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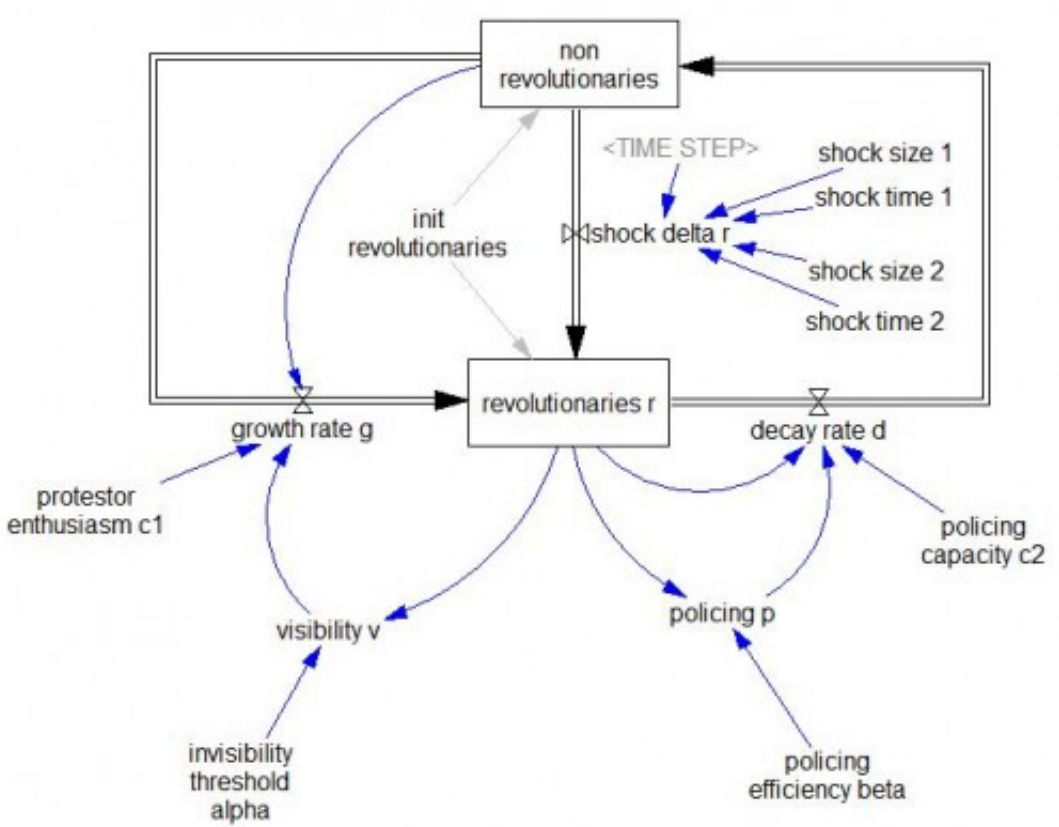
Arab Spring

Published on October 23, 2012 in Published, Social and Vensim. 0 Comments

Hard on the heels of commitment comes another interesting, small social dynamics model on Arxiv. This one's about the dynamics of the Arab Spring.

> The self-immolation of Mohamed Bouazizi on December 17, 2011 in the small Tunisian city of Sidi Bouzid, set off a sequence of events culminating in the revolutions of the Arab Spring. It is widely believed that the Internet and social media played a critical role in the growth and success of protests that led to the downfall of the regimes in Egypt and Tunisia. However, the precise mechanisms by which these new media affected the course of events remain unclear. We introduce a simple compartmental model for the dynamics of a revolution in a dictatorial regime such as Tunisia or Egypt which takes into account the role of the Internet and social media. An elementary mathematical analysis of the model identifies four main parameter regions: stable police state, meta-stable police state, unstable police state, and failed state. We illustrate how these regions capture, at least qualitatively, a wide range of scenarios observed in the context of revolutionary movements by considering the revolutions in Tunisia and Egypt, as well as the situation in Iran, China, and Somalia, as case studies. We pose four questions about the dynamics of the Arab Spring revolutions and formulate answers informed by the model. We conclude with some possible directions for future work.
>
> http://arxiv.org/abs/1210.1841

The model has two levels, but since *non revolutionaries* = 1 – *revolutionaries*, they're not independent, so it's effectively first order. This permits thorough analytical exploration of the dynamics.



This model differs from typical SD practice in that the formulations for *visibility* and *policing* use simple discrete logic – policing either works or it doesn't, for example. There are also no explicit perception processes or delays. This keeps things simple for analysis, but also makes the behavior somewhat bang-bang. An interesting extension of this model would be to explore more operational, behavioral decision rules.

The model can be used as is to replicate the experiments in Figs. 8 & 9. Further experiments in the paper – including parameter changes that reflect social media – should also be replicable, but would take a little extra structure or Synthesim overrides.

This model runs with any recent Vensim version.

ArabSpring1.mdl

ArabSpring1.vpm

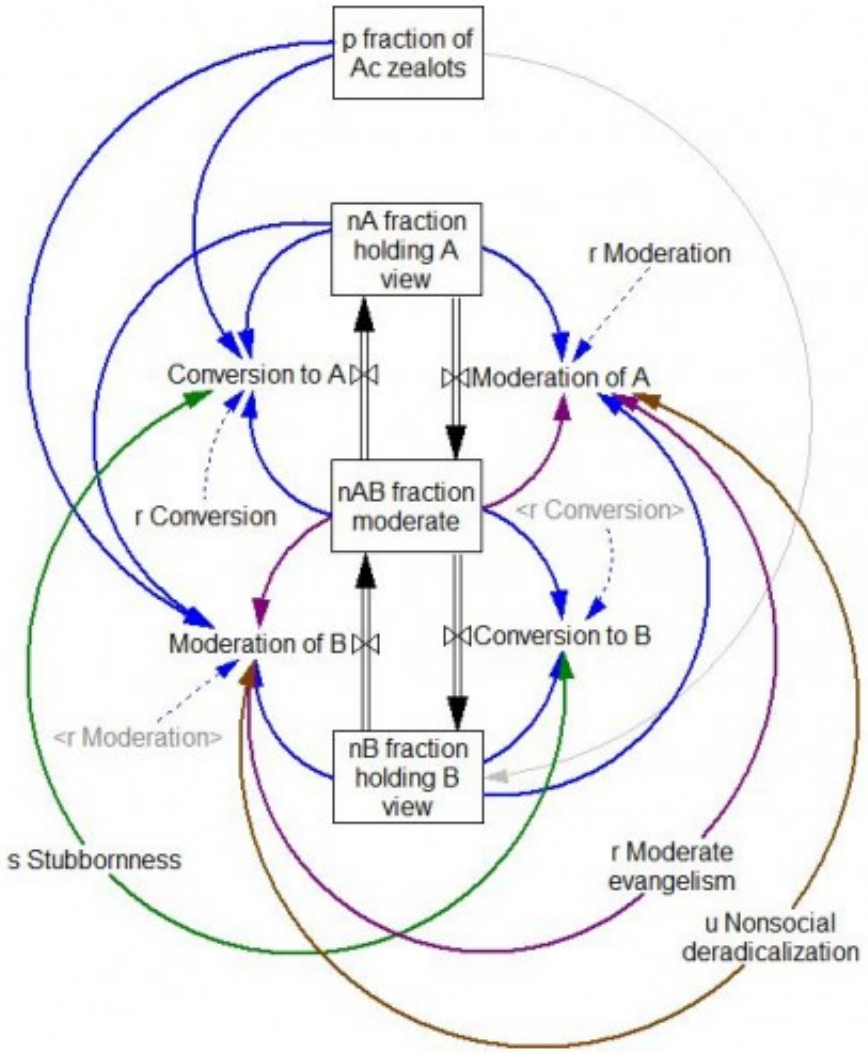
I'd especially welcome comments on the model and analysis from people who know the history of events better than I do.

Encouraging Moderation

Published on September 27, 2012 in Published, Social, Toy Model and Vensim. 0 Comments Tags: Strogatz.

An interesting paper on Arxiv caught my eye the other day. It uses a simple model of a bipolar debate to explore policies that encourage moderation.

> Some of the most pivotal moments in intellectual history occur when a new ideology sweeps through a society, supplanting an established system of beliefs in a rapid revolution of thought. Yet in many cases the new ideology is as extreme as the old. Why is it then that moderate positions so rarely prevail? Here, in the context of a simple model of opinion spreading, we test seven plausible strategies for deradicalizing a society and find that only one of them significantly expands the moderate subpopulation without risking its extinction in the process.



This is a very simple and stylized model, but in the best tradition of model-based theorizing, it yields provocative counter-intuitive results and raises lots of interesting questions. Technology Review's Arxiv Blog has a nice qualitative take on the work.

See also: Dynamics of Scientific Revolutions, Bifurcations & Filter Bubbles

The model runs in discrete time, but I've added implicit rate constants for dimensional consistency in continuous time.

commitment2.mdl & commitment2.vpm

These should be runnable with any Vensim version.

If you add the asymmetric generalizations in the paper's Supplemental Material, add your name to the model diagram, forward a copy back to me, and I'll post the update.

The Economic Long Wave

Published on July 6, 2011 in Chaos & oscillations, Economics, Published and Vensim. 0 Comments

This is John Sterman's model of long waves (long-duration economic cycles), driven by capital accumulation dynamics. This version is replicated from a JEBO article,

> STERMAN, J. D. (1985) A Behavioral Model of the Economic Long Wave. *Journal of Economic Behavior and Organization,* 6**,** 17-53.

There's some interesting related literature (including other economic models in this library). From Sterman's publications list:

> STERMAN, J. D. & MOSEKILDE, E. (1994) Business Cycles and Long Waves: A Behavioral, Disequilibrium Perspective. IN SEMMLER, W. (Ed.) *Business Cycles: Theory and Empirical Methods.* Boston, Kluwer Academic Publishers.
>
> STERMAN, J. D. (1994) The Economic Long Wave: Theory and Evidence. IN SHIMADA, T. (Ed.) *An Introduction to System Dynamics.* Tokyo.
>
> STERMAN, J. D. (2002) A Behavioral Model of the Economic Long Wave. IN EARL, P. E. (Ed.) *The Legacy of Herbert Simon in Economic Analysis.* Cheltenham, UK, Edward Elgar.
>
> STERMAN, J. D. (1985) An Integrated Theory of the Economic Long Wave. *Futures,* 17**,** 104-131.
>
> RASMUSSEN, S., MOSEKILDE, E. & STERMAN, J. D. (1985) Bifurcations and Chaotic Behavior in a Simple Model of the Economic Long Wave. *System Dynamics Review,* 1**,** 92-110.
>
> STERMAN, J. D. (1983) The Long Wave. *Science,* 219**,** 1276.
>
> KAMPMANN, C., HAXHOLDT, C., MOSEKILDE, E. & STERMAN, J. D. (1994) Entrainment in a Disaggregated Economic Long Wave Model. IN LEYDESDORFF, L. & VAN DEN BESSELAAR, P. (Eds.) *Evolutionary Economics and Chaos Theory.* London, Pinter.

MOSEKILDE, E., LARSEN, E. R., STERMAN, J. D. & THOMSEN, J. S. (1993) Mode Locking and Nonlinear Entrainment of Macroeconomic Cycles. IN DAY, R. & CHEN, P. (Eds.) *Nonlinear Economics and Evolutionary Economics.* New York, Oxford University Press.

MOSEKILDE, E., THOMSEN, J. S. & STERMAN, J. D. (1992) Nonlinear Interactions in the Economy. IN HAAG, G., MÜLLER, U. & TROITZSCH, K. (Eds.) *Economic Evolution and Demographic Change.* Berlin, Springer Verlag.

THOMSEN, J. S., MOSEKILDE, E. & STERMAN, J. D. (1991) Hyperchaotic Phenomena in Dynamic Decision Making. IN SINGH, M. G. & TRAVÉ-MASSUYÈS, L. (Eds.) *Decision Support Systems and Qualitative Reasoning.* Amsterdam, Elsevier Science Publishers.

THOMSEN, J. S., MOSEKILDE, E., LARSEN, E. R. & STERMAN, J. D. (1991) Mode-Locking and Chaos in a Periodically Driven Model of the Economic Long Wave. IN EBELING, W. (Ed.) *Models of Self Organization in Complex Systems.* Berlin, Akademie Verlag.

STERMAN, J. D. (1988) Nonlinear Dynamics in the World Economy: The Economic Long Wave. IN CHRISTIANSEN, P. & PARMENTIER, R. (Eds.) *Structure, Coherence, and Chaos in Dynamical Systems.* Manchester, Manchester University Press.

STERMAN, J. D. (1987) Debt, Default, and Long Waves: Is History Relevant? IN BOECKH, A. (Ed.) *The Escalation in Debt and Disinflation: Prelude to Financial Mania and Crash?* Montreal, BCA Publications.

STERMAN, J. D. (1987) An Integrated Theory of the Economic Long Wave. IN WANG, Q., SENGE, P., RICHARDSON, G. P. & MEADOWS, D. H. (Eds.) *Theory and Application of System Dynamics.* Beijing, New Times Press.

STERMAN, J. D. (1987) The Economic Long Wave: Theory and Evidence. IN VASKO, T. (Ed.) *The Long Wave Debate.* Berlin, Springer Verlag.

RASMUSSEN, S., MOSEKILDE, E. & STERMAN, J. D. (1987) Bifurcations and Chaotic Behavior in a Simple Model of the Economic Long Wave. IN WANG, Q., SENGE, P., RICHARDSON, G. P. & MEADOWS, D. H. (Eds.) *Theory and Application of System Dynamics.* Beijing, New Times Press.

And from Christian Kampmann,

"The Role of Prices in Long Wave Entrainment" (with C. Haxholdt, E. Mosekilde, and J.D. Sterman), *International System Dynamics Conference*, Stirling, U.K. and at the Spring 1994 ORSA/TIMS conference, Boston, MA. 1994.

"Disaggregating a simple model of the economic long wave" *International Conference of the System Dynamics Society*, Keystone, CO, 1985.

The long wave model was the guine pig for Kampmann's interesting '96 conference paper that combined a graph-theoretic identification of a set of feedback loops having independent gains with eigenvalue analysis,

Kampmann, Christian E. *Feedback Loop Gains and System Behavior*

There also used to be a nifty long wave game, programmed on NEC minicomputers (32k memory?), but I've lost track of it. I'd be interested to here of a working version.
The model: LongWave2.vpm LongWave2.mdl

Path Dependence, Competition, and Succession in the Dynamics of Scientific Revolution

Published on May 11, 2011 in Arrays, Published, Social and Vensim. 3 Comments Tags: Kuhn, paradigm, science, Sterman, Wittenberg.

This is a very interesting model, both because it tackles 'soft' dynamics of paradigm formation in 'hard' science, and because it is an aggregate approach to an agent problem. Unfortunately, until now, the model was only available in DYNAMO, which limited access severely. It turns out to be fairly easy to translate to Vensim using the dyn2ven utility, once you know how to map the DYNAMO array FOR loops to Vensim subscripts.

Path Dependence, Competition, and Succession in the Dynamics of Scientific Revolution

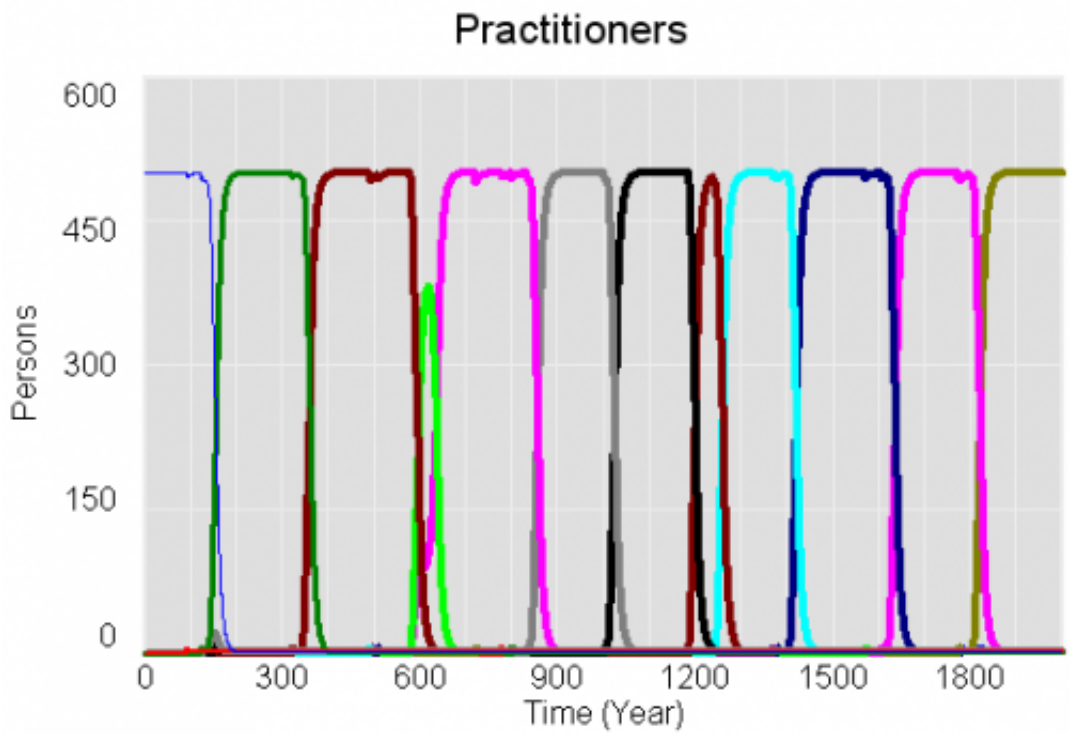
J. Wittenberg and J. D. Sterman, 1999

Abstract

What is the relative importance of structural versus contextual forces in the birth and death of scientific theories? We describe a dynamic model of the birth, evolution, and death of scientific paradigms based on Kuhn's Structure of Scientific Revolutions. The model creates a simulated ecology of interacting paradigms in which the creation of new theories is stochastic and endogenous. The model captures the sociological dynamics of paradigms as they compete against one another for members. Puzzle solving and anomaly recognition are also endogenous. We specify various regression models to examine the role of intrinsic versus contextual factors in determining paradigm success. We find that situational factors attending the birth of a paradigm largely determine its probability of rising to dominance, while the intrinsic explanatory power of a paradigm is only weakly related to the likelihood of success. For those paradigms that do survive the emergence phase, greater explanatory power is significantly related to longevity. However, the relationship between a paradigm's 'strength' and the duration of normal science is also contingent on the competitive environment during the emergence phase. Analysis of

> the model shows the dynamics of competition and succession among paradigms to be conditioned by many positive feedback loops. These self-reinforcing processes amplify intrinsically unobservable micro-level perturbations in the environment – the local conditions of science, society, and self faced by the creators of a new theory – until they reach macroscopic significance. Such dynamics are the hallmark of self-organizing evolutionary systems.
>
> We consider the implications of these results for the rise and fall of new ideas in contexts outside the natural sciences such as management fads.
>
> Cite as: J. Wittenberg and J. D. Sterman (1999) Path Dependence, Competition, and Succession in the Dynamics of Scientific Revolution. *Organization Science*, 10.

I believe that this version is faithful to the original, but it's difficult to be sure because the model is stochastic, so the results differ due to differences in the random number streams. For the moment, this model should be regarded as a beta release.



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