Stranded Rational Bubbles

Abstract

I consider an ecological transition that is unexpected until an announcement date and reduces productivity expectations. I study its impact on the valuation of rational bubbles in an OLG framework. Depending on agents' preferences, some rational bubbles may burst at the time of announcement of the transition. I call them stranded rational bubbles. A trade-off exists between implementing a fast transition or limiting the amount of stranded rational bubbles.

1 Motivation

Unexpected Ecological Transition Ecological transition aims at reducing the use of polluting technologies. It is deemed successful only if it imposes new constraints in the technological choices. If producers were using "brown" technologies before the ecological transition, these new constraints are binding and reduce productivity compared to an unconstrained scenario. Among "techno-optimists", it is hence becoming increasingly clear that the ecological transition will not take place without macroeconomic impacts (Pisani-Ferry, 2021). On the other hand, "techno-pessimists" are more and more vocal, arguing that the required technological changes will imply a decrease in the level of production. Thus, as pointed out by Parrique (2022), degrowth is more and more envisaged in the IPCC reports (IPCC, 2021).

While remaining agnostic on this debate, it can be noticed that the GDP losses associated with an ecological transition are regularly reassessed upwards. Acknowledging this bias in expectations, I assume that the economic impact of a major ecological transition would not be fully anticipated before its announcement.

I will consider, from now on, ecological transition as an unexpected decrease in productivity expectations and address one general question: what would be its effects on asset prices? Moreover, since production processes cannot be changed from one day to the next, government typically allow time for firms to adjust. There is then a time span between the announcement of new constraints and their implementation. This project will study how this time span affect assets valuation effects.

Stranded Assets These two questions have been tackled for assets relying on "brown" technologies (e.g. a thermal car plant or a coal mine). These assets lose in value at the time of announcement of an ecological transition and are therefore called stranded assets (Caldecott, 2017). Since, even in absence of an ecological transition, these assets would have depreciated at some point, the following trade-off has been emphasized: the more abrupt the transition, the larger the value losses.

Rational Bubbles This project examines the impact of an ecological transition on another type of assets: rational bubbles. Literature has long recognized that a fundamentally worthless asset could be priced positively in presence of overlapping generations (Samuelson, 1958), financial constraints (Farhi and Tirole, 2012) or preference for wealth (Michau et al., 2018). In each of these

cases, the steady-state size of rational bubbles is proportional to the size of the present and future expected levels of production. An ecological transition reducing the expected productivity may therefore be a transition from a large rational bubble to a downsized one. The aim of this project is to offer a framework to understand valuation effects on rational bubbles due to an ecological transition.[1] The next two sections focus on a simple two-period OLG model with capital.

2 Model

Demographics and Labour Each cohort s is a continuum of agents of size L_s. Population grows at a rate n_t between $t-1$ and t such that $L_t = (1+n_t)L_{t-1}$. Each agent of cohort s supplies one unit of labour at $t = s$ and doesn't work at $t = s+1$.

Preferences An agent of cohort s maximizes the following isoelastic utility, with $\theta \geq 0$ the elasticity of inter-temporal substitution and β the discount factor $0 < \beta < 1$.

$$u(c_s^y) + \beta u(c_{s+1}^o) \qquad \text{with} \qquad u(c) = \begin{cases} \frac{\theta}{\theta-1}\left[c^{\frac{\theta-1}{\theta}} - 1\right] & \text{if } \theta \neq 1 \\ Ln(c) & \text{if } \theta = 1 \end{cases}$$

Production Technology is Cobb-Douglas with $F_t(K_t; L_t) = A_t K_t^{\alpha} L_t^{1-\alpha}$. Factor of production are paid at their marginal productivity and capital depreciates at rate δ. We define aggregate wages as $W_t \equiv (1-\alpha)F_t(K_t; L_t)$ and rate of return on capital as $R_{t+1} \equiv 1 + F'_{K,t}(K_t, L_t) - \delta$.

Bubble and Budget Constraint There exists one unit of an intrinsically worthless storable asset called bubble. At t, old agents sell the bubble unit against Q_t units of consumption goods to the young agents. This gives us the budget constraints for cohort s:

$$\text{at } s: \quad c_t^y + K_{t+1} + Q_t \leq W_t \qquad\qquad \text{at } s+1: \quad c_{t+1}^o \leq R_{t+1}K_{t+1} + Q_{t+1}$$

Timing of the Ecological Transition Model is deterministic. Before $t = 0$, agents are on a "brown" balanced growth path and expect to remain on it forever. At $t = 0$, the ecological transition is announced: new cohorts expect lower values of A_t or n_t from period T onwards. T captures the time span between the announcement of the transition and its impact on productivity. I study two different types of ecological transition:

1. A decrease in A_t from A^B to A^G in a non-growing economy ($n_t = 0\ \forall t$):
   - For all $t < T$, $A_t = A^B$
   - For all $t \geq T$, $A_t = A^G < A^B$
   - Cohorts $s < 0$ expect $A_t = A^B\ \forall t$
   - Cohorts $s \geq 0$ have perfect foresight on $A_t\ \forall t$
2. A decrease in n_t from n^B to n^G with $A_t = 1$ $\forall t$:
   - For all $t < T$, $n_t = n^B$
   - For all $t \geq T$, $n_t = n^G < n^B$
   - Cohorts $s < 0$ expect $n_t = n^B\ \forall t$
   - Cohorts $s \geq 0$ have perfect foresight on $n_t\ \forall t$

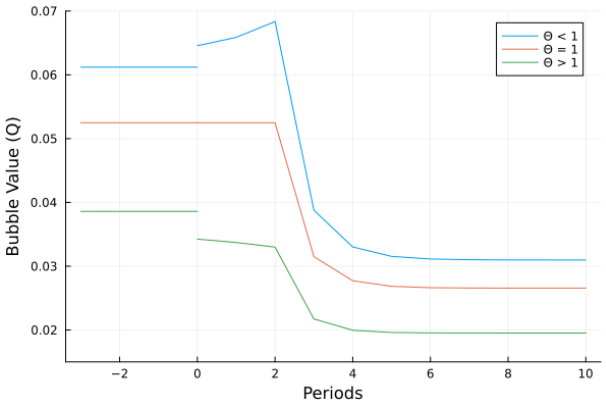
[1] Climate change, pollution or biodiversity loss have also (under-estimated) direct negative effects on production. We can study them by interpreting the announcement of an ecological transition as the anticipation of new damages.

3 Main Results

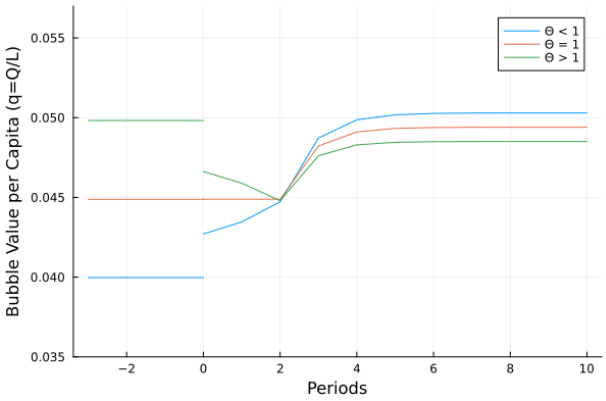
The model is solved numerically. For reasons of brevity, only the rational bubble paths from the brown bubbly steady state (before $t = 0$) to the green bubbly steady state are shown here. I run comparative statics exercises regarding the value of θ, the elasticity of inter-temporal substitution, and T. For the transition from n^B to n^G, we are considering $q_t \equiv Q_t/L_t$ rather than Q_t.

Elasticity of Inter-Temporal Substitution θ determinates which of the income or the substitution effects dominates. If the substitution effect dominates the income effect ($\theta > 1$), the size of the rational bubble decrease at $t = 0$: some of the rational bubble is stranded. Notice that there is no wealth effect in this simple 2-periods OLG (see Next step). Baseline T value is set to 3.

Transition from A^B to A^G - Different θ

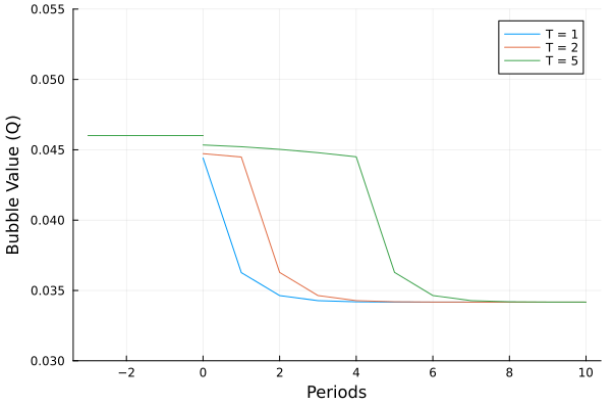


Transition from n^B to n^G - Different θ

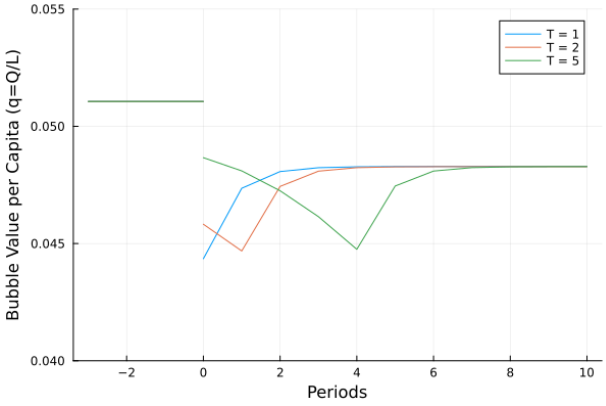


Trade-off Duration of the Transition/Stranded Bubbles In both transitions with $\theta > 1$, the unexpected bubble burst at $t = 0$ can be lowered by a longer transition (higher T).

Transition from A^B to A^G - Different T



Transition from n^B to $n^G < n^B$ - Different T



Not shown Associated phase diagrams, further comparative statics and capital stock paths.

Next Step I should be able to present by June an extended model with agents living for more than 2 periods. This would introduce a wealth effect on top of the substitution and income effects. It would also allow the study of ecological transitions lasting less than one generation.