used the Scipy module in Python to analyze for various statistic values including the p-value, R value, R-squared value, and standard deviation error.

4 Results

In Figure 1, we compared housing investment literacy in Canada as of 2012, as it had the most recent and complete data. We found that there was a slope of 4.43e-10, indicating that every one dollar increase in housing investment from the government resulted in a small increase in literacy. The R value of 0.290 indicates a weak positive correlation between the two variables.
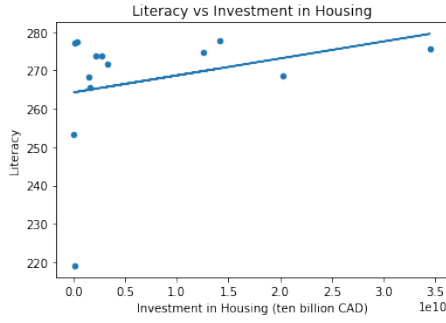
Figure 1: A scatter plot that compares the investment in housing (x-axis) and the literacy (y-axis) for every province and territory in Canada in 2012.

The p-value of 0.33 suggests that the relationship between the two variables may not be very significant. The standard error of the slope calculated is 4.4066e-10 which is considered high.
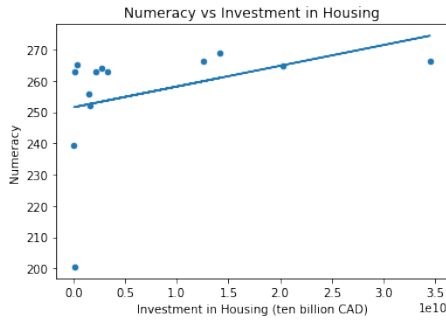

Figure 2: This graph plots investment in housing against numeracy for each province and territory in Canada. The data was taken in 2012.

In Figure 2, we plotted housing investment against numeracy for the provinces and territories in Canada. The slope of the line of best fit has a value of 6.642e-10, indicating that a one dollar increase in investment results in a slight increase in numeracy. The R value of 0.374 suggests a weak positive correlation between housing investment and numeracy. The p-value of 0.207 suggests that the result of this graph is not very significant. The graph has a high standard error estimate of 4.953e-10.

We wanted to see how investment in housing had affected Canada and its citizens' well-being over time. To do this, we took many different years that had a recorded amount of investment and a recorded value for HDI. We plotted all the points to create the graph in Figure 3. The graph has a slope of 7.464e-13 and an R value of 0.965, indicating a very strong positive relationship between housing investment and Canada's Human Development Index. The p-value of
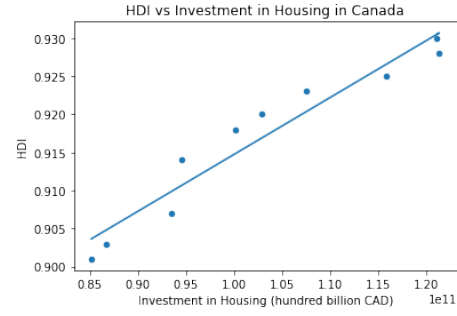

Figure 3: This graph conveys the relationship between housing investment (x-axis) and HDI (y-axis) overtime in Canada.

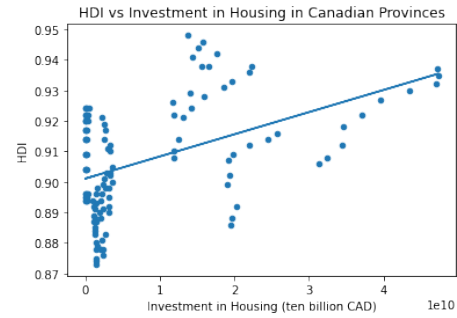6.189e-6 confirms the graph's significance. The standard error estimate is 7.156e-14.

Figure 4: This graph relates housing investment (x-axis) and HDI (y-axis) overtime in Canada's provinces and territories.

The graph is Figure 4 has a similar goal as Figure 3: to see how investment in housing in many different years affected Canada's HDI. This time, we wanted to use the data points from individual provinces and territories to see if it would make any difference. The graph had a slope of 7.264 e-13 and an R value of 0.470, suggesting a weak relationship between the two variables. The p-value of 1.628e-8 supports the significance of the relationship between the two variables. The standard error was 1.204e-13.

5 Discussion

5.1 Analysis of Results

In Figure 1, we plotted investment in housing against literacy, creating a line of best fit with a positive slope of 4.431e-10 and an R-value indicating a weak correlation. Through this graph, we see that the provinces with higher investment in housing also had higher literacy rates. This is likely because provinces that can invest in affordable housing would also be able to invest in the education needed for high literacy rates.

In Figure 2, we wanted to compare housing investment with numeracy to see if there would be any significant differences. Figure 2 had a slope of 6.642e-10, which was similar to Figure 1. Figure 2's R-value is slightly higher than that of Figure 1 at 0.374. The results for numeracy are more strongly correlated and have a slightly higher slope, indicating that housing investment has a higher impact on a community's math skills as opposed to its reading and writing skills.

Figure 3 showed the relationship between housing investment and HDI in Canada over many years. The graph's line of best fit had a small slope of 7.464e-13, but the graph's R-value of 0.965 suggests a strong correlation between the two variables. This is likely because housing investment directly affects GDP, which is a major factor in HDI calculations. Looking at Canada's development over the last few years, increased housing investment would better support people in Canada by making homes more affordable and accessible. This would also make the overall quality of life better.

Finally, Figure 4 compared housing investment and HDI in Canada over multiple years, this time plotting each province and territory's HDI. The slopes of the two graphs are similar, as Figure 4's line of best fit has a slope of 7.264e-13. The major difference is in the R values; when comparing the HDI of Canada as a country over time, an extremely high R-value (suggesting a strong correlation) is present. However, there is only an R-value of 0.470 when the HDI in subnational regions is considered. This may be a result of the clustering of points found in the left portion of Figure 4. Various points at about $0 of investment range by about 0.05 in HDI. This makes it harder for the line of best fit to create a linear regression line that fits as many of the points as possible. As a result, the R value is low. When the data for the provinces and territories are collated, however, this "vertical line" of dots seemingly disappears into a succinct couple of data points, allowing for data that follows a trend.

5.2 Application

The data discussed in this paper has shown that housing investment is positively correlated with HDI, numeracy, and literacy rates — proving that it is highly beneficial for continued government investment in housing. It is important for the government to not only invest in those unable to afford housing, but to look at all housing needs including crowded housing, unsafe neighborhoods, temporary housing, and inadequate housing in need of major repairs. These points of the housing insecurity spectrum are and continue to be underlying problems of educational attainment. Living in crowded homes can result in behavioral problems and loud study environments which impacts a child's education. Having a stable household without frequent moving allows for a smooth and consistent education. Low-income families tend to move at twice the rate of higher-income families due to unstable housing [4]. Youth who move over three times in their childhood have a higher chance of repeating a grade, receiving disciplinary probation from school, and overall having a deteriorating emotional well-being [5]. Many of these housing needs directly affect children's health, potentially disrupting educational attainment. Governments can work with the health care system and youth sectors to build a community for these individuals, as well as strong housing support. This collaborative approach would ensure both affordable, adequate housing and improvement of the children's health mentally and physically in the long run. A main problem of housing insecurity is the high prices of homes or lack of income from families. Governments can help with this issue by establishing tax credits like the mortgage interest deduction for homeowners and establishing a good housing investment program [6]. Policies that recognize this issue at all government levels would be highly beneficial and cause a large positive impact on children and their academic achievements.

5.3 Sources of Error

The main source of error that could have affected our results is the small number of data points that existed on each of our graphs. For the data related to literacy and numeracy, we were only able to find information on the literacy and numeracy rates in Canada and its provinces from the year 2012. The points plotted in Figure 3 displayed the average HDI in Canada over 20 years, with each point representing the HDI of a year. Although the graph in Figure 4 had significantly more data points than the other three graphs since it was looking at HDI on a provincial level, it still didn't have enough data points to be considered Big Data.

Having small data increases the effect of outliers on our analysis. If we were looking at data sets with thousands of values, outliers would have little to no effect on the line of best fit if the difference between the outliers and the rest of the data was small. However, outliers in small datasets have a greater impact on the final graph, potentially causing more drastic effects,

especially when calculating standard error.

Conclusion

We found that HDI, literacy, and numeracy all had a positive correlation with housing investment in Canada, with national HDI and housing investment having the strongest correlation.

Based on the results, it seems clear that increased housing investment would boost numeracy and literacy in Canada. However, we think that this should be done strategically, targeting groups that have fewer opportunities. Affordable housing should be done all over Canada, with a strong focus on areas with fewer affordable housing opportunities. If we can invest enough in the housing economy of these communities, we can potentially increase the overall education enough to improve their well-being, turning these communities into larger successful ones that benefit Canada in turn. Future studies can be done to find out how different communities (based on geography, economy, and size) respond to changes in housing investment to give a deeper insight into how our findings can be applied in Canada. We hope that our study, along with others, enhances Canada's understanding of education and housing and creates a more unified, educated, and safely housed Canada.

Acknowledgements

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