Understanding Financial Crises

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I participated in the **Fields MITACS Undergraduate Summer Research Porgram** from July 3 to August 24, 2012. I was part of a team which worked on the project **Understanding Financial Crises**. We usually debated ideas for the project and worked to understand the stock market crises.

First, I read the book *"This time is different"* by Carmen M. Reinhart and Kenneth S. Rogoff to get some background for the project.

I also helped to collect data of 23 indicators for 46 countries. I mainly collected the data for South Africa, The United Kingdom, The United States, Sweden, Switzerland, Thailand, Turky, Singapore, Spain and Venezuela. The indicators used were GDP, domestic credit, imports, exchange rate, exports, M2, real interest rate, lending rate, deposit rate, industrial production, reserves, current account, inflation and CPI. The source for GDP is The World Bank, and for the others the source is International Monetary Fund. The data are monthly and they are from 1960 to 2010. I interpolated the data for GDP using cubic splines. In addition, I also interpolated data for the other indicators using linear interpolation when there were data for a month, and there weren't data in the next month or two months, but there were data in the next month.

I read the paper *"Leading Indicators of Currency Crises"* by Graciela Kaminsky, Saul Lizondo and Carmen M. Reinhart. After this, I programmed the signals approach model in C++. This model involves monitoring the evolution of several indicators that tend to exhibit an unusual behavior in the periods preceding a crisis. When an indicator exceeds a certain threshold value, this is interpreted as a warning signal that a stock market crisis may take place within the following 24 months.

The performance of each indicator was evaluated using the following matrix

	Crisis (within 24 months)	No crisis (within 24 months)
Signal was issued	A	B
No signal was issued	C	D

In this matrix, A is the number of months in which the indicator issued a good signal, B is the number of months in which the indicator issued a bad signal or "noise", C is the number of months in which the indicator failed to issue a signal, and D is the number of months in which the indicator refrained from issuing a signal. A perfect indicator would only produce observations that belongs to the north-west and south-east cells of this matrix. The noise-to-signal-ratio $([B/(B+D)]/[A/(A+C)])$ of a good indicator is low, and its probability of a crisis conditioned on the occurrence of the signal $(A/(A+C))$ is high.

In addition, I worked on the global index model. In this model, we tried to build a global index for each country that tells how likely is that a stock market crisis may take place within the next months. First, I calculated a weight for each indicator. The weight is the average PCD (Percentage of Crisis Detected),

NSR(Noise-to-Signal Ratio), Persistence and ALT(Average Leading Time). Then I calculated a global index which is

$$\text{Global Index}_{i,j} = \sum_{k \in \mathbb{K}} w_{j,k} \cdot s_{i,k}$$

where $\text{Global Index}_{i,j}$ is the index for the i-th month for the j-th country, $w_{j,k}$ is the weight of the k-th indicator for the j-th country, $s_{i,k}$ is the score of the i-th month for the j-th country and $\mathbb{K}$ is the set of all indicators.

Finally, I worked on the logit model and I used R to program it. This model involves maximizing the log-likelihood function

$$\sum_{t=1}^{T} \left(\sum_{j=1}^{n} Y_j ln(F(Z_t^j)) + \sum_{j=1}^{n} (1 - Y_j) ln(1 - F(Z_t^j)) \right)$$

where $F(x) = \frac{1}{1+exp(-x)}$, $Y_j = \begin{cases} 0 & \text{there is a crisis in the } j\text{-th month} \\ 1 & \text{there isn't a crisis in the } j\text{-th month} \end{cases}$, $Z_t^j = \beta_1 + \sum_{i \in \mathbb{K}} \beta_i X_i^{t,j}$ and $X_i^{t,j}$ is the value of the i-th indicator in the j-th month for the t-th country.

This summer was an excellent experience because I could research and learn some concepts in economics. I learned from our advisor Matheus Grasselli because he always found new things to be researched, and provided us with new ideas which helped us to solve problems that we had. Furthermore, the discussions among the members of the team were very enriching because we could find new solutions to the problems.