Understanding the Great Recession

Martin Eichenbaum

December, 2013
What forces drove real quantities in the Great Recession?

- Shocks to financial markets were key drivers, even for variables like labor force participation.
- Government shocks weren’t key drivers: because of their size and timing (consistent with ZLB literature).
- Fiscal expansion could have been very helpful but it never really happened.

Inferences are based on U.S. data and a modified version of New Keynesian (NK) model used by leading policy institutions.
What about inflation

- Standard NK analysis implies inflation would have dropped by much more than it did.

- We identify other factors that prevented a large drop in inflation.
  - Financial market shocks raised the cost of working capital.
  - Fall and slow recovery in productivity (TFP) also raised firms’ costs.

- The fall in TFP is deeply troubling from a longer term perspective.
The Great Recession - the facts.


Use estimated model to analyze the Great Recession.

A few words about Europe and the ‘Austerians’.

Lessons for Israel.
  - Preventing crises.
  - Managing crisis.
The Great Recession - the facts

Log Real GDP

Inflation (%, y-o-y)

Federal Funds Rate (%)

Unemployment Rate (%)

Employment/Population (%)

Labor Force/Population (%)

Log Real Investment

Log Real Consumption

Log Real Wage

G–Z Corporate Spread (%)

Log TFP


Notes: Gray areas indicate NBER recession dates.

Data 2008Q2

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The Inflation Puzzle

- Inflation dropped far less than many people anticipated.

- For example, in the 1980 recession
  - Unemployment rose by about 5 percentage points.
  - Inflation dropped by 10 percentage points.

- In the Great Recession
  - Unemployment rose by about 5 percentage points.
  - But inflation dropped by about 1 percentage points.

- Did the Phillips curve become flatter?

- Did other shocks affect firms’ marginal costs?
A Structural Model

- Christiano, Eichenbaum and Evans (2005) style NK model.

- Key feature of NK style models: nominal price rigidities.
  - Essential for the ZLB to matter.

- Novel elements of extended model.
  - Endogenize labor force participation.
  - Derive wage inertia as an equilibrium outcome.

- Why not assume sticky wages, as in standard NK models?
  - Can’t examine some key policy issues, e.g. extension of unemployment benefits.
(1 – $L_t$) percent of population aren’t in labor force.
  - Specialize in home production, receive unemployment benefits.

$l_t$ percent of population is employed.

($L_t – l_t$) percent of population is unemployed, i.e. they’re in labor force but aren’t employed.
Labor market dynamics

- At beginning of quarter some people enter the labor force.
  - Some may find jobs and some won’t (unemployed)

- At end of each quarter, a fraction \((1 - \rho)\) of employed workers are separated from firms.

- Some separated workers find jobs immediately (job-to-job transitions) and some don’t.

- Separated and unemployed workers have equal probability, \(1 - s\), of exiting the labor force for exogenous reasons.

- A fraction \(s\) of separated and unemployed workers remain in the labor force and search for work.
Labor market

- Three states, enormous gross flows between each state.
- Two classes of decisions are made in labor market: wage bargaining and labor force participation.
Labor market decisions

- Households make labor force participation decisions
- Split between unemployment and employment determined by job-finding rate
- Firms determine how many workers to hire and therefore the job-finding rate.

\[
E_0 \sum_{t=0}^{\infty} \beta^t U(\tilde{C}_t),
\]

\[
\tilde{C}_t = \left[ (1 - \omega)(C_t)^\bar{x} + \omega(C_t^H)^\bar{x} \right]^{\frac{1}{\bar{x}}},
\]
Labor force participation decisions

- People derive utility from market consumption good and goods produced at home.

- Home good produced by individuals who aren’t in labor force and by unemployed people.

- Household income:
  - Wages of employed members,
  - Unemployment compensation received by unemployed members,
  - Capital income, interest income on bonds.

- Expenditures
  - Consumption
  - New bond investments, capital investments,
  - Taxes

- Members of household pool income, share income risks.
In deciding whether to send people to labor force, household must consider:

- Probability of finding a job,
- Level of unemployment compensation if you don’t find a job,
- Current and future market wage in market relative to productivity at home.
- Probability of keeping a job if you find one.

It’s costly to adjust labor force participation rate, so household faces a dynamic, forward looking problem.
Bargaining in labor markets

Bargaining
Three types of worker-firm meetings:
  i) E to E, ii) U to E, iii) N to E
Exogenous flows between different states

- Employment
- Unemployment
- Non-employment
Alternating Offers in a Simple Macro Model

- Competitive final goods production: \( Y_t = \left[ \int_0^1 (Y_{j,t})^{\frac{1}{\lambda}} dj \right]^\lambda, \lambda > 1 \).

- \( j^{th} \) input produced by monopolistic ‘retailers’ using capital and intermediate goods subject to stochastic changes in technology.

- Retailers subject to Calvo price frictions: the source of nominal rigidities in our model.
  - A fraction \( \zeta \) of these firms change prices each period.

- Retailers have to borrow working capital to pay for variable factors of production.

- Intermediate good is produced by flexible price, competitive firms using labor.
Bargaining in the Labor Market

- Firms pay a fixed cost to meet a worker.

- Then, workers and firms bargain.
  - Better off reaching agreement than parting ways.
  - Disagreement leads to continued negotiations.

- If bargaining costs don’t depend sensitively on state of economy, neither will wages.

- After expansionary shock, rise in wages is relatively small.
  - See CET (2013), for intuition in a DSGE model with capital.
In benchmark model, workers and firms bargain over wage rate in each period (spot wages).

Also consider approach where agents bargain over expected present value of wage payments.

Two approaches lead to identical allocations, though possibly different spot wages.

- Latter approach is consistent with nominal wage of given worker at a firm being constant for extended periods of time.
- Wage changes only for new hires.
- Wages of job changers are more volatile than wages of incumbents.
Spot wages

- ‘Spot wage’ approach is useful benchmark for two reasons.
  - Lets us easily incorporate wage data into our empirical analysis.
  - PV approach makes strong assumptions about agents’ ability to commit to stream of wage payments.
Modified version of Hall-Milgrom

Bargaining protocol:

Day 1: firm makes opening offer. Worker can accept, reject and walk away or make counteroffer.

Day 2: worker makes counteroffer in case he rejected on first day. Firm can accept, reject and walk away or make counteroffer.

Day 3: firm makes counteroffer in case it rejected worker’s counter offer...

Last day: worker makes take-it-or-leave-it offer.

In equilibrium, opening offer is accepted.

Off-equilibrium offers, bargaining power, outside option of participants affect opening offer.
**Modified version of Hall-Milgrom**

- **Bargaining costs:**
  - Direct cost of $\gamma$ to firm of rejecting worker offer and preparing a counteroffer.
  - Rejection risks total break down in negotiations with probability $\delta$.
  - Each day that negotiations continue means firm loses production for that day and workers loses wage.

- **Outside options matter**
  - Unemployment benefits
  - Productivity in home sector
  - Job finding rate
Details

- Other standard features from empirical NK models (e.g., CEE, ACEL, SW).
  - Calvo price setting frictions, but no indexation.
  - Habit persistence in preferences.
  - Variable capital utilization.
  - Investment adjustment costs.
  - Taylor rule for monetary policy.
Estimation Strategy

- Estimation by impulse response matching, Bayesian methods.
- Match dynamic effect of monetary policy shock and two types of technology shocks with analog objects estimated from data.
Estimated Parameters, Pre-2008 Data

- Prices change on average every 4 quarters.

- $\delta$: roughly 0.1% chance of a breakup after rejection.

- $\gamma$: cost to firm of preparing counteroffer roughly 1 day’s production.

- Posterior mode of hiring cost: 0.49% of GDP.

- Elasticity of substitution between home and market goods: 3.
  - set a priori, see Aguiar-Hurst-Karabarbounis (2012).
Estimated Parameters, Pre-2008 Data

- **Replacement ratio**: Unemployment payments relative to wage.

  - In model, estimated to be 0.17 (i.e., 17%).

- **Direct data measure**:

  \[
  \frac{\text{gov't payments for unemp. insurance per unemployed compensation per employed worker}}{}
  \]

  - Mean of ratio in our sample period, 13.7%.

- **Standard DMP model requires replacement ratio > 95% to reproduce volatility of labor market data (Hagedorn-Manovskii).**
Responses to a Monetary Policy Shock

Figure 1: Medium-Sized Model: Impulse Responses to a Monetary Policy Shock

Notes: x-axis in quarters.

VAR 95%  VAR Mean  Model
Responses to a Neutral Technology Shock

Figure 2: Medium-Sized Model: Impulse Responses to a Neutral Technology Shock

Notes: x-axis in quarters.

VAR 95%  VAR Mean  Model
What Shocks Drove the Economy During the Great Recession?

To answer question:
- Must take a stand on what economy would have looked like in absence of shocks.
- Simple statistical procedure.

Use model to assess which specific shocks account for gap between:
- What actually happened.
- What would have happened in absence of the shocks.

Next version of the paper will use a more sophisticated statistical procedure and alternative measures of TFP.
The U.S. Great Recession

![Graphs showing various economic indicators during the Great Recession.](image)

**Notes:** Gray areas indicate NBER recession dates.

Data 2008Q2

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The U.S. Great Recession

Figure 6: The Great Recession in the U.S.

Notes: Gray areas indicate NBER recession dates.
The U.S. Great Recession

Figure 6: The Great Recession in the U.S.

Log Real GDP

Inflation (%, y-o-y)

Federal Funds Rate (%)

Unemployment Rate (%)

Employment/Population (%)

Labor Force/Population (%)

Log Real Investment

Log Real Consumption

Log Real Wage

G-Z Corporate Spread (%)

Log TFP


Notes: Gray areas indicate NBER recession dates.

Data 2008Q2 Linear Trend from 2001Q1 to 2008Q2 Forecast 2008Q3 and beyond
The U.S. Great Recession: Data Targets

Figure 7: The U.S. Great Recession: Data vs. Medium-sized Model

Notes: Data are the differences between raw data and forecasts, see Figure 6. Gray areas indicate NBER recession dates.

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The U.S. Great Recession: Data Targets

Data Targets

- GDP (%)
- Inflation (p.p., y−o−y)
- Federal Funds Rate (p.p., annual)
- Unemployment Rate (p.p.)
- Employment (p.p.)
- Labor Force (p.p.)
- Investment (%)
- Consumption (%)
- Real Wage (%)
- G−Z Corp. Bond Spread (p.p.)
- TFP Level (%)
- Gov. Cons. & Investment (%)

Notes: Data are the differences between raw data and forecasts, see Figure 6. Gray areas indicate NBER recession dates.
Alternative measures of TFP from BLS convey same message

Persistent drop in growth rate of TFP
Financial Market Shocks

- *Consumption wedge, $\Delta^b_t$:* motivated by ZLB literature stressing consumption drop.

- Deleveraging, tighter borrowing constraints,...

  - Implemented as in Smets-Wouters (2007):

\[
1 = (1 + \Delta^b_t) E_t m_{t+1} R_t / \pi_{t+1}
\]
Financial Market Shocks

- *Consumption wedge, $\Delta^b_t$: motivated by ZLB literature stressing consumption drop.*

- Deleveraging, tighter borrowing constraints,...

- Implemented as in Smets-Wouters (2007):

\[ 1 = (1 + \Delta^b_t) E_t m_{t+1} R_t / \pi_{t+1} \]
Financial Market Shocks

- **Financial wedge, \( \Delta^k_t \):** motivated by financial frictions literature

- Increased uncertainty in financial markets, credit risk premia
  
  \[
  1 = (1 - \Delta^k_t) E_t m_{t+1} R^k_{t+1} / \pi_{t+1}
  \]

- Financial wedge also applies to working capital loans:
  - Interest charge on working capital: \( \alpha R_t \left(1 + \Delta^k_t \right) + 1 - \alpha \)
  - \( \alpha \) is share of inputs financed with loans.
  - Higher financial wedge directly increases cost to firms.
1. Financial wedge, $1 - \Delta^k_t$, measured using GZ spread data.

2. Government shock measured using $G$ data.

3. We don’t have data on the consumption wedge, $\Delta^b_t$.
   - Set $\Delta^b_t = 0.005$ for 20 quarters.

- Stochastic simulation starting 2007Q4 (nonlinear model, no perfect foresight).
The U.S. Great Recession: Data vs. Model

Figure 7: The U.S. Great Recession: Data vs. Medium-sized Model

Data

Notes: Data are the differences between raw data and forecasts, see Figure 6. Gray areas indicate NBER recession dates.
The U.S. Great Recession: Data vs. Model

Figure 7: The U.S. Great Recession: Data vs. Medium-sized Model

Notes: Data are the differences between raw data and forecasts, see Figure 6. Gray areas indicate NBER recession dates.
Decomposing What Happened into Shocks

- Our shocks roughly reproduce the actual data.
- We investigate the effect of a shock by shutting it off.
- Resulting decomposition isn’t additive because of nonlinearities in the model.
Effects of Financial Wedge Shock

- Accounts for the biggest effect on real quantities.

- Rise in financial wedge represents tax on intertemporal margin.

- With efficient markets: substitution from investment to consumption.
  - Accomplished by large drop in interest rate.
  - BUT: drop not feasible when ZLB is hit.
  - So, consumption not stimulated -> recession.
  - Drop in investment and consumption -> GDP must fall.
  - Households see terrible labor market -> keep people at home.
    - Labor force drops less than employment -> unemployment rises.
  - Recession leads to lower marginal costs -> inflation falls.
Effects of Financial Wedge Shock

Figure 10: The U.S. Great Recession: Effects of Financial Wedge Shock

Notes: Baseline results as in Figure 7. Gray areas are NBER recession dates.

Baseline model
Effects of Financial Wedge Shock

Figure 10: The U.S. Great Recession: Effects of Financial Wedge Shock

GDP (%)

Inflation (p.p., y−o−y)

Federal Funds Rate (p.p., annual)

Unemployment Rate (p.p.)

Employment (p.p.)

Labor Force (p.p.)

Investment (%)

Consumption (%)

Real Wage (%)

G−Z Corp. Bond Spread (p.p.)

TFP Level (%)

Gov. Cons. & Investment (%)

Baseline model

Constant financial wedge

Notes: Baseline results as in Figure 7. Gray areas are NBER recession dates.

Baseline model

Constant financial wedge

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Findings for Other Shocks

- Paper does similar decomposition for consumption wedge, $G$, and TFP.

- Most important impact on real quantities come from consumption and financial wedges.

- Inflation:
  - Disinflation relatively modest because of the operation of the working capital channel and also TFP.
  - Both raise countervailing pressure on inflation.
Effects of Spread on Working Capital:
Widespread skepticism that NK model can account for modest decline in inflation during the Great Recession.

One response: Phillips curve got flat or always was very flat.

Alternative: standard Phillips curve misses working capital term including financial wedge.
   Usually that term is not very important, but it was in post-2008 period.

Slowdown in TFP works in same direction: contractionary but raises marginal costs and inflation.

Net effect: huge recession, with relatively small change in inflation.
According to our model, increases in government purchases have powerful effects when the ZLB constraint is highly binding.

But they didn’t play a large role in the Great Recession and its aftermath.

That’s because the U.S. never had a major stimulus of the type called for in our model.
The Obama ARRA (2009) fiscal stimulus package cost about to $800 billion.

- Large portions were devoted to tax relief and transfer payments to the ‘vulnerable (roughly $400 billion).
- To a first approximation, effectiveness of this type of government spending depends on failure of Ricardian equivalence.

ARRA also included large transfers to fiscal and state governments.

- States mainly used to funds to reduce borrowing and increase transfer payments like Medicare.

What would have happened to state and local purchases of goods and services if ARRA hadn’t happened?
US real Government Consumption and Gross Investment
Annual rates, billions of chained 2005 dollars

Source: St. Louis Federal Reserve
Effect of ARRA on major Federal budget categories

Annual rates, US $billion
What about Europe?

- We can’t learn much from the U.S. about efficacy of fiscal policy when ZLB is binding.

- What about Europe?

- The European crisis is very different from the US crisis.

- But austerity hasn’t reduced debt-to-GDP ratios much in Europe and certainly hasn’t produced a recovery.
Austerity

**Employment Index**

(Q3 2007 = 100)

- **Ireland**
- **Portugal**
- **Spain**
- **Greece**

Source: IMF
Euro Area Gross Public Debt
Percent of GDP

*2012 is based on quarter 3 data
Source: Eurostat
Lessons for Israel

- Do your best to avoid a Great Recession style episode.

- Israel is a small open economy that’s highly vulnerable to developments abroad.

- Even if you are perfect, other countries won’t be.

- It’s critical that Israel have the right tools in place to deal with either a domestic or a foreign crisis.
Avoiding a domestic crisis

- Stop asset pricing booms associated with highly-leveraged financial intermediaries.

- Not bailing out too-big-to fail financial intermediaries isn’t time consistent.

- You must regulate and pursue macroprudential supervision.
  - High capital requirements on systemically important financial institutions (Basel 3, plus shadow banking system).
  - Central banks must lean against credit-driven bubbles via state-dependant regulations.

- Challenges:
  - Prudential policies are more subject to political pressure than monetary policy.
  - Firms will work hard to get around regulations.
Lessons for Israel: before a crisis

- Set flexible inflation-target to minimize chances of binding ZLB episode.
  - How much of an insurance premium in form of an inflation tax are we willing to pay in non-ZLB period to minimize severity of ZLB-style crises?

- Strong credible commitment to stabilize inflation in long run by having an explicit inflation objective.
  - Gives you flexibility to pursue policies to stabilize output in short run if a crisis does occur.
Lessons for Israel: before a crisis

- Minimize currency mismatch between firms and financial intermediaries’ assets and liabilities.

- This allows you to use exchange rate policy much more aggressively to manage aggregate demand during a crisis.
Despite your best plans, there will be crises

- Central bank needs to be an aggressive lender of last resort.
  - Bonus 1: credible commitment to play this role limits self-fulfilling runs in financial sector.
  - Bonus 2: you’ll probably make a lot of money doing it.

- After the crisis, move rapidly clean up and recapitalize the banks.
  - Didn’t happen in Japan in the 1990s, and was costly.
  - It’s not happening in Europe and it’s also very costly.
  - It did happen in the US in this crisis, and it helped the recovery.
After a ZLB-style crisis

- Use fiscal policy *aggressively*.
  - Don’t repeat the mistakes of Obama’s ARRA.

- You can only do this if you had a prudent fiscal policy before the crisis.
Best way to deal with volatile capital flows is by letting exchange rate absorb most of the adjustment.

If investors want to take their funds out, let them.
  - Exchange rate will depreciate.
  - This depreciation will lead, if anything, to an increase in exports and an increase in output.
Traditional arguments against exchange rate adjustment

1. If domestic firms, banks borrow in foreign currency, depreciation has adverse effects on balance sheets, leads to decrease in domestic demand that may more than offset increase in exports.

2. Much of nominal depreciation may translate into higher inflation.

3. Large movements in exchange rate may lead to disruptions, both in real economy and in financial markets.
Force of first two argument can be minimized by minimizing currency mismatch of firms’, financial intermediaries’ assets and liabilities.

- Macropudential measures,
- Development of local currency bond markets,
- Exchange rate flexibility which leads to better perception by borrowers of exchange rate risk.

Credible monetary policy and inflation targets lead to more anchored inflation expectations

- Limits pass-through of exchange rate movements into inflation.
Intervening in exchange rate markets

- During this crisis, the NIS *appreciated* because of a flight to safety.
The BoI engineered a countervailing depreciation of the NIS.

Open economies versions of model I discussed indicate these measures are highly desirable and effective, especially in a ZLB episode.

But, efforts to depreciate currency can’t be a long-term policy for growth or a substitute for high productivity and entrepreneurship.

Israel has no problem when it comes to entrepreneurship.

According to some recent media reports, Russian officials are purchasing snow-making machines produced in Israel.

But productivity is a real concern, not just in Israel but worldwide.
Beyond the Great Recession

average growth = 0.3%

average growth = 0.05%

average growth = 1.2%

average growth = 1.2%