

**Ren, Bijie; Polasky, Stephen**

**The optimal management of renewable resources under the risk of potential regime shift.**  
(English) [Zbl 1402.91552](#)  
*J. Econ. Dyn. Control* 40, 195-212 (2014).

Summary: Complex dynamic systems can undergo changes in feedbacks between system components causing a rapid and persistent shift in system behavior (“regime shifts”), and potentially reduce welfare from declining provision of important ecosystem services. In this paper, we provide an analytical condition that determines whether the threat of a potential regime shift causes management to be more aggressive or more precautionary. In numerical simulations we find that aggressive management can occur for reasonable parameter values, which is counter prior results that the potential for harmful regime shift always leads to precautionary management.

**MSC:**

[91B76](#) Environmental economics (natural resource models, harvesting, pollution, etc.) Cited in 1 Document

**Keywords:**

[optimal management](#); [uncertainty](#); [growth](#); [renewable resources](#); [regime shift](#)

**Software:**

[CompEcon](#)

**Full Text:** [DOI](#)

**References:**

- [1] Azariadis, C., Self-fulfilling prophecies, *J. Econ. Theory*, 25, 3, 380-396, (1981) · [Zbl 0527.90014](#)
- [2] Banerjee, A., A simple model of herd behavior, *Q. J. Econ.*, 107, 3, 797-817, (1992)
- [3] Benveniste, L. M.; Scheinkman, J. A., On the differentiability of the value function in dynamic models of economics, *Econometrica*, 47, 3, 727-732, (1979) · [Zbl 0435.90031](#)
- [4] Biggs, R.; Carpenter, S.; Brock, W., Turning back from the brink detecting an impending regime shift in time to avert it, *Proc. Natl. Acad. Sci.*, 106, 3, 826-831, (2009)
- [5] Brozovic, N.; Schlenker, W., Optimal management of an ecosystem with an unknown threshold, *Ecol. Econ.*, 70, 627-640, (2011)
- [6] Cass, D.; Shell, K., Do sunspots matter?, *J. Polit. Econ.*, 193-227, (1983)
- [7] Clark, C.; Munro, G.; Sumaila, U., Limits to the privatization of fishery resources, *Land Econ.*, 86, 2, 209-218, (2010)
- [8] Clarke, H.; Reed, W., Consumption/pollution tradeoffs in an environment vulnerable to pollution-related catastrophic collapse, *J. Econ. Dyn. Control*, 18, 5, 991-1010, (1994) · [Zbl 0802.90026](#)
- [9] Cropper, M., Regulating activities with catastrophic environmental effects, *J. Environ. Econ. Manag.*, 3, 1, 1-15, (1976) · [Zbl 0331.90025](#)
- [10] de Zeeuw, A.; Zemel, A., Regime shifts and uncertainty in pollution control, *J. Econ. Dyn. Control*, 36, 939-950, (2012) · [Zbl 1239.91120](#)
- [11] Gjerde, J.; Grepperud, S.; Kverndokk, S., Optimal climate policy under the possibility of a catastrophe, *Resour. Energy Econ.*, 21, 3, 289-317, (1999)
- [12] Gruber, J., 2006. A Tax-Based Estimate of the Elasticity of Intertemporal Substitution. Technical Report, National Bureau of Economic Research.
- [13] Hughes, T.; Baird, A.; Bellwood, D.; Card, M.; Connolly, S.; Folke, C.; Grosberg, R.; Hoegh-Guldberg, O.; Jackson, J.; Kleypas, J., Climate change, human impacts, and the resilience of coral reefs, *Science*, 301, 5635, 929-933, (2003)
- [14] Keller, K.; Bolker, B.; Bradford, D., Uncertain climate thresholds and optimal economic growth, *J. Environ. Econ. Manag.*, 48, 1, 723-741, (2004) · [Zbl 1161.91450](#)
- [15] Miranda, M.; Fackler, P., *Applied computational economics and finance*, (2004), MIT Press, (<http://mitpress.mit.edu/books/applied-computational-economics-and-finance>) · [Zbl 1014.91015](#)

- [16] Mulligan, C., 2002. Capital, Interest, and Aggregate Intertemporal Substitution. Technical Report, National Bureau of Economic Research.
- [17] Musick, J., Criteria to define extinction risk in marine fishesthe American fisheries society initiative, *Fisheries*, 24, 12, 6-14, (1999)
- [18] Pindyck, R. S., Uncertainty in the theory of renewable resource markets, *Rev. Econ. Stud.*, 51, April (2), 289-303, (1984) · [Zbl 0529.90022](#)
- [19] Polasky, S.; de Zeeuw, A.; Wagener, F., Optimal management with potential regime shifts, *J. Environ. Econ. Manag.*, 62, September (2), 229-240, (2011)
- [20] Reed, W., Protecting a forest against fireoptimal protection patterns and harvest policies, *Nat. Resour. Model.*, 2, 23-54, (1987) · [Zbl 0850.92073](#)
- [21] Reed, W., Optimal harvesting of a fishery subject to random catastrophic collapse, *Math. Med. Biol.*, 5, 3, 215-235, (1988) · [Zbl 0657.90032](#)
- [22] Santos, M., Smoothness of the policy function in discrete time economic models, *Econometrica*, 59, 5, 1365-1382, (1991) · [Zbl 0781.90092](#)
- [23] Santos, M., Differentiability and comparative analysis in discrete-time infinite-horizon optimization, *J. Econ. Theory*, 57, 1, 222-229, (1992) · [Zbl 0756.90026](#)
- [24] Saphores, J., Harvesting a renewable resource under uncertainty, *J. Econ. Dyn. Control*, 28, 3, 509-529, (2003) · [Zbl 1179.91205](#)
- [25] Scharfstein, D.; Stein, J., Herd behavior and investment, *Am. Econ. Rev.*, 465-479, (1990)
- [26] Scheffer, M., *Ecology of shallow lakes*, (2004), Springer, (<http://www.springer.com/life+sciences/ecology/book/978-1-4020-2306-4>)
- [27] Scheffer, M.; Bascompte, J.; Brock, W.; Brovkin, V.; Carpenter, S.; Dakos, V.; Held, H.; Van Nes, E.; Rietkerk, M.; Sugihara, G., Early-warning signals for critical transitions, *Nature*, 461, 7260, 53-59, (2009)
- [28] Scheffer, M.; Carpenter, S.; Foley, J.; Folke, C.; Walker, B., Catastrophic shifts in ecosystems, *Nature*, 413, 6856, 591-596, (2001)
- [29] Stokey, N.; Lucas, R.; Prescott, E., *Recursive methods in economic dynamics*, (1989), Harvard University Press, (<http://www.hup.harvard.edu/catalogue.html>)
- [30] Tsur, Y.; Zemel, A., Pollution control in an uncertain environment, *J. Econ. Dyn. Control*, 22, 6, 967-975, (1998) · [Zbl 0899.90064](#)
- [31] Vissing-Jorgensen, A., 2002. Limited Asset Market Participation and the Elasticity of Intertemporal Substitution. Technical Report, National Bureau of Economic Research.
- [32] Zemel, A., Precaution under mixed uncertaintyimplications for environmental management, *Resour. Energy Econ.*, 34, 188-197, (2011)

This reference list is based on information provided by the publisher or from digital mathematics libraries. Its items are heuristically matched to zbMATH identifiers and may contain data conversion errors. It attempts to reflect the references listed in the original paper as accurately as possible without claiming the completeness or perfect precision of the matching.