Secular Stagnation, Financial Frictions, and Land Prices

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Federal Reserve Bank of Philadelphia, November 2019

Introduction

- Many works have been done on the *causes* of the 2008 Great Recession
  - Two main channels: financial distress and house price bust
- Much less on the role of housing and financial frictions in driving the slow recovery *after* the Great Recession
- This paper:
  - Presents a model with financial frictions and endogenous house price dynamics...
  - Where large transitory financial shocks can generate persistent slumps in outputs, house prices, and interest rates...
  - That resemble "secular stagnation" episodes

Motivation House Price GDP Structual Break

This Paper

- Key feature: Financial frictions lead to existence of multiple "regimes" (locally stable steady states)
- Nonlinearity: Asymmetric responses to small and large negative shocks
  - large shocks $\rightarrow$ regime switch $\rightarrow$ push the economy to the bad steady state
- The good steady state corresponds to the classic neoclassic steady state
- The bad steady state resembles secular stagnation: low output, land prices, and interest rates

How?

- Models with financial frictions typically cannot generate quantitatively strong amplification and propagation (Kocherlakota, 2000; Cordopa and Ripoll, 2004)
- One concern is that in these class of models the asset price volatility is too low (Quadrini, 2011)
- This paper proposes a "land consumption channel" that addresses this
  - Land has not only collateral value but also consumption value
  - The consumption value of land can be highly volatile if land services (housing) and other consumption are highly complementarity
  - The high volatility of land value implies that the collateral constraint matters quantitatively

The paper

- The paper consists of a theoretical part and a quantitative part
- First, embed the land consumption channel into a standard neoclassic growth model
- Prove that the model exhibits multiple steady states *if* land services and consumption are sufficiently complementarity
- Second, quantify the model and discipline this complementarity with structural estimates.
- The resulting law of motion for capital is S-shaped with multiple stationary points.
- At the bad steady state, firms are *permanently constrained*, leading to secular stagnation

How Secular Stagnation Happens

- Imagine a recession that destroys certain amount of capital
- Asset (land) prices are low, constraining firms' ability to borrow, reducing their investment, reinforcing low capital $\Rightarrow$ Bad steady state
- Why can't the firms accumulate financial assets or simply issue equity to grow out of the bad steady state?
  1. Due to house price bust, the households experience painful deleveraging
  2. This drives down the equilibrium interest rate, making firms unwilling to hold financial asset
  3. Low consumption and tight borrowing constraint imply households unwilling to purchase equity
- The interaction between firm-side and household-side borrowing constraints lead to secular stagnation

Related Literature

- Macro models with collateral constraints (Kiyotaki and Moore, 1997)
  - Role of land prices: Iacoviello (2005), Liu, Wang, & Zha (2013)
  - Working capital: Mendoza (2010), Jermann and Quadrini (2012)...
- Secular Stagnation
  - Shimer (2012); Fajgelbaum, Schaal, and Taschereau-Dumouchel (2015); Schaal and Taschereau-Dumouchel (2015, 2016); Benigno and Fornaro(2018); Eggertsson et al.(2019)...
- Empirical estimates of IES between housing and consumption
  - Hanushek and Quigley(1980), Flavin and Nakagawa(2008), Siegel (2008), Stokey(2009), Li, Liu, Yang, and Yao(2018);...
- Empirical evidence on real-estate prices and investment/employment
  - Chaney, Sraer, and Thesmar (2012); Mian and Sufi (2013); Chodorow-Reich(2014); Adelino, Schoar, and Severino (2015); Benmelech, Bergman, Seru (2015); Giroud and Mueller (2017)...

Model

Model

- Discrete time. Infinite horizon
- Two types of agents: households and firms. Households are owners of the firms.
- Land: of fixed supply $\bar{L}$; can be used for consumption or production.
- Both capital and land can serve as collateral for its owner (be it household or firm)

The Firms' Problem

- Start with land l_{1t-1}, capital k_{t-1}, and intertemporal debt b_{1t-1}.
- Hire labor n_{1t} at rate w_t and produce $F(z_t, k_{t-1}, n_{1t}, l_{1t})$
  - Simplifying assumption: capital is pre-determined but not land. Kills land as a state variable.
  - Isomorphic to the existence of a land rental market.
- Dividend d_t is distributed after making investment decision i_t, debt issuance decision b_{1t}/R_t, and land allocation decision l_{1t}:

$$b_{1t-1} + d_t + i_t + p_t \left(l_{1t} - l_{1t-1}\right) \leq F\left(z_t, k_{t-1}, n_{1t}, l_{1t}\right) - w_t n_{1t} + \frac{b_{1t}}{R_t}$$

- Next period capital is given by:

$$k_t = (1 - \delta) k_{t-1} + i_t$$

Financial Friction

- The modeling of financial friction follows Mendoza (2010) and Jermann and Quadrini (2012)
- Besides issuing intertemporal debt, the firm needs to raise funds with an intra-period loan to finance working capital.
- Working capital is required to cover cash flow mismatch between payments to various parties (workers, etc) and production revenue
- Total (inter. + intra.) borrowing is limited by a fraction of the collateral asset:

$$\frac{b_{1t}}{R_t} + F\left(z_t, k_{t-1}, n_{1t}, l_{1t}\right) \leq \xi_{1t} p_t l_{1t} + \kappa_t k_t$$

The Firms' Problem

$$\max_{\{b_{1t},k_t,l_{1t},i_t,n_{1t},d_t\}} \quad E\sum_{t=1}^{\infty} M_t d_t$$

$$b_{1t-1} + d_t + i_t + p_t\left(l_{1t} - l_{1t-1}\right) \leq F\left(z_t, k_{t-1}, n_{1t}, l_{1t}\right) - w_t n_{1t} + \frac{b_{1t}}{R_t}$$

$$\frac{b_{1t}}{R_t} + F\left(z_t, k_{t-1}, n_{1t}, l_{1t}\right) \leq \xi_{1t} p_t l_{1t} + \kappa_t k_t$$

$$k_t = \left(1-\delta\right) k_{t-1} + i_t$$

$$k_0, l_{10}, b_{10} \text{ given}$$

- Constant Return to Scale Production Function:

$$F\left(z,k,n,l\right) = z\left[l^{\gamma}k^{1-\gamma}\right]^{\alpha} n^{1-\alpha}$$

The Households' Problem

- Start period t with land holding l_{2t-1} and debt b_{2t-1}.
- His income include labor income $w_t n_{2t}$ and capital income d_t.
- In each period he chooses consumption and next period land and bond holdings subject to the following budget constraint:

$$b_{2t-1} + c_t + p_t \left(l_{2t} - l_{2t-1}\right) \leq d_t + w_t n_{2t} + \frac{b_{2t}}{R_t} \tag{1}$$

- The household can borrow with land as collateral:

$$\frac{b_{2t}}{R_t} \leq \xi_{2t} p_t l_{2t} \tag{2}$$

The households' problem

$$\begin{aligned} \max_{\{b_{2t}, l_{2t}, c_t, n_{2t}\}} \quad & E \sum_{t=1}^{\infty} \beta^t U\left(c_t, n_{2t}, l_{2t}\right) \\ b_{2t-1} + c_t + p_t\left(l_{2t} - l_{2t-1}\right) \quad & \leq d_t + w_t n_{2t} + \frac{b_{2t}}{R_t} \\ \frac{b_{2t}}{R_t} \quad & \leq \xi_{2t} p l_{2t} \\ n_{2t} \quad & \leq \bar{n}, k_0, l_{20}, b_{20} \text{ given} \end{aligned}$$

Preference

$$U(c_t, n_{2t}, l_{2t}) = \frac{\left[(1-\omega)\left(c_t - \chi \frac{{n_{2t}}^{1+1/\nu}}{1+1/\nu}\right)^{1-1/\sigma} + \omega l_{2t}^{1-1/\sigma}\right]^{\frac{1-1/\eta}{1-1/\sigma}}}{1-1/\eta}$$

- CES form of utility function where σ captures the intratemporal elasticity of substitution between the (composite) consumption and land
- The composite consumption term implies no wealth effect on labor supply (GHH preference)

Competitive Equilibrium

Definition

A competitive equilibrium is defined in a standard way in which the firm and the households maximize their respective objectives given market prices, and the markets for goods, labor, land and bonds all clear:

1. Goods: $c_t + i_t = y_t$
2. Labor: $n_{1t} = n_{2t}$
3. Land: $l_{1t} + l_{2t} = \bar{L}$
4. Bond: $b_{1t} + b_{2t} = 0$

Lastly, the firm's pricing kernel is equal to the household's marginal utility:

$$M_t = \beta^t U_{ct}$$

Characterization

- In the absence of equity issuance friction, household borrowing constraint binds if and only if firm borrowing constraint binds
- Suppose otherwise, firm constraint binds but not the household one
- The firm can reduce dividend payment, and the household can increase inter-borrowing to maintain the same level of consumption
- This relaxes the firm's borrowing constraint and yields higher output
- Thus, the two constraints must bind at the same time

Characterization

- Thus, we can write the two borrowing constraints as one aggregate constraint:

$$\frac{b_{1t} + b_{2t}}{R_t} + F\left(z_t, k_{t-1}, n_{1t}, l_{1t}\right) \leq \xi_{2t} p_t l_{2t} + \xi_{1t} p_t l_{1t} + \kappa_t k_t$$

- Or, with bond market clearing condition:

$$F\left(z_t, k_{t-1}, n_{1t}, l_{1t}\right) \leq \xi_{2t} p_t l_{2t} + \xi_{1t} p_t l_{1t} + \kappa_t k_t$$

- The bond distribution is irrelevant for equilibrium allocations

Isomorphism to Representative Agent

- Given that the bond distribution is irrelevant, we can aggregate household and firm into one single agent solving:

$$\begin{aligned} & \max_{\{l_{1t}, l_{2t}, c_t, n_t\}} && E \sum_{t=1}^{\infty} \beta^t U\left(c_t, n_t, l_{2t}\right) \\ c_t + k_t - (1-\delta)k_{t-1} + & && \sum_{i=1,2} p_t \left(l_{it} - l_{it-1}\right) \leq F(z_t, k_{t-1}, l_{1t}, n_t) \\ & F\left(z_t, k_t, n_{1t}, l_{1t}\right) && \leq \xi_{2t} p_t l_{2t} + \xi_{1t} p_t l_{1t} + \kappa_t k_t \\ & && k_0, l_{10}, l_{20} \text{ given} \end{aligned}$$

- We also don't need to keep track of the land distribution: consumption and production take place using *ex post* land holdings
- The only endogenous state variable is capital accumulation

Steady-State Interest Rate

- The steady-state interest rate is pinned down by:

$$\frac{1}{R} = \beta + \frac{\lambda}{R}$$

  where λ is the multiplier on the collateral constraint

- Accumulating financial assets not only increases future consumption, but also relaxes future borrowing constraint

Proposition

The steady-state interest rate is decreasing in the tightness of the collateral constraint (measured by λ)

$$R = \frac{1-\lambda}{\beta} \tag{3}$$

- If constraint binds, the gross interest rate could be less than 1 depending on how tight the collateral constraint is.

Steady State Multiplicity

Strategy

- Given any land price p, solve the representative agent problem at steady state, and obtain the *steady-state land demand* (sum of residential l_1 and commercial l_2 land demand)

$$L(p) = l_1(p) + l_2(p)$$

- Look for p such that the land market clears:

$$L(p) = \bar{L}$$

- Goal: show that the $L(.)$ function is nonmonotonic with financial frictions

Land Consumption Channel

- Absence frictions, the model collapses to a standard growth model, thus land demand L is monotonically decreasing in price p
- In the presence of financial frictions, land demand could be increasing in price p. This nonmonotonicity comes from residential land demand:

$$\underbrace{\frac{1-\omega}{\omega}\left(\frac{\hat{c}}{l_2}\right)^{\frac{1}{\sigma}}}_{\text{Consumption benefit (MRS)}} + \underbrace{\xi_2 p\lambda}_{\text{Collateral benefit}} - \underbrace{(1-\beta)p}_{\text{User cost}} = 0$$

- When land price $p \Uparrow$, output increases, (composite) consumption $\hat{c} \Uparrow$, demand for residential land $l_2 \Uparrow$, the magnitude depends on substitution parameter σ

Theorem

Suppose σ (substitution in utility) and γ (land share in production) are sufficiently small. Then for some combination of loan-to-value ratios, there exists:

1. *a unique unconstrained steady state, in which the collateral constraint is slack and*
2. *at least two constrained steady states, in which the collateral constraints are binding.*

Graphic Illustration

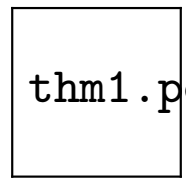


Figure 1: Graphical Illustration of Theorem 1

Remark on Interest Rate

- The interest rates of constrained steady states are lower than the interest rate of the unconstrained steady state, due to the binding collateral constraint.
- Transitions from good to bad steady state would entail a decline of the interest rate

Quantitative Analysis

Calibration

Table 1: Calibration

Parameters		Value	Source
Discount factor	β	0.99	Quarterly model
Intertemporal elasticity	η	0.5	Standard
Disutility of working	χ	2.41	Steady state labor equal to .33
Frisch Elasticity	ν	4	Macro Studies
Pref. weight	ω	0.27	Land value/GDP= 1.06
Depreciation	δ	2.5%	Standard
Capital share	α	0.35	Standard
Land share	$\alpha\gamma$	0.03	Share of commer./res. land=.5
Intratemporal Elasticity	σ	0.487	Micro estimates (Li et al. 2016)
Aggregate land stock	$\bar{l}$	1	Normalization

Calibration

Elasticity of Substitution between Housing and Consumption σ

- Most micro estimates between 0.13 and 0.6
  - Hanushek and Quigley(1980), Flavin and Nakagawa(2008), Siegel (2008), Stokey(2009), Li, Liu, Yang, and Yao(2016)
- Set $\eta = 0.487$ as in the structural estimation of Li, Liu, Yang, and Yao(2016)

Loan-to-value Ratio ξ, κ

- Constraint occasionally binding $\Rightarrow$ cannot estimate using steady state targets
- Set it so that constraint only binds in big recessions
  - Set $\xi = \kappa = 0.03$: Constraint binds with about 6% drop in output

Dynamics: Multiple Steady States

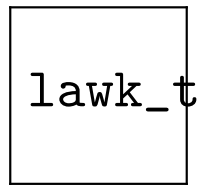
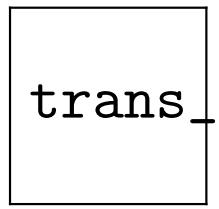


Figure 2: Law of Motion for Capital

Transitional Dynamics

- Transitional dynamics depend on how much capital lost during the recession
- More capital lost during the recession, slower the recovery.

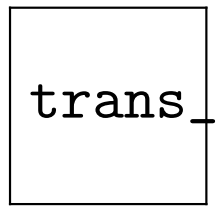
Transitional Dynamics



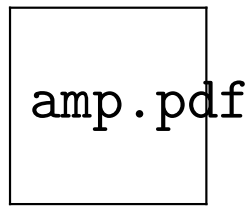
Isolating the Collateral Channel

- Consider an alternative economy where land price is exogenously fixed at the unconstrained steady state level (call it fixed-p economy)
- This captures scenario where there is a severe recession but without financial amplification through collateral constraint
- Model no longer displays slow recovery

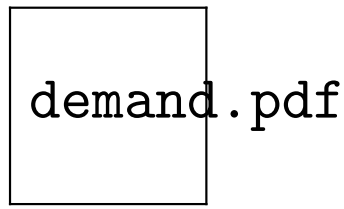
Transitional Dynamics(Fixed-p Economy)



Amplification



Credit Shock v.s. Housing Demand Shock



Accounting for the Slow Recovery

Narratives of the Great Recession and Aftermath

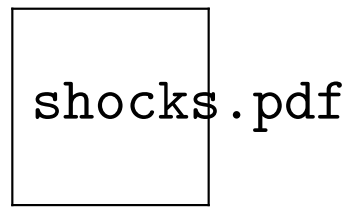
- Large swings in house demand create boom-bust in house prices
- Collapse of the financial sector lead to large financial shocks
- Productivity slow down after the Great Recession

Quantitative Strategy

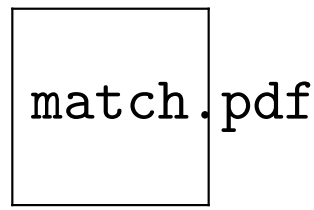
Feed into the model:

- A sequence of housing demand shocks
  - To match house prices between 2007Q4 to 2016Q1
  - Not just the decline but the subsequent house price recovery
- A sequence of credit shocks
  - To match output decline between 2007Q4 to 2009Q4
  - Examine the model's ability to explain subsequent stagnation
- A sequence of productivity shocks
  - Independently computed as the Solow residual

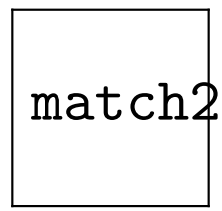
Accounting for the Slow Recovery



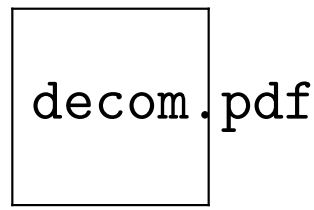
Accounting for the Slow Recovery



Compared to Fixed-p Model without Financial Amplification



Decomposition of Output



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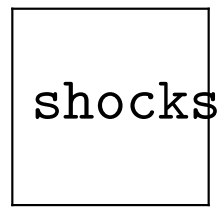

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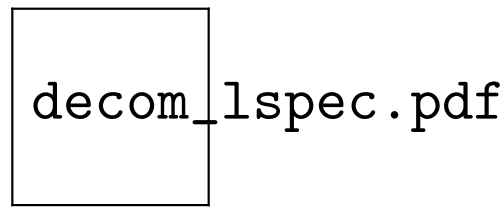
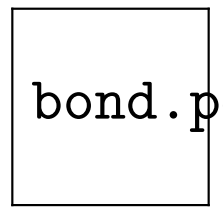
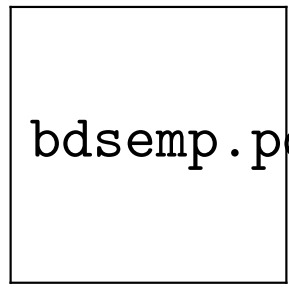


Interest Rate

Interest Rate



Cross-Sectional Evidence



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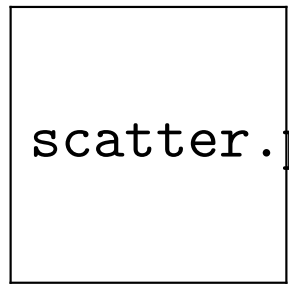

Conclusion

- The paper: A model to explain the slow recovery after the 2008 financial crisis
- Key feature: Multiple steady states and nonlinear dynamics
- Crucial ingredient: Dual role of land as households' consumption and firms' collateral
- Quantitative discipline: Housing-consumption complementarity from cross-sectional evidences and structural estimates
- Quantitative findings:
  - The model can generate persistent recessions comparable to post-Great Recession data
  - Credit Shock, albeit short-lived, contributes non-trivially to the slow recovery

Real GDP

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House Price Index

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Land Price Index

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Motivation

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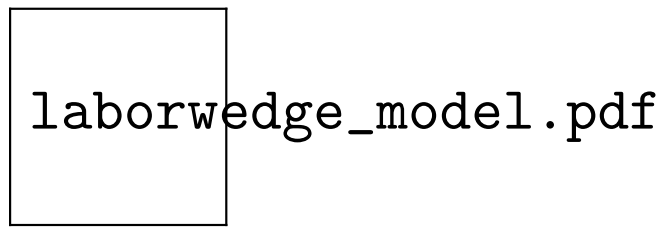
Quantity of land grows smoothly

Quantity of land grows smoothly

Back

Accounting for the labor wedge

Back



Debt Dynamics