The plan

Quick review of the slump following the financial crisis of 2008
THE PLAN

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Ideas about driving forces and propagation mechanisms
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Quick review of the slump following the financial crisis of 2008
Ideas about driving forces and propagation mechanisms
A model constructed to study propagation
The recent slump was similar to earlier ones

<table>
<thead>
<tr>
<th>Peak year</th>
<th>Peak rate</th>
<th>1</th>
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<tr>
<td>1975</td>
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<td>0.84</td>
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<td>1982</td>
<td>9.7</td>
<td>0.99</td>
<td>0.77</td>
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<td>1992</td>
<td>7.5</td>
<td>0.92</td>
<td>0.81</td>
<td>0.75</td>
<td>0.72</td>
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<tr>
<td>2010</td>
<td>9.6</td>
<td>0.93</td>
<td>0.84</td>
<td>0.77</td>
<td>0.65</td>
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</table>
Real GDP, 2000-2014, Billions of 2009 Dollars
Real Consumption Expenditure, 2000-2014, Billions of 2009 Dollars
Employment, 2000-2014, Thousands of Workers
Unemployment, 2000-2014, Percent of Labor Force
Average Real Earnings per Household, 2009 Dollars, 1990-2014
Index of Total Factor Productivity, 2007 = 1, 2000-2014
Labor Share

Business Earnings as a Ratio to the Value of Capital
Driving forces

Some potentially exogenous
Driving forces

Some potentially exogenous

Others clearly induced by a process outside the model, such as rising discounts and frictions resulting from collapse of house prices
Driving force #1: Labor-force participation

Not generally considered in the fluctuations literature
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Decline of about 3 percentage points after 2007; not the result of the slack labor market
Driving force #1: Labor-force participation

Not generally considered in the fluctuations literature

Decline of about 3 percentage points after 2007; not the result of the slack labor market

Continuation of a trend starting in 2000, not the result of demographic shifts
Driving force #2: Capital wedge

Difference between the return to capital and the safe real interest rate
Driving force #2: Capital wedge

Difference between the return to capital and the safe real interest rate

Comprises agency frictions, risk premium, and taxes
Measuring the wedge

\[ q_t = \kappa \left( \frac{k_t}{k_{t-1}} - 1 \right) + 1 \]
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\[ 1 + r_{k,t} = \frac{1}{q_t p_{k,t}} \left[ \frac{\pi_t}{k_t} + (1 - \delta_t) q_{t+1} p_{k,t+1} \right] \]
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\[ 1 + r_{k,t} = \frac{1}{q_t p_{k,t}} \left[ \frac{\pi_t}{k_t} + (1 - \delta_t) q_{t+1} p_{k,t+1} \right] \]

\[ f_t = r_{k,t} - r_{f,t} \]
The capital wedge for two values of the adjustment cost $\kappa$

(a) $\kappa = 0$

(b) $\kappa = 2$
Discounts for risky payoffs seem to rise far more than the return to capital during and after crises.
The S&P Risk Premium, 1960 through 2012
Driving force #4: Total factor productivity

Fernald concludes that the decline was not the result of the crisis.
Driving force #5: Shift in product demand induced by contraction in lending

Shifts from different sources all result in “multiplier” responses
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No important shift in government purchases, the usual variable
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No important shift in government purchases, the usual variable.

But a major decline in household consumption as a result of tightening lending standards and declining collateral.
Driving force #5: Shift in product demand induced by contraction in lending

Shifts from different sources all result in “multiplier” responses. No important shift in government purchases, the usual variable. But a major decline in household consumption as a result of tightening lending standards and declining collateral. Some part of the decline in business investment also resulting from tightening standards.
Driving force #6: Product-market wedge

In the New Keynesian view, the wedge rises in slumps
Driving force #6: Product-market wedge

In the New Keynesian view, the wedge rises in slumps

Another view: Financially constrained firms raise markups
Propagation occurs when the effect of a driving force lasts longer than the force itself.
Mechanism #1: Depletion of the capital stock

This turns out to be the leading source of propagation.
MECHANISM #2: UNEMPLOYMENT DYNAMICS

Because job-finding rates remained high even during the recent slump, leading labor-market models seem to imply that little propagation occurs because of the time it takes displaced workers to find new jobs.
**Mechanism #2: Unemployment dynamics**

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The slow but steady decline of high rates of long-term unemployment is consistent with this view.
Mechanism #3: The Zero Lower Bound

At the lower bound, the real interest rate is minus the expected rate of inflation
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In the Great Depression, expected inflation turned negative, so real rates reached high levels

In the recent slump, expected inflation remained roughly constant

Even so, the bound elevated unemployment for as long as it lasted, more than six years
Inflation Expectations and Forecasts
Effects of the ZLB

Almost all models portray the ZLB as opening a gap between output supply and demand and labor supply and demand.
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Gapology seems realistic but leaves mysteries about how markets respond to congestion resulting from excess supply.

And it’s hard to reconcile gap-based unemployment with DMP-based unemployment.

The ZLB propagated the declines in product demand resulting from financial events—the multiplier for these declines was much higher than normal, according to the demand-gap model.
MODEL SUITED TO STUDYING PERSISTENCE

Medium term; 2-year periods
**Model suited to studying persistence**

Medium term; 2-year periods

Exact stochastic solution
Model suited to studying persistence

Medium term; 2-year periods

Exact stochastic solution

Non-stationary; models unfiltered data
Four-state Markov process for the 6 driving forces
Properties

Four-state Markov process for the 6 driving forces

TFP and labor force evolve as trended random walks with increments a function of the 4-valued random state
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Four-state Markov process for the 6 driving forces

TFP and labor force evolve as trended random walks with increments a function of the 4-valued random state

Levels of other driving forces functions of the state
Properties

Four-state Markov process for the 6 driving forces

TFP and labor force evolve as trended random walks with increments a function of the 4-valued random state

Levels of other driving forces functions of the state

States constructed from principal components of the driving forces
### The States of the Model

<table>
<thead>
<tr>
<th>State</th>
<th>TFP growth</th>
<th>Discount</th>
<th>Labor-force growth</th>
<th>Wedge</th>
<th>Periods in state</th>
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</table>
# Transition Matrix and Ergodic Distribution

<table>
<thead>
<tr>
<th>From state</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Ergodic probability</th>
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<td>1</td>
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<td>0.50</td>
<td>0.13</td>
<td>0.00</td>
<td>0.21</td>
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<td>2</td>
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<td>0.38</td>
<td>0.00</td>
<td>0.25</td>
<td>0.22</td>
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<tr>
<td>3</td>
<td>0.14</td>
<td>0.00</td>
<td>0.71</td>
<td>0.14</td>
<td>0.33</td>
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<tr>
<td>4</td>
<td>0.00</td>
<td>0.14</td>
<td>0.29</td>
<td>0.57</td>
<td>0.24</td>
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</table>
Persistence of the States

Excess probability of being in state vs. Years

- Years: 0, 2, 4, 6, 8, 10
- Excess probability: 0.9 to 0.0

Legend:
- 1
- 2
- 3
- 4
Responses of Driving Forces to Their Own Shocks

(a) Productivity

(b) Labor force

(c) Discount

(d) Wedge
Model specification

One-sector growth model with adjustment costs for investment
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Time to build requires that investment and hiring are determined in the period before they take effect
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One-sector growth model with adjustment costs for investment

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In the asset-pricing equations, marginal utility one period ahead is elevated by the discount driving force, so investment and hiring decisions are made with elevated discount.
Model specification

One-sector growth model with adjustment costs for investment

Time to build requires that investment and hiring are determined in the period before they take effect.

In the asset-pricing equations, marginal utility one period ahead is elevated by the discount driving force, so investment and hiring decisions are made with elevated discount.

The zero-profit condition for recruiting effort in the labor market indexes the future benefit to the employer by the marginal revenue product of labor.
When the ZLB binds, the DMP zero-profit condition drops out
The zero lower bound in the model

When the ZLB binds, the DMP zero-profit condition drops out. Instead, the asset pricing condition for the safe real rate holds that rate at a constant.
Productivity Shock

(a) Market rate

(b) Fixed rate
Discount Shock

(a) Market rate

(b) Fixed rate
Labor-Force Shock

(a) Market rate

(b) Fixed rate
Financial-Friction Shock

(a) Market rate

(b) Fixed rate
Product-Market Wedge Shock

(a) Market rate

(b) Fixed rate
**Product-Market Demand Shock**

(a) Market rate

(b) Fixed rate
Contributions of driving forces to standard deviations of 2-year log changes in the endogenous variables

<table>
<thead>
<tr>
<th>Driving force</th>
<th>Interest rate</th>
<th>Endogenous variable</th>
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<tbody>
<tr>
<td></td>
<td>Market</td>
<td>Capital</td>
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<td>TFP</td>
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<td>0.019</td>
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<td></td>
<td>0.016</td>
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<td>Discount</td>
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<tr>
<td></td>
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<td>Labor force</td>
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<td></td>
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<td>Financial friction</td>
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<tr>
<td></td>
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<tr>
<td>Product market wedge</td>
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<tr>
<td></td>
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<td>0.001</td>
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<tr>
<td>Government purchases</td>
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<td>0.002</td>
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<td></td>
<td>0.004</td>
<td>0.001</td>
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<tr>
<td>Actual data</td>
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### Propagation Ratios by Driving Force, Interest Rate Regime, and Endogenous Variable

<table>
<thead>
<tr>
<th>Driving force</th>
<th>Interest rate</th>
<th>Endogenous variable</th>
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<td>Market</td>
<td>Consumption</td>
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<td>Financial friction</td>
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<tr>
<td>Product market wedge</td>
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<td>Fixed</td>
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<td>Government purchases</td>
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<tr>
<td></td>
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