Spring 2010

The St. Olaf College Economics Department's

OMICRON DELTA EPSILON

Journal of Economic Research

Omicron Delta Epsilon

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Causality in Interest Rate Fluctuations: A Strategy for Borrowing

by Ben Brown for Econometrics

A model was created to determine an order of causality between various interest rates. Using this order, it is possible to predict when an interest rate will increase. Spotting an increase in the first variable in the order of causality can signal a future increase in one of our other rates, one of which may be a rate for borrowing. This would be the proper time to take out a loan since it is expected that the rate will soon increase.

Introduction

If we could predict the future behaviors of interest rates, we could earn quite the profit. However, interest rates are thought to be stochastic. While some people make risky investments hoping to increase their net present worth, others save at the risk free rate. There are several different interest rates that give a riskless return. Zero-coupon Treasury bonds are an example.

There are also interest rates for borrowing money. An individual may need a home mortgage, while a bank may need to borrow money from the Federal Reserve. With so many interest rates which basically all do the same thing, there must be relationships between them.

An interesting topic to investigate is causality among these interest rates. Which interest rate fluctuation will predict a change in the other rates? Do these rates even move up and down together? Answering these questions will give us a better idea about the behavior of interest rates. In turn, that understanding will help us to make more informed choices about deciding when it is a good time to borrow versus when it is a good time to save.

The main difficulty with this is that interest rates are believed to be stochastic. This means they exhibit a random process when fluctuating.

Therefore, we cannot create a model to predict interest rates based on other variables. In the past, people have been embarrassed by their efforts and were not taken seriously in their attempts to model interest rates. The difference in the model created here, is that we are comparing interest rates with other interest rates. While rates may be random, it is easy to see that they are not independent. Lately, all interest rates have been on the decline. Just looking at data for the 1980’s, it is clear that the interest rates rose and fell together. There must be relationships between these rates. Hopefully, one of these variables begins to increase and decrease before the others. Then, we can use that rate to foresee changes in the others.

If we are able to obtain an order of causality, we will essentially be able to predict the future behavior of one interest rate based on changes to another. Whichever variable is first in our order of causality will be our indicator. As the first variable in the order of causality, we expect the other variables to react to our indicator. Then, we will know when it is the right time strike on one of these reactant variables. For example, assume we are interested in taking out a loan, but we want to wait until we think the interest rate is at a local minimum. Assuming we can wait, and that we find a shock to our indicator will cause an increase to the interest rate of borrowing money, we will want to take out a loan when the indicator variable sees a quick increase.

Literature

A paper by the IMF Fiscal Affairs Department (edited by Tanzi, 1984) gives an excellent definition of interest rates. They are “determined in forward-looking markets for assets that represent a claim on a nominal stream of interest payments and return of principle over some future period of time” (page 37).

It can be hard to determine a rate when the market is volatile. The volatility of interest rates can be explained by a wide range of future possible values. High volatilities can lead to increased risk when saving or investing. Recently, interest rates have become more and more volatile. A study done by the Fiscal Affairs Department (1984) compared statistics between different time periods. The standard errors of the rates of Treasury bills and medium-term government bonds grew in each period from 1964-1983. However, the mean of the rates was also increasing throughout these periods.

Joseph Murphy (1987) brings up several myths about interest rates in his book, With Interest. One of these is that investors can make a profit by spotting trends in interest rate changes. What appears to be a trend is most often not significant. Murphy's tests showed that only one out of every three trends had a mean significant at the 95% level. Another problem is when you find a trend from past data, there is no evidence that the trend will continue in the future. You could just as easily lose money as make it by playing the market how a trend suggests.

A similar myth discussed by Murphy (1987) is that interest rates behave in a cyclical manner. Again, analysis of past data may appear to show cycles, but they are not always significant. In fact, the same cycles can be found in random numbers. Statistics can show us cycles where they do not exist. Murphy says, "in order to be something you can make money on, you need a regularity of one kind or another, something that tells you where the turning points are. Without that, you cannot bet, you cannot turn a profit" (page 119).

Several authors have compared the behaviors in interest rates to the behavior of flipping a coin and calling heads an increase, and tails a decrease. This process can be described as stochastic. Murphy (1987) mentioned that before Einstein applied Brownian motion to Physics, making it popular, Bachelier's thesis in 1900 used it to describe changes in financial markets. It was thought of as trivial, and was forgotten. It modeled the interest rate with an expected change and also a random, unknown component. His university did not approve of his topic which they thought of as "gambling." Brownian motion is a probabilistic process that models future possible states of, in this case, an interest rate. The model can predict the probability that the interest rate is in a certain range at some fixed point in the future.

There has been much progress in probabilistic models of interest rates in the last century. Robert McDonald (2002) pointed out that there were a few problems with arithmetic Brownian motion. For one, it is possible for the interest rate to become negative. This is unreasonable since any investor would rather keep his cash rather than pay to not have easy access to it. Another problem with this model is that the random component, or volatility, is constant. It should actually be related to the level of the interest rates.

McDonald (2002) wrote that Rendelman and Bartter eliminated these problems when they used geometric Brownian motion to describe changes in interest rates. Geometric Brownian motion describes the changes in the interest rate in terms of a percent change in the variable rather than additional basis points. This way, the interest rate can never be negative. However, it can become very large.

McDonald (2002) also believes that the expected change, or drift rate, should be “mean reverting.” That means if the interest rate is higher than the mean, it will be expected to drop, and if it is lower, it will be expected to rise. This is important for keeping rates in a proper range. McDonald mentioned that Vasicek incorporated this detail into his model. However, his model neglected that the random component should be proportional to the interest rate. This again allowed the interest rate to become negative.

Finally, McDonald (2002) presented the best model which was developed by Cox, Ingersoll, and Ross. They corrected this one last detail Vasicek missed by allowing the random component to be proportional to the square root of the interest rate. Since only the volatilities differ in these two models, McDonald (2002) compared how these models vary for different levels of volatility. For high volatility, Vasicek has a lower yield than Cox-Ingersoll-Ross. However, low volatility is associated with the Vasicek model producing a higher yield.

These models help people hedge risk for changes in interest rates. None of the models can help make a profit. They are used to price bonds. This way, they can be priced fairly for anticipated random changes in the interest rate.

The literature suggests that there is no way to accurately predict the future behavior of an interest rate. We can only make predictions based on uncertain probabilities. What I would like to test is if perhaps, other interest rates can predict the behavior of another interest rate. Do they behave in a stochastic manner together, or are they independent? What is the order of causality between selected rates?

Econometric Methods

A VAR on the interest rates will be used to detect causality. Lag length criterion will be used in order to determine the appropriate amount of lags that should be included. Also, we must be sure that the unit roots lie within the unit circle, suggesting our model is stable. If the VAR is stable, we will be able to observe what a shock to one of these variables will do to the others when the system is in equilibrium.

We can compare our results between the rates set on long-term lending and medium-term lending. It would be nice if the order of causality is the same for each length. Then, our results would be more significant. With several variables, lags, and observations; patterns are sure to arise. We do not want to be fooled as many have been in the past when dealing with stochastic variables.

Data

To conduct this study, data were taken from each month from June 1990 through June 2009 (229 observations) and include the following variables: the federal funds target rate, prime rate, 15 year home mortgage rates, 30 year home mortgage rates, 10 year T-bill yields, and 30 year T-bill yields. The data comes from the United States Economics database.

The Federal Funds Target Rate is the rate at which banks lend and borrow from each other. The rate is set by the Federal Open Market Committee. They have meetings approximately eight times each year and can change the rate based on the current conditions of the United States’ economy.

The Federal Bank Prime Loan Rate was created as a reference point for which the bank’s most reliable costumers could borrow. Usually, banks give loans to their customers expressed as a certain percentage above the prime rate. The prime rate is usually 3% higher than the Federal Funds Rate.

Our next variables apply to 15 and 30 year home mortgage loans. They are the non-jumbo fixed effective rates. These rates apply to people taking out loans for a house under a certain price. This rate is lower than the jumbo rate because more expensive, more luxurious houses are harder to sell quickly in the event that the borrower is unable to pay back the loan. Also, there is a greater risk in lending money for 30 years opposed to 15. Therefore, the 30 year rate must be higher than the 15 year rate.

Our last variables are related to the United States Treasury. They are the continuously compounded yield rates on zero-coupon bonds for maturities of 10 and 30 years. There is no risk associated with bonds from the United States Treasury. Therefore, these rates can be quite low. The rate for 30 years should also be higher on these bonds since your money is inaccessible for a longer period of time.

See figure 1 for descriptive statistics on each variable. It is also noteworthy that lately, all of these variables have been on the decline. They are not taken from a normal distribution. Our test will hopefully tell us which rate fell first, starting the trend.

Results

The first vector auto-regression estimated equations for and based on the lags of the federal funds target rate, the federal bank prime rate, the rate for a 30 year mortgage, and the yield for a zero-coupon continuously compounded Treasury bond maturing in 30 years. Lag length criterion suggested that five lags be used. With five lags, all of our roots had length less than one, meaning our system is stable. A table of significance, for each variable based on lags of the others, is given in figure 2. The order of causality was found to be: yield for a zero-coupon continuously compounded Treasury bond maturing in 30 years, the rate for a 30 year mortgage, the federal funds target rate, then the federal bank prime rate.

The adjusted R squared for each equation was very high. The treasury yield equation had an adjusted R squared of .97, while the other three variables had equations with adjusted R squared values of .99. There are very strong relationships between these variables as expected.

Another vector auto-regression was done, but this time, a shorter maturity was used on the Treasury bond, and a shorter term was used for the home mortgage. Again, lag length criterion suggested that we use five lags. The auto-regression roots all had length less than one, so this system is stable. When using the medium maturities, our order of causality was similar: yield for a zero-coupon continuously compounded Treasury bond maturing in 10 years, federal funds target rate, the rate for a 15 year mortgage, then the federal bank prime rate. See figure 3 for levels of significance for each equation.

Again, we have very high adjusted R squared values for each of our equations. The treasury yield equation has an adjusted R squared of .96. The other equations have adjusted R squared values of .99.

Notice that the order of causality is similar for rates set for long-term borrowing and lending, and for medium-term borrowing and lending. It might be a coincidence, but for the Treasury yield to lead and the prime rate to end in each model builds confidence in the results. The level of significance is much greater when both of our vector auto-regressions agree.

These results mean that other interest rates react most strongly to changes in the yield for United States Treasury bond, whether it is for 10 years or 30 years. This yield does not significantly depend on any of the other three variables. We cannot gain information about the behavior of this variable based on fluctuations of the others. However, observing a change in this variable can give us an idea about how the others will behave.

When the yield for 30 year zero-coupon Treasury bonds increases, we expect to observe an increase in 30 year mortgage rates over the following three months. See figure 4. These effects continue down the line. Figure 5 shows the response of the federal funds target rate to the rate on 30 year mortgages. When any of these variables increase, the effect is always positive on the others. Looking at figure 2 again, you can see which effects are significant.

A shock to the yield of 10 year zero-coupon bonds causes the rate on 15 year home mortgages, the federal funds target rate, and the federal bank prime rate to increase. Figure 6 shows how the 15 year home mortgage rate reacts to a shock to the yield of 10 year Treasury bonds. Figure 7 shows how the federal bank prime rate reacts to a shock to the federal funds target rate. Again, a shock to any variable causes the other rates to increase. Refer to figure 3 to see which effects are significant.

To apply this to personal finance, we can make decisions based on the behavior of the United States Treasury yield rate. For example, if we are considering buying a new home, when is it a good time to take out a mortgage? Our model can help us apply for a mortgage at the right time, assuming we can wait to buy a house. The strategy we would use is to keep an eye on the United States Treasury yield rate for a zero-coupon bond maturing in thirty years. When this rate jumps from one month to the next, we know that the rate on a thirty year home mortgage will increase in the near future. Therefore, we should take out a mortgage as soon as we see the Treasury yield rate increase. This way, we will save on our interest payment every month. If our model works, we will have saved a significant amount of money over a thirty year period. This pattern also holds true if you want to take out a fifteen year mortgage. Watch the United States Treasury yield rate for a zero-coupon bond maturing in ten years and take out a mortgage when this rate has a quick increase between months.

Another application to personal finance is through the Federal bank prime rate. If we were considering taking out a loan, we could use our model to take out the loan at a time that saves us money. The same strategy would apply; we could watch any of the other rates for a jump. When they increase, we would want to take out our loan before the prime rate increases. Usually, we would get a loan at some percentage above the prime rate. Then, the rate on our loan would increase simultaneously with the prime rate. We expect the prime rate to jump last, so we can observe the other variables and react to them. Similar to the home mortgage case, we would save money by getting a rate lower than the one we expect to be offered in the next month.

Conclusion

A vector auto-regression on various interest rates found a pattern of causality. For both medium term and long term variables, we found that the order of causality starts with the Treasury yield, and ends with the federal bank prime rate. If our model is accurate, we should be able to save money by taking out loans at appropriate times. We can predict when some rates will increase so we can borrow before the new, higher rate arrives, saving us a significant amount of money over the term of our loan.

However, our model is not perfect. The impulse analysis from the vector auto-regression shows how shocks affect a system at a stable equilibrium.

Though our model is stable, we never know that it is in equilibrium. The literature has told us that interest rates are stochastic. This means that they are random and unpredictable. A model could detect patterns that are only happening by chance.

An assumption that is difficult to justify is the assumption that borrowers can simply wait to take out a loan. While waiting until we have a low rate is nice, people need loans for a variety of reasons, most of which are necessary immediately when a problem arises.

For further tests on this subject, I would suggest that more data be collected. Twenty years of observations is nice, but a larger number of degrees of freedom would give us a more accurate analysis. Then, we could also do a Lucas Critique style analysis to verify that our results were the same over different periods. Another way to improve this model is to include other interest rates in the model. There may be other rates that have a more significant response, or perhaps a longer delayed response, that could help us make profitable decision by either buying bonds, or taking out a loan at the best time to avoid a sudden change in the interest rate.

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Appendix

Figure 1. Descriptive Statistics

Variable	Mean	Standard Deviation
Federal Bank Prime Rate (FBPR)	7.075	1.847
Federal Funds Target Rate (FFTR)	4.146	1.953
Treasury Yield (10 yr) (TY10)	5.812	1.356
Treasury Yield (30 yr) (TY30)	6.117	1.344
Home Mortgage Rate (15 yr) (HMR15)	7.262	1.356
Home Mortgage Rate (30 yr) (HMR30)	7.469	1.277

Figure 2. Granger Causality Test (30 yr)

	Lags of				
Dep. Vars	FFTR	FBPR	HMR30	TBR30	All
FFTR			**		***
FBPR	***		***		***
HMR30				***	***
TBR30			*		

* Indicates 90% Significance

** Indicates 95% Significance

*** Indicates 99% Significance

Figure 3. Granger Causality Test (10-15yr)

	Lags of				
Dep. Vars	FFTR	FBPR	HMR15	TBR10	All
FFTR				***	***
FBPR	***			**	***
HMR15				***	***
TBR10					

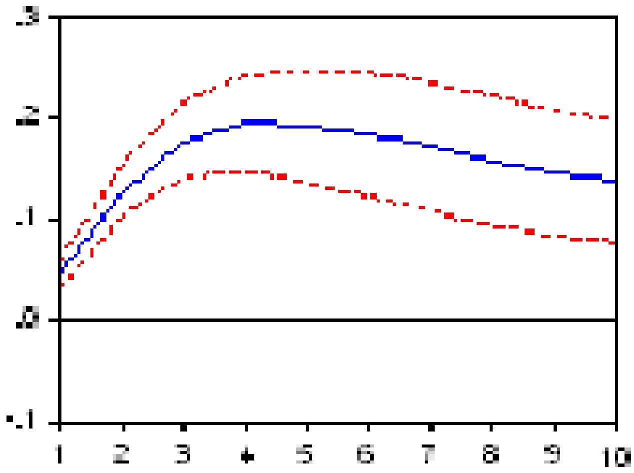
* Indicates 90% Significance

** Indicates 95% Significance

*** Indicates 99% Significance

Figure 4.

Response of 30 year home mortgage rate to shock in yield on 30 year Treasury bonds



Months

Figure 5.

Response of federal funds target rate to shock in 30 year home mortgage rate

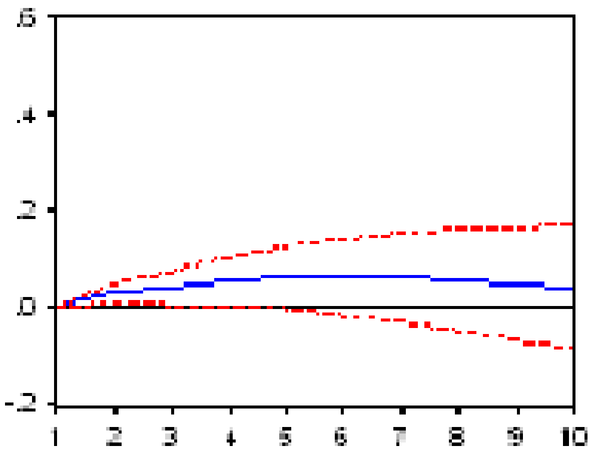


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Figure 6.

Response of 15 year home mortgage rate to shock in the yield of 10 year Treasury bonds

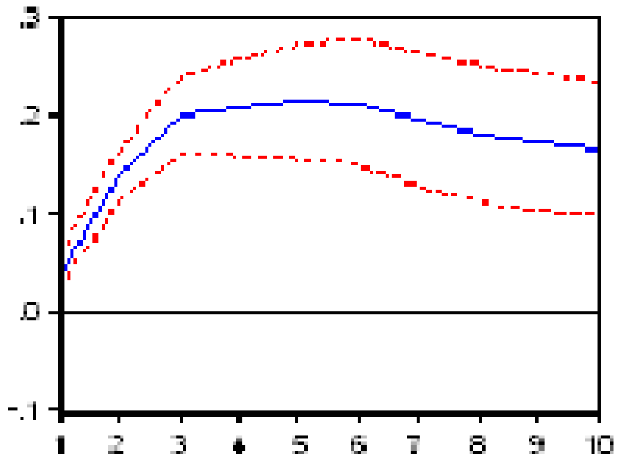

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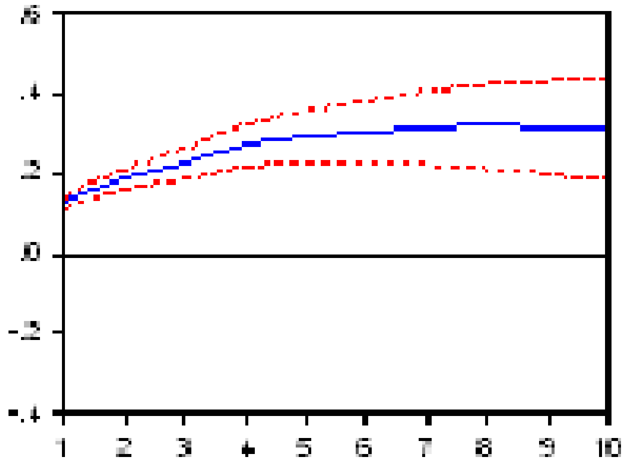
Figure 7.

Response of federal bank prime rate to shock in the federal funds target rate (medium term length model)



Months

An Analysis of Weather Derivatives

by Lincoln James for Money and Banking

Introduction

A weather derivative is a financial instrument whose underlier is some measurable aspect of the weather. These derivatives are different from other types of financial instruments in that the performance of the underlier is not largely affected by the economy.

This topic is approached in the spirit of discovery. I will first present a history of weather derivatives, then I will establish certain premises about what aspects of a general instrument affect its use in hedging situations so that I can show how these aspects relate to weather derivatives.

In analyzing the efficacy of weather derivatives, I describe an optimal weather portfolio for a durable goods or agriculture firm, as well as present both an example of numerical analysis and an example of successful real-world application, using the case of a Canadian vineyard.

I also consider modern weather derivative pricing theory to-date using one well referenced and well established model as well as a simpler Gaussian model. I explain inadequacies with these pricing models and, specifically, the paradigm of how the lack of valuation of expectation in current martingale models breeds arbitrage as well as possibly offering stability for hedgers. I offer a suggestion for improvement as well as images displaying martingale simulations with and without my suggestions.

Finally, I conclude that weather derivatives have great potential to act as both a powerful hedge tool in industry and a stabilizer in the financial market.

Note: The majority of the mathematics in this paper is left not cited for two reasons. Firstly, I generated and rigorously selected many of those equations not cited; and secondly, many of the equations not cited are logically simple and did not require years of research and development to generate. A good background for these equations can be found in Joshi[1]. All of the equations that I did not write myself or that are not common knowledge are cited. Interest rates are not considered.

History

To those who are not familiar with the methods of modern investors, a visit to the Chicago Mercantile Exchange website will probably induce a serious case of raised-eyebrowism.[2] One group of trading instruments that is listed on the site is particularly strange - of course I mean “weather products.” The funny thing is that further investigation into the definition of weather products is not an effective cure for confusion, especially in a country where gambling is mostly illegal.

Similar to other futures products, the famous “pork bellies” future for instance, speculators and hedgers alike can use these weather futures to profit on temperatures, amounts of rainfall, and even the occurrence of hurricanes.

The weather derivative is a relatively new financial tool. It was first traded privately in 1996 and OTC in 1997. Weather derivatives experienced a surge of trading in 1997-1998 because of atmospheric phenomena associated with El Nino. Much like the markets for CDSs, CDOs, and many other financial innovations, the market for weather derivatives has seen popularity and curiosity in the form of millions of trades[3] and serious concern by regulatory groups[4] [5] since its inception.

The history of these “natural” financial instruments is strongly tied with

1 Joshi (2003)
2 CMEGroup
3 Considine (CMEGroup)
4 Bates and Brown (2004)
5 Brown (2009)

the infamous Enron, a company that doesn't have quite the zing it did once upon a time. Famous for using tricky innovations, Enron was probably one of the most effective corporations at curbing uncertainty in its day and, perhaps, of all time.[6] Ironically, Enron's preternatural sense for cutting risk is well documented.

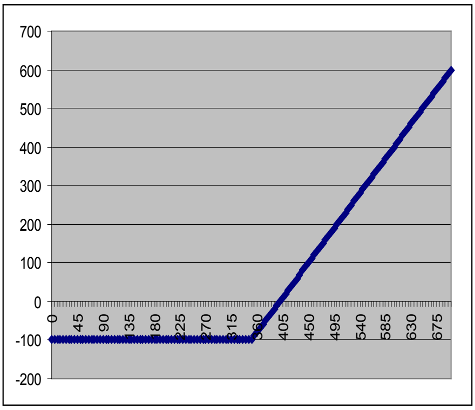


Fig.1: Payoff of a Call Option

Enron was the first to seriously consider the idea of creating a hedge for inclimate weather. Enron's business was energy, and at least at the time of the weather derivative's conception, a great deal of the energy supplied by Enron went to heating and cooling buildings. The amount of energy the occupants of a building need per day depends on the differential of their comfort level temperature with the temperature outside. So, for instance, when the weather outside on a winter day is warmer than usual, less heating will be required and therefore less energy will be used.

In its crusade against risk, Enron noted that the uncertainty of a particularly warm day in winter or a particularly chilly day in summer could reduce daily cash flow by millions of dollars. Hence, the first two OTC weather derivatives were planned: Heating Degrees Days HDD and Cooling Degrees Days

6 Considine (CMEGroup)

CDD.[7]

An average “comfort level” temperature for an occupant is about 65F. The difference between the temperature and outside will be called CD’s if the temp is higher than 65F (when more cooling is likely to be required) or HD’s if the temp is lower than 65F (when more heating is likely to be required). So, if it’s 98F outside, there will be 33 CDs and 0 HDs; similarly, if it is 60F outside, there will be 0 CDs and 5 HDs. HDD and CDD weather derivatives are based on a given number of HDs or CDs until expiry, usually a month or a season after the spot of the derivative.

Consider the example a city whose March HDD mean is 400 HDs. Suppose we are preparing a call option with strike 350 HDs, payoff $2/HD and price $100. The payoff curve in fig. 1 would apply.

To date, the most commonly traded weather derivatives are HDDs and CDDs. Although, as previously mentioned, others based on rainfall and catastrophes are also traded with less volume. For simplicity, in this paper I will only consider the dynamics of HDD and CDD instruments.

Considerations about the Efficacy and Feasibility of Weather Options

Clearly, it is of interest to Energy corporations like Enron to hedge against good weather. So, most likely, the average Energy corporation interested in trading a weather product will buy a put option. Where is the supply for the put options, though? Put-call parity demands such a supply, and up to this point no reasoning has been given in support of one. To answer this, we must delve further into the mathematics of the situation.

7 idem

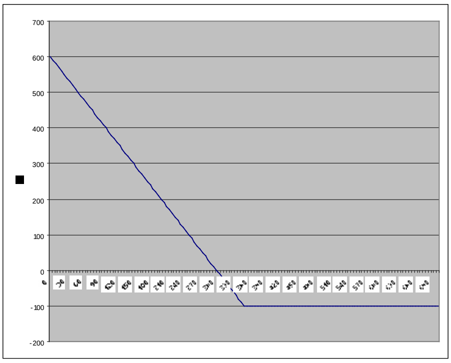


Fig.2: Payoff of a Put Option

Enron would prefer to buy a put option on CDDs or HDDs for one reason alone: the Payoff curve of the put option and the profit curves criss cross each other. For a simple theoretical example consider the put option scenario above.[8] Also, assume that Enron's revenues only come from cooling houses. Clearly, when CDD is 0 for a month, Enron didn't do a lot of business. Only those who feel very warm at 65F will be buying energy. Lets assume that that isn't enough to cover fixed costs. On the other hand, a heat wave might bring a month of 900 CDD's, in which case Enron's profits, assuming that Enron has the capital to cover demand efficiently, will be higher than ever. This is shown in Fig. 2.

Efficacy

The purpose of a hedge is to reduce risk. In mathematical terms, a hedge acts to lower the volatility of the firm's profits with respect to a risky variable. In this case for an energy firm, risk takes the form of nice weather. The volatility of the firm's profits is based on the volatility of the climate. If the profits of the firm are $\Pi(X)$, where X is a random variable, and the payoff of the weather instrument portfolio is PO(X). Then the hedged profits can be

8 idem

written

(1) $$\Pi_H(X) = \Pi(X) + D(X)$$

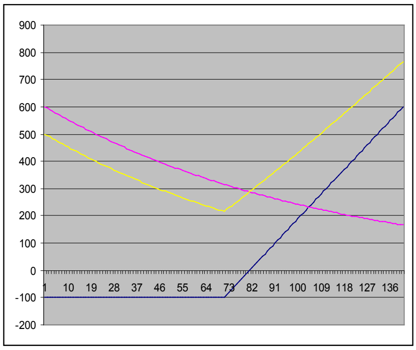


Fig 4: Theoretical graph of Profit/Call option for a weather sensitive company along with hedged profit (Yellow).To see the efficacy of the hedge in curbing risk, we define the “Hedge Efficacy” term as a ratio of the original profit volatility to the hedged profit volatility:

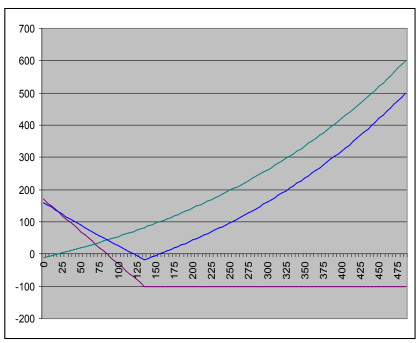


Fig 5: Theoretical Graph of Profit/Put option for a weather sensitive company along with hedged profit (Blue)

(2) $$H_p = \frac{\sigma_{\Pi}(X)}{\sigma_{\Pi_H}(X)}$$

If $H_p > 1$ the hedge is effective; otherwise, it is ineffective. After some manipulation, we see that the requirement for a hedge to be effective is simply that

(3) $$1 > -\frac{2COV(\Pi(X), \text{Ᵽ}(X))}{\sigma^{2}_{\text{Ᵽ}}}$$

Or analogously,

(4) $$\rho_{\Pi,\text{Ᵽ}} < -\frac{\sigma_{\Pi}(X)}{2\sigma_{\text{Ᵽ}}(X)}$$

Hence, when profits and payoff are negatively correlated with a correlation coefficient less than negative one half times the ratio of the standard deviation of profit to payoff regarding X, the hedge is effective. In the second appendix, I present inequalities of efficacy for a normally distributed HDD variable.

This proves true in the model of the energy company because the profits and payoffs have a clearly negative correlation especially in the money. To use this diagnostic tool further, we must put restrictions on the profit function. We know that the profit function, $\Pi = R - C$, is related to the quantity of a good sold, how efficiently the good was produced, and how expensive the inputs are in producing the quantity needed.

In theory, profit maximization could be as simple as continuous production functions and naturally negative definite Hessian matrices. In reality, the science is much more fuzzy. The tool we have generated here will be of great use to us, but for now it must be made clear that profits depend on other stochastic quantities. In this sense, all of the theory presented here is demand-side and relies on an essentially unwavering profit mechanism so that the effects of demand-side shocks due to weather can be seen.

Feasibility

I now present the second condition that I hold to be integral in the rational adoption of a hedge scheme - feasibility. A hedge scheme is not a good scheme if expected profits decline hugely in proportion to the risk averted, so the second condition for weather derivatives must relate, the percent change in expected profits before and after the hedge is taken to a value, $0 < \delta < 1$, that represents the maximum loss in expected profits that the hedger is willing to take. This condition is offered in a simple inequality.

(5) $$\frac{E(Đ)}{E(\Pi)} < d$$

Notice that, if the probability distribution of temperature is not skewed (that is, the mean and median are not significantly different) and if the distribution offers accurate information, as the number of months for which the same number of options are purchased increases, the difference of the actual HDD and the mean HDDs should approach zero. Because payoff is dependent on HDD, the expected payoff should also approach zero. In other words, over time, these options as hedges should do no harm to the bottom line.

The feasibility and efficacy inequalities provide a simple diagnostic for whether or not a business would benefit from a weather derivative hedge. Because payoff curves are usually simply defined and tractable, using the diagnostic, it is now possible to make two sensible statements about the prescription of inclimate weather instruments. Firstly, buyers of simple put options hold risk in good weather because the correlation of their profits with the payoff curve must be negative and the linear payoff curve is negatively sloped. Secondly, buyers of simple call options hold risk in bad weather because the payoff curve for a simple call is positively sloped. So, to find a basis for call buyers, we need only wonder which market sectors would make less money than they expect in inclimate weather.

Starr-McCluer of the Federal Reserve Board conducted research on weather risk in the retail industry and statistically showed many things that seem pretty sensical. She determined that during very hot days during the summer, retail stores (especially shopping malls) would experience surges in sales. She also found that during very cold months, people would put off the purchase of durable goods, especially new autos and home construction/ improvement materials.

I will bring to light a one example explored by Starr-McCluer of this and offer empirical evidence that in these cases weather derivatives will remove risk and increase expected profits.

Empirical Analysis of Hedging Temperature Risk

Starr-Mcluer[9] determined that over a monthly period, very cold weather can often cause dramatic shifts in demand for certain retail businesses. She finds that, during periods of cooling, the most affected are sellers of home construction and supply goods and resturants. She found that major shifts in monthly demand of durable goods would equilibrate itself seasonally (usually in the next two following months). Implicit in these findings is profit loss and cash flow risk for the months of bad weather.

Consider this case in terms of hedging strategy. Starr-Mcluer's findings state that for durable goods seasonal purchases are not significantly affected by weather. Therefore, for three consecutive months in which cold weather is to be expected and hedged against, acquiring a portfolio of three call HDD instruments each representing consecutive months is our prime consideration. To analyze this, we present the portfolio possibilities as a span vector with integral coefficients of the three weather instruments.

9 Starr-McCluer (2000)

(6) $$P = \sum_{i=1}^{3} \alpha_i M_i$$

If for each month, M_i, there is a different strike, s_i, and premium, D_i, then month i has a payoff function

(7) $$\wp(M_i, s_i) = \begin{cases} -D_i & s_i > S_i \\ -D_i + (S_i - s_i) & s_i \le S_i \end{cases}$$

So, our complete payoff function is

(8) $$\wp(X) = \sum_{i=1}^{3} \alpha_i \wp(M_i, s_i).$$

Common practice equates the premium (D_i) of the instrument to its expected return. To calculate this, we must have a probability distribution for X over a month M. As we will discuss later, in terms of volatility arbitrage and volatility hedging, there is currently no definitive pricing mechanism for weather derivatives. But for continuity's sake, we assume now that there is a perfectly known probability distribution of HDDs in a given area that describes the probability of a number of HDDs for a certain month of a certain year and relies on n parameters. We say that

(9) $$X \sim \mathrm{P}(M, \{a_i\}_{i=1}^{n})$$

With probability distribution function, $p(X)$, the premium of an option is then

(10) $$D = \int_{allX} \wp(X) p(X) d(X).$$

Clearly, the premium reflects expected payoff. So, if buying options over a specific three-month period is systematic for the firm and the options are priced by an unskewed symmetric distribution, losses due to premiums are negligible. However, in the short run they are not and actually help supply the ability of the hedge to decrease the volatility of profits. To emphasize that weather does cause volatility in the sales of durable goods, consider the Construction and Home Improvement sector. Starr-Mcluer found that over months of particularly low temperatures, Construction and Home Improvement firms see a substantial sales growth decline. S, sales during a month of cold weather, is proportional to the expected sales (including any other factors that might effect sales), and the exponential difference of X from the normal temperature. Recall that the sales are equilibrated usually in the months to follow.

Using her numbers we can estimate the effect on sales for this industry during the three month period of hedge. This is described by the matrix Σ that shows all possible effects on profit of a month of abnormally cold weather. The first row contains information on sales over a three month period when the first month is abnormally cold. The second row contains information for sales when the second month is abnormally cold. Part of the risk of managing a portfolio consisting of only monthly weather derivatives is the uncertainty of calling your options. There's no telling that your portfolio will hedge against anything. The fourth row demonstrates three months where the hedge is not necessary. Later, we will see that during these three months the firm will take losses from premiums.

$$(11)\quad \Sigma = \Phi(m - X)\vec{S} = \begin{bmatrix} e^{-0.109(m_1 - X_1)} & e^{0.091(m_2 - X_2)} & e^{0.068(m_3 - X_3)} \\ 1 & e^{-0.109(m_2 - X_2)} & e^{0.091(m_3 - X_3)} \\ 1 & 1 & e^{-0.109(m_3 - X_3)} \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix}.$$

Looking at the hedged sales matrix below, we see that the numbers in low months are boosted, and the numbers in high months are reduced.

Therefore, this firm will experience lower volatilities and a more even cash flow in the short run if it chooses to hedge effectively without injuring long-term gains.

$$(12) \qquad \Sigma_H = \Sigma + D\!\!\!/ \;(\Phi(m - X) =$$

$$\begin{bmatrix} S_1 e^{-0.109(m_1 - X_1)} + a_1(X_1 - m_1) & S_2 e^{0.091(m_2 - X_2)} - a_2(D_2 - (X_2 - m_2) & S_3 e^{0.068(m_3 - X_3)} - a_3(D_3 - (X_3 - m_3) \\ S_1 - a_1(D_1) & S_2 e^{-0.109(m_2 - X_2)} + a_2(X_2 - m_2) & S_3 e^{0.091(m_3 - X_3)} - a_3(D_3 - (X_3 - m_3) \\ S_1 - a_1(D_1) & S_2 - a_2(D_2) & S_3 e^{-0.109(m_3 - X_3)} + a_3(X_3 - s_3) \\ S_1 - a_1(D_1) & S_2 - a_2(D_2) & S_3 - a_3(D_3) \end{bmatrix}$$

In other words, feasibility is not a concern because monthly losses are less than they would otherwise be and the hedge is at least somewhat effective because it reduces volatility.

Optimization of a Weather Derivative Portfolio Hedge

After a few brief calculations, it is possible to show that there is a prefect number in the trade-off between profits and derivative prices in a weather derivative hedge. To work a consistent example, I assume that the company in conversation is one that is sensitive to higher temperatures.

Recall that Starr-Mcluer related expected sales to actual sales in a month of low returns in terms of not-normal HDDs, represented as t, by the exponential equation:

$$(13) \qquad S = \overline{S} e^{-kt}$$

Also, remember that profits consist of revenues less costs; so, it is important to distinguish between costs that are perfectly related with sales and costs that are not. To do this very simply, I assume that

(14) $$\Pi = (S - C_S)e^{-kt} - C_{NS}$$

where C is divided into costs assumed perfectly related with sales, and costs that are unrelated to sales. Only the costs that are related to sales are taken into account, and simplistically, other costs are held constant.[10]

We establish a difference between mean profits and actual profits by the following equation:

(15) $$\Pi^{\Delta} = \Pi - \overline{\Pi} = (S - C_S)e^{-kt} + C_{NS} - (S - C_S - C_{NS}) = (S - C_S)e^{-kt} - (S - C_S)$$

(From now on, we will write $A = S - C_S$ to simplify.)

Also we arrange a new variable centered at zero to describe the difference between mean HDD values and actual HDD values for the month in question:

(16) $$T = HDD - m_{HDD}$$

And we say as before that

(17) $$T \sim \mathrm{P}(M, \{a_i\}_{i=1}^{n})$$

The payoff function for a call, is assumed to be similar to those above; geometrically, two lines one with no slope and one with a positive slope beginning at strike and passing through the mean with zero payoff. Incorporating the payoff function, we can parse out the hedged product difference function (HPD) as such

(18) $$\Pi_H^{\Delta} = \{\Pi_{H,1}^{\Delta}, \Pi_{H,2}^{\Delta}\}$$

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10 It would be easy to argue that other costs should be taken into account (e.g. energy costs), but here I hold them constant.

Where

(19a) $$\Pi^{\Delta}_{H,1} = \Pi^{\Delta}(T) - xD \qquad T < strike = F = -D$$

(19b) $$\Pi^{\Delta}_{H,2} = \Pi^{\Delta}(T) - xD + xT \qquad T \geq strike = F = -D$$

In which, x is the number of options purchased and D is the price for which they were purchased.

Because D>0, there is certainly some added cost incurred in putting together a portfolio. One good strategy is to rely on the general principle that less than average profits are undesirable for cash flow. So, because negative values of the HPD function represent less than average profits, we will be focusing on minimizing the area underneath the T-axis and above the hedged profit difference curves.

To approach this, we first recognize that in this problem there are actually two feasible cases: firstly, there could be an x value so insignificant that the first section of the hedge product difference function does not see a zero and both of the zeros seen by the function occur in the second portion. Secondly, the first section (18a) of the hedge product difference function does see a zero and the second section (18b) passes through the origin (0,0). This is explained and illustrated later.

We ignore the first possibility because it results in gaping areas for positive T values, which only offering large negative expected HPDF values are inherently (this will be demonstrated) useless for optimization and are therefore irrelevant for optimization purposes. We, therefore, focus our efforts on the second possibility only.

Because we are only considering the second possibility, we can say that the zero of (18a) is

(20) $$T_1 = -\frac{1}{k}\ln\left(1+\frac{kD}{A}\right).$$

In minimizing this region, it is important to note that the T-axis, with which we are integrating, has an associated non-skewed symmetric probability distribution function. Observing that the Payoff function is zero at the mean HDD-value (T=0) and that the profit difference at T=0 is also zero and that the HPD is the sum of these two components, we know that the second part of the second part of HPD (18b) has a zero at the origin. Because of our assumptions about the probability of each T and the payoff function, minimizing the size of the interval between the two zeros of the HPD function is now congruent to minimizing the expected negative value of the HPDF.

We approach the problem by constructing an integral that describes in terms of x, the number of weather instruments purchased, the negative area that we want to minimize. However, before doing that, we must generate constraints to insure that our optimization is of the correct case (in which both 18a and 18b experience a zero).

Constraint 1: Because the second part of the HPD must reflect an effective hedge in its slope, its slope must be positive at zero, so $x > kA$.

Constraint 2: Because $T_1 < F = -D < 0$, we know also that for positive k and D, so $x \geq \frac{A(e^{kD}-1)}{D}$.

By expanding the right side of Constraint 2 using a quadratic Taylor Polynomial, we find that Constraint 2 is sufficient in determining constraint 1 because

(21) $$x \geq \frac{A(e^{kD}-1)}{D} > \frac{A(kD + D^2k^2(1/2))}{D} > kA$$

Our goal is to maximize the negative area thereby minimizing the absolute area. Our optimization concludes that:

(22)

$$
\begin{aligned}
x^* &= \min_{x > \frac{A(e^{\text{Đ}}-1)}{D}} \left(\int_{(\Pi_H^{\Delta}<0)} \Pi_H^{\Delta}(T)\,p(T)\,dT \right) = \min_{x > \frac{A(e^{\text{Đ}}-1)}{D}} \left(\int_{T_1}^{0} \Pi_H^{\Delta}(T)\,dT \right) = \\
&= \min\left(x\left(\frac{D}{k} + \frac{D^2}{2}\right) - A\left(1+\frac{\text{Đ}}{A}\right) \text{h} \left(1+\frac{\text{Đ}}{A}\right)\right) \\
&= \max\left(\frac{A}{D}\left(e^{\frac{\text{Đ}}{2}} - 1\right), \frac{A}{D}\left(e^{\text{Đ}} - 1\right)\right)
\end{aligned}
$$

The second derivative test verifies that this is a local maximum; however the offered minimum is not greater than our necessary boundary in constraint 2, so the actual optimal portfolio contains $x^* = \frac{A(e^{\text{Đ}}-1)}{D}$ instruments (Fig. 5).[11]

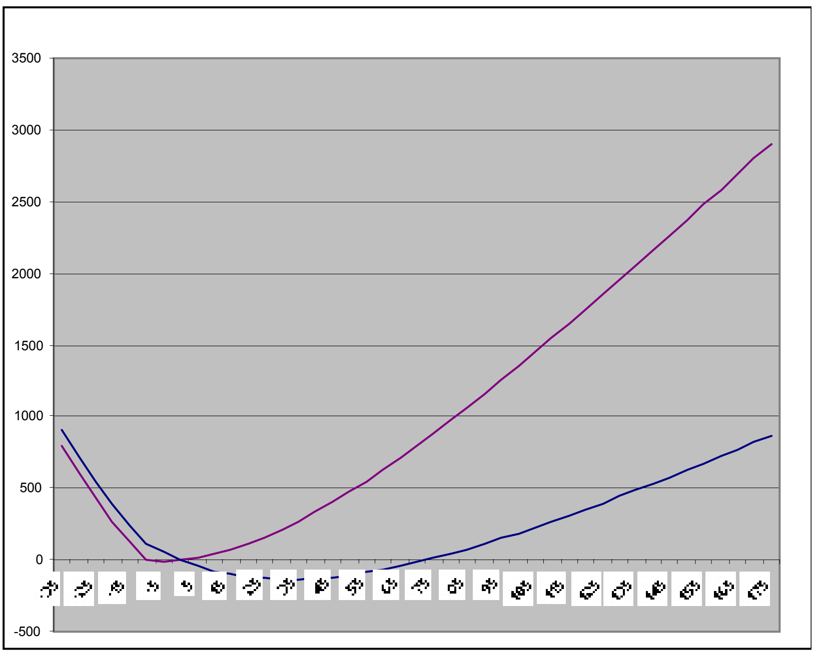

Fig. 5: Graph demonstrating the effects of two hedges. The purple hedge is the optimal hedge for the constraints. The area underneath the axis is less than average profit.

11 The miminum valued offered by differentiation is actually the minimum value for the first case mentioned above in which the first section (18a) does not see a zero and the second section sees two zeros.

To be more specific, consider the case of a Home Construction firm (k=.109) with A=$1M. Assume for extreme simplicity that the difference between the mean temperature and the actual temperature is described by T ~ N(0, 25), so that most temperatures lie no more than 10 degrees away from the mean temperature. The probability that we will earn less than average without a hedge is .5. However, the probability that he will earn less than average with a hedge is 0.15.[12]

In essence, as a hedge, weather derivatives have the potential to be very effective during months of economically hazardous weather. To conclude this section, I present one example of successful hedge activity in weather-sensitive industries.

One of the most obvious potential users of weather derivatives is the farmer. Due to the sensitivity of plant-life to weather, when subsidies are present the agricultural industry produces goods that experience almost characteristic profit around a range of optimal temperatures and rainfall. A theoretical model of the farmer’s profit without subsidy over a range of rainfall, for instance, would appear to have negative concavity. Too much rainfall will cause crops to fail, too little rainfall will lead to higher water costs. In the case of the farmer, a more complicated payoff curve will be more adequate. Hence, the farmer should hedge both against too little rainfall and too much rainfall. He should have a portfolio of both call options for high rainfall and put options for low rainfall. Canadian Ice Wine Firms have considered these strategies and have implemented them to at least some degree of success.[13]

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12 $\frac{1}{5\sqrt{2p}} \int_{-D/5=1/\sqrt{2p}}^{0} e^{-x^2/2}\,dx \approx 0.15$

13 Salmon (2009)

Pricing Models

Statistics, or more precisely stochastic analysis, may be one of the most fascinating aspects of the modern financial industry. Sophisticated, innovative methods have been both a blessing and a curse for options and futures pricing since the coming of Black-Scholes in 1973. After the recent economic downturn, Wired magazine published an article demonizing a retrospectively grim Gaussian copula formula, along with its inventor, for the unrealistic assessment and modeling of CDOs.[14] On the brighter side, formulas like that of Li’s and Black-Scholes have been very useful in pricing options to an incredible degree of accuracy for the last thirty years.

As complicated stochastic models and ever more realistic probabilities become known, pricing a contract correctly becomes increasingly important for financiers wishing to remain in business. Being unaware of the “good price” for a contract will likely eventually lead to either great losses or no sales.

Apart from weather derivatives, the most commonly used contract pricing tools are derivatives of the Black-Scholes formula. Given a payoff function, a date of expiry, a drift term of the underlying asset (an average of % movements), and a volatility term of the underlying asset (the standard deviation of % movements), one can, through SDEs or probability theory or even the Heat equation, start with a spot price and decide how much a contract should be valued. Essentially, one takes all of possible movements in price of the underlying asset until expiry and weights each one according to its probability. This gives an expected payoff which should equal the price of the contract.

Pricing weather derivatives is not that simple. More specifically, the equations defining random temperature movements are not that simple. For instance, it has long been understood that temperatures across the globe are changing at different rates; further, that global weather patterns do change

14 Cyr and Kusey (2005)

over time. To demonstrate the complexity of this issue in a few words, there is no absolute pricing mechanism for weather derivatives, although there are many suggestions.

Most of the suggestions use an Ornstein-Uhlenbeck process to describe temperature variations. Among the most thorough of these out to date is charged to Clements, Hurn and Lindsay (CHL).[15] Essentially, the CHL-model treats the variation of daily average temperature from its historical mean as its random variable but also takes into account via an additional term changes alterations in the mean and variance of Temperature over time. After one has done regressions for his specific location, he can standardize the modeled mean and variance to create a tractable value of the price of an option at a specific time over a specific expiry.

In mathematical terms, you must first start with some assumptions. First, you must gather data on specific calendar dates over many years and decide upon a temperature mean for that date, then you must suggest that all variations in this temperature mean can be modeled by a dependent variable

(23) $$\theta_t = \overline{T}_t - T_t .$$

Second, you must assume that temperature follows a dependent stochastic movement that is modeled in the form:

(24) $$d\theta_t = -a\theta_t dt + \sigma(t) dW_t .$$

Then you must use either an auto-regression as in CHL or a fractionally integrated process for deviations as in Caballero and Jewson in order. In doing so, however, you must add some sort of term to rule out the weakness of

15 Clements et al (2008)

modeling every year independently from the same statistics.

This is a powerful step toward a reasonably accurate pricing system, but what still remains is estimation of the change in temperatures year-to-year and an unreasonable disregard for future predictions based on non-martingale methods. Although CHL adds a linear term to their regressive finite Fourier series to describe year-to-year changes, such a term is probably not adequate in describing drift very accurately. Further, daily changes other factors such as information will certainly yield different implied market volatilities and will likely change the value of the option over time.

The natural question to ask is whether or not is it adequate to use autoregressive statistics on weather based strictly on the past when predicting prices based on weather patterns for the next month or season? Or, more precisely, how heavily should we rely on past information?

The CME group currently uses a simplified version of the “Optimal Climate Normal” via local weather stations. The Optimal Climate Normal (OCN) attempts to find the best distribution for the weather of the future based on weather of the past. People who have worked with this system have spent much time pondering appropriate data sets and trends.

The Inadequacies of Martingale Pricing Methods

Although there is a high degree of sophistication entailed in the work of these authors, to the question of whether anyone should rely on single martingale methods, like those discussed above, for the sake of pricing weather derivatives I offer a resounding “no.” I have waited until this time to go into further detail about martingales, but now it is important to understand one fundamental concept of martingales for purposes of continued analysis.

Firstly, all discrete-time martingales (the continuous case is similar) describe random variables X such that

(25) $$E\left[X_i \middle| \{X_1, \cdots, X_{i-1}\}, I\right] = f(X_{i-1})$$

The expected value of an event given all of the previous events and some information about drift or volatility should be a simple function of the last event.

In the case of the pricing methods above, we are only considering some drift term that is based on our regression analysis and all of the past information to describe future temperature distributions. However, we are completely denying any power to predictions of temperature and weather patterns based on observational research (watching a cold front swing in from the Atlantic, for instance).

If information about future weather patterns that is predicted on the basis of observation is given any quantity at all, single martingale models are not alone sufficient to price weather derivatives. Or mathematically, if we are given a prediction, P, with 90% real probability that X_i will be X and a 10% chance of being irrelevant, then the true expected value should functionally reflect that adjustment. In some sense, the martingale should respect good predictions according to their relevancy.

I offer a few martingale-like simulations based on a single series of Brownian motions and altered parameters in an appendix to demonstrate this point graphically. The graphs simulate the change in probability density, and therefore derivative price, by taking into account information about a predicted cold front.

Conclusively, for a pricing method to be sufficient, it must consider all possibly true information at hand, otherwise there can be arbitrage. Because the probability of the occurrence of predicted weather increases as the ability to predict weather increases, a side conclusion is that pricing methods should also increase in accuracy as weather predictions increase in accuracy.

Information and Arbitrage

In 1989, Stephen Ross wrote an article in response to the New York City financial crisis that had occurred a few years earlier which was caused, at least in part, by information. Ross writes specifically about the newspapers covering the story of a large audit describing “the state of revenue collection” that was to occur three months in the future and completed in an additional month. Instead of delaying the report of the audit for three months after its completion, whoever was in charge of the information decided to relay it immediately. Ross reasoned that, at face value, there must be a market difference between information delayed and information reported immediately.

Among several surprising theorems based on a no-arbitrage assumption, Ross concluded that the variance of price must equal the rate of true information flow. He does this essentially by reasoning that in a perfect world (no-arbitrage) a variable q, the pricing standard, and s, information, are enough to judge the price of a contract. By attributing martingales to both q and s, he demonstrates that

(26) $$s_p^2 = s_s^2 .$$

A realistic corollary of this theorem is that when the variance of price is not equal to the flow of information (i.e. when the above equality does not hold), there is opportunity for arbitrage.[16]

Suppose your buddy wagers you to stand on a particular railroad track for a chosen two minutes during a chosen day. Suppose also that your martingale predictions based on years and years worth of previous data suggest that during that specific two-minute period of that specific day there is only a .01% chance of a train passing that spot. Would you hold true to the wager

16 Ross (1989)

if you saw a train in the distance, relying solely to fend off nuclear force with the claim that "the event is improbable?" No. Information is highly important in this situation. In this case, if your friend saw the train and you didn't but relied, reasonably, on past knowledge, then your friend conducted arbitrage via information.

Realizing now that current pricing methods rely on random martingales extended over relatively long periods of time, and also that temperature distributions can vary predictably based on somewhat foreseeable events (cold-fronts, cloud cover, etc.), it becomes clear that information is also of huge importance in weather derivatives.

The occurrence of a predictable cold front has immediate applications for volatility arbitrage as well. The pricing strategies above consider temperature variations as regressive to a moving mean, so wide spreads should in theory autocorrect. But it is easily imaginable that a cold front could drag on through the expiry of the contract. In this case, the realistic volatility between days, which will reflected in the implied market volatility of the contract between days, is certainly not the same as the volatility that a stochastic model would state about such a period. In terms of a cold front, the implied volatility is almost certainly less than the predicted volatility. If two contracts are up for grabs, a fresh one reflecting predicted volatility and a dirty one reflecting implied volatility, an opportunity for arbitrage exists.

I suspect that better algorithms will combine future events with expected values from past data and trends. Indeed, it is likely that some of these algorithms are already being employed.[17]

Better models in this case lead to a paradigm. As technology for weather prediction becomes more advanced and more accurate, and as weather prediction becomes more incorporated into pricing models, the volatility of price and the extent of arbitrage opportunity will likely decrease alongside the

17 Arrington (2009)

premium for weather instruments. However, because volatility of price and hedging power are not linearly related it is likely that the decrease in volatility of price will negatively affect the hedging efficacy of weather derivatives.

Because these derivatives exist because of their use in hedging, it would be insulting to watch them become purely speculative, for that purpose we must ask if it is a good idea to make these models extremely accurate. Where there is arbitrage, it will only exist for a short time and is fairly harmless in the long-run.

Location

HDD and CDD derivatives concern only a handful of cities. This is probably because, to date, energy companies have been the biggest users of weather derivatives. However, as this form of hedging becomes more useful for agriculture businesses, there is concern that geographic generality will become more important.

This problem has not gone unnoticed. Work has been done that moves weather derivatives closer to being applicable for agriculture. Manfredo and Richards concluded that properly accounting for the volume of the hedge was more important for those in the agricultural industry than selecting the correct weather station.[18] Other work has offered the solution of triangulating the farm between different stations and weighting their portfolio thusly.

Conclusions

I have presented a background for weather derivatives and I have explored analytically their hedging potential for home improvement and construction businesses. I also found an optimal hedging portfolio depending on the sensitivity of the business to poor weather.

18 Manfredo and Richards (2009)

Having critiqued the modern pricing techniques of weather derivatives, I feel that most of the work to come in weather derivatives will deal primarily with this challenge. Although it would include a huge amount of calculation, I believe it would be fruitful to consider aspects other than temperature (cloud cover patterns, storms, etc.) in order to more accurately distribute HDDs and CDDs.

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Neoliberalism in Brazil: Short Term Gains, Long Term Trouble

by Chris Mohler-Morgan for Money and Banking

Neoliberalism flourished across the world in the late 20th century as the perceived silver bullet for third world development in a globalized market. In Brazil, the strongest adherent to this economic ideology was Fernando Henrique Cardoso, who first entered into the political arena as the minister of finance and was subsequently elected as president two consecutive times. In Brazil, the effects of Neoliberalism did not lead to the promised development outlined in the Washington Consensus. In this paper Neoliberalism will be analyzed using three separate events and ideas, the 1994 Real Plan, interest rates in the 1990's, and the role of current president Luiz Inácio da Silva in continuing Cardoso's legacy. This paper will show that Neoliberalism was, and still is, not the ideal development strategy for Brazil and proposes several alternate strategies to combat growing inequality and macroeconomic instability

This analysis of economic and fiscal development in Brazil has drawn from a rich background of scholarship. This section will describe the academic literature which has served as a foundation for this analysis. This literature has been separated into three separate categories corresponding with the various portions of the paper, historical development, fiscal policy, and neoliberal policies, and the differing scholarly viewpoints will be analyzed.

Lopes and Font provide historical context to current debates. It is necessary to understand not only the transition from military rule to democratization, but also the history of Brazil as a Portuguese colony. Lopes goes great lengths to explain the roots of the multicultural Brazilian society and their impacts on culture and overall development. While both authors detail historical events, Font does not focus on events outside of the twentieth century. These books were written prior to the 2002 elections in which Luiz Inácio Lula da Silva was elected. Thus, the conclusions drawn about economic concerns in the 1990’s are stunted, but still relevant. Rojas-Suarez provides another aspect of development in her collection of development profiles. She focuses on the factors that will increase GDP growth and overall economic development, this include fiscal, judicial, educational, and political reforms among others (Rojas-Suarez 2009). She is writing as a representative for the Center for Global Development and the ideas proposed in her research are echoed by other scholars, such as Eul-Soo and Cinquetti. The Organization for Economic Co-operation and Development provides essential data concerning the state of Brazil during the current global financial crisis. While the OECD does have a strong Neoliberal bias, its data and analyses are sound.

The last two decades in Brazil have been turbulent financially, causing many researchers to analyze the situations underpinning the various crises of the 1990’s. This historical volatility underpins De Mello’s study of market expectations for inflation, which centers on the importance of price stability. Amman and Baer question whether recent fiscal reforms aimed at the opening up of Brazil’s domestic market to foreign competition and investment have really led to a diversification of corporations. Their analysis using the contestable market hypothesis concludes that the loosening of tariffs and barriers of entry to foreign corporations has actually forced a market concentration in Brazil (Amman, Baer 2007). All of these authors provide valuable insight into the recent and historical developments in banking and monetary policy.

Neoliberal economic thought became prevalent in Brazil in the early 1990’s under the presidency of Fernando Henrique Cardoso. Lourdes and Saad-Fiho offer an introduction the theories underpinning Neoliberalism, which centered around the assumption that market regulation is the best way to delegate economic activity. Neoliberalism also relied on the privatization of many previously state-owned enterprises, in an effort to liberalize the market. This was in direct reaction to the prior state policy of dirigisme, which was the governing economic principle during military rule, as explained by Pang. There was no disagreement amongst the various authors that the policies of Cardoso were extremely effective in curbing the outrageously high inflation during the Real Plan in 1994. Amann and Baer argue that many of the policies utilized were meant to be merely temporary and are hampering current and future growth. Cinquetti also rallies against the untenable laissez-faire attitude of fiscal policy; he argues that more regulation is needed because exchange rates and high interest rates are not sufficient tools to further development. Mollo and Saad-Filho point out that while many leading politicians and economists wanted economic policy shifts in the 2002 election, pressure from the corporate and financial sector coupled with the specter of inflation forced Luiz Inácio Lula da Silva do continue the policies implemented by Cardoso a decade earlier.

It is important to explore the evolution of the Brazil from its discovery and colonization up until the fall of military rule in 1988. This section will seek to highlight the most pertinent details in historical evolution culminating with the modern Brazilian state. In 1500, Pedro Álvares Cabral discovered Brazil under the flag of the Portuguese empire. Initially, this new colony seemed to lack the raw materials which served as incentives for European exploration, mainly spices and gold. "The Land of The True Cross" as the new territory was initially known, became Brazil after the discovery of pau-brasil, a special type of wood used in making red dye (Russel-Wood 2008). In 1510 the Portuguese began the introduction sugarcane cultivation to the new colony. This would prove to be the backbone of the Brazilian colonial economy until coffee supplanted sugar as the most lucrative agricultural commodity produced. In the 17th century, Brazil dominated the world sugar market, producing over 40% of all sugar in the world (Lopes 2002). In the eyes of the Portuguese, Brazil was to be a primary source of raw materials, thus the economy was predominantly agricultural and export-oriented. Commencing in the 18th century, coffee cultivation supplanted sugar as the most lucrative export (Russel-Wood 2008). The production of sugar and coffee (and for a brief period, extracting gold), was extremely labor-intensive operations. Coinciding with the rise of sugarcane, in 1540, Brazil began importing slaves initiating a brutal period in Brazilian history which lasted until 1888 (Lopes 2002).

The 18th century was tumultuous period in Europe, as the Napoleonic Wars raged across the continent. Escorted by a fleet of British vessels, the ruling prince of Portugal fled to Brazil in 1807. This inaugurated the only modern monarchy in the western hemisphere, which lasted for 81 years (Dean 2008). Brazil benefited immediately from the movement of the crown, sea trade was opened, industrial activity was encouraged, and universities were established (Lopes 2002). Following the parliamentary recall of the king to Portugal in 1815; the prince regent Pedro declared Brazil an independent empire in 1822 (Dean 2008). The modern period of Brazilian history began in 1889 marked by the transition from a constitutional monarchy to republic. This transition led to the abolishment of slavery and greater suffrage rights nationwide. The following period of Brazilian history was marked by rising union power, revolts against republican corruption, and the power inequalities amongst the three branches of government would cause systemic destabilization. It was against this backdrop that the revolution of 1930 occurred. The bourgeois led this revolt against powerful landlords and their purchased political influence. The revolution resulted in a brief dictatorship followed by a return to democracy that lasted up until 1964 (Maria Laymehyer Lobo and Morgan 2006).

Inflation was the key cause behind the military seizure of the government in 1964. The rise of the military regime caused society wide restrictions on economic activity as the military government was a firm supporter of dirigiste economic policy (Pang 2002). This coincided with the rise of import substitution programs, which were meant to promote domestic innovation. Instead they lead to a greater concentration of wealth amongst government officials and chosen business partners. The 1970's witnessed exponential economic growth for the nation and seemed to validate the economic policies of the ruling generals. Yet, this growth was not destined to be long-term. Domestic capital was inferior to international standards, thus good produced were not competitive on an international level. Brazilian goods had great difficulty in appealing to foreign consumers. These state-owned enterprises had little incentive to be efficient or maximize profit; instead they were incredibly corrupt and marked by over employment and fraud. Furthermore, Brazil was at the mercy of international creditors during spikes in energy or other imported commodities (Pang 2002). Domestic production began to fall while foreign debt and domestic poverty rose under the import substitution industrialization policies (Maria Laymehyer Lobo and Morgan 2006). After the drafting of the 1988 constitution, Brazil once again had a democratically elected president after decades of military rule. The reforms during this period were insufficient to bring order to a society that was still undergoing the effects of capital inefficiency, inflation, and closed markets (Bresser-Perreiera 2009, Pang 2002).

By the early 1990's American economic policy makers had formulated what they considered to be the "silver bullet" to international economic development. This set of development orthodoxies was collectively dubbed the "Washington Consensus". The ideal developing nations were those undergoing the transition for socialist, dirgiste planned economies to free-market capitalism. These technocrats were especially successful at convincing leaders of East Asian countries to liberalize their economies, such as China, Korea, Singapore, Hong Kong, and Thailand. Many Latin American governments also followed the principles of the Washington Consensus with varying levels of adherence, for instance Mexico, Argentina, Brazil and Peru (Massey et al. 2006). In this section, the history and origins of neoliberal economic thought will be explored, followed by an analysis of how these fundamentals were transformed into the Washington Consensus.

Neoliberalism arose from several different schools of economic thought in the early 20th century. The Austrian school has had the most impact on the modern theory of Neoliberalism under the two leading economic theorists at the time, Ludwig von Mises and Friedrich von Hayek (Turner, 2005). These two economists made the necessity of free markets the foundation to their concepts concerning ideal markets and the world economy. With the preeminence of free markets established, Hayek and Mises explicated their theory further with four main premises, the "spontaneous order of markets", the transmission of limited knowledge, the inherent efficiency of a free market, and the essential, albeit limited, role of the government (Turner, 2005).

The first premise is that the market is a natural evolution of human need and desire, similar to Adam Smith's notion that the pursuit of individual needs creates market efficiencies. The Austrian school went further and based their theory of the evolution of the market off David Hume's idea of human reason being incapable of understanding the basic rules underpinning social order. In this sense, the market was truly a manifestation of individual need, Hayek explains the market as "a result of human action, but not human design," (Turner 122, 2005). In this sense, no one person could grasp the true complexity of the market, but in pursuing their financial goals, they would help cement the stability of the whole market. Thus, the market is merely a means of delivering knowledge in a way that is digestible.

The efficiency of a market is based upon this same evolutionary underpinning. Income is not tied to the amount of work; instead it is tied to how your individual contribution is valued by the consumer. In this sense, to compete in the market you must have a marketable skill that is needed by others, if not, you are eliminated (Turner, 2005). It is interesting to note that at the time of the Austrian school, many other schools of thought were being affected by evolutionary theory, for instance the support for eugenics in the medical community. This presents a dog-eat-dog success strategy, however Neoliberal ideology does support minimum government welfare. In the implementation of Neoliberal policies, especially in the United Kingdom and the United States in the 1980's but also in Latin American countries, welfare programs have faced fierce opposition in favor of private enterprise, voluntary charity, and family (Cohen and Centeno 2006, Turner 2005)

The role of the government is limited, but it does provide necessary infrastructure (Massey et al. 2006). Hayek's ideal government was one that delineated between the necessity of a free market and the essential rules of law which underpin a society and facilitate the functioning of the market (Turner 2005). In Brazil, the selling of state owned enterprises was one of the ways in which the government's role in the market was reduced (Pang 2002). There was no sizeable decrease in government spending, instead many government tariffs were abolished (Centeno and Cohen 2006). Thus, this principle of Neoliberalism was effected in varying degrees and methods by developing nations.

The theory of Neoliberalism is not without its detractors. Because Neoliberalism holds that money is neutral, making inflation an imbalance of currency and goods, there is a strong emphasis on the manipulation of interest rates to control inflation. The neutrality of money is rejected almost universally by economists, especially post-Keynesians, along with the quantity theory of money (Mollo and Saad-Filho 2006). In addition, one of the key concepts of the Washington Consensus, which will be explained in the following section, was to attract foreign investment (Amann and Baer 2006). This required interest levels had to be relatively high, thus weakening one of the few tools available to control inflation and encourage savings. The overreliance on interest rates severely hampered the role of monetary and fiscal policies in promoting growth and reducing inflation. Neoliberalism has also been criticized for worsening poverty and global inequality by promoting global capital mobility and increased financialization, which can exacerbate the already fragile economic conditions present in developing countries (Lourdes and Saad-Filho 2006). In the case of Brazil, it was the trap of high interest rates and exchange rate manipulation that hampered economic growth (Bresser-Pereira 2009). These initial concerns represent a few of the critiques aimed at Neoliberalism. In truth, the greatest critique available is the detrimental effects this policy implementation in developing countries.

The theories of the Austrian school were resurrected in the 1980’s and 1990’s by leading economists and propagated as the ideal way to for a developing nation to become competitive in a globalized world. The key components to this consensus were: reduce trade barriers, encourage foreign investment and the entry of foreign firms, reduce the presence of the government in the market, and privatize state owned enterprises (Amann and Baer 2006, Bresser Pereira 2009).

In the case of Brazil, the economy prior to the implementation of neoliberal policies was ruled by a heavy-handed, corrupt state that relied on import substitution industrialization through state owned enterprises (Pang 2002, Massey et al. 2006). The Washington Consensus represented an enormous policy shift for Brazil. Indeed, the last two decades of Brazilian history were quite tumultuous politically, economically, and socially. The effects of neoliberal monetary and fiscal policy reforms have been long-lived and perpetuated by current leadership (de Lourdes Rollemberg Mollo and Saad-Filho 2006). Neoliberal economic policies and the political coalitions that have formed around them have been collectively dubbed the “Neoliberal-Dependent Pact”, which is based upon the concepts of the Washington Consensus (Bresser-

Perriera 2009). In the following section, three separate events will be analyzed to present a comprehensive view of Neoliberalism in Brazil, the Real Plan, the interest rate trap, and finally current economic policy under Lula.

The Real Plan arose out of the need to combat rampant inflation in Brazil during the early 1990's. The threat of inflation had been present in Brazil for two decades prior to the plan and in the early 1990's there were record levels of inflation (Amann and Baer 2000). This drastic plan did have immediate results, in 1996, only two years after the Real Plan's inception; inflation had fallen from a high of 50.7% to the low teens (Amann and Baer 2000).

Table 4. *Annual rates of inflation 1990–99*[a]

1990	2739
1991	415
1992	991
1993	2104
1994	2407
1995	68
1996	9.3
1997	7.5
1998	1.7
1999[b]	8.9

[a] *Source*: Conjuntura Economica.
[b] Estimate.

This plan was the brainchild of Cardoso while he was serving as Minister of Finance under President Itamar Franco. Cardoso's initial reforms focused on reducing government spending and increasing the efficiency of tax collection. The Real Plan emerged as a two-pronged attack on the economic woes of Brazil, which included increased taxes and reduced government expenditures; the second part was the introduction of a new temporary currency, the URV. Because the dates in which units of real value or URV's, the interim currency, would switch to reals were announced prior to the transfer, prices and markets were able to adjust effectively (Cinquetti 2000). While prices initially increased as retailers capitalized on consumer confusion, they soon began to fall along with weekly interest rates (Amann and Baer 2000). As Brazil made the transition away from the cruzeiro to the real, official exchange rates were changed daily, thus, when goods were purchased in URVs, change was given in cruzeiros (Pang 2002). In effect, by dollarizing the currency of Brazil, Cardoso dampened inflationary expectations and brought back short term-stability to the Brazilian market. To further reduce the risk of inflation, monetary policy became very restrictive and the monetary base was not allowed to increase (although increased demand for money, not related to inflation forced the central bank to increase the monetary base). Additionally, interest rates were raised to discourage excessive consumer spending, a move which had dire consequences for long-term stability (Amann and Baer 2000). The Real Plan had amazing short-term benefits for the Brazilian economy, furthermore, it cemented Cardoso's role as the economic savior of Brazil.

To keep the real/dollar exchange rate stable and to diminish the risk of inflation, short-term interest rates were raised substantially (Amann and Baer 2000). It is important to note that Brazil has no publicly traded long term bonds, thus, short term interest rates are of vital importance. These short term interest rates greatly increased the amount of foreign savings in Brazil. This growth was congruent with the open-market ideals of Neoliberalism which held that international financial markets should be easily accessible and allow for the free flow of capital to places with inviting interest rates or investment opportunities (Bresser Pereira 2009, Massey et al. 2006). These high interest rates also curtailed domestic investment which in turn exacerbated unemployment. Compared to other developing economies, Brazil's interest rates were indeed quite high and also experienced a lot of volatility in the 1990's (Bresser Pereira 2009, De Lourdes R. Mollo and Saad-Filho 2006).

	GDP growth rate (%)	Inflation rate (%)[a]	Real interest rate (%)[b]	DPD (%GDP)[c]	DPD interest payments (%GDP)[d]	Primary fiscal surplus (%GDP)
1990	−4.3	1476.7	−5.6	17.6	n.a.	4.6
1991	1.0	480.2	8.6	15.9	29.5	2.7
1992	−0.5	1157.8	37.9	15.6	47.3	1.6
1993	4.9	2708.2	9.5	17.0	67	2.2
1994	5.9	1093.9	32.0	21.7	32.2	5.2
1995	4.2	14.8	33.5	22.7	7.5	0.3
1996	2.7	9.3	16.8	26.1	5.8	−0.1
1997	3.3	7.5	16.6	29.3	5.2	−1.0
1998	0.1	1.7	26.5	34.1	7.9	0.0
1999	0.8	20.0	4.7	39.4	13.2	3.2
2000	4.4	9.8	7.2	39.4	8.0	3.5
2001	1.3	10.4	6.5	41.6	8.8	3.6
2002	1.9	26.4	−7.0	44.1	14.2	3.9
2003	0.5	7.7	15.3	44.0	7.9	4.3
2004	5.2	12.1	3.9	45.0	7.1	4.6

[a]General Price Index, domestic availability (IGP-DI).
[b]Calculated from monthly Selic rates and centred IGP-DI.
[c]Net domestic public sector debt (December, excluding 1990 (= January 1991).
[d]Nominal interest payments by the municipal, state and federal governments (including social security), the central bank and the state-owned enterprises.
Sources: Central Bank of Brazil (http://www.bcb.gov.br) and Ipeadata (http://www.ipeadata.gov.br).

These volatile interest rate shifts resulted from the trap caused in part by inherent instability which the Real Plan only patched. In effect, the high interest rates caused the real to appreciate and encourage capital accumulation, not investment. This worsens the government deficit as there is little expansion of the tax base, while they still have to pay high levels of interest (De Lourdes R. Mollo and Saad-Filho 2006). But, if the interest rates fall, inflation will rise as the real appreciates. The fear of inflation and the specter of inflationary expectations force the central bank to preserve high interest rates at the detriment to development (Bresser Pereira 2009). It was in this environment of high interest rates and low growth, which led to two successive balance-of-payment crises in 1998 and 2002 (Bresser Pereira 2009, Pang 2002).

As Asia and Russia succumbed to financial crises in the late 1990's, Brazil was also struggling with its own crises. Capital outflow was massive in emerging markets as investors feared that the crises would have global impacts. To combat this flight, the government raised interest rates to levels approaching 50%, which in turn brought the whole nation to the brink of a massive recession (Amann and Baer 2000). Interest rates this high were wholly unsustainable, especially as the government was already transferring large amounts of tax revenue from income and assets to interest payments (De Lourdes R. Mollo and Saad-Filho 2006). For the first time since the inception of the Real Plan, the exchange rate floated freely, causing the real to devaluate by 40% in just two months in 1999 (Amann and Baer 2000, 1817).

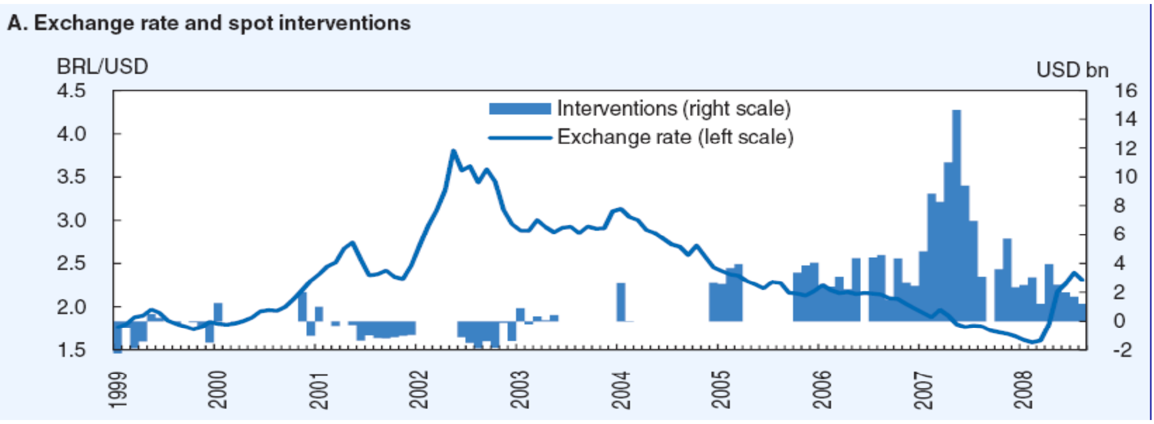
Table 3. *Monthly exchange rate (R$ per US$), 1994–99*[a]

	1994	1995	1996	1997	1998	1999
January	0.14	0.85	0.97	1.04	1.12	1.98
February	0.20	0.84	0.98	1.05	1.13	2.06
March	0.28	0.89	0.99	1.06	1.13	1.72
April	0.40	0.91	0.99	1.06	1.14	1.66
May	0.58	0.90	0.99	1.07	1.15	1.72
June	0.83	0.91	1.00	1.07	1.15	1.77
July	0.93	0.93	1.01	1.08	1.16	1.79
August	0.90	0.94	1.01	1.09	1.17	1.91
September	0.87	0.95	1.02	1.09	1.18	1.92
October	0.84	0.96	1.02	1.10	1.19	1.95
November	0.84	0.96	1.03	1.11	1.19	1.92
December	0.85	0.97	1.04	1.11	1.21	1.85

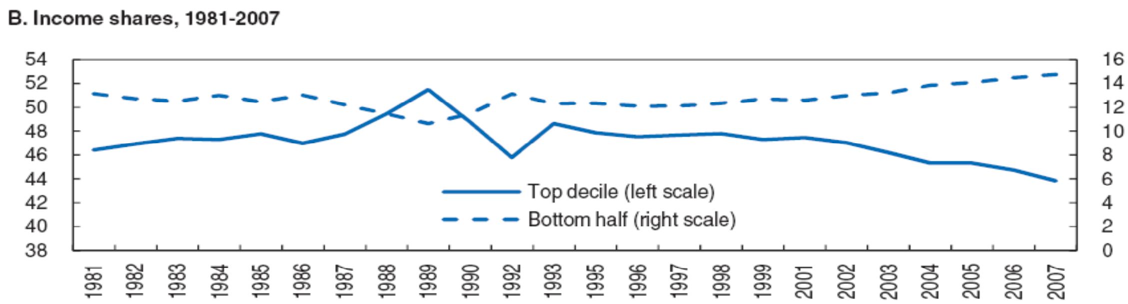
[a] *Source*: Banco Central.

This triggered an enormous trade balance between Argentina and Brazil, as Brazil's currency depreciated and its exports became very attractive. It was in this environment that Luiz Inácio da Silva became president, thus ending the Cardoso era. Prior to his election, domestic and international financial institutions demanded that Lula guarantee a continuation of high interest rates at the risk of capital flight (De Lourdes R. Mollo and Saad-Filho 2006). The four main areas of importance were maintaining a fiscal surplus, fighting inflation, preserving a floating exchange rate system, and respecting existing contracts (Paiva 2006). Furthermore, the IMF, itself a staunch supporter of Neoliberal economics, demanded that any forthcoming loans would be contingent on the complete independence of the Brazilian central bank (Bresser-Pereira 2009). .

Since the election of Luiz Inácio da Silva as president, there have been quite a few changes in the economic policies of Brazil. For instance, Brazil stopped targeting exchange rates in 1999 and focused on inflation rate targeting. The central bank is still active in the foreign-exchange market. The role of the bank is to smooth out volatility and increase international reserves through open market activity; this graph shows their recent interventions since the new policy (OECD 2009).



It is interesting to note that the increased speculative volatility stemming from uncertainty in the economic policies of Lula led to a huge speculative attack on the real in 2002 (De Lourdes R. Mollo and Saad-Filho 2006, OECD 2009). The new Lula administration worked hard to decrease public debt by running fiscal surpluses in the early years of the administration. This made spending for social programs decrease. Lula was a populist candidate who showed strong support to unions, social programs, and welfare. In the 2006 elections, his voting base was a disparate mix of the poor, which he enticed with promised minimum wage increases and increased social spending, and the very wealthy, which he enticed with promises of continued high interest rates. Thus, paradoxically, Brazil experienced greater income concentration along with a reduction in poverty (Bresser-Parreira 2009). These policies have had an overall positive effect on equality and income distribution in Brazil since 2006 (OECD 2009).



One of the best signs of positive economic growth and change in Brazil is that during the financial crisis of the past year, Brazil was able to emerge relatively unscathed. The central bank lowered reserve ratios to increase liquidity and the government loaned money to specific banks to encourage lending and investment (OECD 2009). Brazil is emerging from the deleterious effects of many of the economic policies implemented two decades ago. As Brazil emerges from the global financial crisis it needs to acknowledge that here are still significant roadblocks to development and growth.

In terms of monetary policy, the last great development obstacle is the high interest rate. The Central bank fears that reduction of the short term interest rate would cause inflation and serve as a disincentive for foreign investment. Critics believe that were the central bank to show a long-term commitment to lowering and stabilizing interest rate volatility this may mitigate these effects (Bresser-Pereira 2009). The state has severely limited the tools in which it can affect monetary policy and the overall economy through the overreliance on interest rate manipulation. Larger state expenditures could help compensate for initially low levels of foreign investment and capital during the initial period of lowering interest rates. This would also help to alleviate the high unemployment rate in the interim before domestic savings and investment rebound (De Lourdes R. Mollo and Saad-Filho 2006). While Neoliberal ideology may balk at strong state development initiatives, it must be remembered that much of Brazil's growth was under these policies (Pang 2006). Additionally, strong state and high government expenditure does not preclude a country from development as seen in the examples of China, Vietnam, and South Korea. All three of these nations along with other Latin American and South Asian nations have forged ahead with their own development policies after abandoning strict Neoliberal policies.

There are many conflicting views as to just what form the new development model for Brazil will take. There are some recurring themes amongst several of the authors. One of the primary concerns is Brazil's overreliance on foreign investment. Were Brazil to lower the short-term interest rate, it would increase the willingness of domestic firms to invest in new capital and go a long way in lowering unemployment and underemployment (Bresser-Perriera 2009). Furthermore, to make foreign currency assets less desirable, the central bank could increase the risk associated with these assets to increase the accounting costs for companies (De Lourdes R. Mollo and Saad-Filho 2006). Furthermore, it is necessary to step outside of the Neoliberal framework imposed Brazil. There needs to be more monetary and fiscal tools available to the state and central bank to help fight inflation and promote growth. Finally, the state needs to increase its infrastructure spending. This is meant not only in terms of highways, railways, and shipping, but also in terms of just systems in which citizens interact with the state. For instance fair, consistent judicial systems, strong support of increased education, and work to decrease the role of corruption and purchased political influence in the government (Rojas-Suarez 2009). In essence, as Brazil shifts away from Neoliberalism, it should increase government expenditure, encourage domestic investment, and reduce the volatility of interest rates.

In some ways, Brazil was too hastily added to the BRIC designation of rising international development stars. As seen in the following table, the GDP of Brazil has lagged far behind that of comparable nations, especially the per capita GDP (OECD 2009).

Table 1.2. **Basic indicators: Enhanced engagement countries, 2007**

	Brazil	China	India	Indonesia	South Africa
GDP (in current USD billion)	**1 333.8**	3 205.5	1 176.9	432.8	283.0
GDP per capita (in current USD)	**6 854.7**	2 431.5	1 046.3	1 918.3	5 914.4
GDP growth (real, 2002-07 average, in per cent)	**3.9**	11.0	8.9	5.5	4.7
GDP per capita (in current USD, PPP)	**9 566.7**	5 383.2	2 753.3	3 712.3	9 757.4
GDP per capita growth (real, 2002-07 average, in per cent)	**2.5**	10.4	7.4	4.1	3.5
Population (millions)	**191.6**	1 318.3	1 124.8	225.6	47.9
Population density (inhabitants per sq. km)	**22.6**	141.3	378.3	124.5	39.4

Source: Central Bank of Brazil and World Bank (*World Development Indicators*).

The necessity of transformation from dirigisme, and military rule to an open, democratic republic is without question. What is being debated is whether the policies of Neoliberalism have had positive or negative long term benefits for Brazil. The past fifteen years have been a period of instability and low growth for the country as a whole (Bresser Pereira 2009). The reforms initiated by Cardoso and continue by Lula were beneficial in the short term. In the long term they only created interest rate traps that perpetuated inherent macroeconomic instability. Perhaps the greatest lesson that can be extracted from the past two decades of Neoliberalism in Brazil and the global influence of the Washington consensus is that there is no universal path to development. Inflation was a great threat to the stability of Brazil prior to the implementation of the Real Plan under Cardoso, thus Neoliberalism did have positive effects. Neoliberalism is not an effective ideology for effecting systemic development. Instead, countries should seek to follow those models proven efficient in the real world, such as those used by the East Asian Tigers, and take into account the unique strengths and weaknesses of their own nation. Development models based primarily on the collective knowledge of technocrats who have the luxury of holding all else et cetaris parabis are difficult to translate into a world dominated by globalized markets and a degree of interconnectedness not imagined even decades ago. The leaders of Brazil must accept short-term consequences as the abandon restrictive Neoliberal policies in favor of other models of development. A development model as unique as the culture, history, and people of Brazil needs to be implemented to bring the nation comprehensive social, political, and economic development.

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Why Indonesia Suffered During the Asian Financial Crisis: Bank Vulnerability, the Crawling Peg, and Cronyism

by Erik van Mechelen for International Economics

“Almost every technical economic indicator looked safe.”

-Hal Hill

Background

Hal Hill’s comment about Indonesia’s economic status preceding the Asian Financial Crisis of 1997 summarizes a commonly held viewpoint of the Southeast Asian island archipelago. When the Thai Baht was allowed to float on July 7 1997, no-one expected that Indonesia would be as adversely affected as they quite quickly became from August onward. The abandonment of the peg in Thailand led to substantial currency and financial system failures throughout Southeast Asia. The effects of the crisis were felt on a global scale. The regional players most affected by the crisis, however, were Thailand, Indonesia, Malaysia, Singapore, and the Philippines.

The current account of the balance of payments for Indonesia (Figure 1) was continuously in deficit from 1991 to 1996. During this period, the Rupiah’s real exchange rate was also overvalued against the dollar (Sinnakkannu, 2008).

The spike in exchange rate in 1997 through 1998 and after following the decision to allow the Rupiah to float against the dollar is strong evidence of this over-valuation. Despite this, Indonesia, along with Malaysia, Singapore, Thailand, and the Philippines, had solid conventional macroeconomic fundamentals in the years leading up to the crisis in 1997. These fundamentals included high GDP growth rates, investment, net capital inflows, and savings rates. In addition, Indonesia had reasonable levels of inflation, strong foreign exchange reserves, strong fiscal surpluses, low public debts, and low unemployment. (IFS 2000; pp 390-93). When the crisis hit, though, it hit Indonesia hard. Indonesia's foreign debt soared from Rp 127 trillion in 1997 to Rp 450 trillion in 1998, while GDP volume dropped from 112.9 in 1997 to 97.6 in 1998 (1995=100) (Figure 2). Meanwhile, Indonesia's currency struggled to maintain its vastly diminished value, averaging around Rp 10,000 to the dollar throughout 1998 (IFS, 2000; pp 390-93).

Objective

This paper will examine Indonesia's economic position in the years leading up to 1997 and 1998, when the financial crisis hit the hardest. As mentioned before, the adverse effects of the crisis are well documented. Indonesia endured several months of struggle and years of recovery. The causes, however, are less clear.

Indonesia, like some of the other East Asian countries, had weaknesses prior to the crisis in 1997. Financial liberalization and the "crawling peg" exchange rate policy allowed domestic firms to borrow recklessly domestically and abroad. Firms borrowed heavily in US dollars and lent in Rupiah. With the Rupiah loosely pegged to the US dollar, the US dollor appreciation in the late 1980s and early 1990s hurt the real value of the Rupiah. In this period, the banking sector became more competitive, and partially due to under-regulation, developed high levels of non-performing loans that would later put Indonesia in jeopardy.

Analysis: Banking Sector

The factors lending to the severity of the crisis experienced in Indonesia are several. The fundamental vulnerability, however, lies in the nature of Indonesia's banking system. It was a system that was over-guaranteed yet under-capitalized and under-regulated. We begin by examining this system.

Indonesia had sound economic fundamentals in the early 1990s, but was still severely affected by the crisis. The roots of its vulnerability likely see their source in the mid-1980s, when Indonesia initiated its economic reform program (Sharma, 127). Essentially, the program aimed to diversify the economy and reduce dependence on the oil sector, increase development of non-oil-export oriented sectors, and finally to increase the role of the private sector which included foreign capital. Major aims in these reforms included a steady liberalization of direct investment flows (with the goal of encouraging non-oil exports and economic diversification), maintaining a competitive exchange rate, trade liberalization, making monetary management more efficient, liberalization of external inflows, and encouraging competition in the banking sector (Sharma, 128).

Beginning in October 1988, there was a relaxing of regulation regarding standards and reserve requirements for new banks. In 1989, the monetary authorities did away with limits on banks borrowing from foreigners. This move effectively liberalized portfolio capital inflows. In 1990 direct investment inflow regulations were lowered further, when foreign investors were allowed to sell foreign exchange directly to commercial banks instead of having to carry the transaction through the central bank. The rapid economic liberalization without enough regulation likely “made Indonesia high vulnerable to economic shock” (Sharma, 128). Indeed, the collective capital accounts of deposit money banks dropped sharply from Rp 57.8 trillion to Rp -84.8 trillion between 1997 and 1998 (IFS 2000; pp 390).

In the late 1980s and early 1990s Indonesia appeared to have huge growth potential and its newer policies encouraged foreign investment. At the same time, “commercial banks bustled to acquire more overseas funds,” resulting in liabilities increasing from Rp. 11 trillion in March of 1989 to Rp 31.6 trillion in March of 1991 (Rosul 1998, 246). Actually, capital inflows surged to US$14.7 billion by 1994 and represented around 4 per cent of GDP between 1990 and 1996. By the middle of 1997, the debt outstanding to foreign banks was US$59 billion. To make matters even more vulnerable, the maturity structure of the foreign borrowing was weighted heavily towards the short term. By mid-1997, short-term debt owed to foreign banks was over one and a half times the size of Indonesia's foreign exchange reserves (Radelet 1999, 3).

Short-term debt was particularly attractive in Indonesia in part because of their exchange rate system. From the mid-1980s until August 14, 1997, the government the "crawling peg regime" which was essentially an intervention band system. In this system, the Indonesian government would intervene as needed to maintain the Rupiah to US dollar exchange rate and prevent the Rupiah from appreciating or depreciating relative to the American currency to a set percentage. Because of the predictability of the Indonesian government's intervention (the nominal depreciation target was between 3 and 5 per cent per annum with little variation), the majority of foreign borrowing in the banking sector remained unhedged (Sharma, 129). According to Sharma (2003), the inaccurate pricing of foreign credits along with an expanded supply of funds in financial markets worldwide "contributed to very large capital inflows and created vulnerability for firms with substantial foreign-exchange exposure." One other additional vulnerability was that about 40% of Indonesia's short term credit was provided by Japanese banks (Radelet, 1999). Because of the large amount of credit held by Japanese banks, Indonesia was hurt when Japan began to withdraw this credit at the onset of the crisis.

A second vulnerability brought about by the "crawling peg" exchange rate regime was a moderately overvalued exchange rate and a slowed growth in exports. This upward trend began after the 1987 Plaza Accord, and saw the Yen appreciate against the US dollar and against the Asian currencies, including the Indonesia Rupiah. Between 1990 and 1997, the Rupiah appreciated in real terms by 22% (IFS 2000; pp 390). At the same time, non-oil exports slowed considerably from 26% between 1991 and 1992 to 14% between 1993 and 1995. Indonesia took an activist policy to stabilize the real exchange rate, conducting a somewhat flexible exchange rate policy (here we see the merits of the crawling peg regime) by adjusting the Rupiah according to its current-account deficit levels. This policy, however, wasn’t enough to cover the lull in productivity in the early 1990s.

The inherent weaknesses in the banking sector were the main vulnerability leading to Indonesia’s sudden financial struggle after August of 1997. Bank Indonesia, the central bank of Indonesia, though responsible for managing the banking system, also had to report directly to President Suharto during his thirty-two political insiders without hesitation and banks funded certain projects without proper consideration for the economic viability of the projects or borrowers. Essentially, despite a reasonable set of banking regulations, the rules were rarely enforced.

The banking reform began in 1983 when Bank Indonesia gained the power to set interest rates on deposits and loans, but it wasn’t until October 1988 that the central bank released a pivotal series of banking reform called the “October 1988 Package.” Also called PAKTO 88, the banking reforms drastically liberalized the banking system setting the stage for increased competition and an influx of new banks in Indonesia. J. Soedradjad Djiwandono, the Governor of Bank Indonesia at the time, noted that the package “fundamentally changed the face of banking in Indonesia. (Djiwandono 1997, 7-8). The banking reforms aimed to increase competition by lowering barriers to entry, which made it easier for private and foreign-owned banks to enter the Indonesian market, as well as current banks to open new branches. The PAKTO reforms allowed for very low capitalization, with a minimum requirement of equivalent US$5 million. Bank reserve requirements were slashed from 15% to 2% of third-party funds. Further deregulation in 1989 meant that Bank Indonesia was no longer required to approve medium and long-term loans and also removed ceilings on off-shore loans (Djiwandono 1998, 8-10). At the time of the reform, there were 111 commercial banks. By year’s end 1992, there were already 208 commercial banks. And by the end of 1996, there were 238 commercial banks in Indonesia, of which 7 were state-owned, 27 were regional government banks, 160 were private banks, 34 were joint-venture banks, and10 were foreign banks (Djiwandono 1998, 11). At this time, 84% of total assets in the financial sector were held by commercial banks (Figure 4). While the reforms of PAKTO 88 brought about greater competition and financial services, Bank Indonesia simultaneously lost its share of 65% of outstanding bank credit (down to 40% at year's end 1997). In addition, these reforms came without too much attention given to the proper prudential supervisory, which opened Indonesia's vulnerability up somewhat more to crisis.

PAKTO 88 quickly expanded bank credit, a factor widely considered an indicator of financial vulnerability. Between 1992 and 1996, outstanding bank credit increased by an average of 24% (a decent portion of which was provided by foreign borrowing). When the regulations were lifted, banks also began to extend credit to property and real estate. Some of these projects included overly ambitious and expensive infrastructure ventures. Between 1995 and 1996, bank lending to real estate sector jump by about 40% (Djiwandono 1999, 1999a). The reason for the increase in these at least speculative loans was two-fold. First, the increased competition brought on by PAKTO 88 pressured banks to make loans without ensuring the financial outlook of the borrower. Second, in the case of large loans issued by state-owned banks, officials were probably pressured by the "memo-lending" system (political pressure to lend) to ensure job-security. In this way, the percentage of bad loans held by state-owned banks increased steadily following 1988 into the early and mid-1990s.

Nasution (1999, 83) notes the macroeconomic perspective on these Indonesian banking difficulties.

> Despite average annual economic growth of over 6 per cent since 1990, the volume of problem loans held by Indonesia's banks remained considerable. In 1995, 8.8 per Cent of total bank credit outstanding was classified as sub-standard, doubtful, or bad

> Debt. As of November 1996, the bad debt of the banking system amounted to Rp. [Rupiah] 10.4 trillion (equivalent to about 2 per cent of GDP or around 10 per cent of total loans). Of this amount, state-owned banks held Rp. 7.1 trillion (68 per cent).

In a sense, private bank growth succeeded but sector stability was lost. As Sharma notes (135), "in the case of private banks, risky lending practices usually involved banks making loans to affiliated companies." Several bank failures in the 1990's made evident the delicate nature of the balance sheets of Indonesian banks (Cole and Slade, 1996, p. 135). These included Bank Pembangunan, which was rife with fraud and collusion, and Bank Summa, one of the first private banks established after the PAKTO 88 reforms.

In 1990 Bank Indonesia attempted to confront the banking problems that faced the sector (high level of exposure to property companies, high levels of short-term liabilities denominated in foreign currency, and in many cases low levels of collateral). To do this, the Banking Law (Banking Act No. 7) of 1992 permitted sanctions to be issued in cases of violation of bank management law. In addition, capital requirements were raised by five times and reserve requirements were increased from 2% to 3% and the capital adequacy ratio was increased from 8% to 12%. Furthermore, Indonesia adopted a supervisory program modeled after the United States' CAMEL (Capital, Asset, Quality, Management, Earnings, Liquidity) system. Despite the efforts to modify and improve regulation of the sector, the banking system was already in deep trouble and quite vulnerable to economic shocks.

Analysis continued: Suharto's Leadership

Beneath the already shaky banking sector were the effects of political favoritism and cronyism. Suharto's (Soeharto) children and family expanded their influence in business in the early 1990s. Richburg (1998, A40) provides a telling description of the Suharto family's involvement in the economy.

> The Suharto children are all reputed to have become multi-millionaires by trading on their direct line to the presidential palace, which involved everything from clove cigarettes to toll roads, from petrochemical plants to automobile manufacturing. So pervasive is the first family's reach into the Indonesian economy that a long-running joke here is that the corruption begins as soon as you arrive at Jakarta's international airport: You can buy a pack of cigarettes, hop in a taxi, take a toll road to the city and check into a hotel, putting money into a Suharto family member's pocket with each step.

The legacy of Suharto's presidency are mixed. He was the second president of Indonesia and held power from March of 1968 to May of 1998. During his presidency, Suharto reduced the number of Indonesians in the "very poor" category from 65% to 7% in 1990. During these 25 years GDP growth was an average 7% per year. In the early 1990s, the growth continued, with 6.05% growth in 1993, 7.03% growth in 1994, 7.6% growth in 1995, and 7.8% growth in 1996 (IFS 2000; pp 392). Much of these gains, of course, would be undone by the imminent financial crisis.

Suharto's role cannot be discounted in determining the causes for the severity of the crisis in Indonesia. Suharto was responsible for banking reforms that relaxed financial controls on banking sector, but also (as Richburg explained above) for encouraging a culture of patron-client relationships between state-owned banks and preferred borrowers and projects. In addition, though perhaps not directly related to the crisis, Suharto is estimated to have misappropriated between US $15-35 billion during his presidency. In addition, Suharto was accused of embezzlement of US $571 million of government donations under his watch and then redirecting the funds to the financing of family investments (Sharma 137).

When the crisis began to sharpen, the adverse effects of a corrupt leader and bad policies began to catch up with Suharto. This weakened leadership did not help Indonesia make the correct policy shifts to stem the tide of the financial crisis. Suharto struggled to handle dealings with the IMF and eventually had to resign. The political transition period (before and after Suharto's resignation) were unhealthy for Indonesia's economy, as it continued to suffer.

Though it is difficult to quantify the relationship, it is likely that the political instability increased the economic difficulties. At the same time, the economic instability damaged Suharto's control over his party and the country. Suharto's corruption and embezzlement of funds throughout his presidency may also have contributed to the economic uncertainty within the government and banking system.

As Sharma (2004) notes, Indonesia's banking sector was "undercapitalized and, in large measure, burdened with poorly diversified and badly performing loan portfolios, Indonesia's over-guaranteed but under-regulated banking system lay exposed and highly vulnerable to economic shocks. Because of his position in power and ability to persuade the central bank to do his bidding, Suharto's part in the crisis should not be overlooked.

Discussion

The trigger that set Indonesia reeling was the contagion from Thailand. On July 2, 1997 Thailand deserted the Baht's traditional peg. Almost immediately the Baht depreciated against the US dollar. Six days later, on July 8, the Indonesian Rupiah came under fire and the Indonesian government reacted quickly to prevent depreciation of the national currency by widening the trading band around the Rupiah from 8% to 12% (as we know, this didn't prevent the Rupiah from depreciating rapidly after August 1997. Indonesia, as was mentioned before, had much better macroeconomic fundamentals leading up to the crisis, but still had two large weaknesses that led to its downfall: 1) the massive foreign debt held by private Indonesian corporations (most of which was short-term and not hedged against exchange rate fluctuations), and 2) the inherent weaknesses of the financial and banking sectors lowered confidence in Indonesia's possibility of to defend the Rupiah's peg.

If it is taken as given that the contagion from Thailand played a role in triggering the negative effects in Indonesia, it serves noting that the banking sector, the pegged exchange rate regime, and political cronyism had some part in preparing Indonesia to be even more severely affected than it may have been otherwise.

The banking sector developed and expanded rapidly at the expense of proper prudential regulation and supervision. The "crawling peg" exchange rate regime did not help matters as it indirectly made short-term debt attractive and in turn increased Indonesia's holding of foreign liabilities significantly in the years leading to 1997. Cronyism complicated loans and abused the lack of banking supervision resulting in high levels of non-performing loans held by banks (especially state-owned banks).

As has already been developed, Indonesia's banking sector underwent major reform in the late 1980s and early 1990s. The result was a largely over-guaranteed, under-capitalized, and under-regulated. The sector became more competitive but, because of a lack of supervision, took on greater and greater levels of bad loans. Firms borrowed heavily in short-term foreign exchange markets and lent in Rupiah. The maturity structure of the borrowing put Indonesia's banks in difficult spots when the crisis arrived. The non-performing loans probably resulted in part from the higher levels of competition, but were likely also more prevalent because of the lack of regulation in the banking sector.

Though difficult to quantify, it seems more likely that Indonesia's banking sector weaknesses were more important in sending Indonesia into its downward spiral, but the exchange rate regime must be at least briefly examined. Indonesia's "crawling peg" regime was probably safer than

Thailand's strong peg to the US dollar (80%). Indonesia's exchange rate could be altered through government intervention in the foreign exchange markets. By buying and selling foreign currency they maintained the pegged rate within a band relative to the US dollar. The advantage of the crawling peg is that the value of the Indonesian Rupiah could be slightly altered vis-à-vis the dollar without the explicit dangers of real exchange rate depreciation often encountered in a strictly fixed or pegged exchange rate regime (such as Thailand's). As previously noted, however, the Rupiah was probably overvalued throughout the early 1990s (Wu, 2006). This occurred because the Indonesian government could only intervene in foreign exchange markets to affect the exchange rate up to a limit (usually a 3% to 5% change per annum) and thus the Rupiah's real exchange rate was doomed to some devaluation with the appreciation of the US dollar and the Yen in the early 1990s.

Cronyism was rampant throughout Indonesia during the 1980s and 1990s. The impact upon levels of non-performing loans in the banking sector is, again, difficult to quantify, but it seems clear that political pressure within the banking system brought about some cases of non-performing loans. Political insiders, especially Suharto's family, were granted funding and loans for projects from state-owned banks without proper prudential supervision. The banking regulations existed but were not enforced.

And so, Indonesia, with its recent record of strong growth and enormous growth potential saw its economy take several steps back with the onset of the Asian contagion; for Indonesia, it was their weak banking sector, crawling peg, and cronyism that led to the severity of the disaster.

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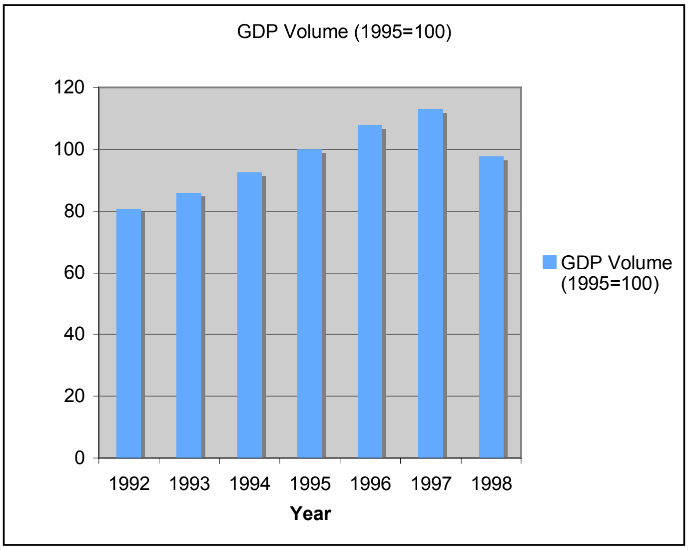
Figure 1

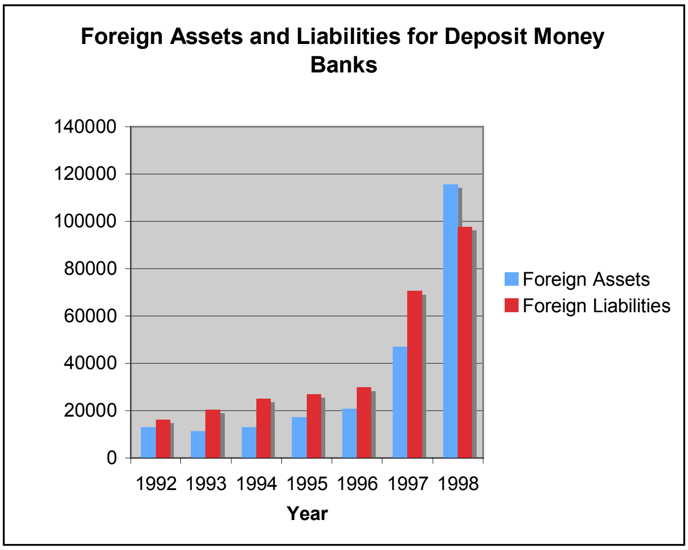
(IFS 2000; 392)

Figure 2



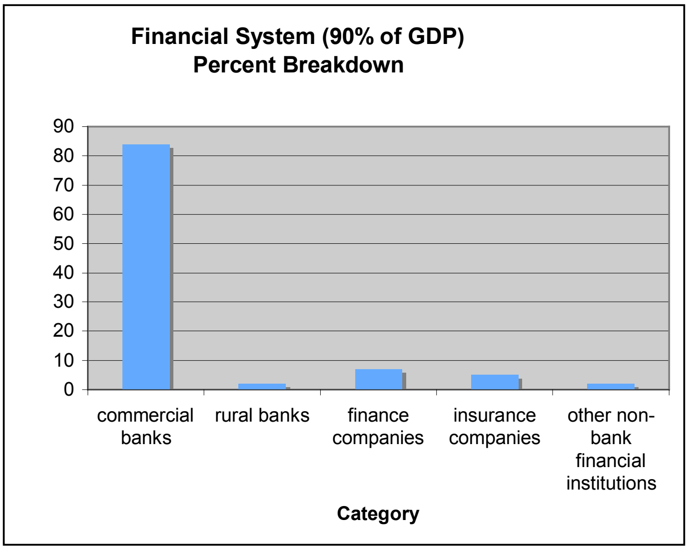
(IFS 2000; 392)

Figure 3



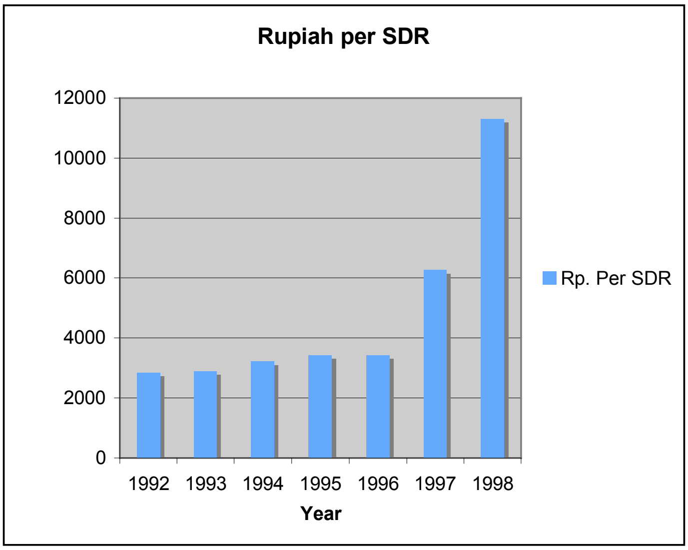
(IFS 2000; 390)

Figure 4



(Sharma; 132-3)

Figure 5



(IFS 2000; 390)

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