SUMMARY

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Project Summary: The purpose of this project is to determine the effects of Brazil's expanding electricity grid on its population and GDP distribution. Since over 80% of Brazil's electricity comes from hydropower, we use the natural variation in generating capacity (due to exogenous factors such as river slope and flow accumulation) to predict hydropower plant placement. Using an engineering optimization program, we model the likely pattern of expansion of Brazil's electricity grid from the 1950's to the 2000's. We then examine the effects of the expansion on GDP and population distribution. We found that the effect of grid expansion is to cause strong population movement to areas suitable for hydropower generation. Moreover, the availability of electricity is seen to cause significant growth in local GDP. However, these results may at least partially be the result of certain sources of endogeneity, such as a cross-sectional correlation between population and water availability.

Student Responsibilities: During the first two weeks of the program, I was responsible for data conversion and entry. We had transmission line maps of Brazil representing the transmission grid of Brazil during various decades, showing different voltages of line. I was responsible for converting these maps to spreadsheet format, listing the lines by source and destination, as well as marking the voltage. For the remainder of the program, I was responsible for writing the program which would optimize Brazil's electricity grid for each decade, given geological and economic constraints. It was this program which was used to model the expansion of Brazil's electricity grid. The program used a modified simulated annealing approach; it started with a random grid configuration, and then repeatedly proposed candidate configurations to which the grid might be changed. If the candidate had a lower cost (derived from a separate cost function program) than the original, the grid was changed to the candidate. After several thousand iterations, the grid would converge to near the optimal configuration. This was done for each decade since the 1950's, and the result was a realistic modeled expansion of Brazil's electricity grid, which we could then use as an instrument for determining the effect on GDP and population.

What I Learned: The most important thing I learned from this SRO experience was how to use the quantitative software MATLAB. I wrote the entirety of the grid optimization program in MATLAB, having never before worked with the program, or having substantial experience with any quantitative computing language. The familiarity and competence that I gained from working with MATLAB will prove invaluable to me in my future research endeavors. Furthermore, having never worked in an academic research atmosphere, this summer was a great opportunity to get a taste of what academic research is like.

Evaluation of SRO Experience: Overall, my SRO experience was an unequivocally positive one. I learned some extremely important skills which will be useful to me in any area of quantitative academic study. The only unfortunate circumstance was that my time at SRO did not coincide with the final draft of the paper we were working on, and so I left the project a work in progress.