On Interest Rate Policy and Asset Bubbles: A Theoretical Model of Leaning Against the Wind

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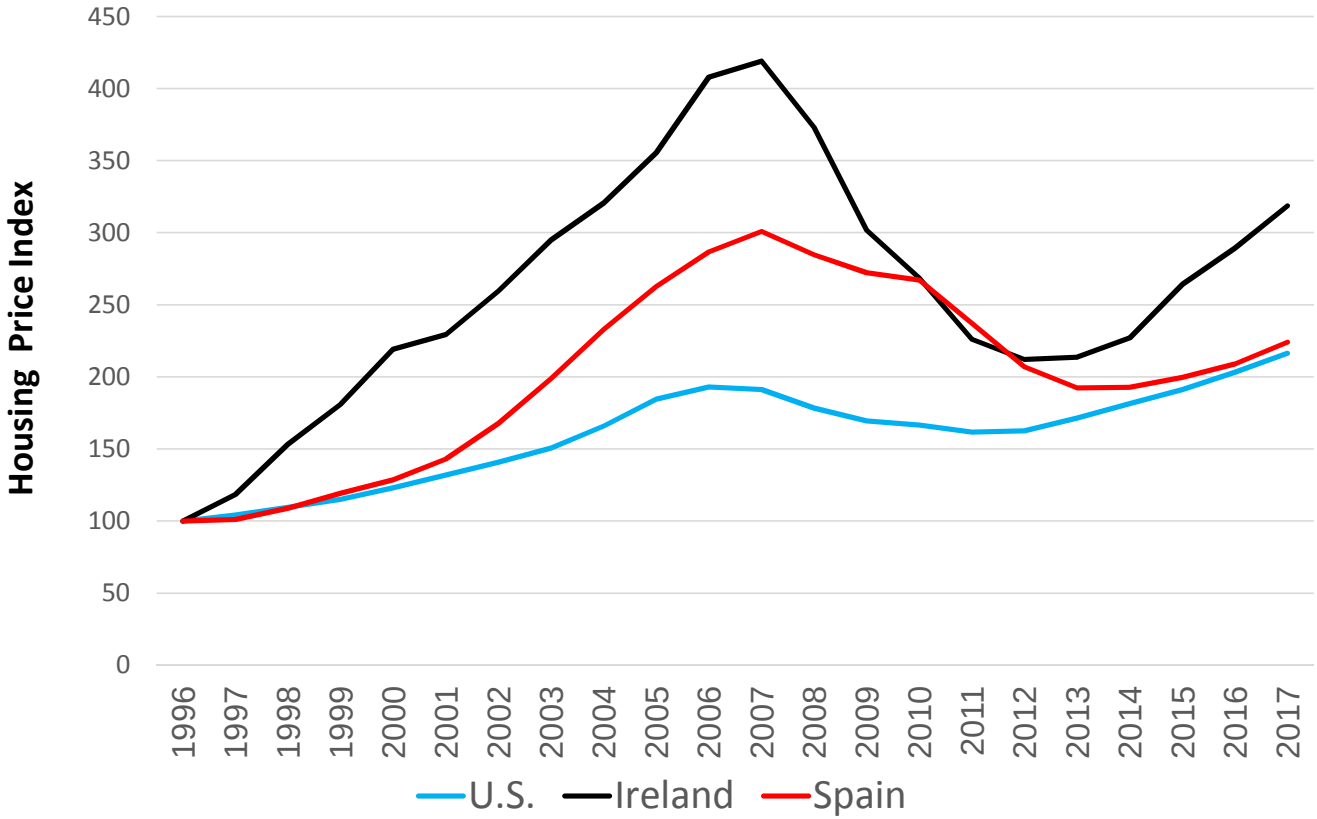
Introduction

- Borio and Lowe (2002) documented a relationship between credit growth, asset price increases and collapses (bubbles) and financial instability

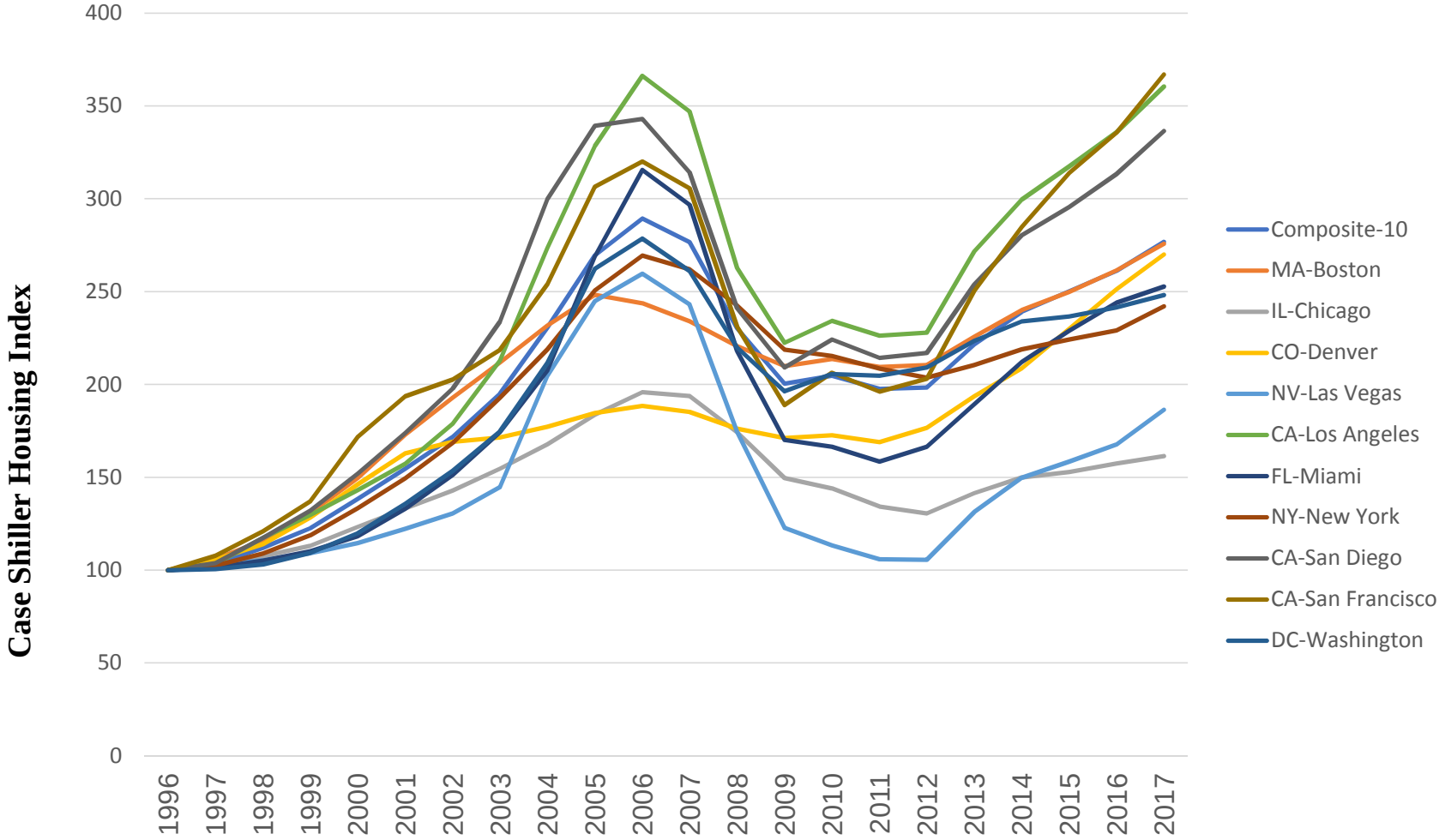
- The global financial crisis that struck in 2007 illustrates this relationship

- In countries such as the U.S., Ireland and Spain, significant run ups in property prices were followed by collapses, bank runs and bail outs

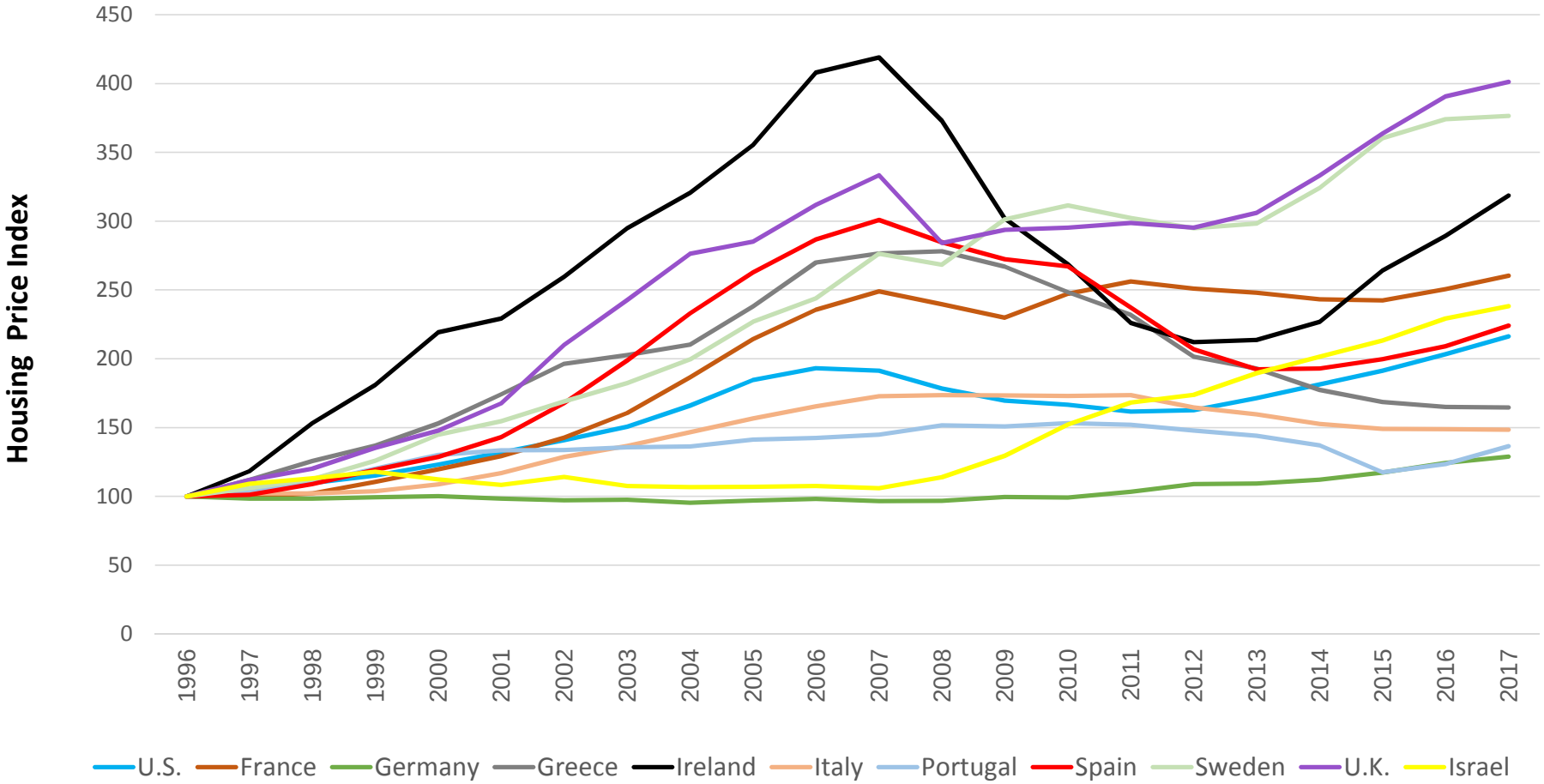
Nominal housing Prices in Ireland, Spain and the U.S.



Nominal Housing Prices in Different U.S. Cities



Nominal Housing Prices in U.S. and Various European Countries



Introduction (cont.)

- Borio and Lowe (2002) argued central banks should consider “leaning against the wind” by raising interest rates to burst the bubble and prevent subsequent financial instability
- This policy has been controversial and has only been followed in a few instances
- The standard view became to clean up after any bubble collapse
- This did not work well in the global financial crisis of 2007-9 and the debate shifted to using macro-prudential versus interest rates to prevent bubbles

Introduction (cont.)

- Gali (2014) has gone beyond the notion that there are preferable alternatives to interest rate hikes and has argued that leaning against the wind can be counterproductive in that this policy can increase bubbles

- We argue that his approach relies on equilibrium selection arguments and even in models like his interest rate increases can dampen bubbles

- A more important problem is that bubbles in his model arise from dynamic inefficiency and it is actually undesirable to dampen them

Introduction (cont.)

- In contrast, we develop an overlapping generations model where
  - The bubble equilibrium is unique
  - Bubbles do not arise from dynamic inefficiency but from informational frictions in the credit market
  - There are costs of default from financial instability
  - If these costs are large enough, raising interest rates can result in a Pareto improvement
- We develop the model in stages starting with one related to Gali's

1.1 Dynamic Inefficiency and Bubbles – The Model

We consider an infinite horizon OLG model with an asset that pays off $d_t = d \geq 0$ per period where agents live for two periods

- Agents only care about consumption when old:

$$u(c_t, c_{t+1}) = c_{t+1}$$

- At t = 0 the old own all the fixed supply of the asset of one unit, the young are endowed with consumption only when young with the initial young having e_0 and growth of endowment e_t of $g \geq 0$ per period:

$$e_t = (1+g)^t e_0$$

Agents can convert endowment when young into consumption when old by

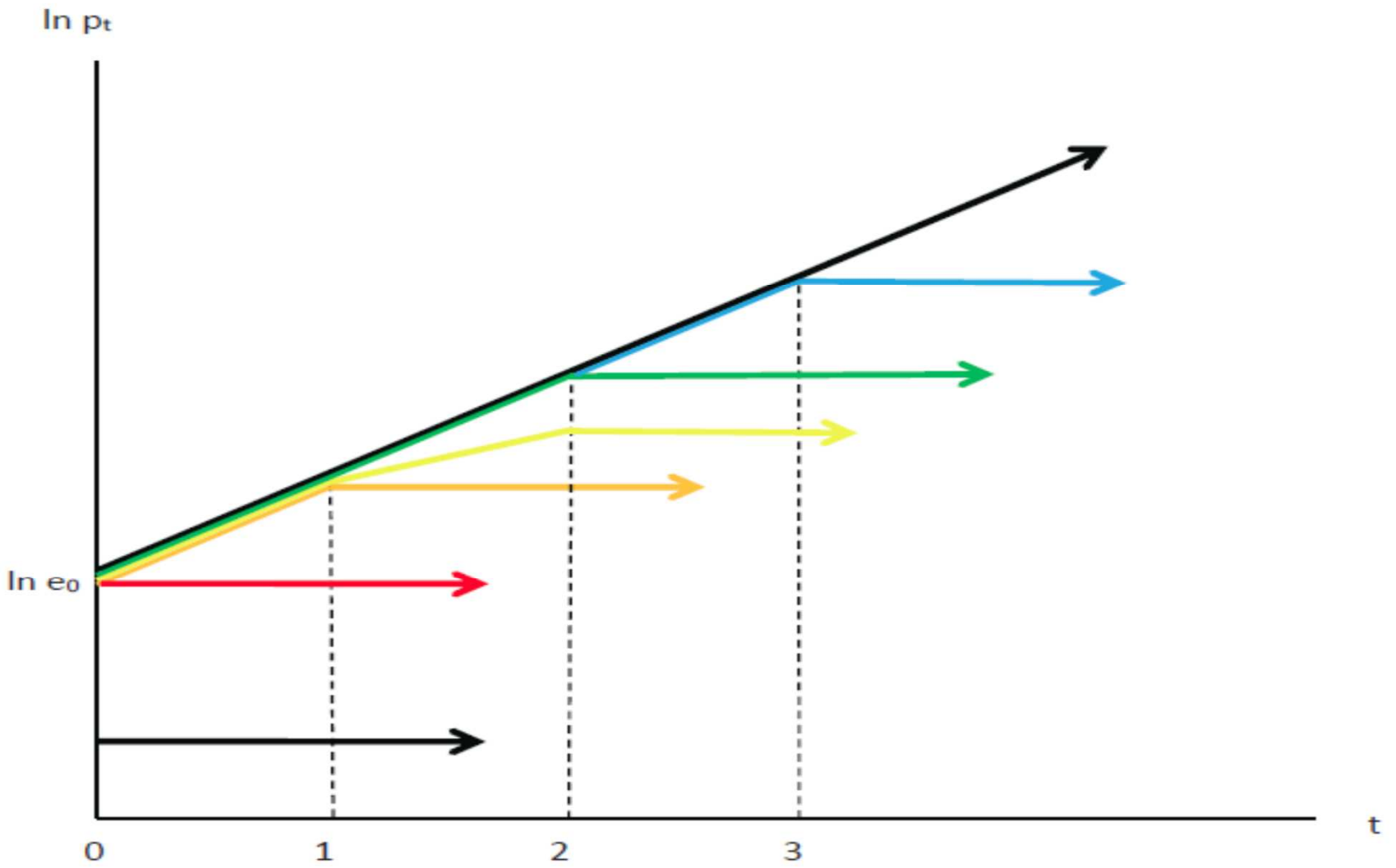
- Storing goods on a 1 → 1 basis
- Trading goods for the asset then trading back for goods

1.1 Dynamic Inefficiency and Bubbles – Equilibria

- Equilibrium is a deterministic price path from t = 0 to ∞ at which the old want to sell assets and the young want to buy
- Let r_t denote return on the asset then when d = 0, $1 + r_t = p_{t+1} / p_t$
- If $r_t > 0$, then storage dominated and all endowment → asset, $p_t = e_t$
- If $r_t = 0$, then $p_{t+1} = p_t \leq e_t < e_{t+1}$, so some storage at t+1
  But if storage at t+1 then $r_{t+1} = 0$ so zero interest is absorbing

Proposition 1 With d = 0, a price path p_t is an equilibrium iff there exists a cut-off date t^* with $0 \leq t^* \leq \infty$ and some value $p_{t^*} \in [e_{t^*-1}$) such that

$$p_t = \begin{cases} e_t \text{ if } t<t^* \\ p_{t^*} \text{if } t \geq t^* \end{cases}$$


ln p_t
ln e_0
0
1
2
3
t

1.2 Monetary Policy and Nominal Price Rigidity

- Gali (2014) showed how monetary policy could matter in a production economy with rigid prices where there are bubbles

- We develop a similar model where preferences and incomes are consistent with the endowment economy in Section 1.1 (see Appendix B of the paper for full details)

- Monetary policy is captured by introducing a central bank that can announce a nominal interest rate $1 + i_t$ at which it will borrow and lend to agents

- To allow for nominal rigidities we assume sellers set the price of their goods before a sunspot variable is realised while the central bank sets i_t after observing it

1.2 Monetary Policy and Nominal Price Rigidity (cont.)

There are multiple equilibria in the model

(1) There exists an equilibrium in which a higher nominal interest rate is associated with lower output, lower input prices, lower asset prices, and a higher real return to buying the intrinsically worthless asset

- Higher interest rates lead to young agents being poorer, they save less and given the asset is in fixed supply its price falls

(2) There is another equilibrium in which a higher nominal interest rate is associated with the same output, higher asset prices, and a higher real return from buying the intrinsically worthless asset

- Higher interest rates lead agents to buy assets rather than store their goods and since the asset is in fixed supply its price rises – the rate rise effectively leads to a change in paths in Figure 1

1.2 Monetary Policy and Nominal Price Rigidity (cont.)

- Dong, Miao and Wang (2017) and Ikeda (2017) focus on the equilibrium (1)
- Gali (2014) focuses on the equilibrium (2)
- The dependency of the effect of monetary policy on the equilibrium chosen is clearly unsatisfactory
- We develop a version of the model with a unique equilibrium

1.3 Eliminating Indeterminacy

- Tirole (1985) showed that if

(1) There is an asset that pays a positive dividend

(2) Without a bubble the real interest rate agents earn would tend to zero or a negative value

Then the bubble is unique in a dynamically inefficient economy since the present value becomes infinite and people can't afford to buy the asset

- We use this insight to develop a model with a unique equilibrium in our endowment economy but with $d > 0$

1.3 Eliminating Indeterminacy (cont.)

- Suppose that $d > 0$ so that the asset yields a real dividend as, for example, with real estate or stocks
- The indeterminacy of equilibrium is now eliminated
  - If $r_t = 0$ then $p_{t+1} = p_t - d$ and eventually price turns negative but this cannot be an equilibrium, since the cohort that owns the asset would refuse to sell them
  - The only candidate equilibrium is one with strictly positive interest rates at all dates so storage is dominated and $p_t = e_t$ for all t.

Proposition 2 With $d > 0$, the unique equilibrium path p_t from t to ∞ is

$$p_t = e_t$$

$$r_t = \frac{p_{t+1}+d}{p_t} - 1 = \frac{(1+g)e_t+d}{e_t} - 1 = g + \frac{d}{e_t}$$

1.3 Eliminating Indeterminacy (cont.)

- Asset is a bubble in this unique equilibrium even though now d > 0
  - Fundamental value is $f_t = \sum_{j=1}^{\infty}(\prod_{i=0}^{j-1} \frac{1}{1+r_{t+i}})d$ where $r_t = g + \frac{d}{e_t} > g$
  - Given $r_t > g$, the fundamental value is bounded asymptotically $\lim_{t\to\infty} f_t = \frac{d}{g}$
  - But price grows without bound: $\lim_{t\to\infty} p_t = \lim_{t\to\infty} e_t = \lim_{t\to\infty}(1+g)^t\, e_0 = \infty$
  - So there is a bubble at some point but in fact we can show there is always a bubble
  - Now $p_t = \frac{d+p_{t+1}}{1+r_t}$ and $f_t = \frac{d+f_{t+1}}{1+r_t}$ so the bubble $b_t = p_t - f_t = \frac{b_{t+1}}{1+r_t}$

    Since $b_T > 0$ as $T \to \infty$, it follows that $b_0 > 0$ and there is a bubble at all dates

1.4 Welfare

- In simple OLG models the equilibrium is typically Pareto inefficient because by transferring from the young to the old at each date it is possible to make everybody better off

- What this means is that dampening the bubble in models of dynamic inefficiency can actually make everybody worse off in the equilibrium

- To understand why leaning against the wind can be beneficial we need a model in which bubbles do not alleviate the friction that allows them to arise in the first place

- We next develop a model where the friction leading to bubbles is different from dynamic inefficiency

2 Credit-Driven Bubbles

- We next construct a model with credit-driven bubbles that trigger default when they collapse that captures policymakers' concerns and show how an intervention can lead to a Pareto improvement

- This is done in stages

  (1) We assume that g = 0 so that the economy is dynamically efficient

  (2) We add a credit market with information frictions that prevent lenders from monitoring borrowers and assume dividends are stochastic (but always positive) – this leads to bubbles

  (3) With default costs, we determine the conditions where dampening bubbles through a rise in interest rates can lead to a Pareto improvement

2.1 An Economy with Credit

- The starting point is the model in the previous section with a constant $d > 0$
  - $g = 0$ so that all cohorts receive $e_t = e$
  - The unique equilibrium without credit markets $p_t = e$ and $r_t = d/e$ for all t
  - $f_t = d/r = e$ so there is no bubble for now and the economy is dynamically efficient
  - Since only the young trade, we need heterogeneity to have a credit market

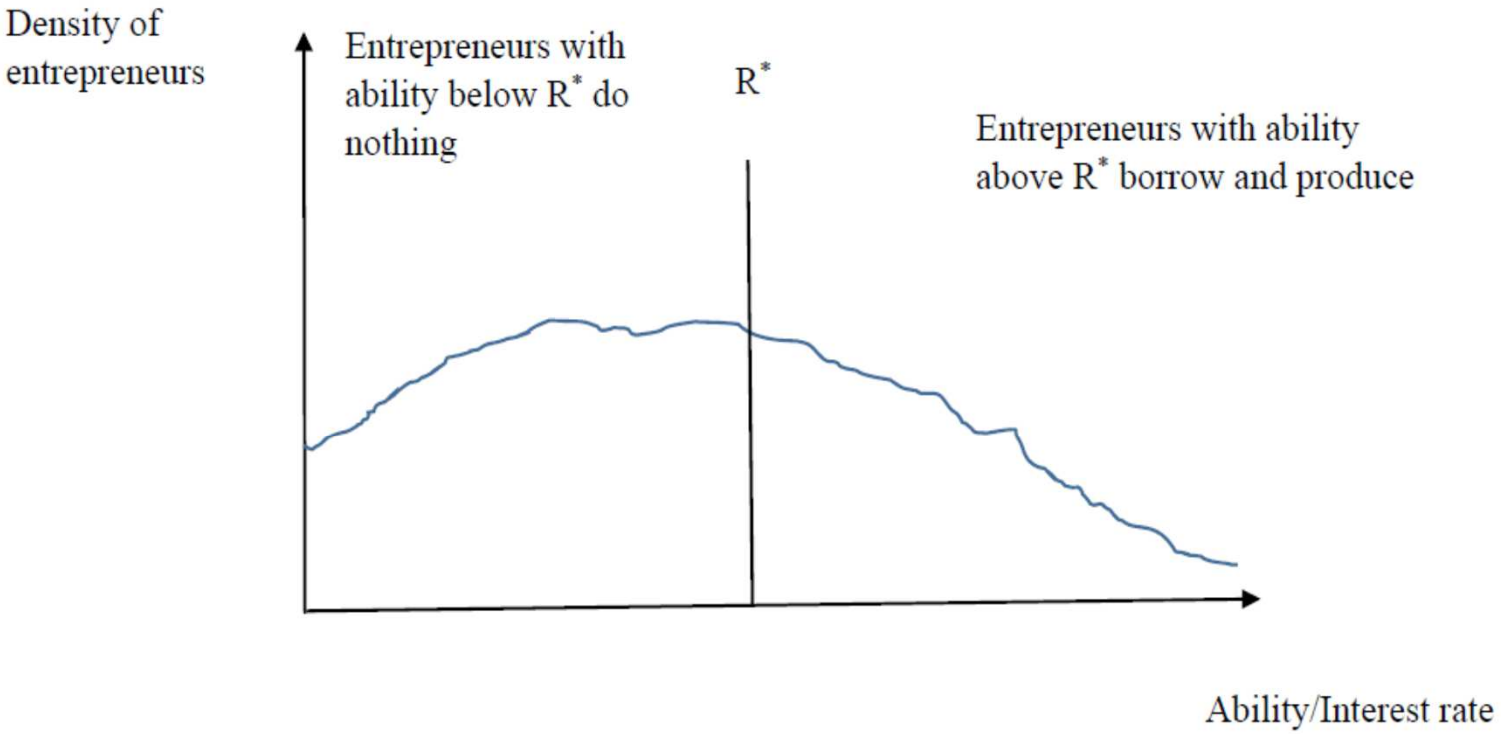
    (i) There exist **savers** as before who are born with an endowment

    (ii) There are also **entrepreneurs** with varying abilities who can borrow to produce – the most able always find it profitable to produce
  - Savers and entrepreneurs trade in a centralized credit market with interest rate R_t
  - An entrepreneur who cannot make the repayment defaults and the lender receives the output

2.1 An Economy with Credit (cont.)

- The unique equilibrium for the economy with credit involves
  - Some savers putting their money in the asset and some lending to entrepreneurs
  - A constant asset price $p_t = p^*$
  - A constant return on the asset $r_t = d/p^*$ for all t
  - An equal interest rate in the credit market $R^* = d/p^*$ for all t
  - The fundamental of the asset $f_t = p^*$ so there is no bubble

2.1 An Economy with Credit (cont.)

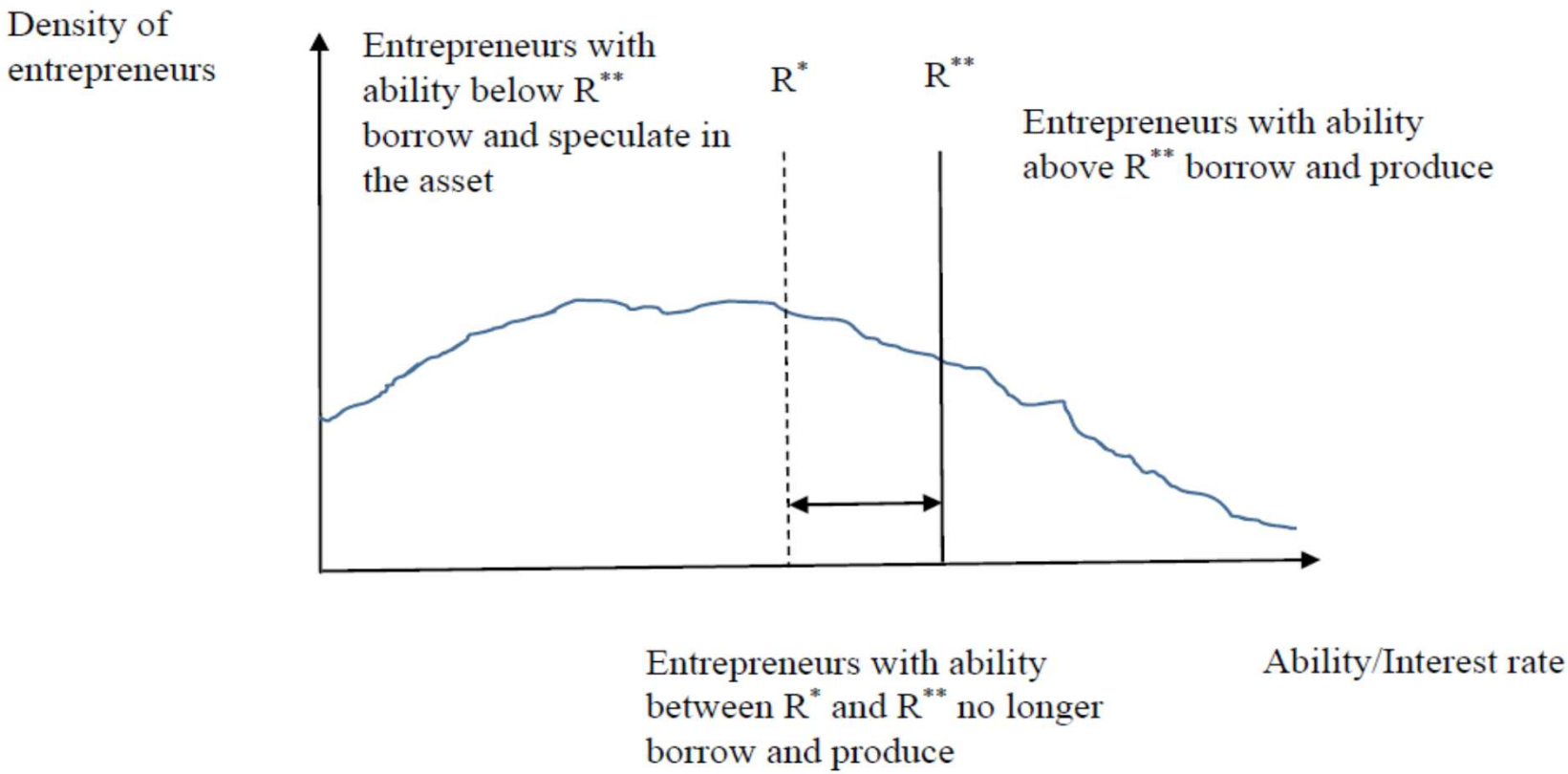


- To have a bubble we introduce risky assets and asymmetric information

2.2 Risky Assets and Information Frictions

- To introduce risk we use a regime switching process similar to that in Zeira (1999)
  - The asset initially pays a dividend $d_t = D > 0$
  - There is a probability $\pi > 0$ each period that the dividend falls to d where $0 < d < D$
  - Once the dividend is d it stays there forever
- The informational friction is as in Allen and Gorton (1993), Allen and Gale (2000) and Barlevy (2014) that lenders can't observe an entrepreneur's productivity and cannot observe what the borrower does with the funds
  - This friction means that the low ability entrepreneurs who cannot make a profit at the rate R^* by producing can now borrow and invest in the asset
  - They bid up the price of the asset until they can just repay the loan if the dividend turns out to be D but default if it switches to d
  - This risk shifting results in a bubble in the price of the asset

2.2 Risky Assets and Information Frictions (cont.)



2.2 Risky Assets and Information Frictions (cont.)

- There are two regimes in the unique equilibrium
  - The dividend has not yet fallen and the asset is risky with p_t^D and R_t^D
  - The dividend has fallen and the asset is safe with p_t^d and R_t^d
- The equilibrium after the dividend has fallen is the same as in the previous section with constant p^d and R^d
- The key insight is that the risk shifting behaviour of the low ability entrepreneurs means that before the dividend falls the prices and interest rates are constant and the same as if D were to continue forever – they are denoted p^D and R^D
  - If this wasn't true then low ability entrepreneurs could make a positive profit but in equilibrium they must make zero profits – they can afford paying $p^D + R^D$ as long as the dividend is D but default when it switches to d
  - Only low ability entrepreneurs hold the asset while the savers lend since there they have some entrepreneurs definitely repaying their loans

2.4 Monetary Policy and Welfare

- Now that we have established that there is a bubble before the dividend drops we can go on to ask whether raising the real rate dampens the bubble and whether there can be a welfare improvement

- There is scope for improving the allocation because the high interest rate in the bubble equilibrium means that some entrepreneurs who would obtain credit in the full information equilibrium do not with asymmetric information

- We model monetary policy section by assuming the initial young generation have their endowment reduced

- However, using monetary policy to raise interest rates dampens the bubble but exacerbates the allocation to entrepreneurs problem and this together with the reduction in endowment means there is a welfare reduction

- In order for monetary policy to be able to raise welfare we need to add another feature

2.5 Costly Default and Welfare-Increasing Interventions

- Financial crises are very costly – Hoggarth, Reis, and Saporta (2002) and Reinhart and Rogoff (2009) estimate a fall in per capita GDP between 9% and 16% while Atkinson, Luttrell, and Rosenblum (2013) estimate that for the US alone the loss from the recent crisis was even higher

- We next model these costs in a simple way by assuming that lenders incur default costs that are proportional to the amount they lend

- Our main result is to show that provided the costs of default are sufficiently high, there is a Pareto improvement in welfare that occurs from using monetary policy to dampen the bubble

2.6 Macro-prudential Regulation as an Alternative

- We have preliminary results regarding the alternative of controlling bubbles through macro-prudential regulation rather than interest rates
  - Increasing leverage restrictions enough will kill a bubble
  - However, if you don't raise them enough to kill the bubble it will only make things worse
  - In other words, a little bit of macro-prudential intervention hurts rather than helps

3 Conclusion

- The problems with the OLG framework relying on dynamic inefficiency are:

  (1) Multiple equilibria

  (2) The bubble in the dynamic inefficiency set up alleviates the friction that allows the bubble to arise in the first place so there is no reason to act against the bubble

- We develop a framework with a unique equilibrium and derive the circumstances where leaning against the wind by increasing interest rates can lead to a Pareto improvement

- Our framework can be used to explore other questions

  - Add features to allow a thorough comparison of interest rate policy and macro-prudential policies to deal with bubbles

  - Small open economy a la Gali and Monacelli (2005) to study capital flows