Fiscal Policy in an Unemployment Crisis

Pontus Rendahl

University of Cambridge

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Introduction

What is the size of the fiscal multiplier?

- I argue that the can be large (≈ 2) under three conditions

  1. Low nominal interest rates (liquidity trap)
  2. High and . . .
  3. . . . persistent unemployment

Introduction

What is the size of the fiscal multiplier?

- I argue that the can be large (≈ 2) under three conditions
  1. Low nominal interest rates (liquidity trap)
  2. High and ...
  3. ... persistent unemployment
- Key assumptions
  1. Zero lower bound
  2. Nominal wage rigidity (but flexible prices)
  3. Frictional labour market

A tale of recovery is a tale of a slump

- Disappointing news yields saving motive
- Can be averted by fall in nominal interest rate
- However, if news are really bad, the nominal interest rate will hit the zero lower bound
  - Still excess demand? $\Rightarrow$ hoarding cash
- Yields a shortfall in nominal demand

A tale of recovery is a tale of a slump

- Will a fall in nominal demand imply a fall in real demand?
- Only if there are nominal rigidities
  - Sticky nominal wages
- Prices fall, and profits plummet
- The fall in profits lowers output and raises unemployment
- And unemployment exhibits inertia (frictional matching market)

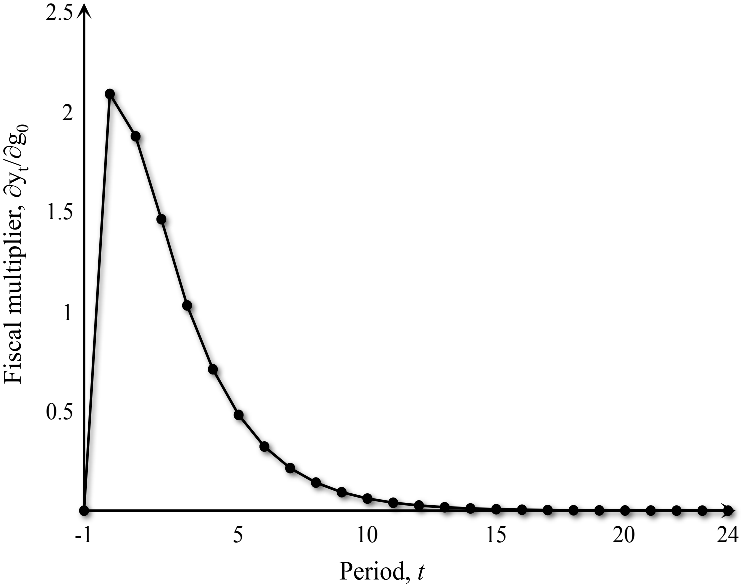
A tale of recovery is a tale of a slump

- An increase in unemployment today leads to an increase in unemployment tomorrow
- Now the future looks even worse
  1. $\rightarrow$ more cash hoardings
  2. $\rightarrow$ larger drop in prices
  3. $\rightarrow$ less profits
  4. $\rightarrow$ less output
  5. $\rightarrow$ higher unemployment
  6. $\rightarrow$ back to step 1

Fiscal policy

- Is this intertemporal propagation mechanism important?
  - In a stylized framework, even very small drops in future productivity can push current output to zero
- So what can the government do?
  - By borrowing (or taxing) some of that hoarded cash and spending it, prices will increase
  - Profits will go up
  - Unemployment will fall
- By inertia, the future looks bright!
  - Government spending turns a vicious circle around
  - Hoardings are reduced, and private spendings increased
  - Unemployment falls even more, and on and on

The fiscal multiplier



Model

- Continuum of households of measure one
- Continuum of potential firms
- A government
- Two physical commodities
  - Cash, m_t, storable but not edible (numeraire)
  - Output, y_t, edible but not storable (trade at p_t)
- Cash in fixed supply $m_t = m$
- Time is discrete, $t = 0, 1, 2 \ldots$, and the horizon infinite
- Investments, but no capital

Model: Households

- Households supply labor inelastically, $\ell_t = 1$
- Employment denoted n_t, so $u_t = 1 - n_t$
- Wage-rate is denoted $\tilde{w}_t$
- Total income, w_t, is labor income, $n_t \times \tilde{w}_t$, and dividends $q_t^t \times \tilde{d}_t$
- q_t^t is the quantity of asset held in time t (subscript) purchased in time t (superscript)

Model: Households

- Only a fraction of the firms survive from one period to the next: $q_{t+1}^t = (1-\lambda)q_t^t$
- Interpretation: q_t^t is a diversified asset portfolio of which λ firms go belly-up each period
- Will use a Lucas (1982;1984) Cash-in-Advance timing
  - w_t paid out by the end of the period t
  - Thus, w_t is disposable first in period $t+1$
  - Need cash to go out shopping

Model: Households

- Period budget constraint

$$b_t(1+i_t) + p_t J_t(q_t^{t-1} - q_t^t) + (M_{t-1} - p_{t-1}c_{t-1}) \\ + w_{t-1} - T_t = M_t + b_{t+1}$$

- With CIA constraint

$$p_t c_t \leq M_t$$

- For simplicity, define $x_{t+1} = M_t - p_t c_t$ (excess cash)

Model: Households

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- With CIA constraint

$$0 \leq x_{t+1}$$

- For simplicity, define $x_{t+1} = M_t - p_t c_t$ (excess cash)

Model: Households

- Problem: Given prices and taxes pick feasible $\{c_t, b_{t+1}, q_t^t, x_{t+1}\}$ to maximize

$$U(\{c_t\}_{t=0}^{\infty}) = E\sum_{t=0}^{\infty}\beta^t u(c_t)$$

- E denotes the (mathematical) expectations over future processes

Model: Households: FOC

First order condition with respect to

- Bonds, b_{t+1}

$$u'(c_t) = \beta E_t[(1 + i_{t+1})\frac{p_t}{p_{t+1}}u'(c_{t+1})]$$

- Excess cash, x_{t+1}

$$u'(c_t) - \mu_t = \beta E_t[\frac{p_t}{p_{t+1}}u'(c_{t+1})]$$

- $x_{t+1} \geq 0$, $\mu_t \geq 0$, $x_{t+1} \times \mu_t = 0$

Model: Households: FOC

- When is $\mu_t = 0$? When $i_{t+1} = 0$ (and vice versa)
- Bonds and cash are perfect substitutes; liquidity trap
- $\Rightarrow x_{t+1} \geq 0,\ i_{t+1} \geq 0,\ x_{t+1} \times i_{t+1} = 0$

Model: Households: FOC

- When is $\mu_t = 0$? When $i_{t+1} = 0$ (and vice versa)
- Bonds and cash are perfect substitutes; liquidity trap
- $\Rightarrow x_{t+1} \geq 0,\ i_{t+1} \geq 0,\ x_{t+1} \times i_{t+1} = 0$
- It should be noted that the ZLB is a consequence of the model, and not a constraint per se
  - If $i_{t+1} < 0$, households would like to borrow indefinitely and save borrowed funds as excess cash

Model: Households: FOC

First order condition with respect to assets, q_t^t

$$J_t = \beta E_t \left[\frac{u'(c_{t+1})}{u'(c_t)} \left(\frac{\tilde{d}_t}{p_{t+1}} + (1-\lambda) J_{t+1} \right) \right]$$

Model: Government

- $\{G_t, T_t, d_t\}$ is a fiscal plan satisfying

$$T_t + d_{t+1} = G_t + (1 + i_t)d_t$$

- and

$$\lim_{t \to \infty} \frac{d_{t+1}/p_{t+1}}{\prod_{n=0}^{t}(1 + i_{n+1})p_n/p_{n+1}} \leq 0$$

Model: Firms and Labour markets

- The labour market is frictional
- Matching takes the standard form

$$H_t = H(v_t, u_t)$$

- With CRTS, the probability that a firm will match with a worker is given by

$$\frac{H_t}{v_t} = \phi_t = \phi(\theta_t), \quad \theta_t = \frac{v_t}{u_t}$$

Model: Firms

- Analogously, an (unemployed) worker will meet a firm with probability

$$\frac{H_t}{u_t} = \rho_t = \rho(\theta_t), \quad \rho(\theta_t) = \theta_t \phi(\theta_t)$$

- If a firm and a worker are matched, they produce z_t units of the output good in period t
- The nominal wage, $\tilde{w}_t$, is taken as given
- Dividends in period t is therefore given by $\tilde{d}_t = p_t z_t - \tilde{w}_t$
- With probability $1 - \lambda$ the firm and the worker separate

Model: Firms

- The (real) cost of posting a vacancy is given by k
- As a consequence, an entrepreneur will post a vacancy iff

$$k \leq \phi(\theta_t) J_t$$

- Employment evolves according to

$$\begin{aligned} n_t &= H_t + (1-\lambda) n_{t-1} \\ &= (\lambda n_{t-1} + (1 - n_{t-1}))\rho(\theta_t) + (1-\lambda) n_{t-1} \end{aligned}$$

Equilibrium

Given a fiscal plan, a competitive equilibrium is a process of prices, $\{p_t, p_t^A, i_{t+1}\}$, and quantities, $\{c_t, q_t^t, b_{t+1}, x_{t+1}, \theta_t, y_t, n_t, I_t\}$, such that

1. Given prices, $\{c_t, q_t^t, b_{t+1}, x_{t+1}\}$ solves the households' problem
2. $\{\theta_t\}$ satisfies the free-entry condition $k = \phi(\theta_t)J_t$
3. Employment, $\{n_t\}$, satisfies the law of motion

$$n_t = (\lambda n_{t-1} + (1 - n_{t-1}))\rho(\theta_t) + (1 - \lambda)n_{t-1}$$

4. Output, $\{y_t\}$ is given by $y_t = z_t \times n_t$
5. Investment $\{I_t\}$ is given by $I_t = p_t v_t k$
6. Bond markets clear; $b_t = d_t$
7. Equity markets clear; $q_t^t = n_t$
8. Goods markets clear; $p_t y_t = p_t c_t + G_t + I_t$

The equation of exchange

- Budget constraints

$$b_t(1+i_t) + x_t + p_t J_t(q_t^{t-1} - q_t^t) \\ + w_{t-1} - T_t = p_t c_t + x_{t+1} + b_{t+1}$$

  and

$$-d_t(1+i_t) + T_t = G_t + d_{t+1}$$

- Can be combined to yield

$$(b_t - d_t)(1+i_t) + x_t + p_t J_t(q_t^{t-1} - q_t^t) + w_{t-1} \\ = p_t c_t + G_t + x_{t+1} + (b_{t+1} - d_{t+1})$$

The equation of exchange

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- Bond market clearing, $b_t = d_t$.

The equation of exchange

$$x_t + p_t J_t(q_t^{t-1} - q_t^t) + w_{t-1}$$
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- Bond market clearing, $b_t = d_t$.
- National accounting, $p_t y_t \equiv p_t c_t + G_t + I_t$
- Equity markets and law of motion for employment infer

$$p_t J_t(q_t^{t-1} - q_t^t) = -p_t J_t H_t$$

The equation of exchange

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$$p_t J_t(q_t^{t-1} - q_t^t) = -p_t J_t H_t$$

- Free-entry of firms: $k = \phi(\theta_t) J_t$

$$k = \phi J_t = \frac{H_t}{v_t} J_t \quad \Leftrightarrow \quad p_t^A H_t = k v_t p_t = I_t$$

The equation of exchange

$$x_t + w_{t-1} = p_t y_t + x_{t+1}$$

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The equation of exchange

$$x_t + w_{t-1} = p_t y_t + x_{t+1}$$

- Suppose $x_t + w_{t-1} = m$

$$\Rightarrow \quad m = p_t y_t + x_{t+1}$$

- $p_t y_t$ is dividends and labour income tomorrow, w_t
- x_{t+1} is cash tomorrow
- Thus $x_{t+1} + w_t = m$

The equation of exchange

- Initial condition

$$x_0 + w_{-1} = m$$

- So

$$m = p_t y_t + x_{t+1} \quad t = 0, 1, \ldots$$

- Or define $v_t = \frac{m - x_{t+1}}{m}$

$$m v_t = p_t y_t \quad t = 0, 1, \ldots$$

Nominal wage rigidity

Assumption 1

Nominal wages are rigid; $\tilde{w}_t = \tilde{w}$

Calibration

- The matching function is given by

$$H_t = v_t(1 - e^{-\frac{\eta}{\theta_t}})$$

  which displays CRTS, and ρ_t and ϕ_t are in $(0, 1)$ for $\theta \in [0, \infty)$
- The parameters to calibrate are therefore: σ, β, k, λ, $\tilde{w}$, and η

Calibration

- Monthly frequency: $\beta = 0.95^{\frac{1}{12}}$
- The coefficient of relative risk aversion, σ, is set to 3
- The separation rate, λ, is set to 3.4% per month (JOLTS)
- Average labor market tightness 2000-2010 is 0.45 (JOLTS), set η such that $u = 0.95$
- The steady state level of z is normalised to one, and cash, m, to 0.95
- $\Rightarrow$ steady state prices, p, equals one

Calibration

- Government spending is constant at: $\bar{g} = 0.2y$ (NIPA)
- The wage rate, $\tilde{w}$, is set to 0.971 (cf. Hall: 0.965, Shimer: 0.993)
- The steady state level of (real) asset prices can be calculated as

$$J = \frac{z - \tilde{w}}{1 - \beta(1 - \lambda)}$$

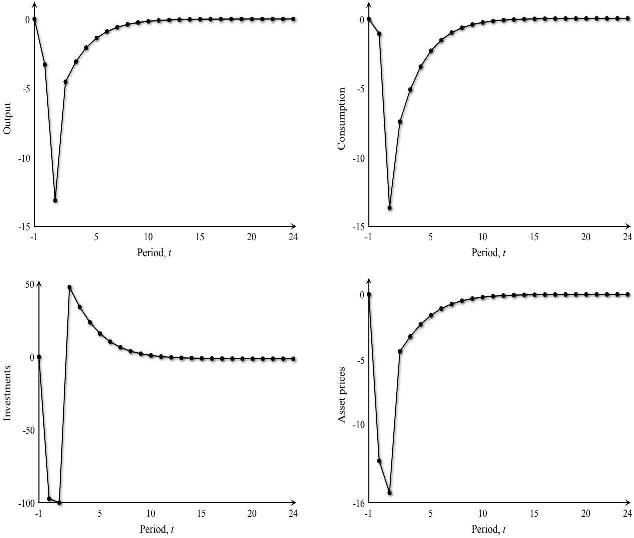
and k is therefore set such that

$$k = q(\theta)J$$

Experiment: News shock

- The economy is initialized at it's steady-state in period $t = -1$
- In time zero, agents are informed that $z_1 = 0.93$, but $z_t = 1$ for $t = 2, 3, \ldots$
- Evaluate the effect on the economy
- Evaluate the effect of a discretionary one-shot increase in government spending in period zero

“Business Cycle Properties”



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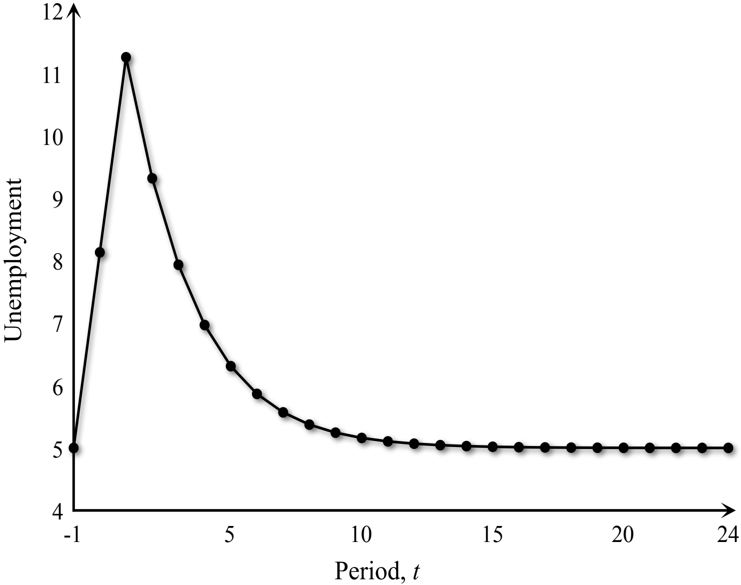
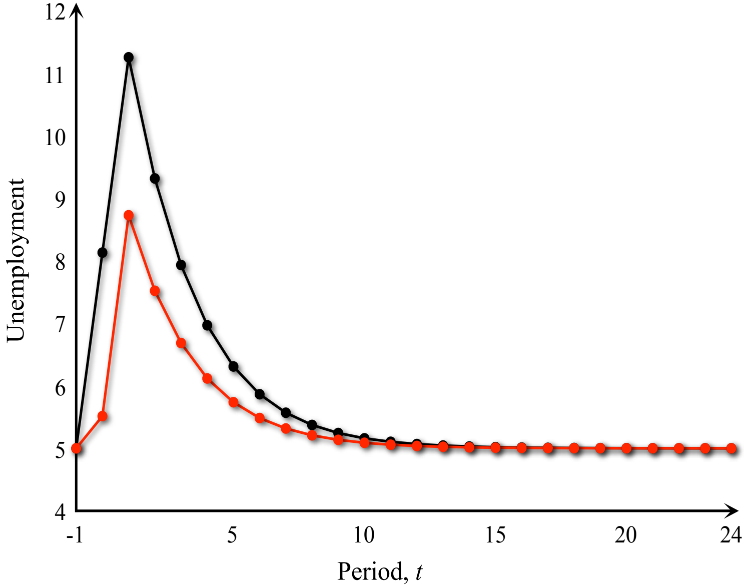


Effect of government spending



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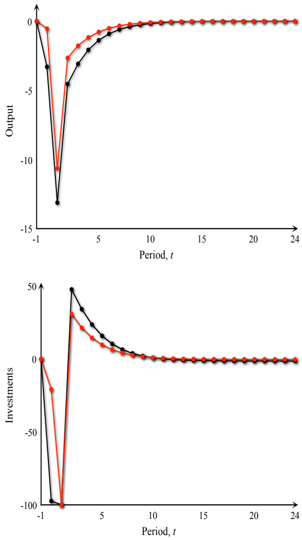

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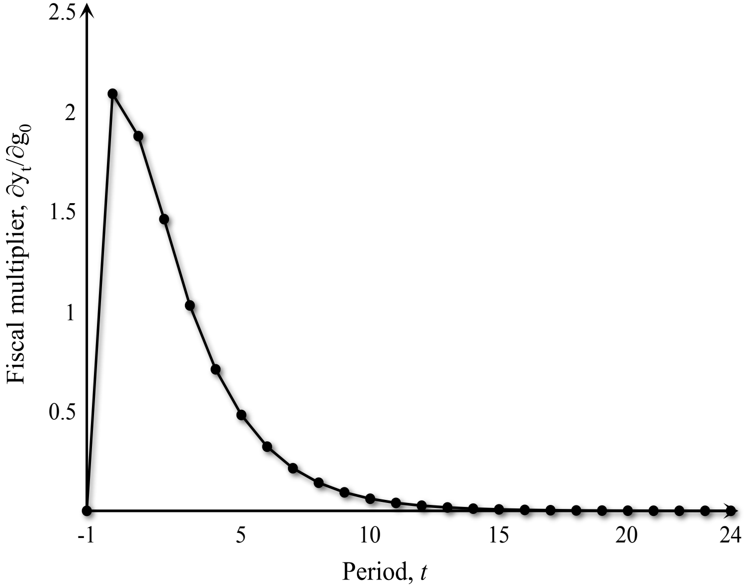

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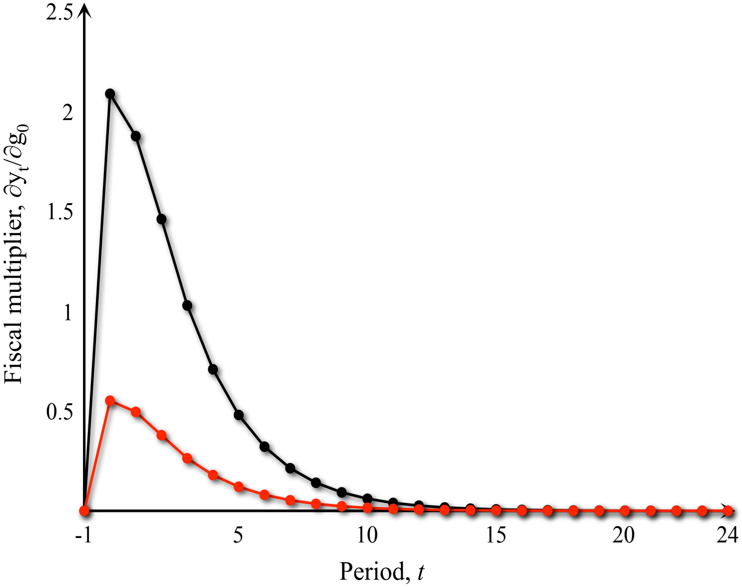

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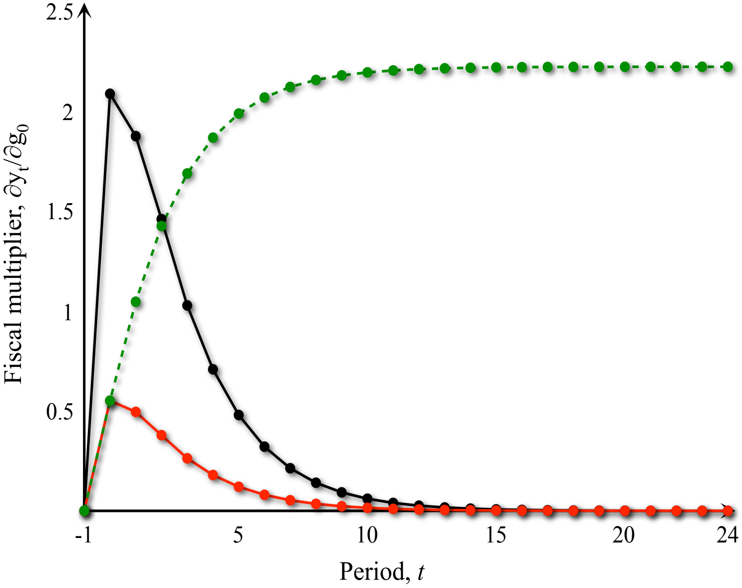

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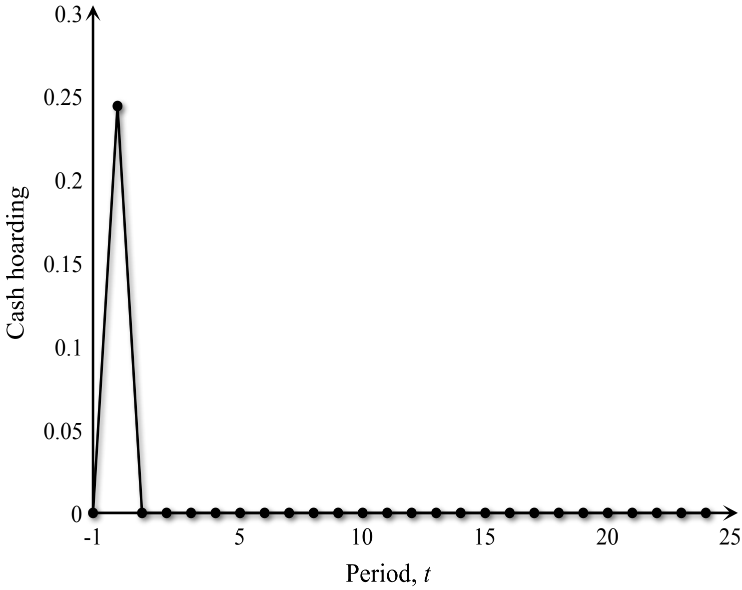

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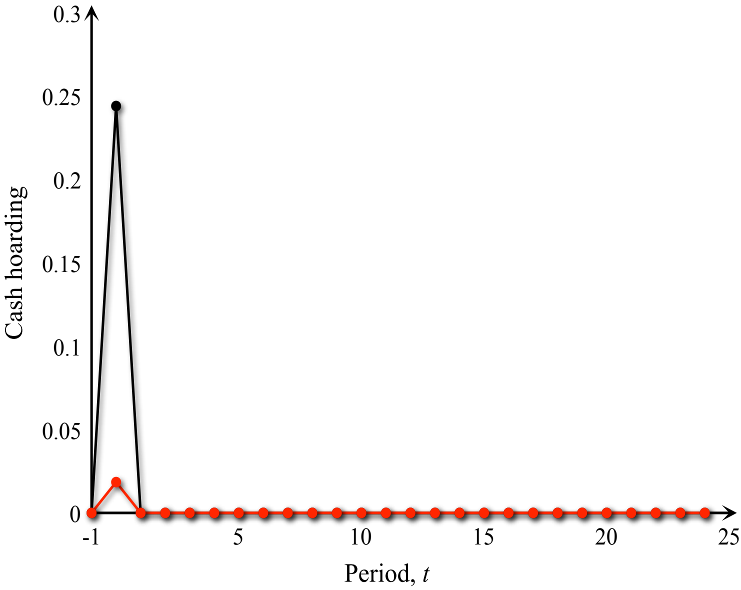

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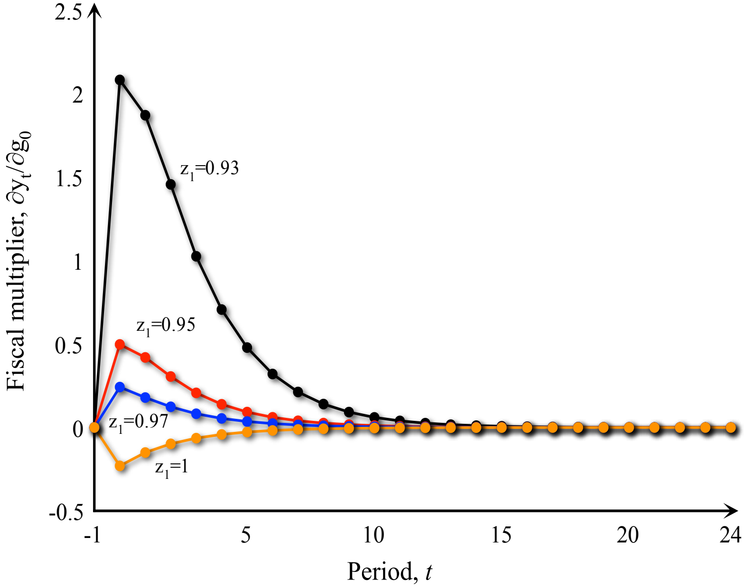

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