***MEASURING THE IMPACTS OF NUCLEAR ACCIDENTS ON ENERGY POLICY***

Zsuzsanna Csereklyei, Vienna University of Economics and Business, +436643238603, Zsuzsanna.Csereklyei@wu.ac.at

## Overview

Energy policy, including decision on the energy mix, is formed and shaped by many factors, including energy security, the availability of resource, growth of energy demand, public pressure, and environmental concerns. In the last years until Fukushima, the notion of nuclear renaissance emerged, and many, mostly Asian countries started aggressive nuclear energy programs, even the United States has passed laws to boost its nuclear industry.

This paper investigates the impacts of nuclear accidents on energy policy with the help of a panel dataset of 31 countries with civilian nuclear power from 1965-2009, using annual data about the capacity of reactors under construction, primary energy consumption, several economic variables, as well as three nuclear accidents scaled INES five or higher at the International Atomic Energy Agency scale. The paper aims to estimate the potential impact Fukushima is likely to have on worldwide nuclear power plant constructions.

## Methodology

I use multiple regressions conducted on construction starts, measured in electrical capacities. The accidents are modeled with dummies (Lucens 1969, Three Mile Island 1979, and Chernobyl 1986), and their impact length is allowed to vary per country. Thus, the effect of an accident may stop before the end of the sample period.

To do this, I allow the Lucens dummy to take on the value of ”1” in successive time periods. The variable thus takes on a positive value first in 1969, then in 1969&1970, and then progressively covers the entire sample period of 1969-2009. Similarly, I allow for the impact of the TMI accident to run from 1979 to 2009 and for Chernobyl, to run from 1986 to 2009. What the optimal impact length of an accident is, taking into account the other accidents, the constructions of the previous year and the energy consumption of the previous year, I ascertain by running the entire array of models, in this case 41\*31\*24=30504 regressions for each country.

The accident impact length for each country is chosen by the AIC selection criterion. The results of the individual regressions are afterwards pooled, and used in a dynamic panel setting with fixed effects. This method was found superior for macroeconomic panel data compared to other, available GMM techniques.

## Results

After conducting the panel regressions, I find that neither Three Mile Island nor Lucens had a worldwide negative impact on construction starts, while Chernobyl did. The significant negative effect of TMI was found to be limited to the United States. The worldwide impact of Chernobyl is however shown to wear-off in certain geographical clusters, after ten to thirty years. I find that nuclear capacity enlargement shows a significant persistence or lock-in effect, but it was also significantly driven by primary energy consumption and energy insecurity in the past five decades. The effects of real interest rates, inflation, or gross domestic product on reactor construction were not found significant. Thus, an accident is likely to have a negative and long lasting impact in the country where it happened, and possibly in countries affected by the direct consequences, or where governments are subject to severe public pressure.

## Conclusions

## Where and how far the negative policy impact of Fukushima might spread will now depend on the objectivity of the media coverage, on the depth of technology understanding in the public, whether or not there are existing nuclear infrastructures and know-how in a country, but also on the existing political structures. We have seen that the impact-length of an accident can, but need not “wear off” anywhere between ten to thirty years. Areas closer to the accident might be affected more negatively and for a longer time. Growing concerns of energy supply security and greenhouse gas emissions may counteract this impact at the legislative level.

## References

1. Böck. H., Villa, M., (2011): Nuclear Engineering I-II, Vienna University of Technology, Atominstitut
2. BP, 2010 Statistical Review of World Energy <http://www.BP.com>
3. Cohen, B.L, (1990): The Nuclear Energy Option, Plenum Press. ISBN: 978-0306435676
4. Corner, A., Venables, D., Spencear, A., Poortinga, W., Demski, C., Pidgeon, N., (2011): Nuclear power, climate change and energy security: Exploring British public attitude, Energy Policy 39 (2011), p 4823-4833
5. Ebinger, C.K., (2011): Three Strikes and Out? Nuclear Energy in the United States in the Wake of Three Mile Island, Chernobyl and Fukushima, The Brookings Institution, [www.brookings.edu](http://www.brookings.edu)
6. Felder, F.A. (2009): A critical assessment of energy accident studies, Energy Policy 37 (2009), 5744-5751
7. Fuhrmann, M. (2012): Splitting Atoms: Why do countries build nuclear power plants?, International Interactions, Vol 38. No.1, (2012), p 1-37
8. Gourley, B., Stulberg, A.N., (2010): Correlates of Nuclear Energy; Paper presented a the annual meeting of the International Studies Association , Montreal, Canada, March 16-19, 2011
9. Harding, J., (2007): Economics of New Nuclear Power and Proliferation Risks in a Carbon-Constrained World , Nonproliferation Policy Education Center
10. Heston Alen, Robert Summers and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011.
11. International Atomic Energy Agency (1992): INSAG-7: The Chernobyl Accident, Safety Series No. 75-INSAG-7, ISBN-92-0-104692-8; (1999): INSAG-12: Basic Safety Principles for Nuclear Power Plants; 75 INSAG-3 Rev.1., Safety Series No. 75-INSAG-12, ISBN-92-0-102699-4; (2011): Fukushima Daiichi Status Report, 27 October 2011 downloaded from [www.iaea.org](http://www.iaea.org); (2011): Nuclear Power Reactors in the World, Reference Data Series 2, 2011 edition ISBN: 978-92-0-117810-7
12. Joskow, P.L., Parsons J.E (2009): The economic future of nuclear power, Daedelus, 138 (2009), No. 4, p 45-59, American Academy of Arts and Sciences
13. Lester R.K., Rosner R., (2009): The growth of nuclear power: drivers and constraints, Daedelus, MIT Press Volume 138 (2009), No. 4, p 19-30
14. Löfstedt, R.E., (1996): Risk communication, The Barsebäck nuclear plant case, Energy Policy 24 (1996) 689-696
15. Massachusetts Institute of Technology (2011): The Future of the Nuclear Fuel Cycle, an interdisciplinary MIT Study ISBN: 978-0-9828008-4-3
16. Massachusetts Institute of Technology (2003): The Future of the Nuclear Power, an interdisciplinary MIT Study ISBN: 0-615-12420-8
17. Miller, S.E., Sagan, S.D., (2009): Nuclear Power without nuclear proliferation?, Deadelus, MIT Press Volume 138 (2009), No. 4, p 7-18
18. Nelson, P., (2010): An Empirical Assessment of Elements of the Future of Civil Nuclear Energy, Nuclear Security Science and Policy Institute, NSSPI-10-001
19. Nohrstedt, D., (2008): The Politics of Crisis Policymaking: Chernobyl and Swedish Nuclear Energy Policy, The Policy Studies Journal, Vol. 36. No.2. (2008)
20. Nuclear Energy Agency (2010): Comparing Nuclear Accident Risks with Those from Other Energy Sources, OECD-NEA Publication, ISBN: 978-92-64-99122-4
21. Slovic, P., (1987), Perception of Risk , Science Volume 236, Issue 4799, 280-285
22. UNSCEAR (2011): Sources and Effects of Ionizing Radiation, United Nations Publication, ISBN: 978-92-1-142280-1
23. Van Roey, E., (2009): Three Mile Island, SCK-CEN compliation, [www.sckcen.be](http://www.sckcen.be)
24. WHO (2012): Preliminary dose estimation from the nuclear accident after the 2011 Great East Japan Earthquake and Tsunami , ISBN: 978 92 4 150366 2
25. World Bank (2012): World Bank Database, real interest rates, inflation, [www.data.worldbank.org](http://www.data.worldbank.org), accessed April 2012
26. Zhou, Y., Renfigo.,C., Chen, P., HInze, J., (2011): Is China ready for ist nuclear expansion? Energy Policy 39 (2011), 771-781