Cagan → Ramsey
Optimal Financial Repression

Tomás Caravello + Iván Werning (MIT)
Jornadas Monetarias del BCRA 2024

Motivation

Motivation

- **Standard policy practice today…**
  - interest rate policy (not M, not exchange rate)
  - ↑ interest rate → ↓ inflation

Motivation

- **Standard policy practice today…**
  - interest rate policy (not M, not exchange rate)
  - ↑ interest rate → ↓ inflation
- **Ideas and mechanisms…**
  - higher interest ≈ lower money supply (robust to shifts in money demand)
  - interest rate → output → inflation
  - interest rate → exchange rate → inflation

Motivation

- **Standard policy practice today…**
  - interest rate policy (not M, not exchange rate)
  - ↑ interest rate → ↓ inflation
- **Ideas and mechanisms…**
  - higher interest ≈ lower money supply (robust to shifts in money demand)
  - interest rate → output → inflation
  - interest rate → exchange rate → inflation
- **But Argentina…**
  - low credit: interest rate → output broken? (commonly noticed)
  - already in recession, without lowering rates! (not so commonly said!)
  - **interest paid on various forms of money**
  - **fiscal monetary interaction key: interest rates →fiscal effects**
  - **capital controls: exchange rate**

Motivation: Argentina…

Motivation: Argentina…

- Argentina 2023…
  - 211% year; above 10% monthly in 2nd half of year
  - Central Bank liabilities = 3-4 x money base (~M2 or M3)
  - capital controls (dual exchange rate + more)

Motivation: Argentina…

- Argentina 2023…
  - 211% year; above 10% monthly in 2nd half of year
  - Central Bank liabilities = 3-4 x money base (~M2 or M3)
  - capital controls (dual exchange rate + more)
- Argentina 2024…
  - fiscal adjustment → zero deficit (treasury)
  - stabilization: exchange rate anchor (crawl of 2% month)
  - capital controls: still in place
  - lowering of nominal interest rates!

Motivation: Argentina…

- Argentina 2023…
  - 211% year; above 10% monthly in 2nd half of year
  - Central Bank liabilities = 3-4 x money base (~M2 or M3)
  - capital controls (dual exchange rate + more)
- Argentina 2024…
  - fiscal adjustment → zero deficit (treasury)
  - stabilization: exchange rate anchor (crawl of 2% month)
  - capital controls: still in place
  - lowering of nominal interest rates!

Q1: Lower interest rates to fight inflation?

Q2: Maintain capital controls?

- capital controls (dual exchange rate + more)

- Argentina 2024…
  - fiscal adjustment → zero deficit (treasury)
  - stabilization: exchange rate anchor (crawl of 2% month)
  - capital controls: still in place
  - lowering of nominal interest rates!

Notes on Central Bank Interest Payments and its Effect on Inflation

Iván Werning, MIT

November 2023
Preliminary and Incomplete

Summary: If countries find themselves sufficiently constrained to have to resort to the inflation tax, then efforts should be made to widen its tax base to lower the inflation tax. Going further, other assets should be taxed and or financially repressed. Inflation should go hand in hand with financial repression.

Disclaimer: This note is preliminary and part of an ongoing exploration. I do not yet fully embrace the conclusions, even if they follow logically. The dust needs to settle on their relevance.

In this note, I study interest payments on central bank liabilities and their effect on inflation. When inflation is very high, such as in Argentina today (about 140% annual), interest rates tend to be comparably high. Moreover, the Central Bank may be paying interest on reserves or other forms of debt in a situation of fiscal dominance. Can these high interest rates paid by the Central Bank contribute towards high inflation? Should interest rates be lowered? Are there wider policy implications? How far should liquidation of debts, financial repression and wealth taxation go?

The note was initially motivated by reading a classic argentine paper by Rodriguez (1986), which I will use as a launching pad for a wider discussion.[1] That paper considered the payment of interest on a single form of money and its effect on inflation. It employed a Cagan-like model of seignorage, where money demand and expectations adapt slowly to new policy. Rodriguez found that interest payments increase inflation in the long run, but decrease it in the short run. Intuitively, higher interest paid by a fiscally dominated central bank leads to a greater quasi-deficit, with greater monetization and inflation.

After reviewing the argument, I consider a few alternatives to the specification of expectations and money demand. I find that the long-run result is robust to these extensions, but the short-run prediction is not. Indeed, under rational expectations, inflation moves one-for-one with the current interest rate, at any point in time. Furthermore, the

[1] ...de la Reforma de Financiera de Julio 1982" in reference to ... The recent presentation "El efecto ... Sargent reviews

Notes on Central Bank Interest Payments and its Effect on Inflation

Iván Werning, MIT

November 2023
Preliminary and Incomplete

Summary: If countries find themselves sufficiently constrained to have to resort to the inflation tax, then efforts should be made to widen its tax base to lower the inflation tax. Going further, other assets should be taxed and or financially repressed. Inflation should go hand in hand with financial repression.

Disclaimer: This note is preliminary and part of an ongoing exploration. I do not yet fully embrace the conclusions, even if they follow logically. The dust needs to settle on their relevance.

In this note, I study interest payments on central bank liabilities and their effect on inflation. When inflation is very high, such as in Argentina today (about 140% annual), interest rates tend to be comparably high. Moreover, the Central Bank may be paying interest on reserves or other forms of debt in a situation of fiscal dominance. Can these high interest rates paid by the Central Bank contribute towards high inflation? Should interest rates be lowered? Are there wider policy implications? How far should liquidation of debts, financial repression and wealth taxation go?

The note was initially motivated by reading a classic argentine paper by Rodriguez (1986), which I will use as a launching pad for a wider discussion.[1] That paper considered the payment of interest on a single form of money and its effect on inflation. It employed a Cagan-like model of seignorage, where money demand and expectations adapt slowly to new policy. Rodriguez found that interest payments increase inflation in the long run, but decrease it in the short run. Intuitively, higher interest paid by a fiscally dominated central bank leads to a greater quasi-deficit, with greater monetization and inflation.

After reviewing the argument, I consider a few alternatives to the specification of expectations and money demand. I find that the long-run result is robust to these extensions, but the short-run prediction is not. Indeed, under rational expectations, inflation moves one-for-one with the current interest rate, at any point in time. Furthermore, th

From Cagan to Ramsey*
Optimal Financial Repression

Iván Werning, MIT

December 2023
Preliminary and Incomplete

The inflation tax is best avoided, but if employed due to fiscal constraints then it should go hand in hand with financial repression. Intuitively, there is little justification in narrowly taxing the most liquid form of wealth. One should widen the tax base, to other assets, so as to lower the tax rate.

1 Introduction

How should a government embarking on reforms navigate the transition out of high inflation, severe fiscal and financial constraints? A la Cagan, seignorage is unavoidable: for $t < T$ government spending is high, labor taxes are constrained and government borrowing is limited. A la Ramsey, after T all constraints will be lifted: the government may lower spending, set optimal taxes, regaining access to financial markets; as a result, the optimal inflation tax is zero. What is the best transition from Cagan to Ramsey if the government has a few limited additional policy levers during the transition, beyond money printing?

Inflation is not optimal in the Ramsey phase and should be minimized during the Cagan transition by widening the base of the inflation tax via "financial repression": lowering the interest rates other central bank liabilities and maintaining currency or capital controls that lower the domestic interest rate.

2 A Constrained Planner

Normative Analysis

Normative Analysis

- **First Best:** Friedman Rule: zero tax money → low inflation

Normative Analysis

- **First Best:** Friedman Rule: zero tax money → low inflation
- **Ramsey: Optimal 2nd Best Theory…**
  - Phelps: positive inflation tax?…
  - Lucas-Stokey Chari et al → zero inflation tax!
  - Chamley-Judd: zero tax capital! (no cepo)

Normative Analysis

- **First Best:** Friedman Rule: zero tax money → low inflation
- **Ramsey: Optimal 2nd Best Theory…**
  - Phelps: positive inflation tax?…
  - Lucas-Stokey Chari et al → zero inflation tax!
  - Chamley-Judd: zero tax capital! (no cepo)
- **Cagan 4th best…**
  - fiscal deficit: tax and spending decisions not fully flexible (politics)
  - financial frictions: cannot borrow freely (credibility, coordination)

Normative Analysis

- **First Best:** Friedman Rule: zero tax money → low inflation
- **Ramsey: Optimal 2nd Best Theory…**
  - Phelps: positive inflation tax?…
  - Lucas-Stokey Chari et al → zero inflation tax!
  - Chamley-Judd: zero tax capital! (no cepo)
- **Cagan 4th best…**
  - fiscal deficit: tax and spending decisions not fully flexible (politics)
  - financial frictions: cannot borrow freely (credibility, coordination)
- **This paper:** Cagan → Ramsey
  - Cagan $t \in [0,T]$
  - Ramsey at $t \geq T$

Normative Analysis

- **First Best:** Friedman Rule: zero tax money → low inflation
- **Ramsey: Optimal 2nd Best Theory…**
  - Phelps: positive inflation tax?…
  - Lucas-Stokey Chari et al → zero inflation tax!
  - Chamley-Judd: zero tax capital! (no cepo)
- **Cagan 4th best…**
  - fiscal deficit: tax and spending decisions not fully flexible (politics)
  - financial frictions: cannot borrow freely (credibility, coordination)
- **This paper:** Cagan → Ramsey
  - Cagan $t \in [0,T]$
  - Ramsey at $t \geq T$

3RD BEST…
CAGAN + INTEREST RATE + CAPITAL CONTROLS

Framework for Financial Repression

(increase debt)

$$\dot{b}_t = \bar{r}_t b_t + g_t$$

$$\left(b = \sum_i b_i \right)$$

Framework for Financial Repression

(increase debt)

$$\dot{b}_t = \sum_i r_{it} b_{it} + g_t$$

$$\left(b = \sum_i b_i \right)$$

Framework for Financial Repression

(increase debt)

$$\dot{b}_t = r_t b_t - \sum_i (r_t - r_{it}) b_{it} + g_t$$

$$\left(b = \sum_i b_i \right)$$

Framework for Financial Repression

(increase debt)

$$\dot{b}_t = r_t b_t - \sum_i \underbrace{(r_t - r_{it})}_{\tau_{it}} b_{it} + g_t$$

$$\left(b = \sum_i b_i \right)$$

Framework for Financial Repression

(increase debt)

$$\dot{b}_t = r_t b_t - \sum_i \tau_{it} b_{it} + g_t$$

$$\left(b = \sum_i b_i \right)$$

Framework for Financial Repression

(increase debt)

$$\dot{b}_t = r_t b_t - \sum_i \tau_{it} b_{it} + g_t$$

$$\left(b = \sum_i b_i \right)$$

$$b_1 = m$$
$$\tau_1 = \pi$$

Base Money

Framework for Financial Repression

(increase debt)

Policy

$$\dot{b}_t = r_t b_t - R(b_t, \theta) + g_t$$

$$\left(b = \sum_i b_i \right)$$

$$b_1 = m$$
$$\tau_1 = \pi$$

Base Money

Evidence: Giovannini & de Melo

TABLE 1—THE SIZE OF REVENUE FROM FINANCIAL REPRESSION

Country	Sample	Revenue from financial repression: Percentage of GDP	Revenue from financial repression: Percentage of tax revenue
Algeria	1974–1987	4.30	11.42
Brazil	1983–1987	0.48	1.57
Colombia	1980–1984	0.24	2.11
Costa Rica	1972–1984	2.33	12.76
Greece	1974–1985	2.53	7.76
India	1980–1985	2.86	22.38
Indonesia	1976–1986	0.00	0.00
Jamaica	1980, 1982	1.38	4.74
Jordan	1978–1987	0.60	2.40
Korea	1975–1987	0.25	1.36
Malaysia	1974–1981	0.12	0.31
Mexico	1984–1987	5.77	39.65
Morocco	1977–1985	2.31	8.89
Pakistan	1982–1983	3.23	20.50
Panama	1977–1987	0.69	2.49
Papua New Guinea	1981–1987	0.40	1.90
Philippines	1975–1986	0.45	3.88
Portugal	1978–1986	2.22	6.93
Sri Lanka	1981–1983	3.40	19.24
Thailand	1976–1986	0.38	2.57
Tunisia	1978–1987	1.49	4.79
Turkey	1980–1987	2.20	10.89
Zaire	1974–1986[a]	0.46	2.48
Zimbabwe	1981–1986	5.50	19.13

Evidence: Giovannini & de Melo

HIGH REVENUE!

TABLE 1—THE SIZE OF REVENUE FROM FINANCIAL REPRESSION

Country	Sample	Revenue from financial repression: Percentage of GDP	Revenue from financial repression: Percentage of tax revenue
Algeria	1974–1987	4.30	11.42
Brazil	1983–1987	0.48	1.57
Colombia	1980–1984	0.24	2.11
Costa Rica	1972–1984	2.33	12.76
Greece	1974–1985	2.53	7.76
India	1980–1985	2.86	22.38
Indonesia	1976–1986	0.00	0.00
Jamaica	1980, 1982	1.38	4.74
Jordan	1978–1987	0.60	2.40
Korea	1975–1987	0.25	1.36
Malaysia	1974–1981	0.12	0.31
Mexico	1984–1987	5.77	39.65
Morocco	1977–1985	2.31	8.89
Pakistan	1982–1983	3.23	20.50
Panama	1977–1987	0.69	2.49
Papua New Guinea	1981–1987	0.40	1.90
Philippines	1975–1986	0.45	3.88
Portugal	1978–1986	2.22	6.93
Sri Lanka	1981–1983	3.40	19.24
Thailand	1976–1986	0.38	2.57
Tunisia	1978–1987	1.49	4.79
Turkey	1980–1987	2.20	10.89
Zaire	1974–1986[a]	0.46	2.48
Zimbabwe	1981–1986	5.50	19.13

Evidence: Giovannini & de Melo

HIGH REVENUE!

TABLE 1—THE SIZE OF REVENUE FROM FINANCIAL REPRESSION

Country	Sample	Revenue from financial repression: Percentage of GDP	Revenue from financial repression: Percentage of tax revenue
Algeria	1974–1987	4.30	11.42
Brazil	1983–1987	0.48	1.57
Colombia	1980–1984	0.24	2.11
Costa Rica	1972–1984	2.33	12.76
Greece	1974–1985	2.53	7.76
India	1980–1985	2.86	22.38
Indonesia	1976–1986	0.00	0.00
Jamaica	1980, 1982	1.38	4.74
Jordan	1978–1987	0.60	2.40
Korea	1975–1987	0.25	1.36
Malaysia	1974–1981	0.12	0.31
Mexico	1984–1987	5.77	39.65
Morocco	1977–1985	2.31	8.89
Pakistan	1982–1983	3.23	20.50
Panama	1977–1987	0.69	2.49
Papua New Guinea	1981–1987	0.40	1.90
Philippines	1975–1986	0.45	3.88
Portugal	1978–1986	2.22	6.93
Sri Lanka	1981–1983	3.40	19.24
Thailand	1976–1986	0.38	2.57
Tunisia	1978–1987	1.49	4.79
Turkey	1980–1987	2.20	10.89
Zaire	1974–1986[a]	0.46	2.48
Zimbabwe	1981–1986	5.50	19.13

TABLE 3—THE FINANCIAL-REPRESSION TAX RATE AND ITS COMPONENTS (PERCENTAGES PER YEAR)

Country	Currency depreciation	Interest-rate differential	Tax rate
Algeria	1.59	8.49	10.08
Brazil	196.77	−183.32	13.45
Colombia	18.97	3.46	22.43
Costa Rica	20.9	4.21	25.11
Greece	14.29	1.65	15.94
India	7.38	3.43	10.81
Indonesia	11.6	11.67	23.27
Jamaica	0.47	6.85	7.32
Jordan	0.47	6.71	7.18
Korea	5.94	0.04	5.98
Malaysia	−0.64	2.40	1.76
Mexico	89.06	−43.25	45.81
Morocco	10.33	5.74	16.07
Pakistan	15.19	10.10	25.29
Panama	0.00	4.36	4.36
Papua New Guinea	4.66	0.90	5.56
Philippines	10.42	1.53	11.95
Portugal	17.36	−2.00	15.36
Sri Lanka	12.53	2.00	14.53
Thailand	2.45	1.84	4.29
Tunisia	7.22	5.98	13.2
Turkey	54.64	0.85	55.49
Zaire	56.29	6.00	62.29
Zimbabwe	17.8	2.50	20.3

Evidence: Giovannini & de Melo

HIGH REVENUE!

HIGH TAX RATE!

TABLE 1—THE SIZE OF REVENUE FROM FINANCIAL REPRESSION

Country	Sample	Revenue from financial repression: Percentage of GDP	Revenue from financial repression: Percentage of tax revenue
Algeria	1974–1987	4.30	11.42
Brazil	1983–1987	0.48	1.57
Colombia	1980–1984	0.24	2.11
Costa Rica	1972–1984	2.33	12.76
Greece	1974–1985	2.53	7.76
India	1980–1985	2.86	22.38
Indonesia	1976–1986	0.00	0.00
Jamaica	1980, 1982	1.38	4.74
Jordan	1978–1987	0.60	2.40
Korea	1975–1987	0.25	1.36
Malaysia	1974–1981	0.12	0.31
Mexico	1984–1987	5.77	39.65
Morocco	1977–1985	2.31	8.89
Pakistan	1982–1983	3.23	20.50
Panama	1977–1987	0.69	2.49
Papua New Guinea	1981–1987	0.40	1.90
Philippines	1975–1986	0.45	3.88
Portugal	1978–1986	2.22	6.93
Sri Lanka	1981–1983	3.40	19.24
Thailand	1976–1986	0.38	2.57
Tunisia	1978–1987	1.49	4.79
Turkey	1980–1987	2.20	10.89
Zaire	1974–1986[a]	0.46	2.48
Zimbabwe	1981–1986	5.50	19.13

TABLE 3—THE FINANCIAL-REPRESSION TAX RATE AND ITS COMPONENTS (PERCENTAGES PER YEAR)

Country	Currency depreciation	Interest-rate differential	Tax rate
Algeria	1.59	8.49	10.08
Brazil	196.77	−183.32	13.45
Colombia	18.97	3.46	22.43
Costa Rica	20.9	4.21	25.11
Greece	14.29	1.65	15.94
India	7.38	3.43	10.81
Indonesia	11.6	11.67	23.27
Jamaica	0.47	6.85	7.32
Jordan	0.47	6.71	7.18
Korea	5.94	0.04	5.98
Malaysia	−0.64	2.40	1.76
Mexico	89.06	−43.25	45.81
Morocco	10.33	5.74	16.07
Pakistan	15.19	10.10	25.29
Panama	0.00	4.36	4.36
Papua New Guinea	4.66	0.90	5.56
Philippines	10.42	1.53	11.95
Portugal	17.36	−2.00	15.36
Sri Lanka	12.53	2.00	14.53
Thailand	2.45	1.84	4.29
Tunisia	7.22	5.98	13.2
Turkey	54.64	0.85	55.49
Zaire	56.29	6.00	62.29
Zimbabwe	17.8	2.50	20.3

Evidence: Giovannini & de Melo

HIGH REVENUE!

HIGH TAX RATE!

TABLE 1—THE SIZE OF REVENUE FROM FINANCIAL REPRESSION

Country	Sample	Revenue from financial repression: Percentage of GDP	Revenue from financial repression: Percentage of tax revenue
Algeria	1974–1987	4.30	11.42
Brazil	1983–1987	0.48	1.57
Colombia	1980–1984	0.24	2.11
Costa Rica	1972–1984	2.33	12.76
Greece	1974–1985	2.53	7.76
India	1980–1985	2.86	22.38
Indonesia	1976–1986	0.00	0.00
Jamaica	1980, 1982	1.38	4.74
Jordan	1978–1987	0.60	2.40
Korea	1975–1987	0.25	1.36
Malaysia	1974–1981	0.12	0.31
Mexico	1984–1987	5.77	39.65
Morocco	1977–1985	2.31	8.89
Pakistan	1982–1983	3.23	20.50
Panama	1977–1987	0.69	2.49
Papua New Guinea	1981–1987	0.40	1.90
Philippines	1975–1986	0.45	3.88
Portugal	1978–1986	2.22	6.93
Sri Lanka	1981–1983	3.40	19.24
Thailand	1976–1986	0.38	2.57
Tunisia	1978–1987	1.49	4.79
Turkey	1980–1987	2.20	10.89
Zaire	1974–1986[a]	0.46	2.48
Zimbabwe	1981–1986	5.50	19.13

TABLE 3—THE FINANCIAL-REPRESSION TAX RATE AND ITS COMPONENTS (PERCENTAGES PER YEAR)

Country	Currency depreciation	Interest-rate differential	Tax rate
Algeria	1.59	8.49	10.08
Brazil	196.77	−183.32	13.45
Colombia	18.97	3.46	22.43
Costa Rica	20.9	4.21	25.11
Greece	14.29	1.65	15.94
India	7.38	3.43	10.81
Indonesia	11.6	11.67	23.27
Jamaica	0.47	6.85	7.32
Jordan	0.47	6.71	7.18
Korea	5.94	0.04	5.98
Malaysia	−0.64	2.40	1.76
Mexico	89.06	−43.25	45.81
Morocco	10.33	5.74	16.07
Pakistan	15.19	10.10	25.29
Panama	0.00	4.36	4.36
Papua New Guinea	4.66	0.90	5.56
Philippines	10.42	1.53	11.95
Portugal	17.36	−2.00	15.36
Sri Lanka	12.53	2.00	14.53
Thailand	2.45	1.84	4.29
Tunisia	7.22	5.98	13.2
Turkey	54.64	0.85	55.49
Zaire	56.29	6.00	62.29
Zimbabwe	17.8	2.50	20.3

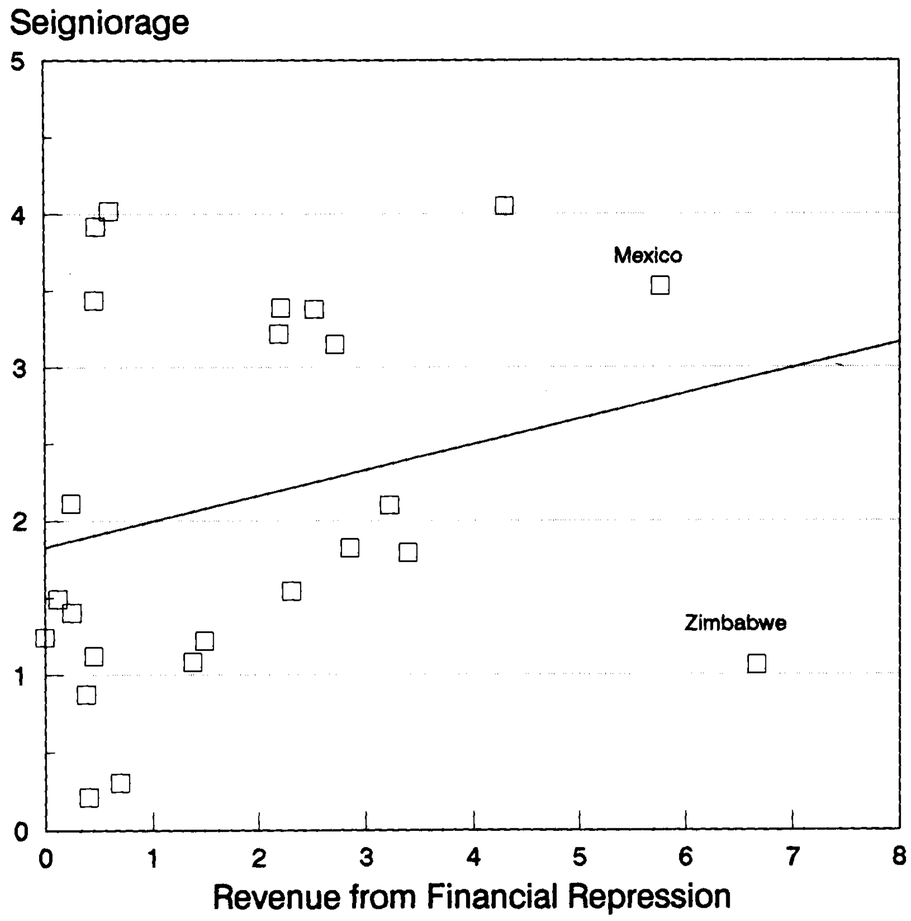


FIGURE 1. FINANCIAL-REPRESSION REVENUE AND SEIGNIORAGE (PERCENTAGES OF GDP)

Evidence: Giovannini & de Melo

HIGH REVENUE!

HIGH TAX RATE!

POSITIVELY RELATED TO SEIGNORAGE

TABLE 1—THE SIZE OF REVENUE FROM FINANCIAL REPRESSION

Country	Sample	Revenue from financial repression: Percentage of GDP	Revenue from financial repression: Percentage of tax revenue
Algeria	1974–1987	4.30	11.42
Brazil	1983–1987	0.48	1.57
Colombia	1980–1984	0.24	2.11
Costa Rica	1972–1984	2.33	12.76
Greece	1974–1985	2.53	7.76
India	1980–1985	2.86	22.38
Indonesia	1976–1986	0.00	0.00
Jamaica	1980, 1982	1.38	4.74
Jordan	1978–1987	0.60	2.40
Korea	1975–1987	0.25	1.36
Malaysia	1974–1981	0.12	0.31
Mexico	1984–1987	5.77	39.65
Morocco	1977–1985	2.31	8.89
Pakistan	1982–1983	3.23	20.50
Panama	1977–1987	0.69	2.49
Papua New Guinea	1981–1987	0.40	1.90
Philippines	1975–1986	0.45	3.88
Portugal	1978–1986	2.22	6.93
Sri Lanka	1981–1983	3.40	19.24
Thailand	1976–1986	0.38	2.57
Tunisia	1978–1987	1.49	4.79
Turkey	1980–1987	2.20	10.89
Zaire	1974–1986[a]	0.46	2.48
Zimbabwe	1981–1986	5.50	19.13

TABLE 3—THE FINANCIAL-REPRESSION TAX RATE AND ITS COMPONENTS (PERCENTAGES PER YEAR)

Country	Currency depreciation	Interest-rate differential	Tax rate
Algeria	1.59	8.49	10.08
Brazil	196.77	−183.32	13.45
Colombia	18.97	3.46	22.43
Costa Rica	20.9	4.21	25.11
Greece	14.29	1.65	15.94
India	7.38	3.43	10.81
Indonesia	11.6	11.67	23.27
Jamaica	0.47	6.85	7.32
Jordan	0.47	6.71	7.18
Korea	5.94	0.04	5.98
Malaysia	−0.64	2.40	1.76
Mexico	89.06	−43.25	45.81
Morocco	10.33	5.74	16.07
Pakistan	15.19	10.10	25.29
Panama	0.00	4.36	4.36
Papua New Guinea	4.66	0.90	5.56
Philippines	10.42	1.53	11.95
Portugal	17.36	−2.00	15.36
Sri Lanka	12.53	2.00	14.53
Thailand	2.45	1.84	4.29
Tunisia	7.22	5.98	13.2
Turkey	54.64	0.85	55.49
Zaire	56.29	6.00	62.29
Zimbabwe	17.8	2.50	20.3

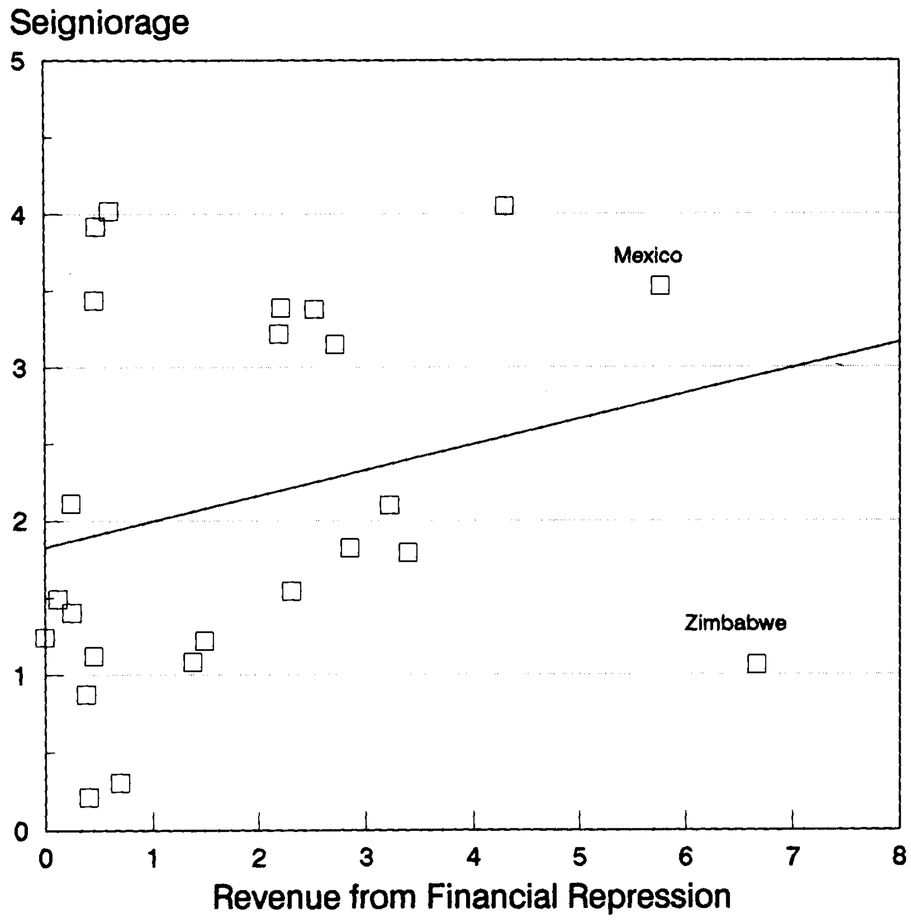


FIGURE 1. FINANCIAL-REPRESSION REVENUE AND SEIGNIORAGE (PERCENTAGES OF GDP)

Main Results

Main Results

1. Optimal interest rate…

Main Results

1. Optimal interest rate…

- Inflation → tax on M0

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!
  - increases welfare, may increase revenue

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!
  - increases welfare, may increase revenue
  - lower inflation on average
    … price level jump: down (appreciation) or up (depreciation)

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!
  - increases welfare, may increase revenue
  - lower inflation on average
    … price level jump: down (appreciation) or up (depreciation)

2. Optimal capital control…

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!
  - increases welfare, may increase revenue
  - lower inflation on average
    … price level jump: down (appreciation) or up (depreciation)

2. Optimal capital control…

- Positive capital control (even if no direct revenue!)
  → depress domestic rate
  → increase demand for government liabilities

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!
  - increases welfare, may increase revenue
  - lower inflation on average
    … price level jump: down (appreciation) or up (depreciation)

2. Optimal capital control…

- Positive capital control (even if no direct revenue!)
  → depress domestic rate
  → increase demand for government liabilities
- Lowers inflation on average…
  … and price level jumps down (appreciation)

Main Results

1. Optimal interest rate…

- Inflation → tax on M0
- Lower interest → tax on liabilities (~M3)
- Optimum…
  - tax on both forms of money!
  - increases welfare, may increase revenue
  - lower inflation on average
    … price level jump: down (appreciation) or up (depreciation)

2. Optimal capital control…

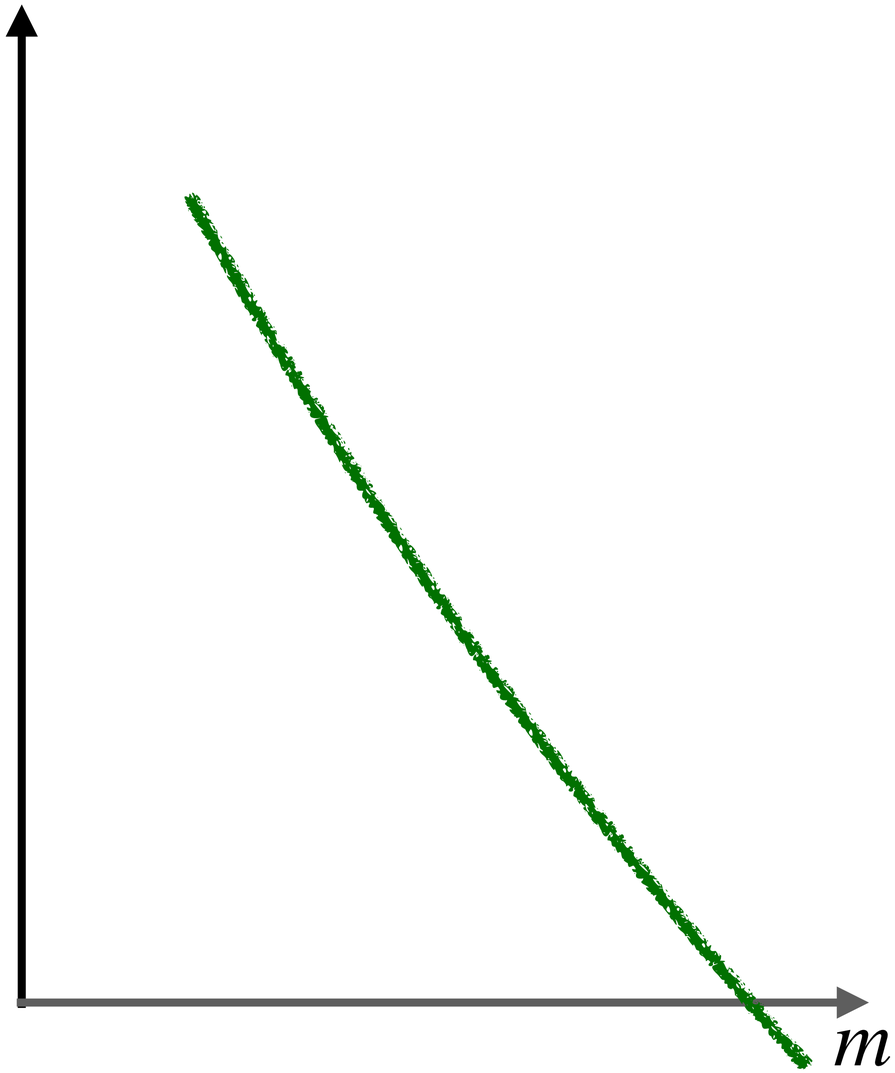
- Positive capital control (even if no direct revenue!)
  → depress domestic rate
  → increase demand for government liabilities
- Lowers inflation on average…
  … and price level jumps down (appreciation)

INFLATION = REPRESSION…

…BETTER OPTIMIZE REPRESSION!

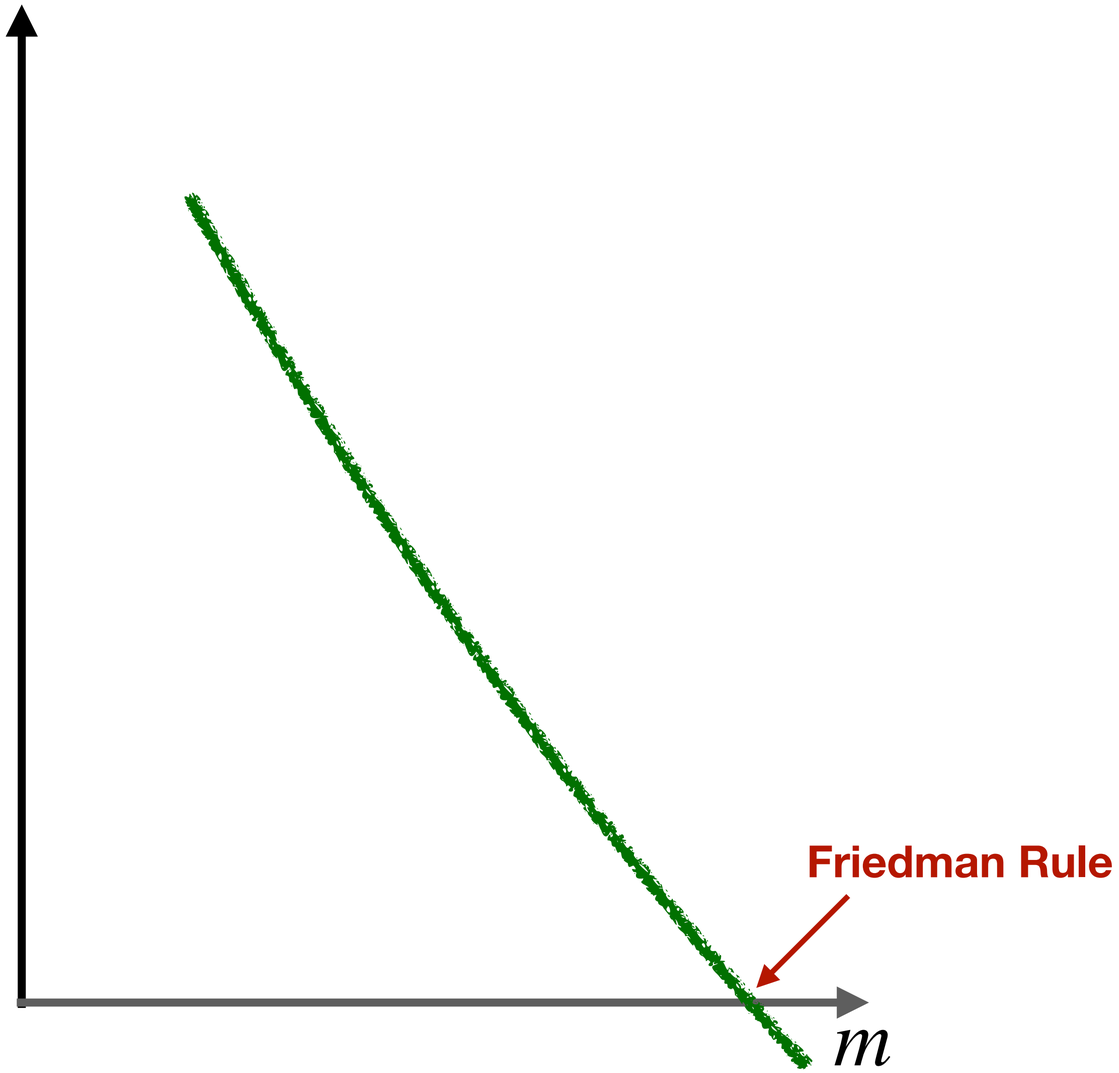
Main Results

$$\tau_m = \pi - i_m = \pi$$



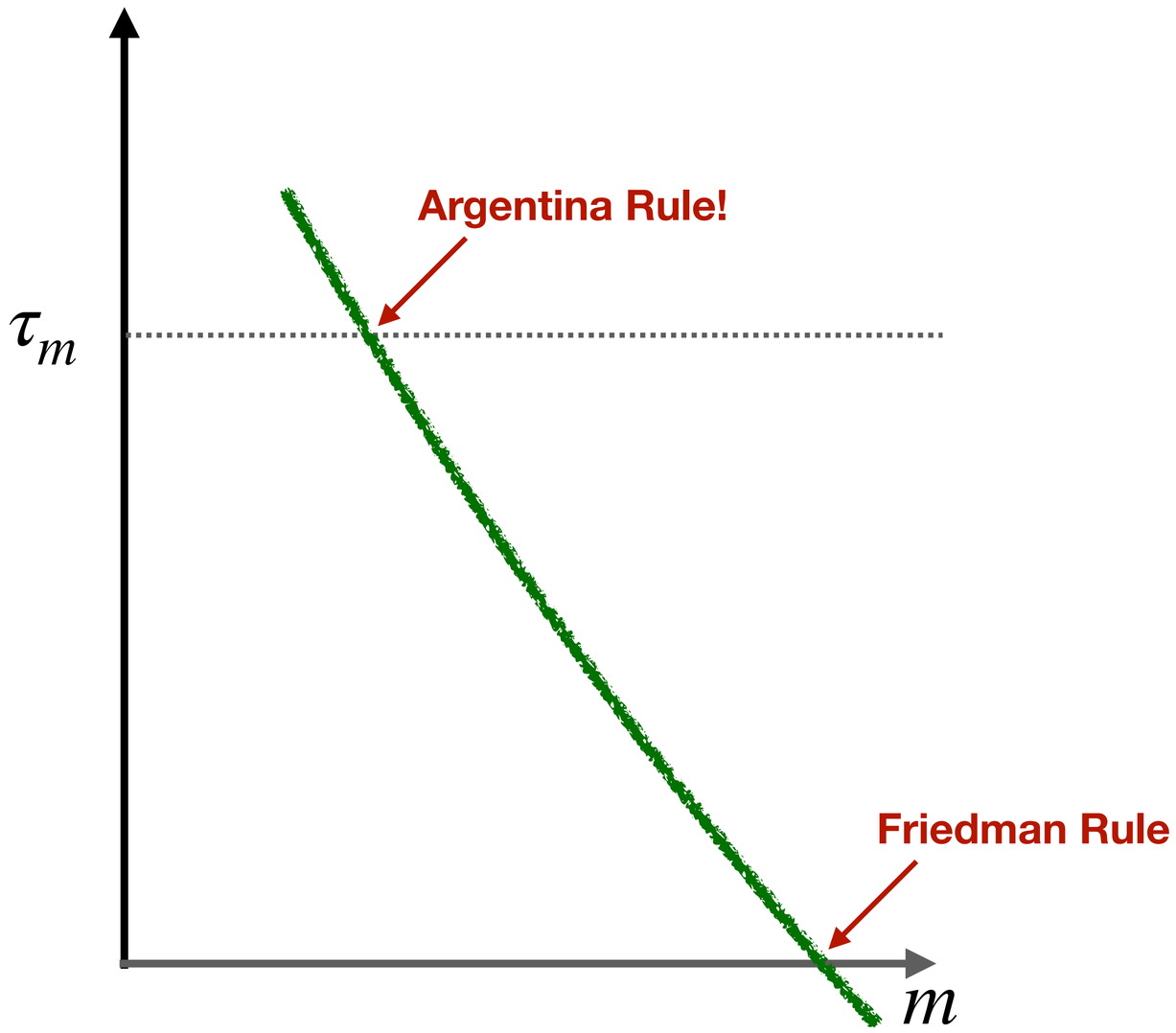
Main Results

$$\tau_m = \pi - i_m = \pi$$



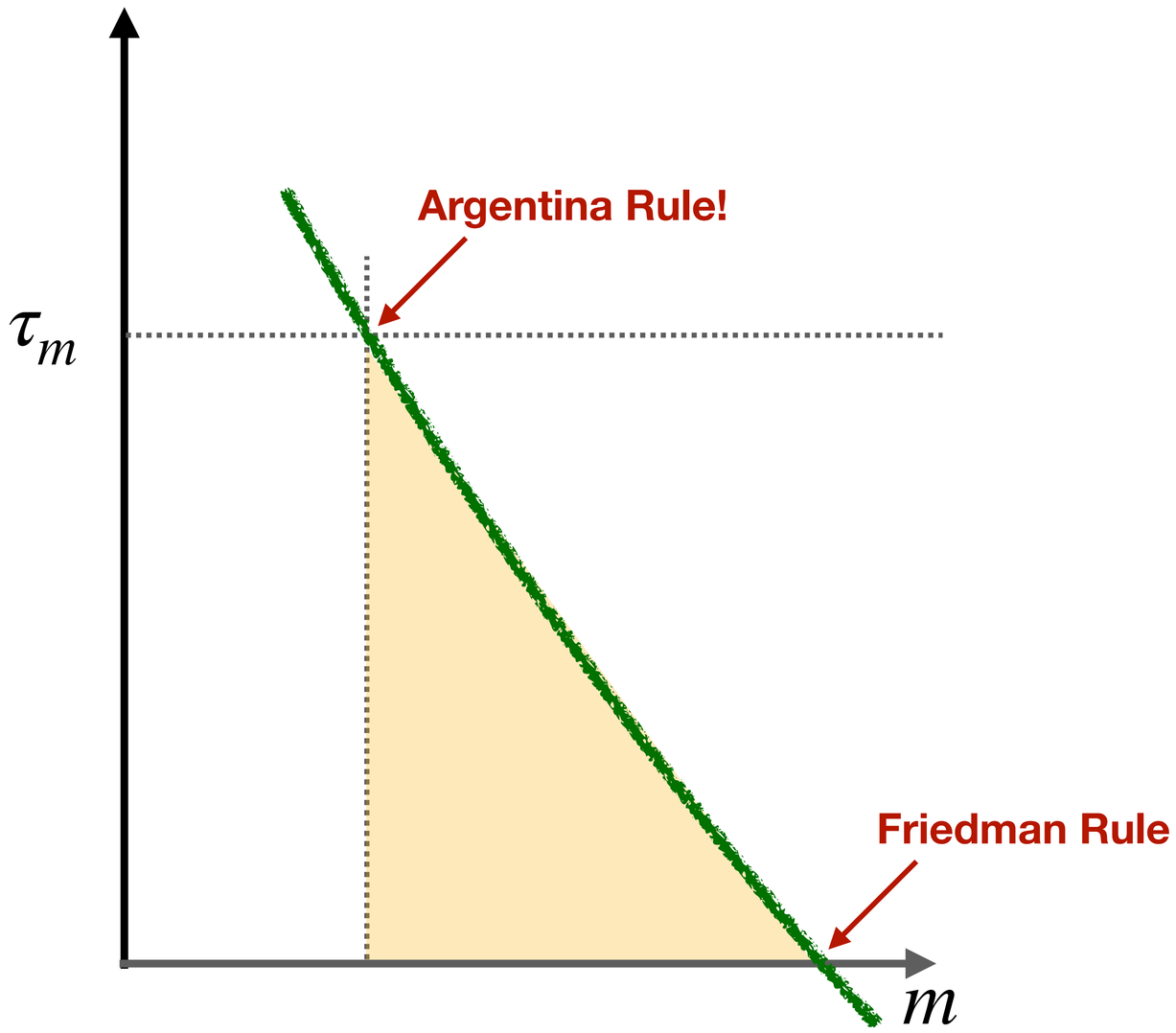
Main Results

$$\tau_m = \pi - i_m = \pi$$



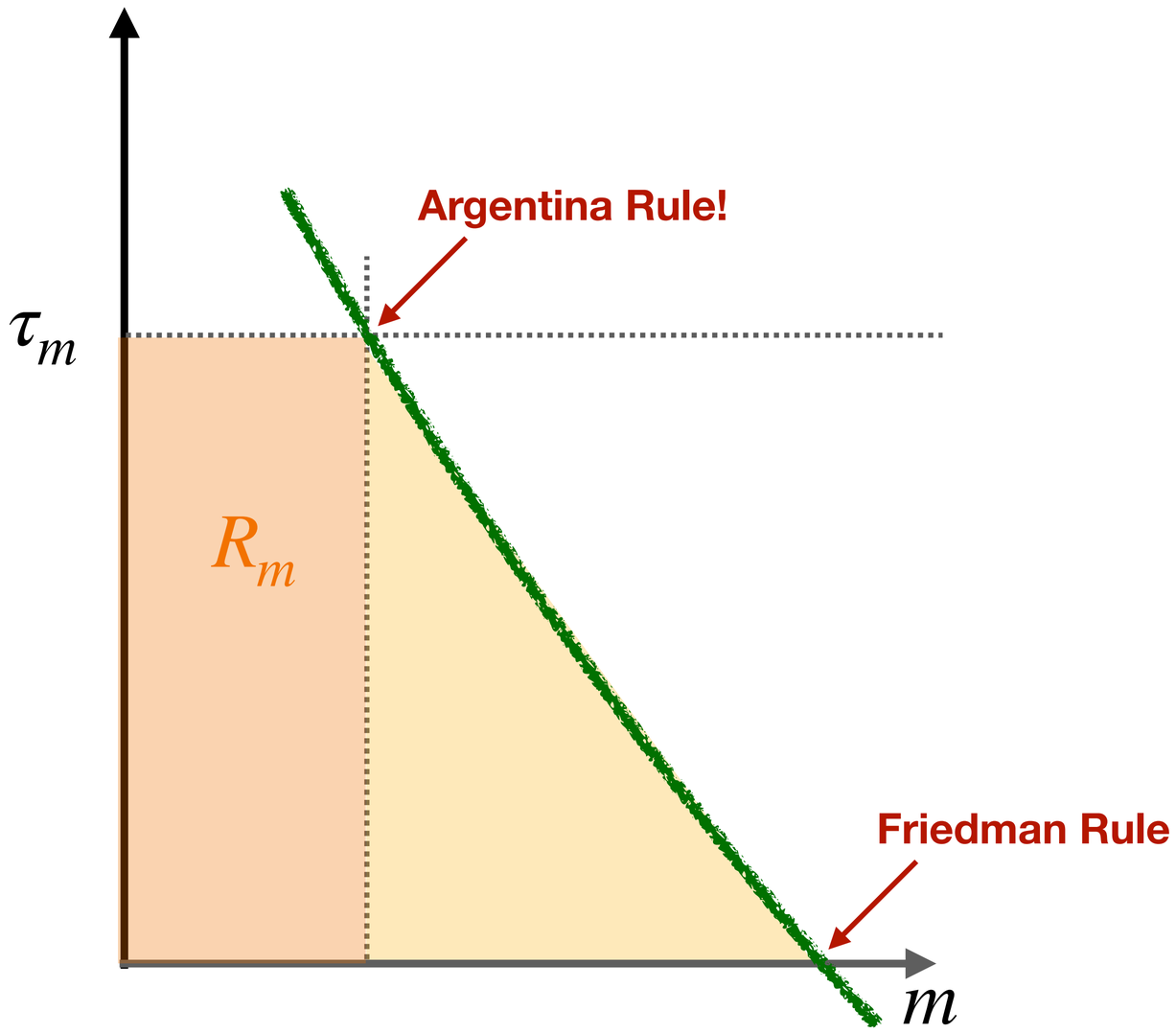
Main Results

$$\tau_m = \pi - i_m = \pi$$



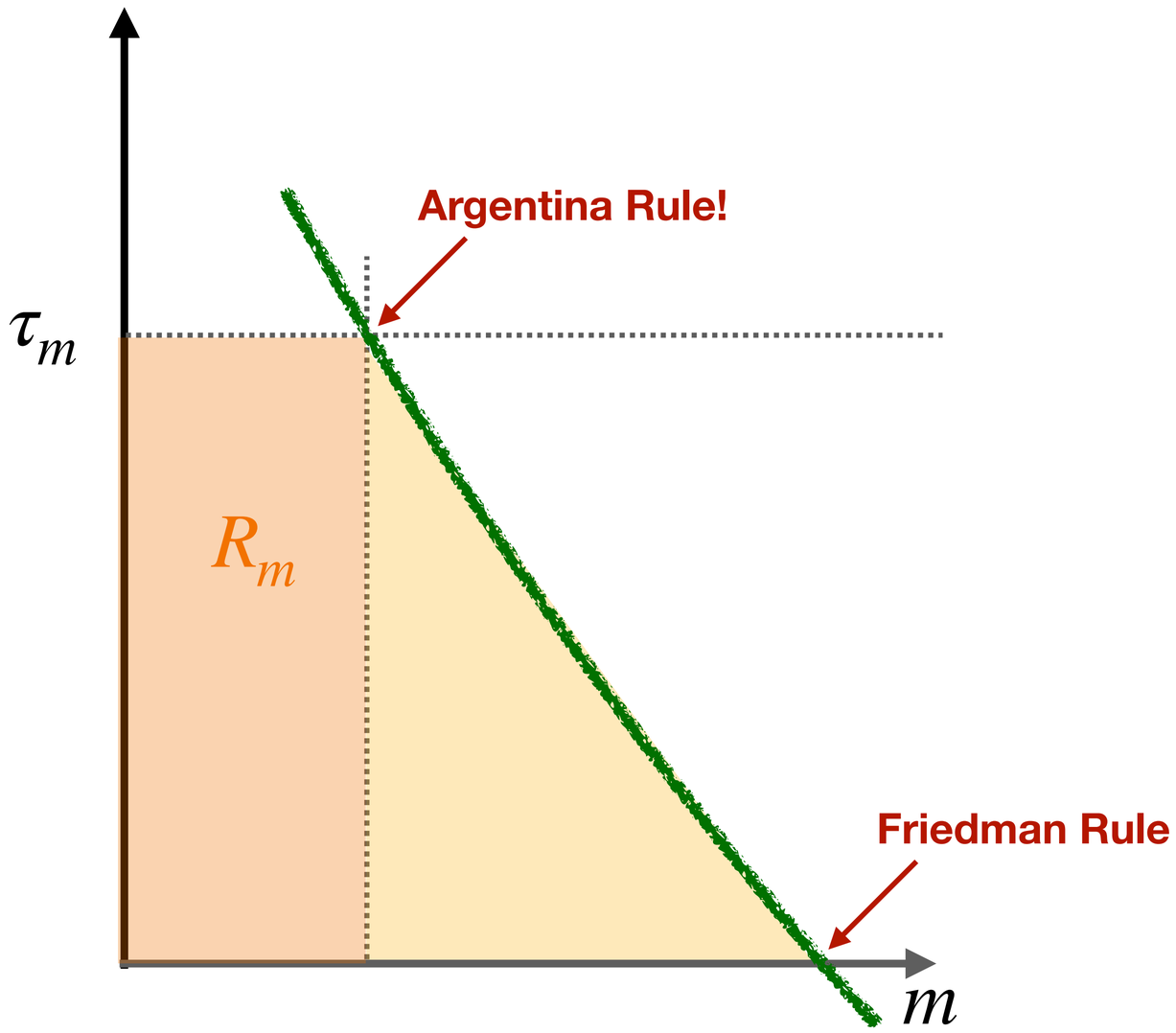
Main Results

$$\tau_m = \pi - i_m = \pi$$

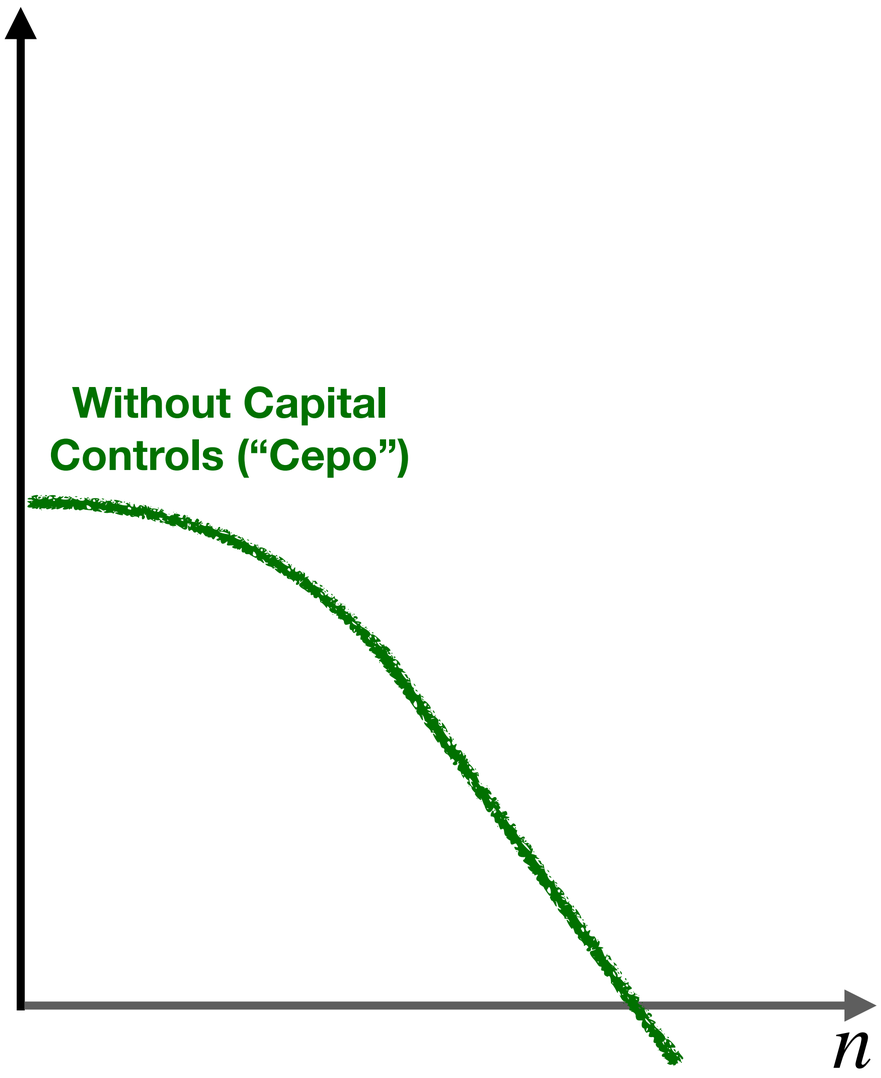


Main Results

$$\tau_m = \pi - i_m = \pi$$

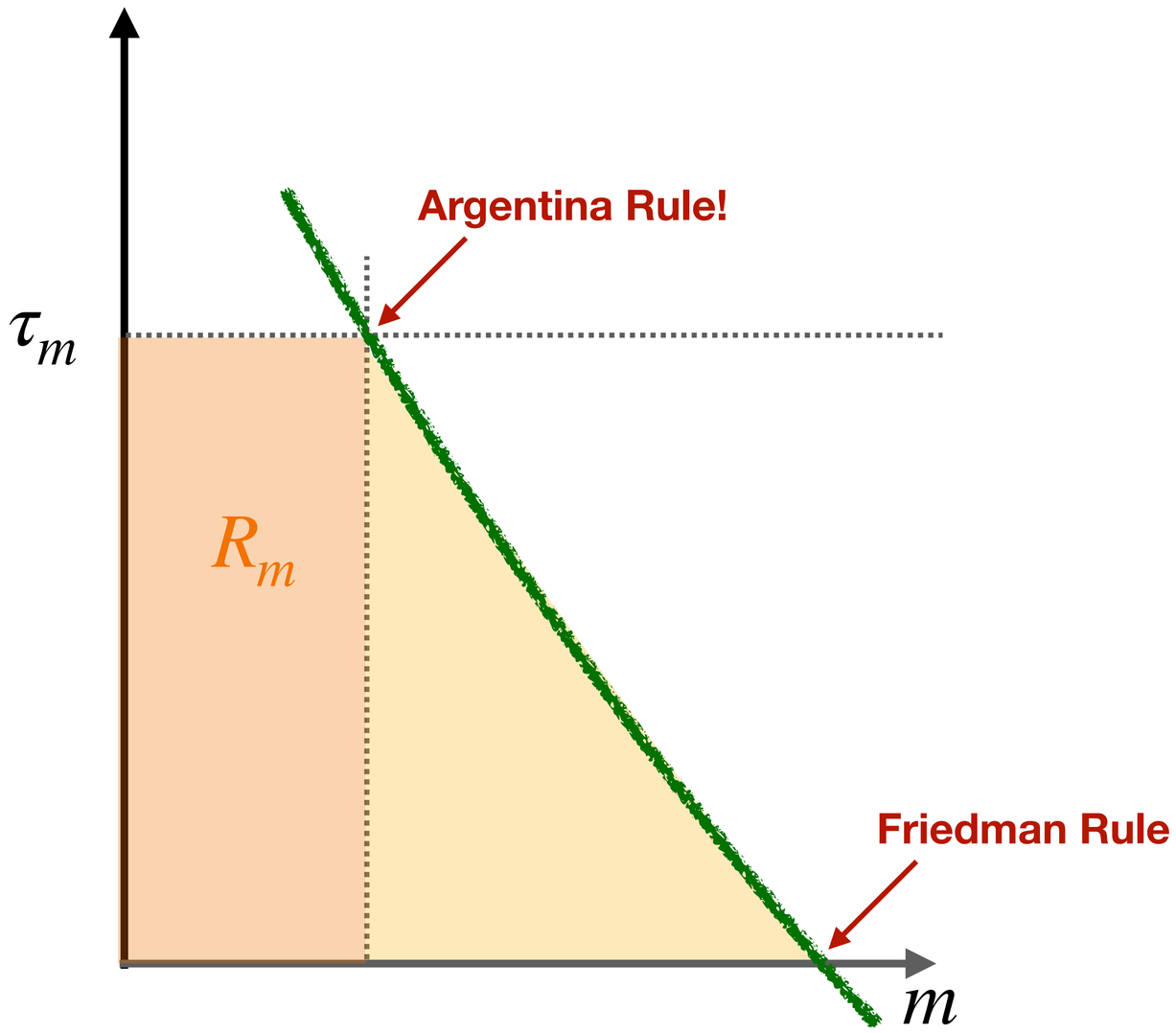


$$\tau_n = \pi - i_n$$

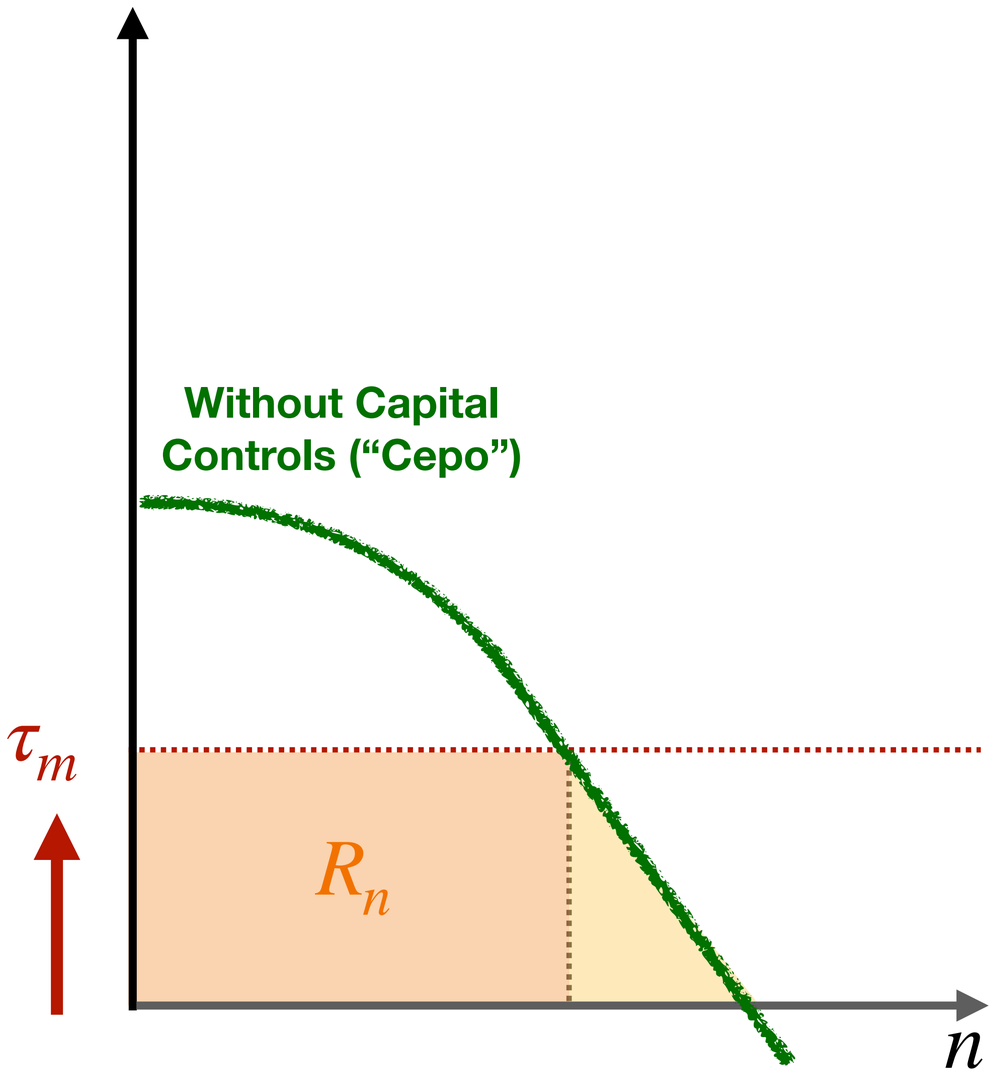


Main Results

$$\tau_m = \pi - i_m = \pi$$

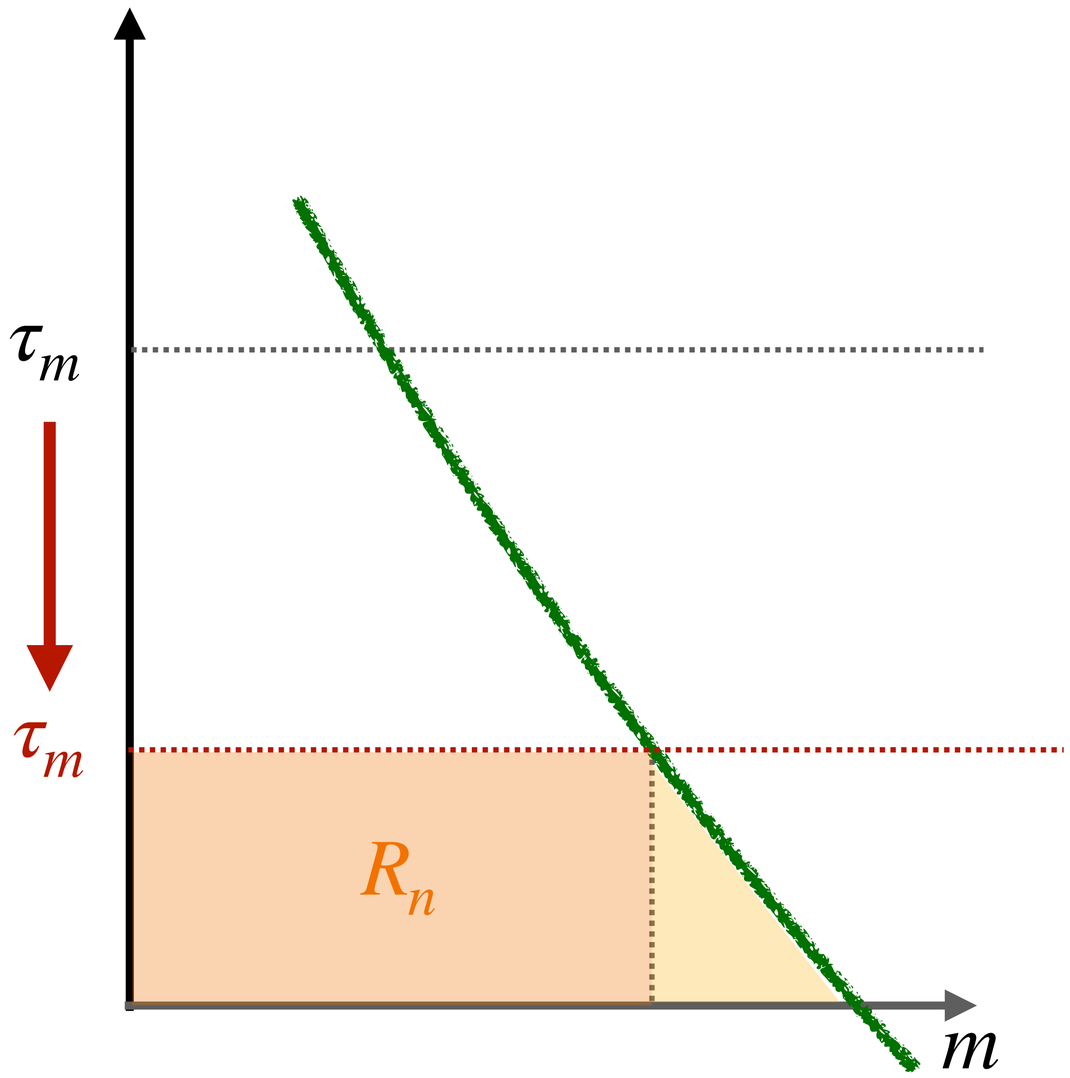


$$\tau_n = \pi - i_n$$

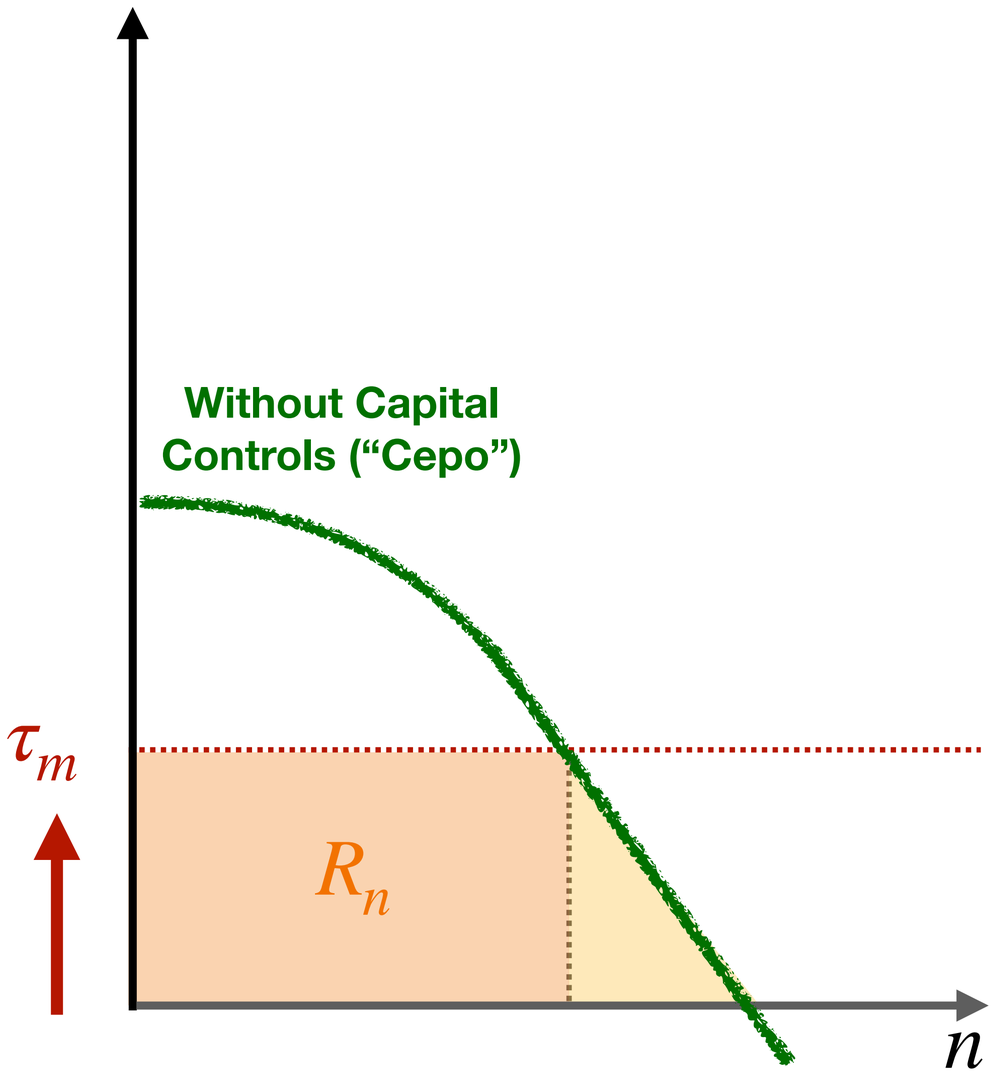


Main Results

$\tau_m = \pi - i_m = \pi$



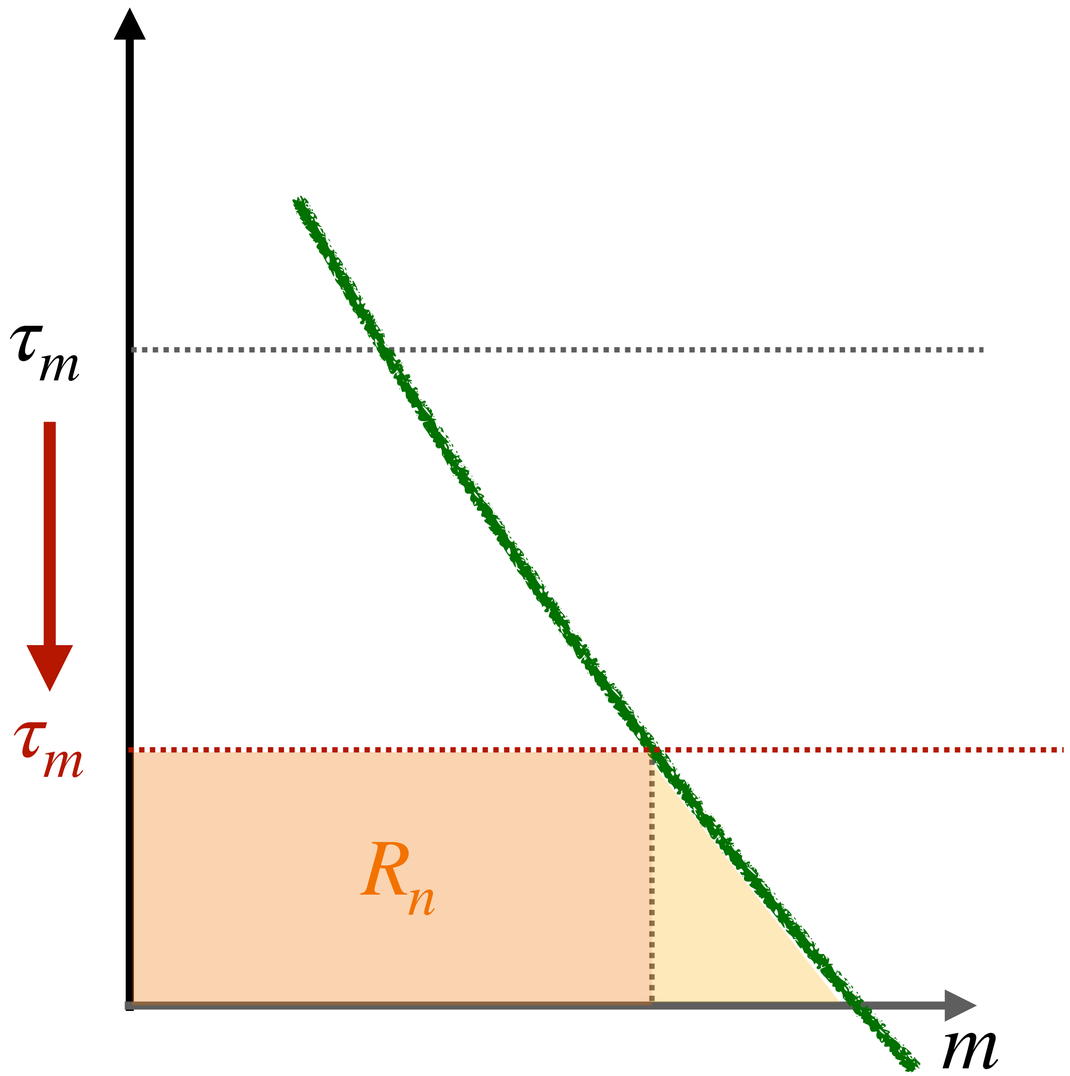
$\tau_n = \pi - i_n$



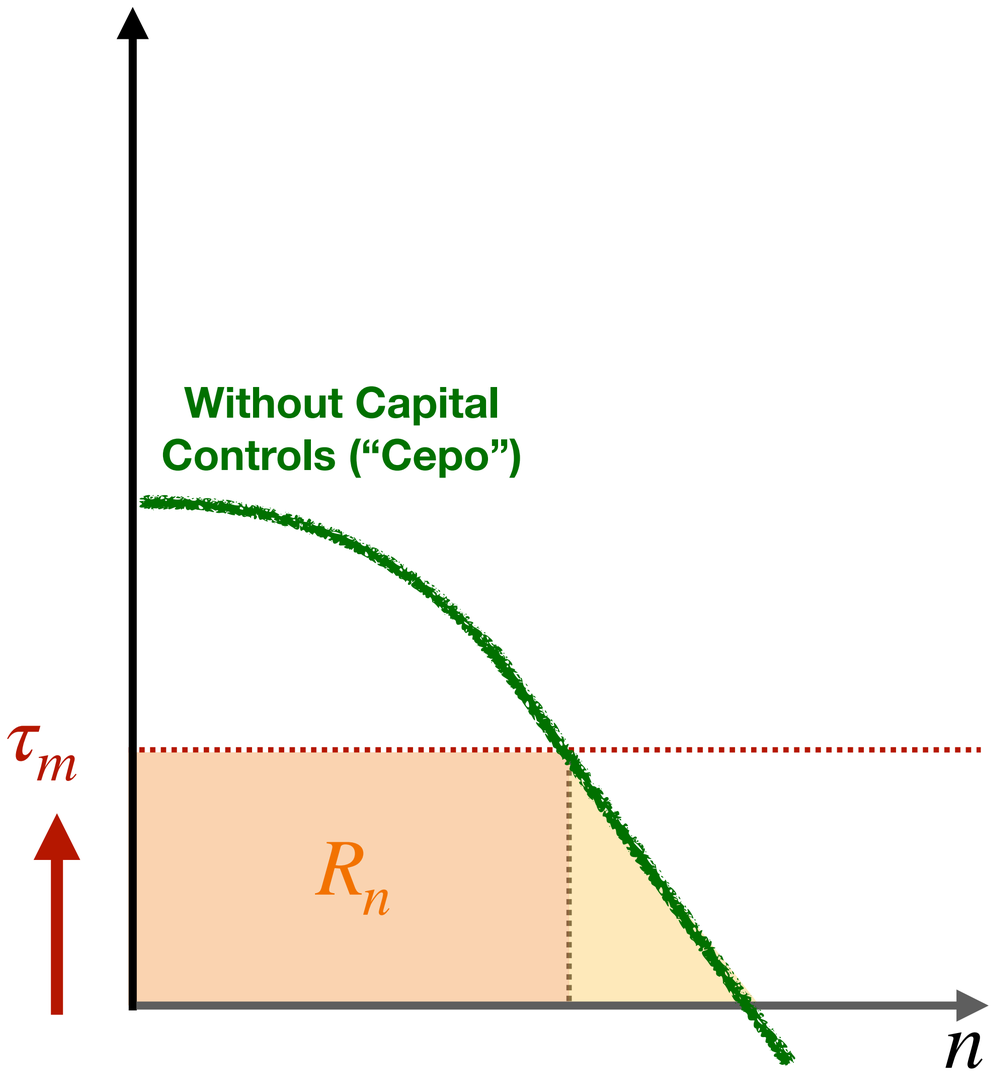
Main Results

$$\downarrow i_n \Rightarrow \downarrow \pi$$

$$\tau_m = \pi - i_m = \pi$$



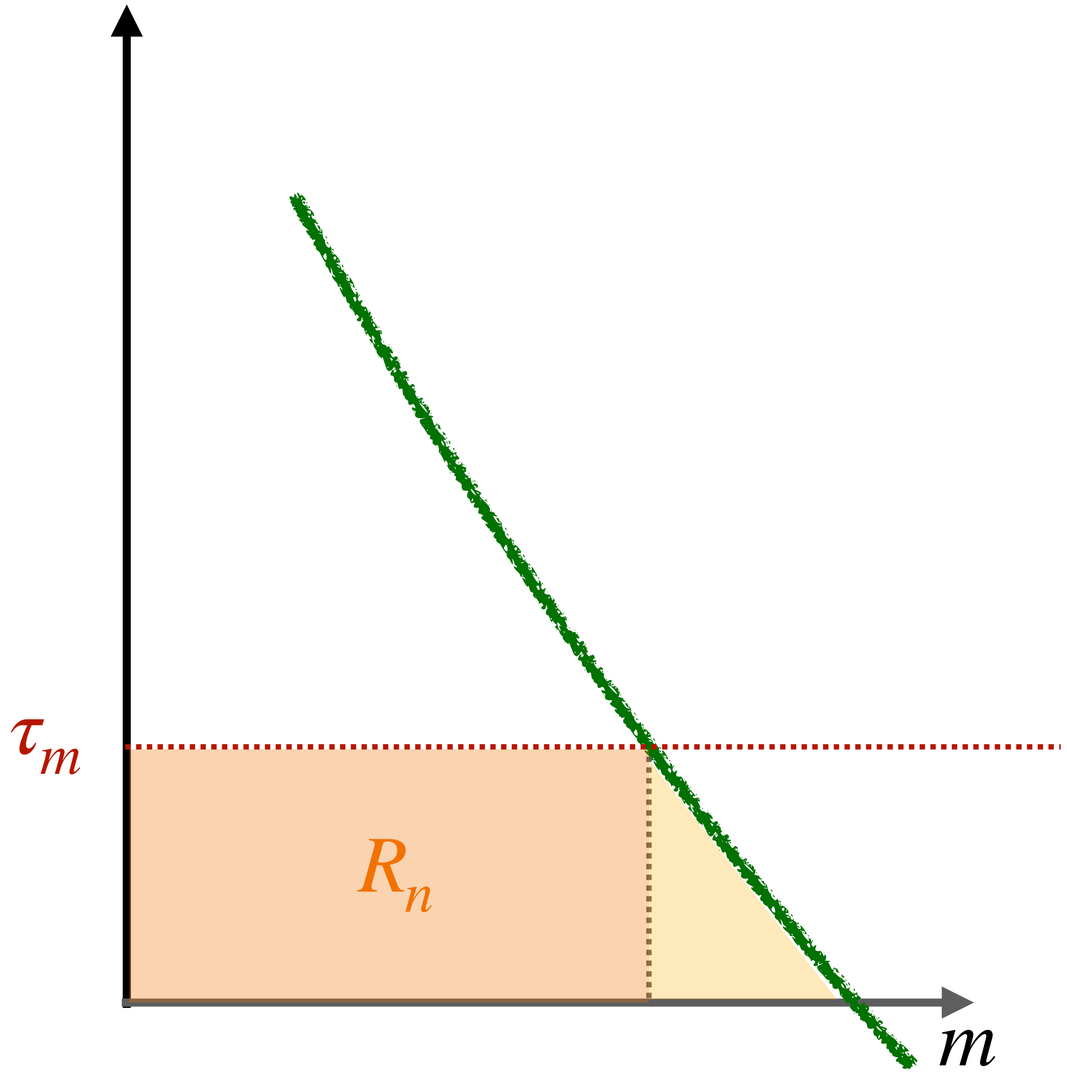
$$\tau_n = \pi - i_n$$



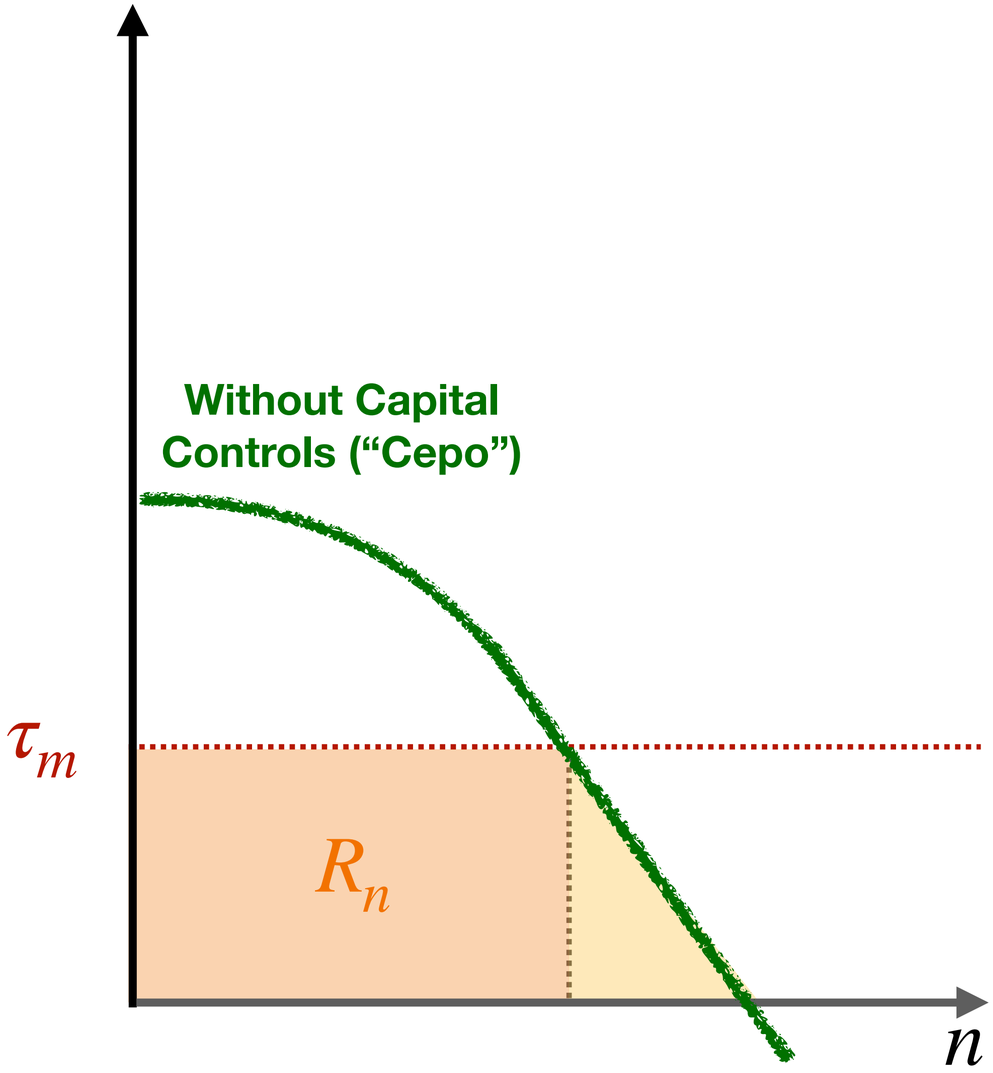
Main Results

$$\downarrow i_n \Rightarrow \downarrow \pi$$

$$\tau_m = \pi - i_m = \pi$$



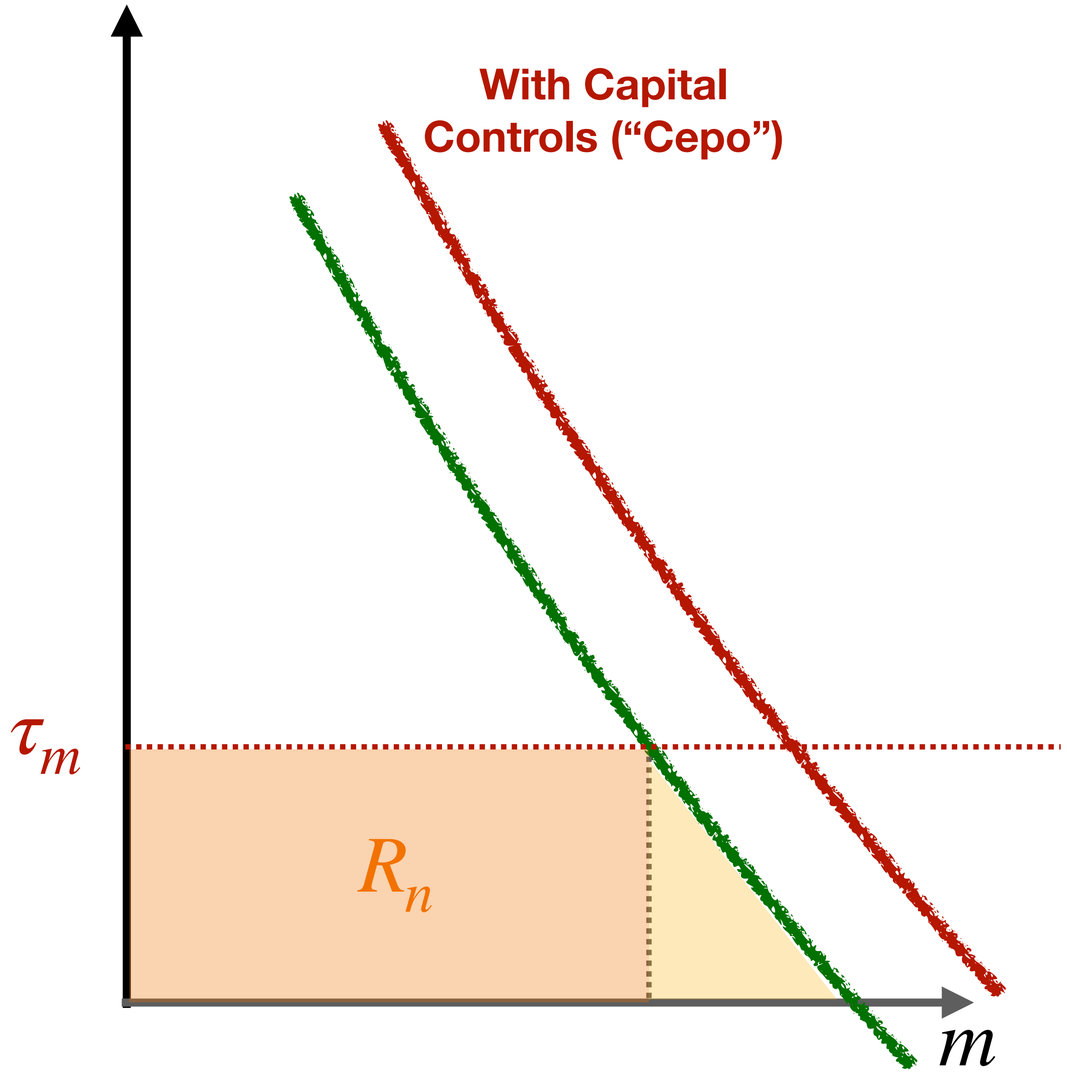
$$\tau_n = \pi - i_n$$



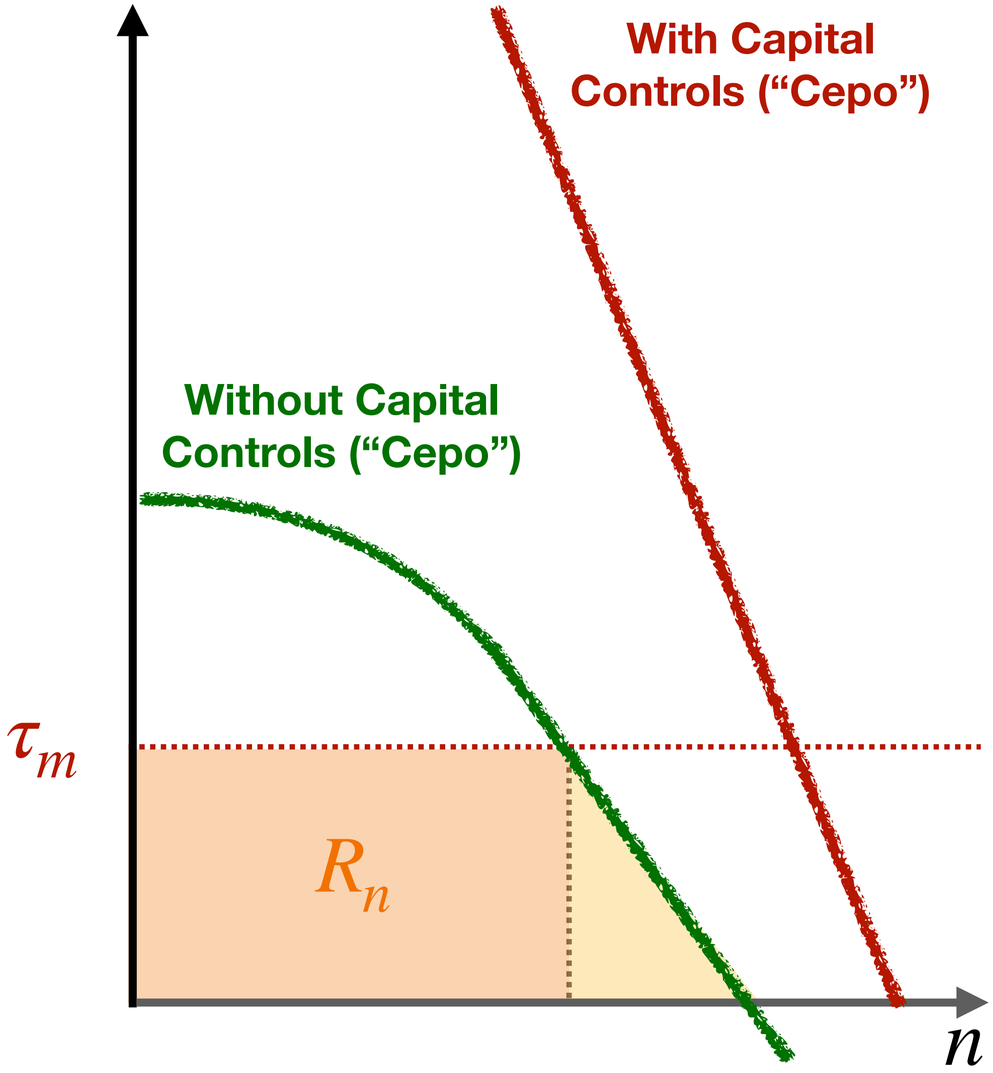
Main Results

$$\downarrow i_n \Rightarrow \downarrow \pi$$

$$\tau_m = \pi - i_m = \pi$$

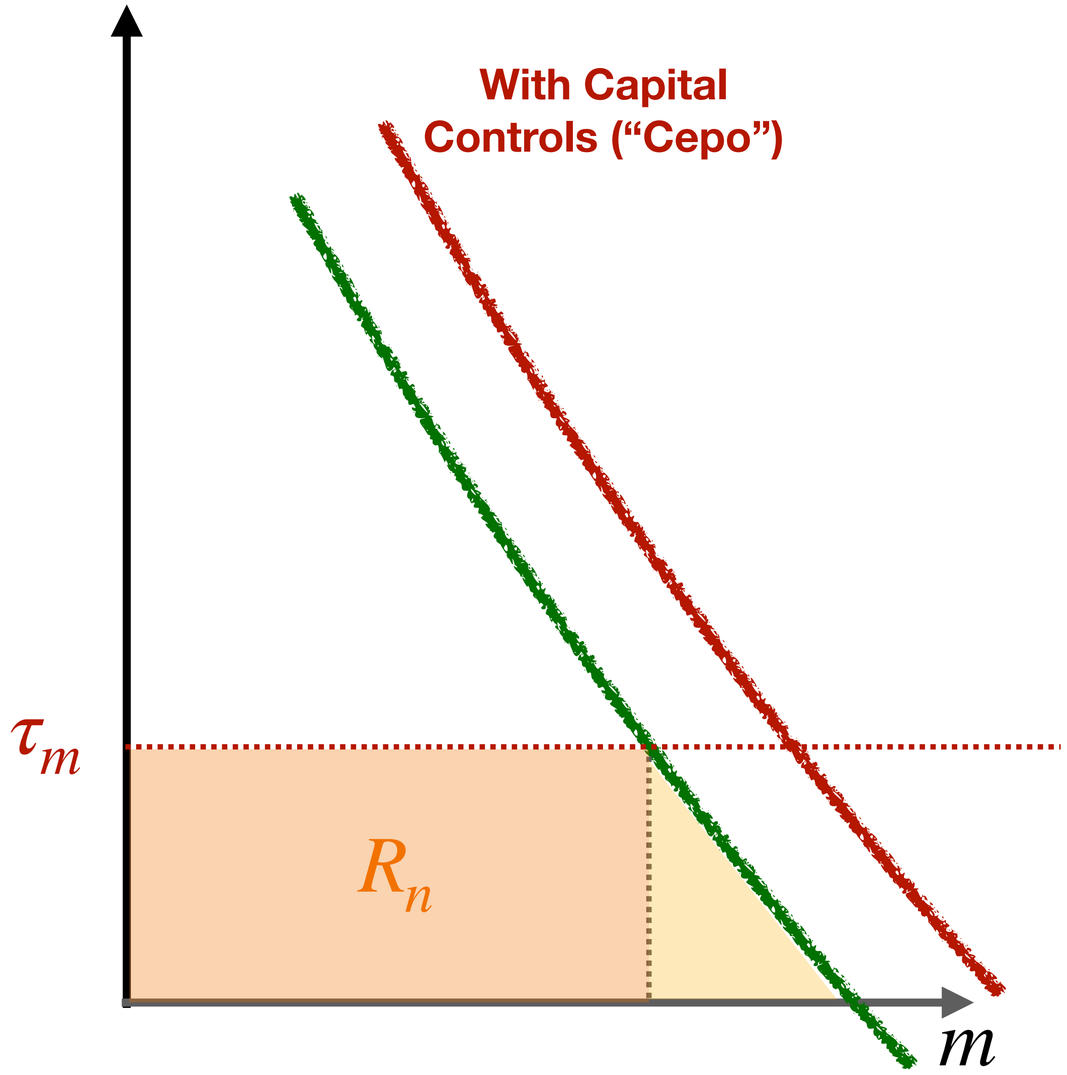


$$\tau_n = \pi - i_n$$



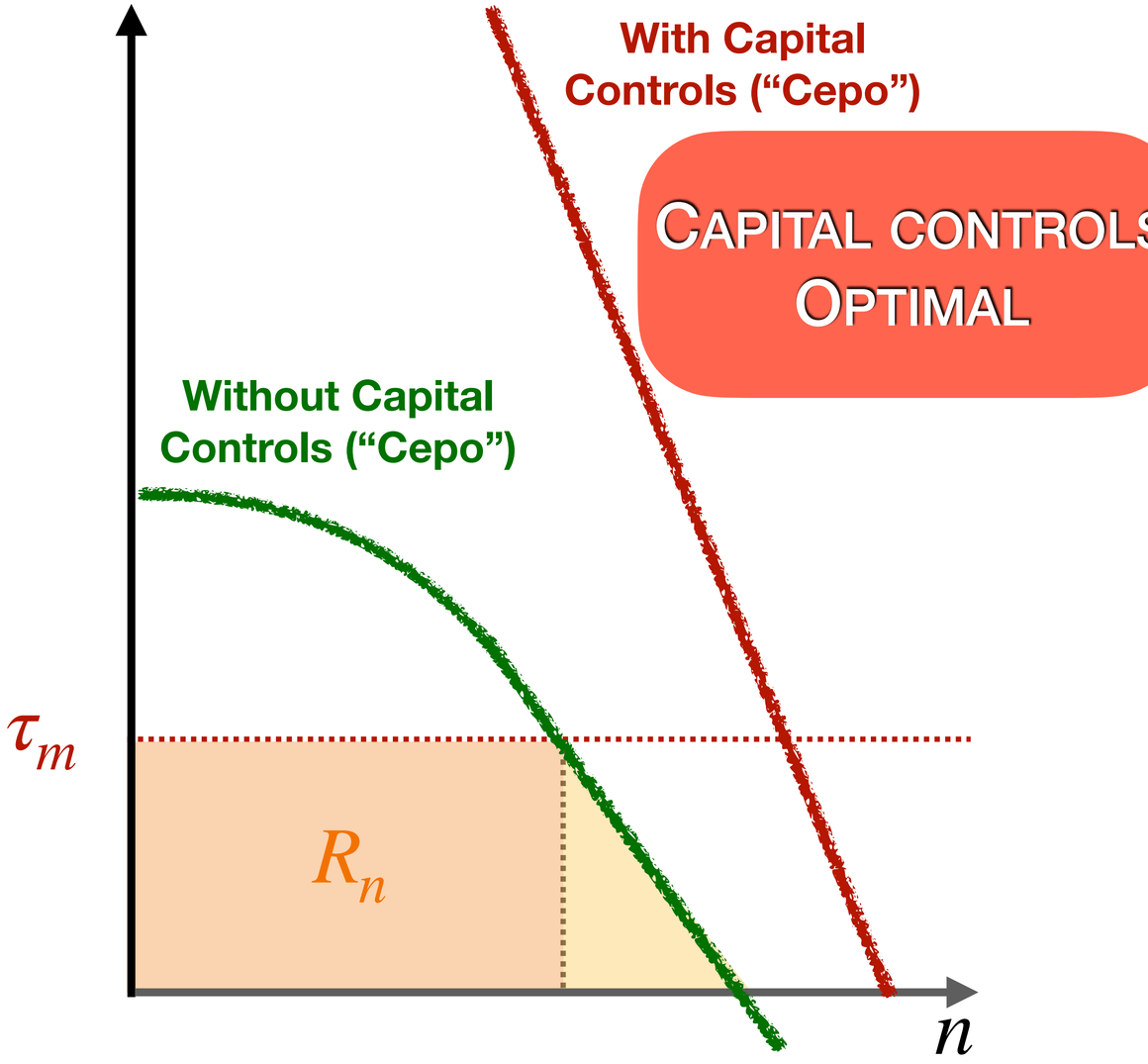
Main Results

$$\tau_m = \pi - i_m = \pi$$



$$\tau_n = \pi - i_n$$

$$\downarrow i_n \Rightarrow \downarrow \pi$$



CAPITAL CONTROLS
OPTIMAL

Not This Paper…

Not This Paper…

- **Not This Paper…**
  - no time zero capital levy surprise (plan Bonex) not a “Calvo price jump” (no time inconsistency here!)

Not This Paper…

- **Not This Paper…**
  - no time zero capital levy surprise (plan Bonex) not a “Calvo price jump” (no time inconsistency here!)
- **Oversimplified discussions…**
  - N is fixed → easy to tax! (licuadora)
  - N reinvested → lower interest → erodes N mechanically (licuadora)
  - partial equilibrium: inflation fixed → ↑ revenue

Not This Paper…

- **Not This Paper…**
  - no time zero capital levy surprise (plan Bonex) not a “Calvo price jump” (no time inconsistency here!)
- **Oversimplified discussions…**
  - N is fixed → easy to tax! (licuadora)
  - N reinvested → lower interest → erodes N mechanically (licuadora)
  - partial equilibrium: inflation fixed → ↑ revenue
- … **Wrong or Incomplete…**
  - N is endogenous: $\downarrow i \rightarrow$ substitute away
    (money M, foreign assets, consumption)
  - welfare ≠ revenue
  - general equilibrium: ↓ inflation

Not This Paper…

- **Not This Paper…**
  - no time zero capital levy surprise (plan Bonex) not a “Calvo price jump” (no time inconsistency here!)
- **Oversimplified discussions…**
  - N is fixed → easy to tax! (licuadora)
  - N reinvested → lower interest → erodes N mechanically (licuadora)
  - partial equilibrium: inflation fixed → ↑ revenue
- … **Wrong or Incomplete…**
  - N is endogenous: $\downarrow i \rightarrow$ substitute away
    (money M, foreign assets, consumption)
  - welfare ≠ revenue
  - general equilibrium: ↓ inflation
- **Not constrained to do this, optimal to do it!**

Model 1:
Optimal Interest Rate (No Cepo)

Model 1: Central Bank Liabilities M,N

Model 1: Central Bank Liabilities M,N

- Model…
  - representative agent
  - single consumption good, endowment, flexible nominal price of good P
  - small open economy: private agents save or borrow at world interest rate

Model 1: Central Bank Liabilities M,N

- Model…
  - representative agent
  - single consumption good, endowment, flexible nominal price of good P
  - small open economy: private agents save or borrow at world interest rate
- Government: Cagan scenario…
  - financial autarky: no bonds
  - issues: M and N (money/liabilities)
  - sets interest rate on N

Model 1: Central Bank Liabilities M,N

- Model…
  - representative agent
  - single consumption good, endowment, flexible nominal price of good P
  - small open economy: private agents save or borrow at world interest rate
- Government: Cagan scenario…
  - financial autarky: no bonds
  - issues: M and N (money/liabilities)
  - sets interest rate on N
- No capital controls for now…

Model 1: Central Bank Liabilities M,N

$$\int_0^{\infty} e^{-\rho t}(u(c_t) + V(m_t, n_t))\, dt$$

$$m_t \equiv \frac{M_t}{P_t} \qquad n_t = \frac{N_t}{P_t}$$

Model 1: Central Bank Liabilities M,N

- Preferences…

$$\int_0^\infty e^{-\rho t}(u(c_t) + V(m_t, n_t))\, dt$$

$$m_t \equiv \frac{M_t}{P_t} \qquad n_t = \frac{N_t}{P_t}$$

Model 1: Central Bank Liabilities M,N

- Preferences…

$$\int_0^\infty e^{-\rho t}(u(c_t) + V(m_t, n_t))\, dt$$

$$m_t \equiv \frac{M_t}{P_t} \qquad n_t = \frac{N_t}{P_t}$$

- Present value constraint… $(r_t^* = \rho)$

$$\int_0^\infty e^{-\rho t}\,(c_t - y)\, dt = a_0^*$$

Model 1: Central Bank Liabilities M,N

- Preferences…

$$\int_0^\infty e^{-\rho t}(u(c_t) + V(m_t, n_t))\, dt$$

$$m_t \equiv \frac{M_t}{P_t} \qquad n_t = \frac{N_t}{P_t}$$

- Present value constraint… $(r_t^* = \rho)$

$$\int_0^\infty e^{-\rho t}\,(c_t - y)\, dt = a_0^*$$

- Budget constraint…

$$\dot{m}_t + \dot{n}_t + \dot{a}_t^{\,*} = \rho a_t^* + (i_{mt} - \pi_t)m_t + (i_{nt} - \pi_t)n_t + g_t + y - c_t$$

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

$$\frac{\dot{M}_t + \dot{N}_t}{P_t} = \frac{i_{nt} N_t}{P_t} + g_t \qquad (i_m = 0)$$

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

deficit

$$\frac{\dot{M}_t + \dot{N}_t}{P_t} = \frac{i_{nt} N_t}{P_t} + g_t \qquad (i_m = 0)$$

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

deficit

$$\frac{\dot{M}_t + \dot{N}_t}{P_t} = \frac{i_{nt} N_t}{P_t} + g_t \qquad (i_m = 0)$$

interest-bearing liabilities

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

deficit

$$\frac{\dot{M}_t + \dot{N}_t}{P_t} = \frac{i_{nt} N_t}{P_t} + g_t \qquad (i_m = 0)$$

interest-bearing liabilities

$$\dot{m}_t + \dot{n}_t = -\pi_t m_t + (i_{nt} - \pi_t) n_t + g_t$$

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

deficit

$$\frac{\dot{M}_t + \dot{N}_t}{P_t} = \frac{i_{nt} N_t}{P_t} + g_t \qquad (i_m = 0)$$

interest-bearing liabilities

$$\dot{\bar{m}}_t = -\left(\tau_{mt} m_t + \tau_{nt} n_t\right) + \rho \bar{m} + g_t$$

Model 1: Central Bank Liabilities M,N

no debt for treasury

$$B_t = 0$$

deficit

$$\frac{\dot{M}_t + \dot{N}_t}{P_t} = \frac{i_{nt} N_t}{P_t} + g_t \qquad (i_m = 0)$$

interest-bearing liabilities

$$\dot{\bar{m}}_t = -(\tau_{mt} m_t + \tau_{nt} n_t) + \rho \bar{m} + g_t$$

- Ramsey $t \geq T$: g_t free + m_T, n_T given (zero or low inflation, low tax on n)

Equilibrium Conditions

$$c_t = \bar{c} = y + \rho a_0^*$$

Equilibrium Conditions

$$c_t = \bar{c} = y + \rho a_0^*$$

Money Demand system

$$m = m(\tau_m, \tau_n)$$

$$n = n(\tau_m, \tau_n)$$

$$\bar{m} = m + n$$

Equilibrium Conditions

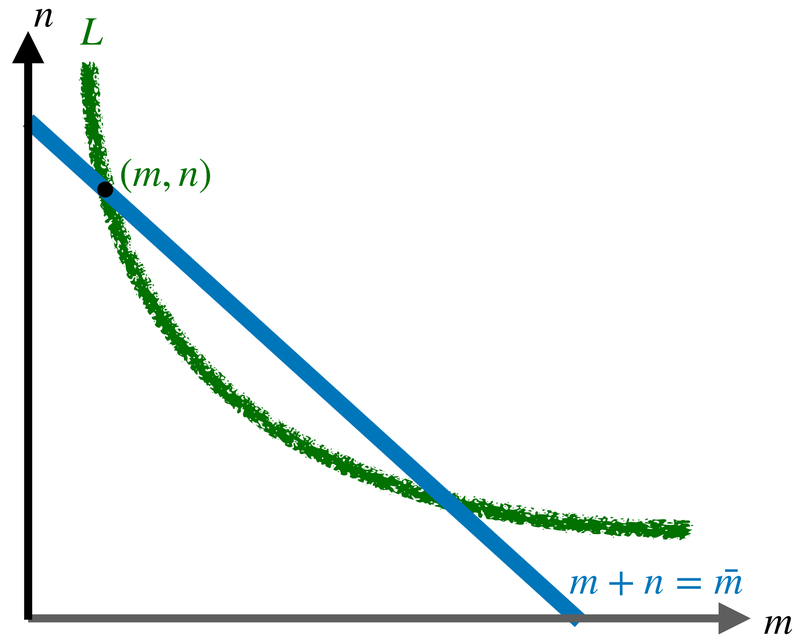
$$c_t = \bar{c} = y + \rho a_0^*$$

Money Demand system

$$m = m(\tau_m, \tau_n)$$

$$n = n(\tau_m, \tau_n)$$

$$\bar{m} = m + n$$



$$(\bar{m}_t, i_{nt}) \rightarrow (m_t, n_t, \pi_t) \rightarrow (\tau_m, \tau_n)$$

Equilibrium Conditions

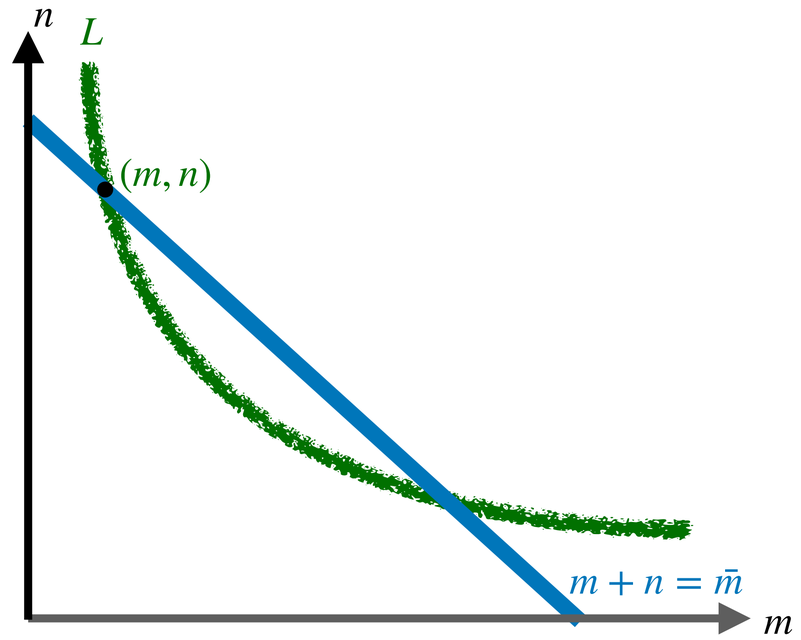
$$c_t = \bar{c} = y + \rho a_0^*$$

Money Demand system

$$m = m(\tau_m, \tau_n)$$

$$n = n(\tau_m, \tau_n)$$

$$\bar{m} = m + n$$



$$(\bar{m}_t, i_{nt}) \rightarrow (m_t, n_t, \pi_t) \rightarrow (\tau_m, \tau_n)$$

$$\dot{\bar{m}}_t = -(\tau_{mt} m_t + \tau_{nt} n_t) + \rho \bar{m} + g_t$$

Equilibrium Conditions

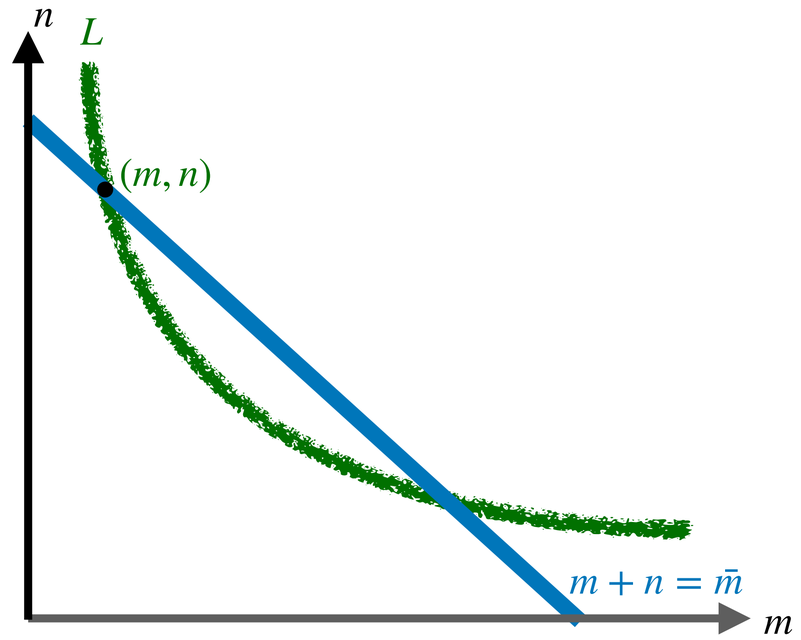
$$c_t = \bar{c} = y + \rho a_0^*$$

Money Demand system

$$m = m(\tau_m, \tau_n)$$

$$n = n(\tau_m, \tau_n)$$

$$\bar{m} = m + n$$



$$(\bar{m}_t, i_{nt}) \rightarrow (m_t, n_t, \pi_t) \rightarrow (\tau_m, \tau_n)$$

$$\dot{\bar{m}}_t = -(\tau_{mt} m_t + \tau_{nt} n_t) + \rho \bar{m} + g_t$$

$$\dot{\bar{m}}_t = -R(\bar{m}, i_n) + \rho \bar{m} + g_t$$

Planning Problem

Planning Problem

$$V(m,n) = \frac{L(m,n)^{1-\gamma}}{1-\gamma}$$

L CRS

$$\bar{V}(\bar{m}) = \bar{m}$$

Planning Problem

$$V(m,n) = \frac{L(m,n)^{1-\gamma}}{1-\gamma}$$

L CRS

$$\bar{V}(\bar{m}) = \bar{m}$$

Simple!

$$\int_0^{\infty} e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

$$\dot{\bar{m}}_t = -R(L_t) + \rho\bar{m} + g_t$$

$$L_t \leq \bar{m}_t \qquad \bar{m}_T \text{ given}$$

Planning Problem

$$V(m,n) = \frac{L(m,n)^{1-\gamma}}{1-\gamma}$$

L CRS

$$\bar{V}(\bar{m}) = \bar{m}$$

Simple!

$$\int_0^\infty e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

$$\dot{\bar{m}}_t = -R(L_t) + \rho\bar{m} + g_t$$

$$L_t \leq \bar{m}_t \qquad \bar{m}_T \text{ given}$$

$$R(L) = \bar{R}L^{1-\gamma}$$

Planning Problem

$$V(m,n) = \frac{L(m,n)^{1-\gamma}}{1-\gamma}$$

L CRS

$$\bar{V}(\bar{m}) = \bar{m}$$

Simple!

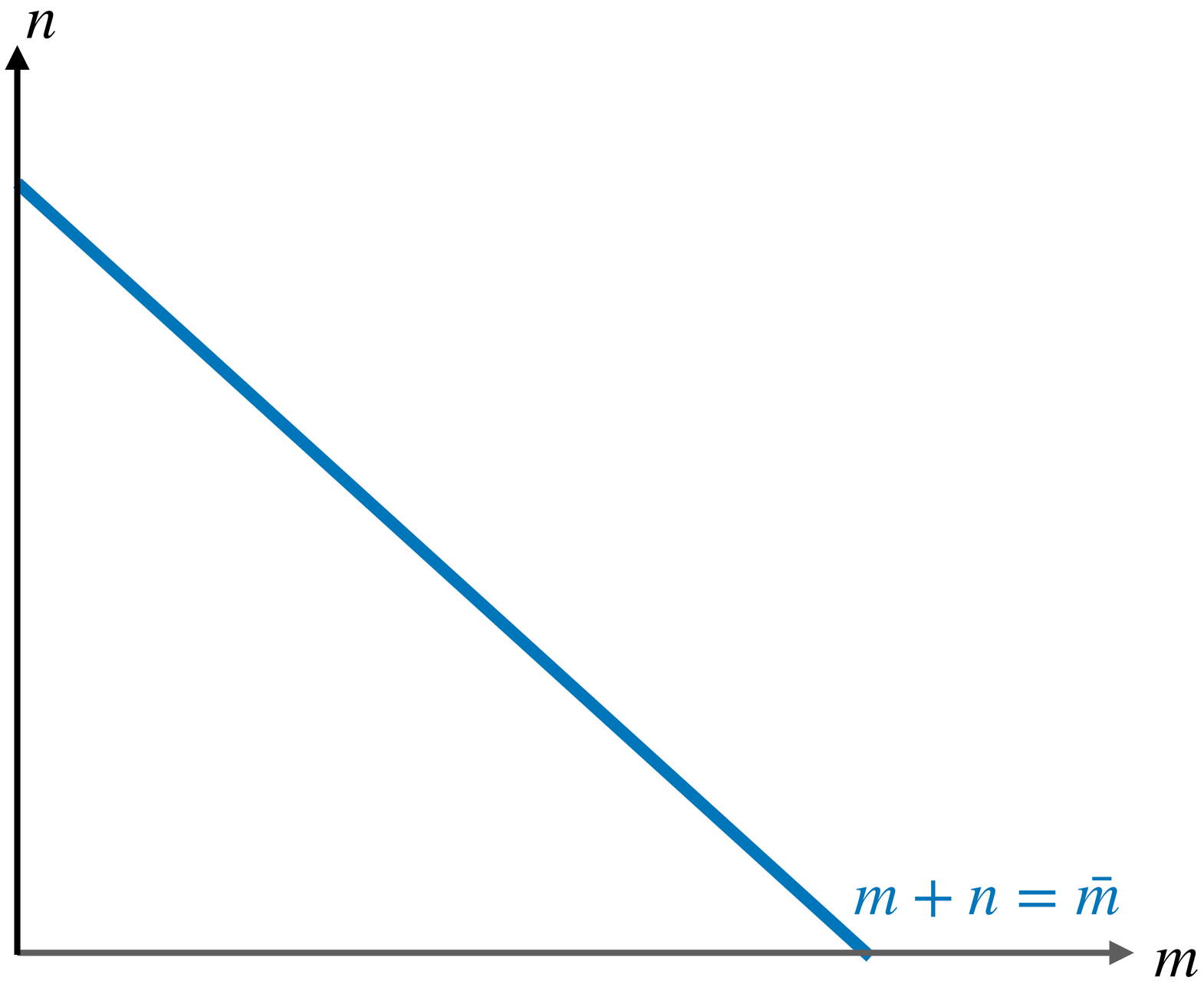
$$\int_0^{\infty} e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

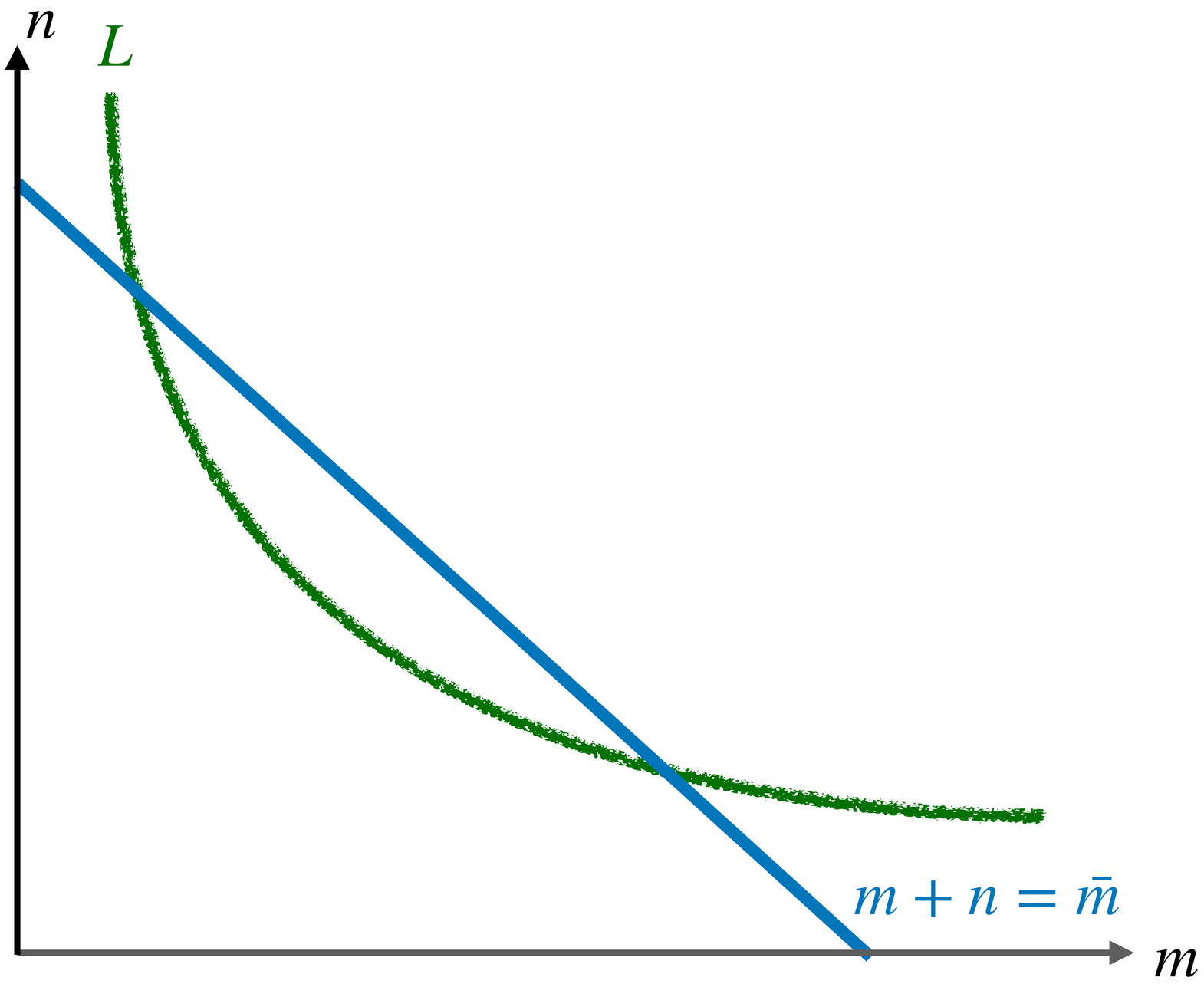
$$\dot{\bar{m}}_t = -R(L_t) + \rho\bar{m} + g_t$$

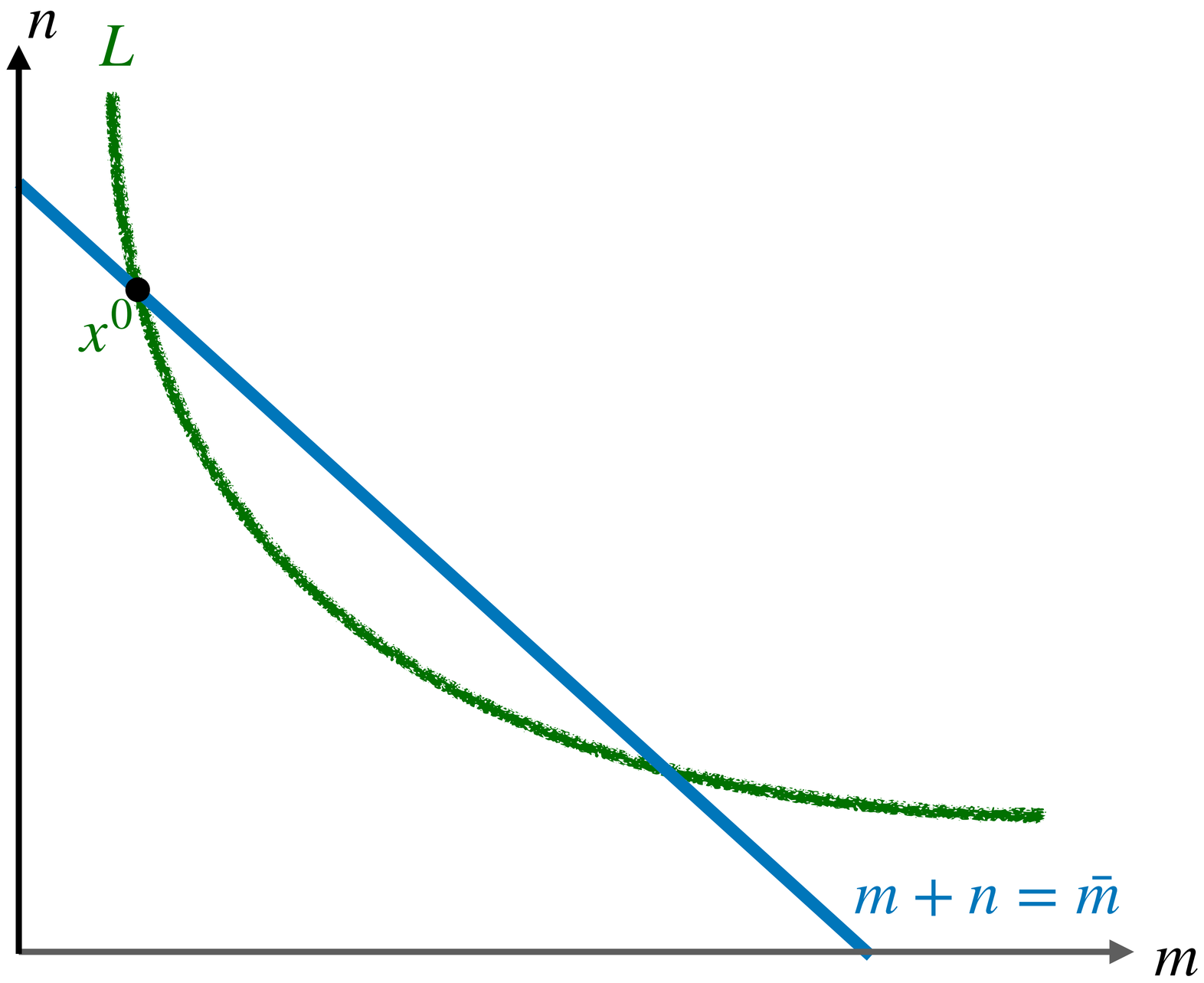
$$L_t \leq \bar{m}_t \qquad \bar{m}_T \text{ given}$$

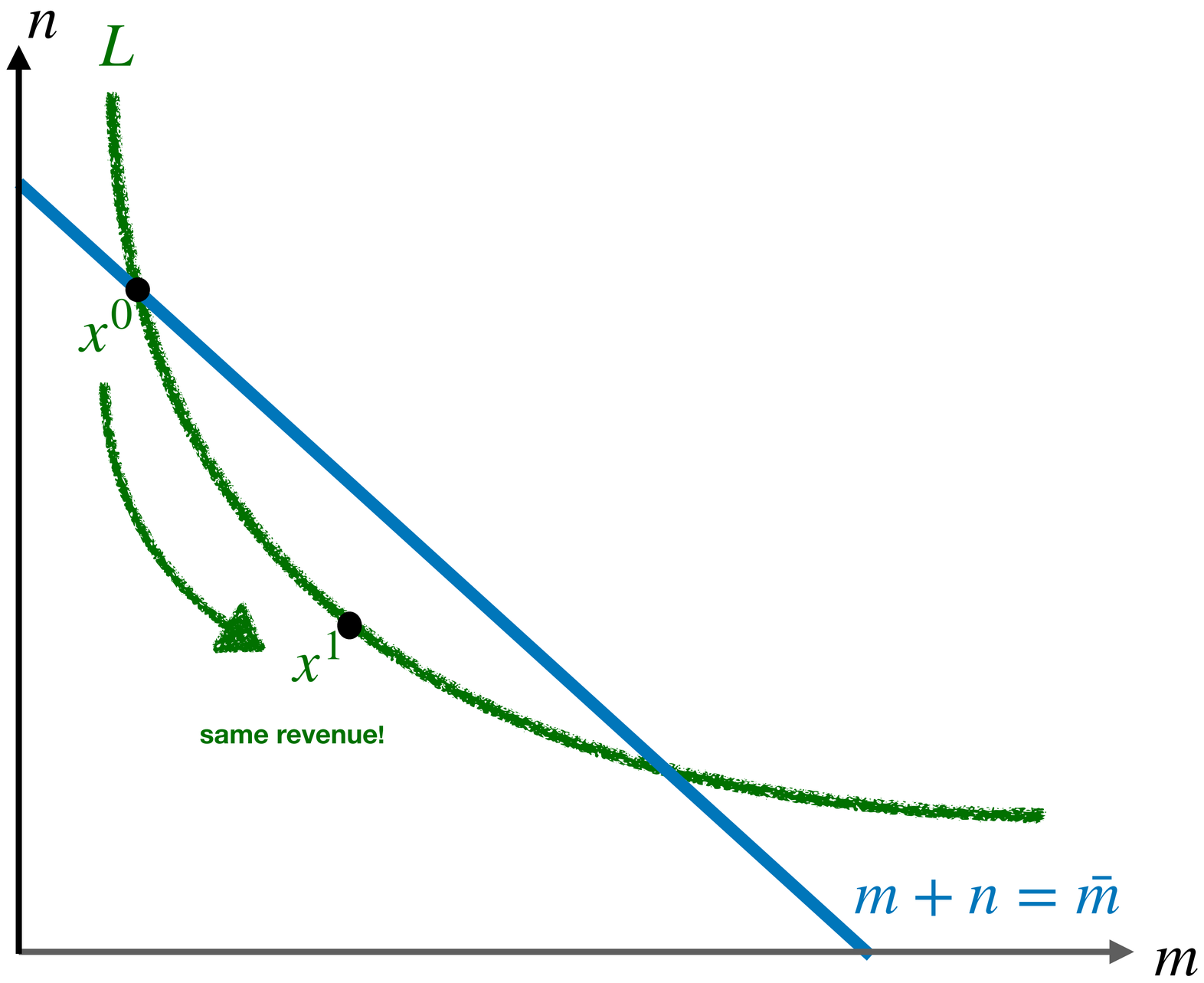
$$R(L) = \bar{R}L^{1-\gamma}$$

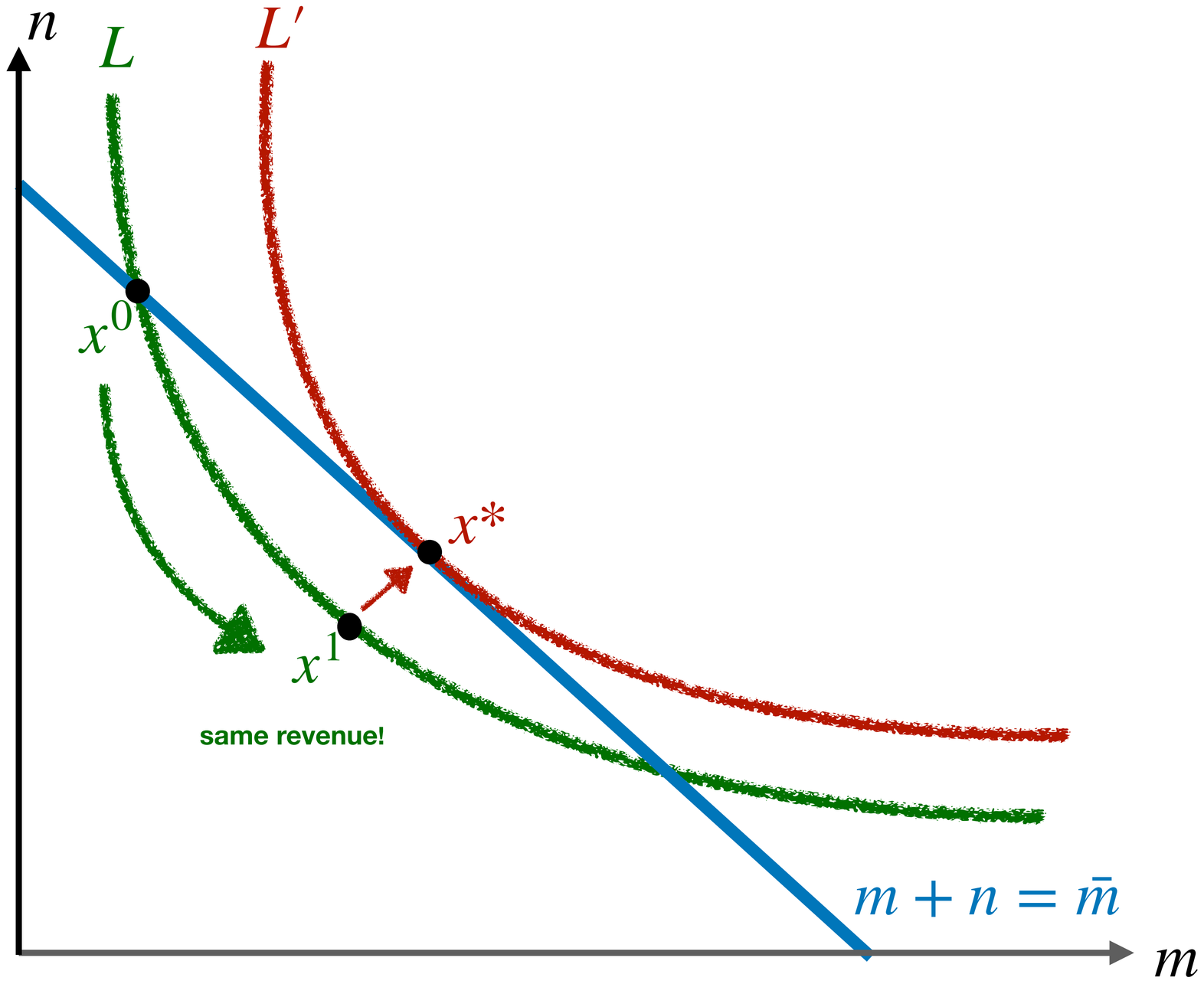
Calvo 1978:
just one money, so $L_t = m_t$
but {g} path endogenous

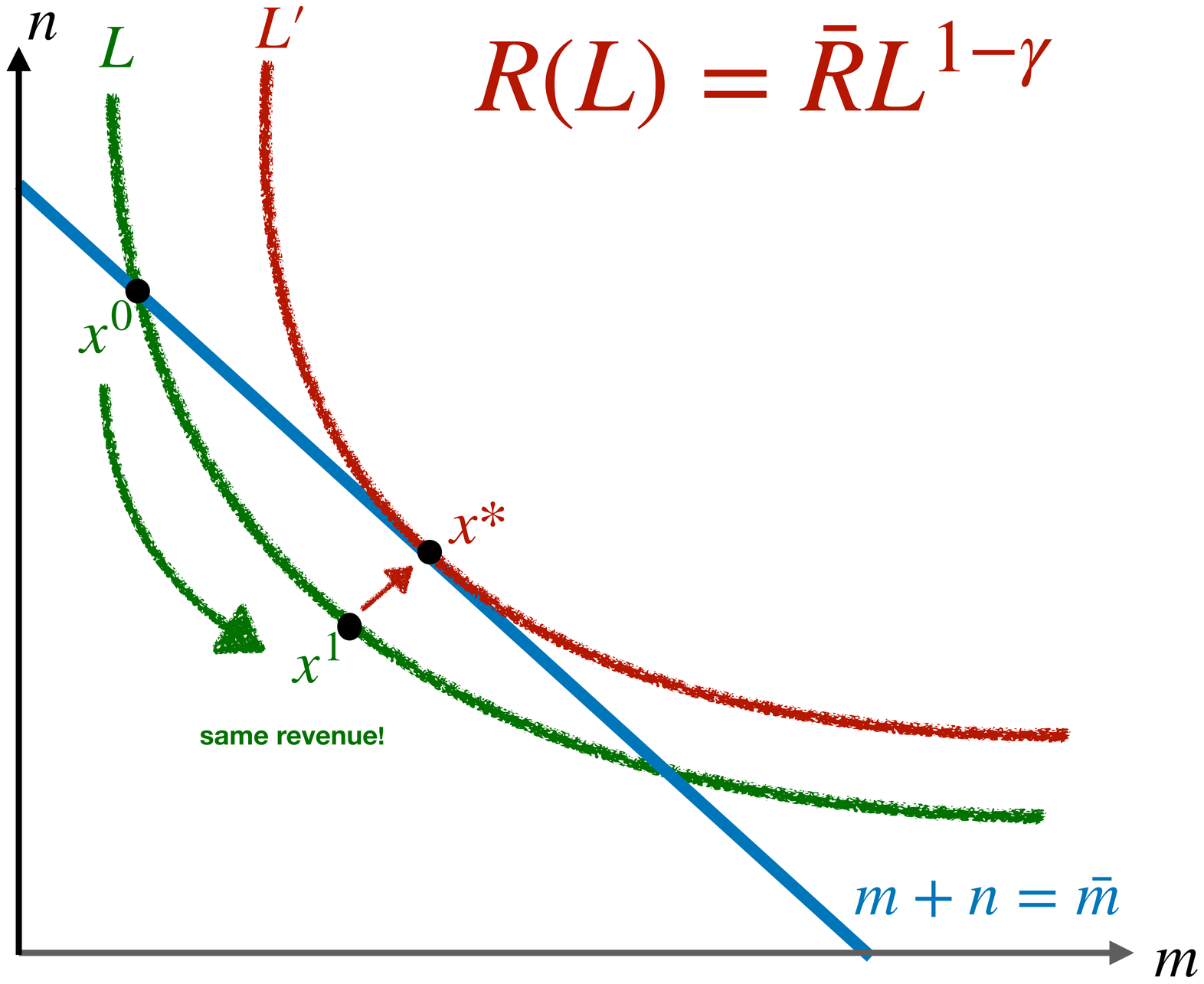

n
m + n = m̄
m

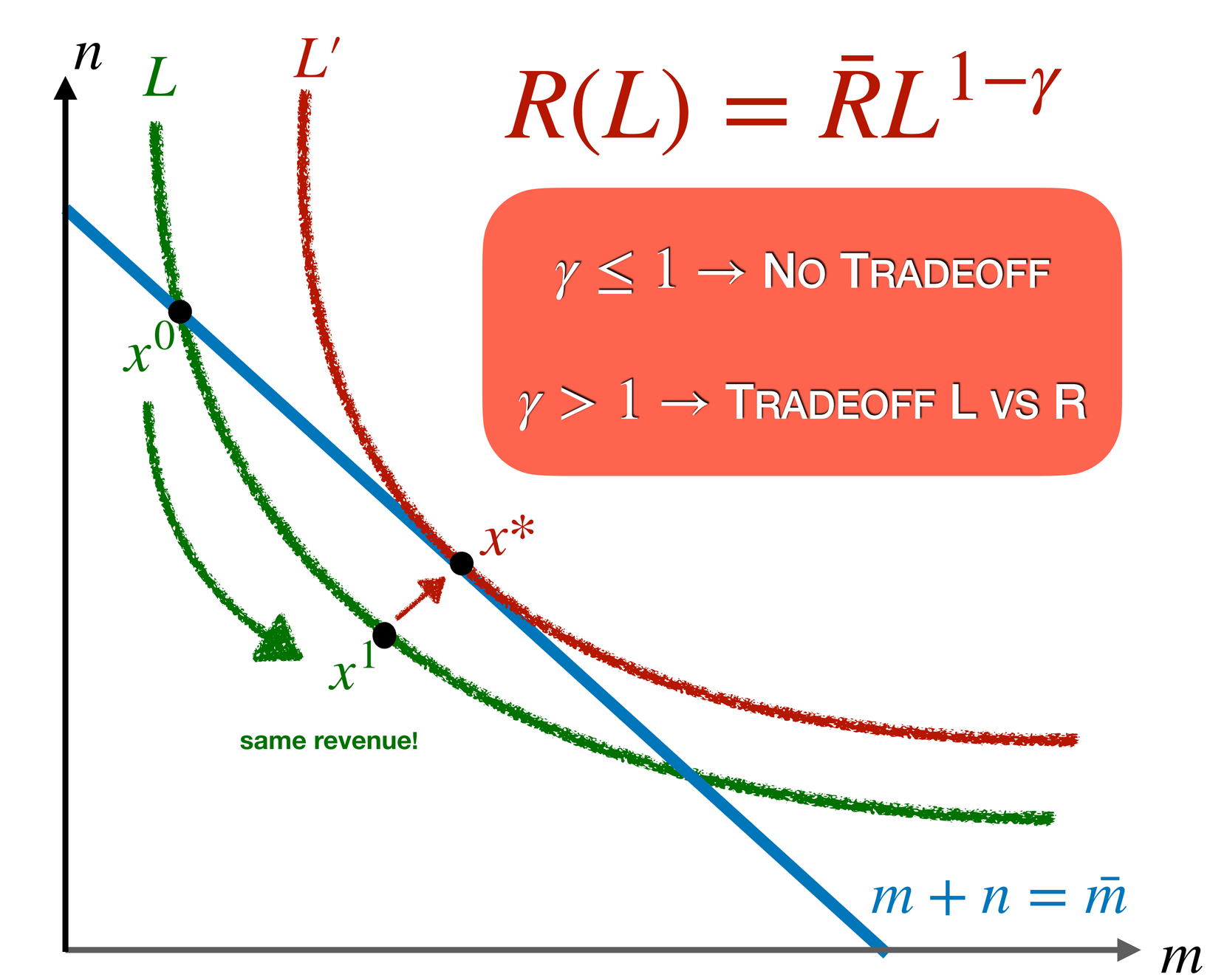

n
L
m + n = m̄
m


n
L
x^0
$m + n = \bar{m}$
m


n
L
x^0
x^1
same revenue!
$m + n = \bar{m}$
m


n
L
L′
x0
x*
x1
same revenue!
m + n = m̄
m

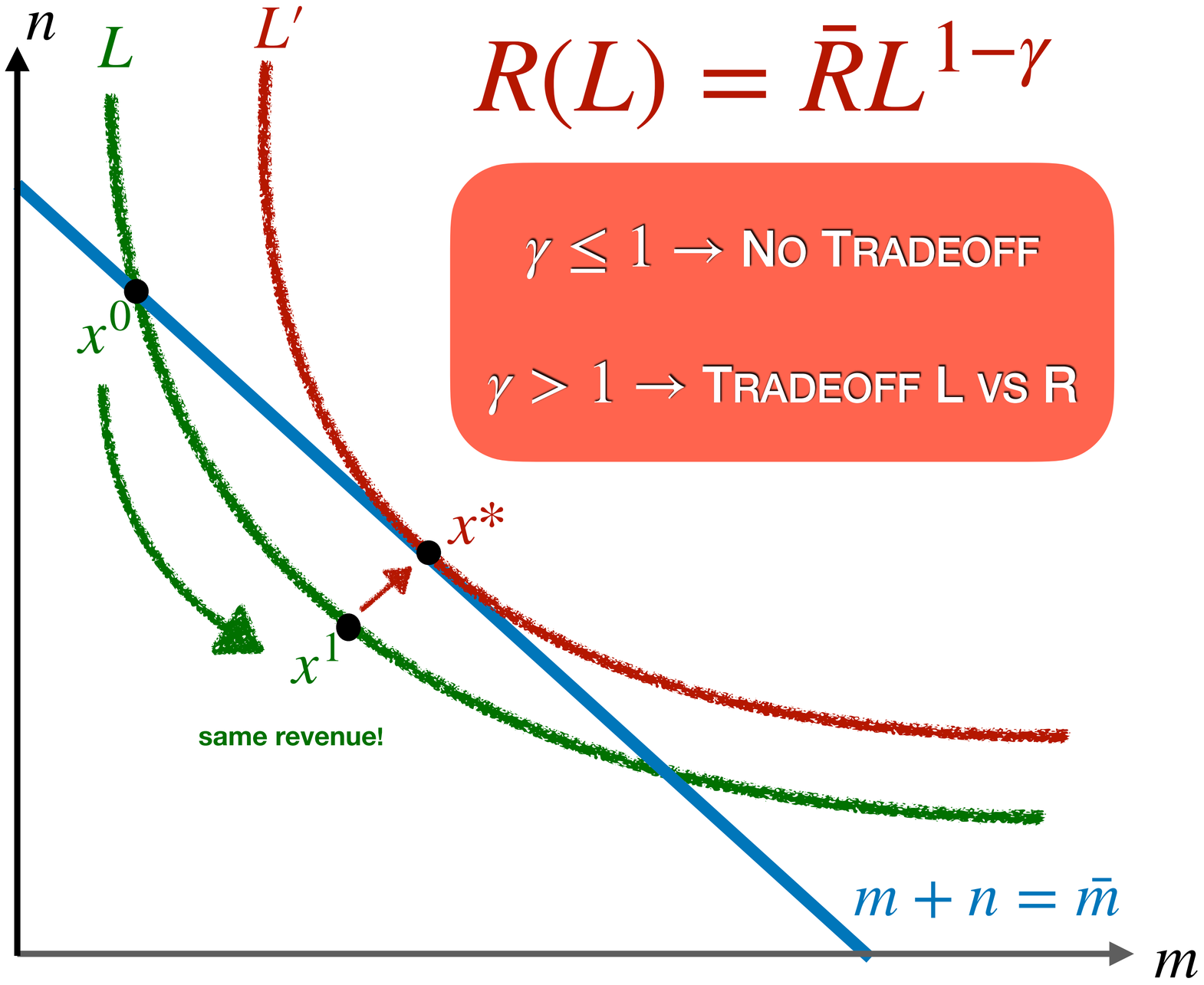

n
L
L′
$R(L) = \bar{R}L^{1-\gamma}$
x^0
x^*
x^1
same revenue!
$m + n = \bar{m}$
m



$$R(L) = \bar{R}L^{1-\gamma}$$

$\gamma \leq 1 \rightarrow$ NO TRADEOFF

$\gamma > 1 \rightarrow$ TRADEOFF L VS R



$$R(L) = \bar{R} L^{1-\gamma}$$

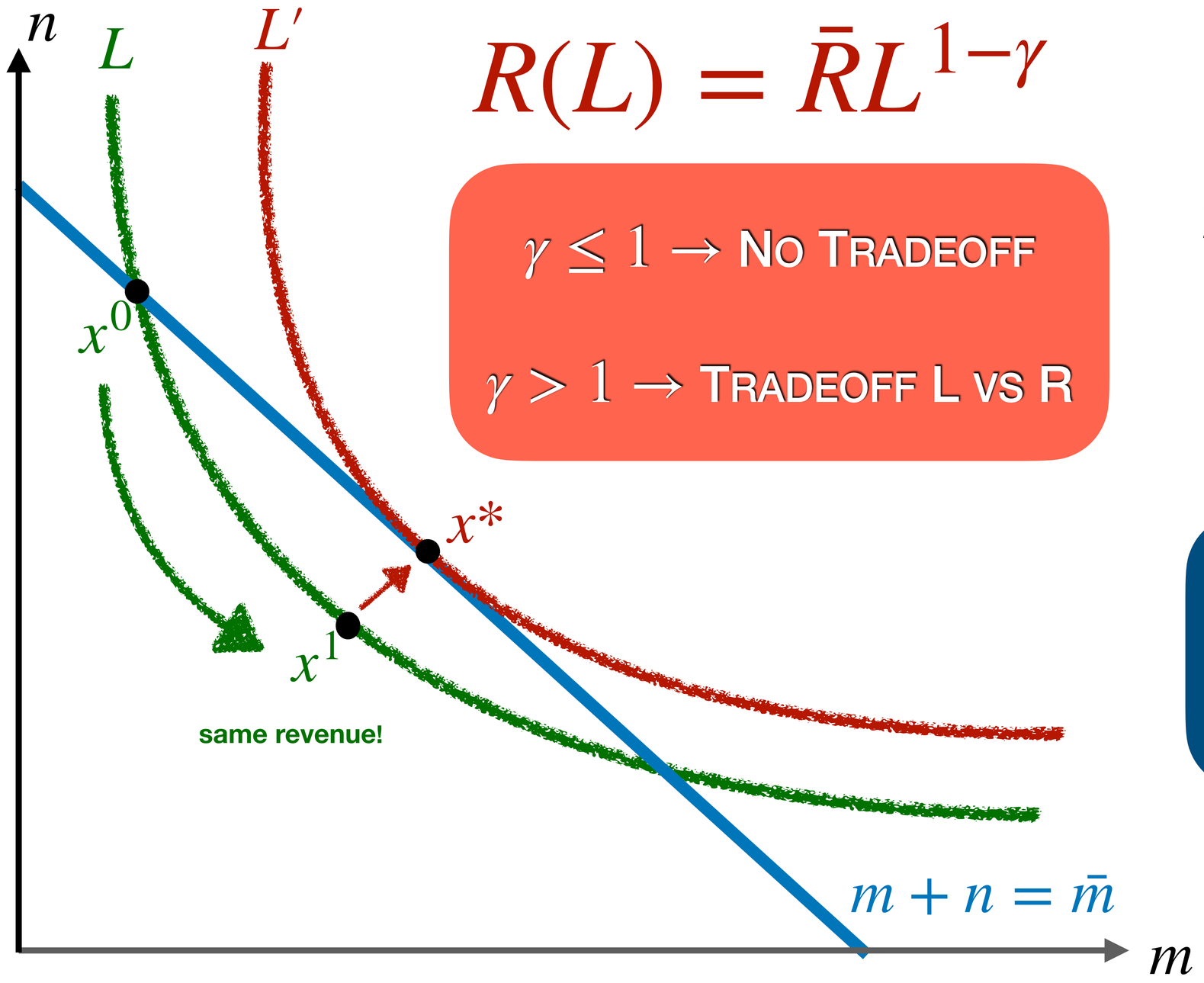
$\gamma \leq 1 \rightarrow$ No Tradeoff

$\gamma > 1 \rightarrow$ Tradeoff L vs R

$$\int_0^{\infty} e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

$$\dot{\bar{m}}_t = -R(L_t) + \rho \bar{m} + g_t$$

$$L_t \leq \bar{m}_t$$



$$R(L) = \bar{R} L^{1-\gamma}$$

$\gamma \leq 1 \rightarrow$ NO TRADEOFF

$\gamma > 1 \rightarrow$ TRADEOFF L VS R

$$\int_0^\infty e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

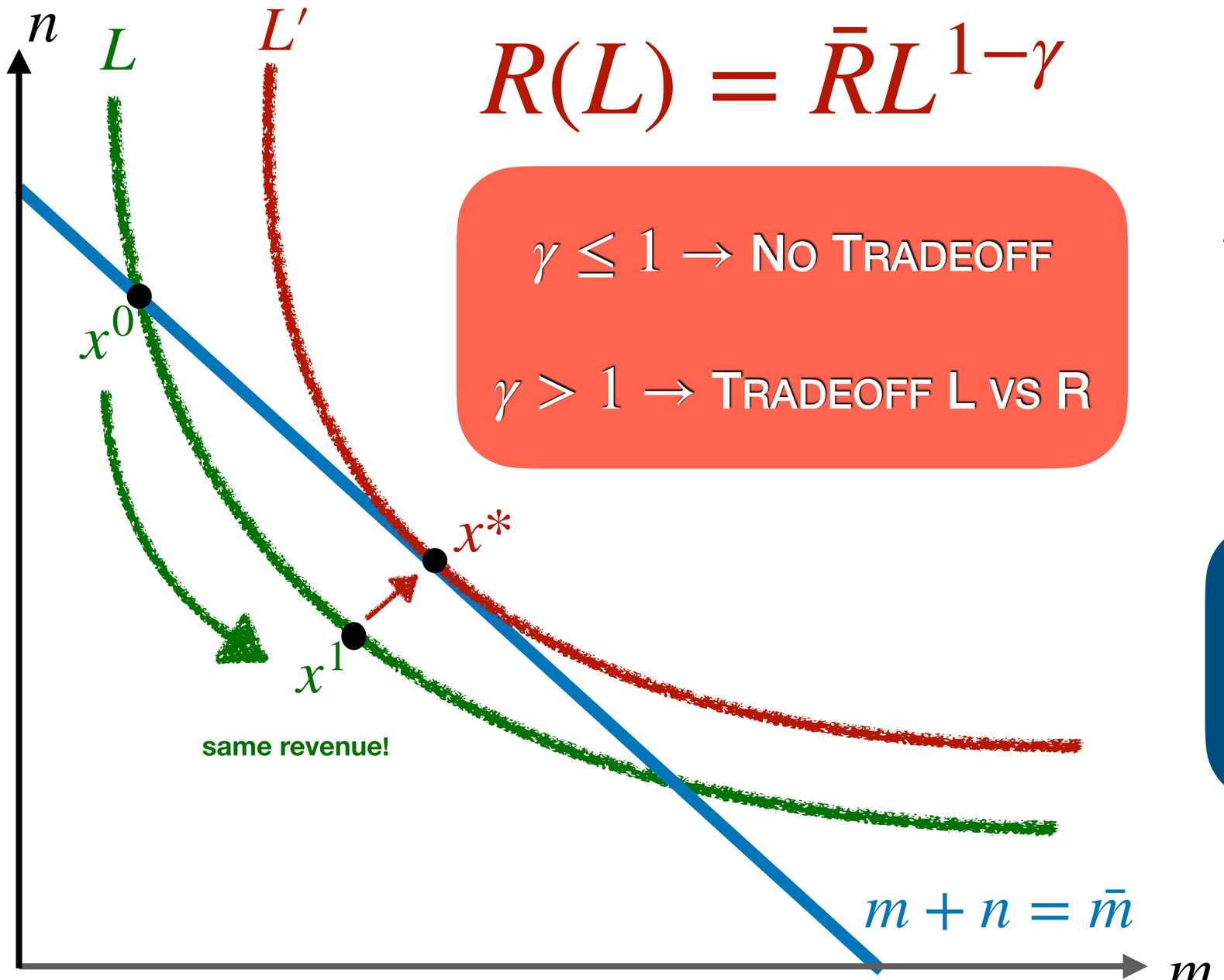
$$\dot{\bar{m}}_t = -R(L_t) + \rho \bar{m} + g_t$$

$$L_t \leq \bar{m}_t$$

RESULT. FOR ANY $\gamma \geq 0$

$$\tau_n^* = \tau_m^* \quad L^* = \bar{m}$$

$$i_n^* = 0$$



$$R(L) = \bar{R} L^{1-\gamma}$$

$\gamma \leq 1 \rightarrow$ NO TRADEOFF

$\gamma > 1 \rightarrow$ TRADEOFF L VS R

$$\int_0^\infty e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

$$\dot{\bar{m}}_t = -R(L_t) + \rho \bar{m} + g_t$$

$$L_t \leq \bar{m}_t$$

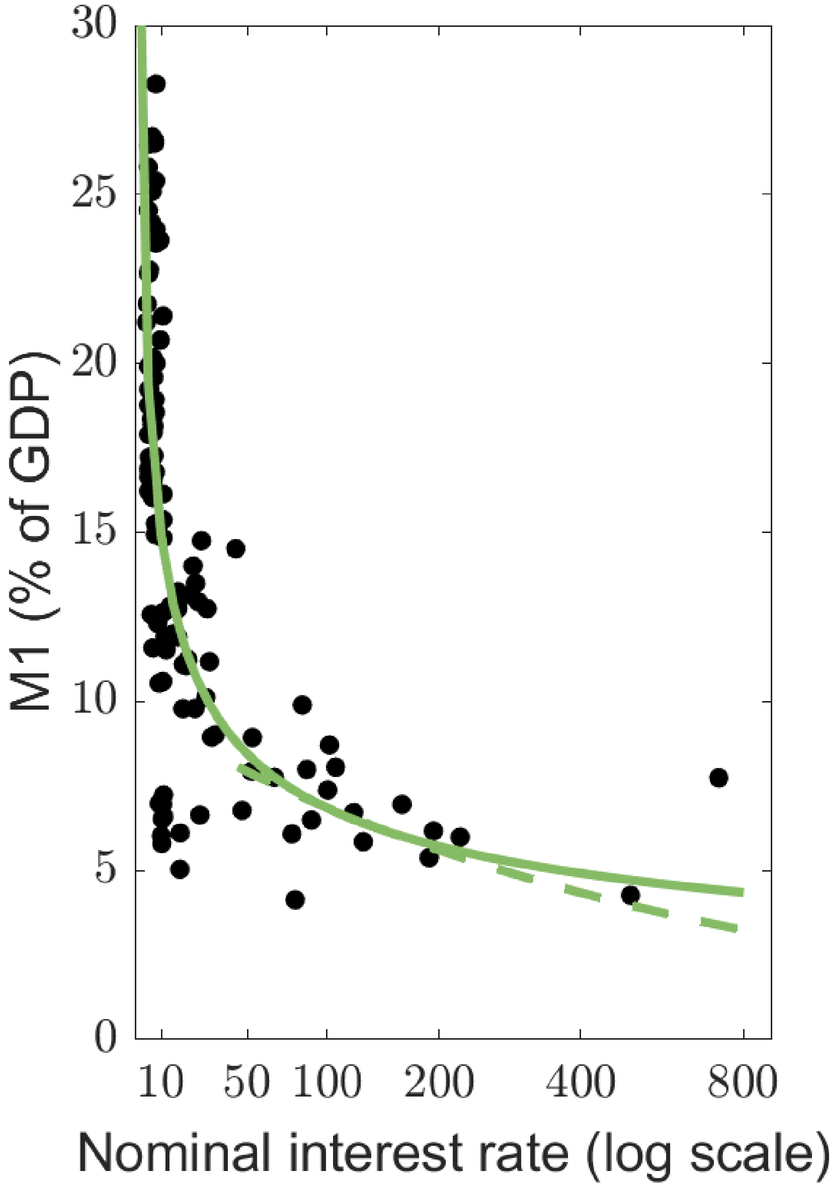
RESULT. FOR ANY $\gamma \geq 0$

$$\tau_n^* = \tau_m^* \quad L^* = \bar{m}$$

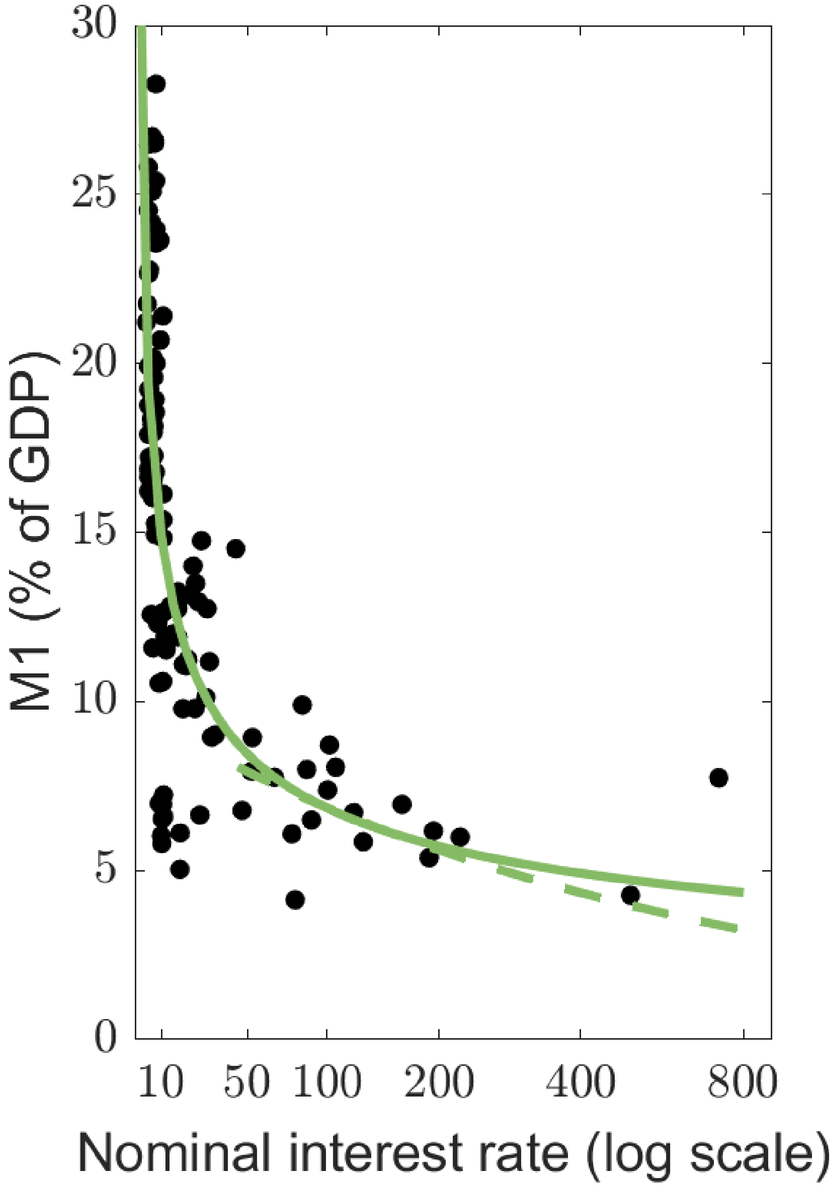
$$i_n^* = 0$$

NO TIME INCONSISTENCY

Estimation of Money Demand



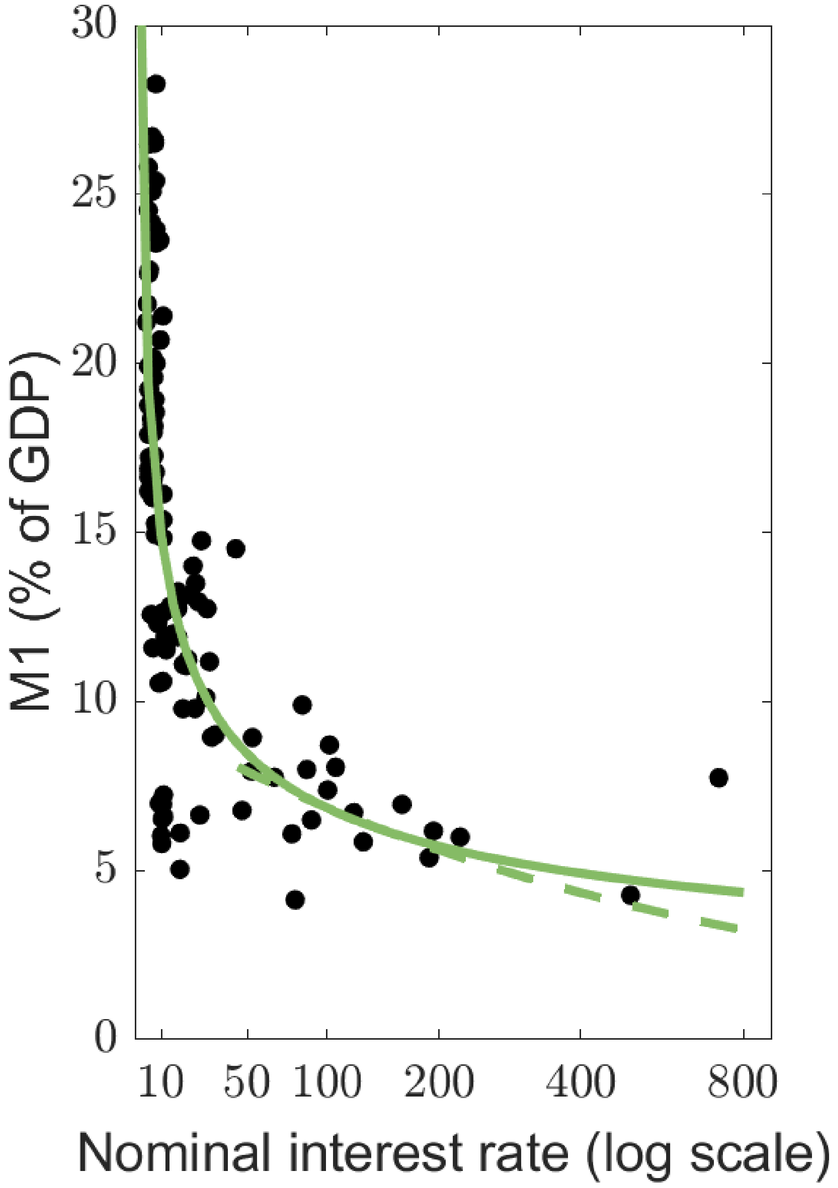
Estimation of Money Demand



LOG-LOG

$\gamma \approx 3$

Estimation of Money Demand

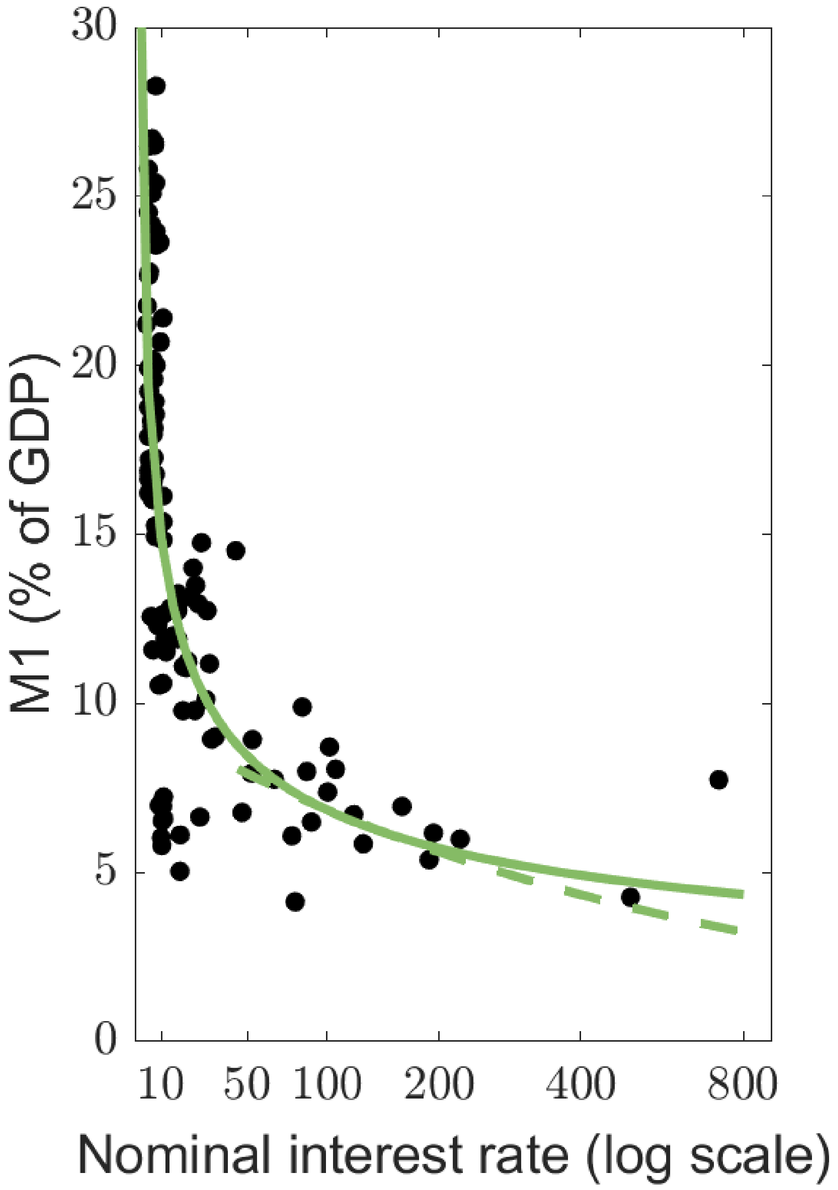


LOG-LOG

$\gamma \approx 3$

… SEMI LOG?

Estimation of Money Demand



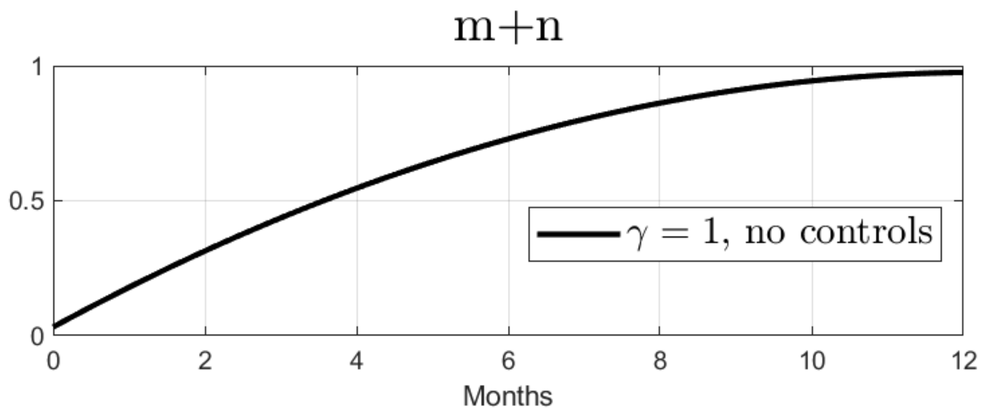
LOG-LOG

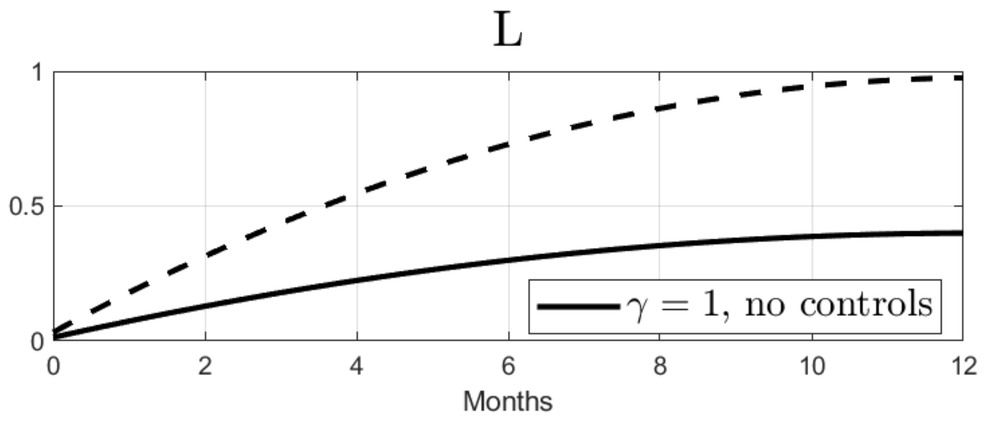
$\gamma \approx 3$

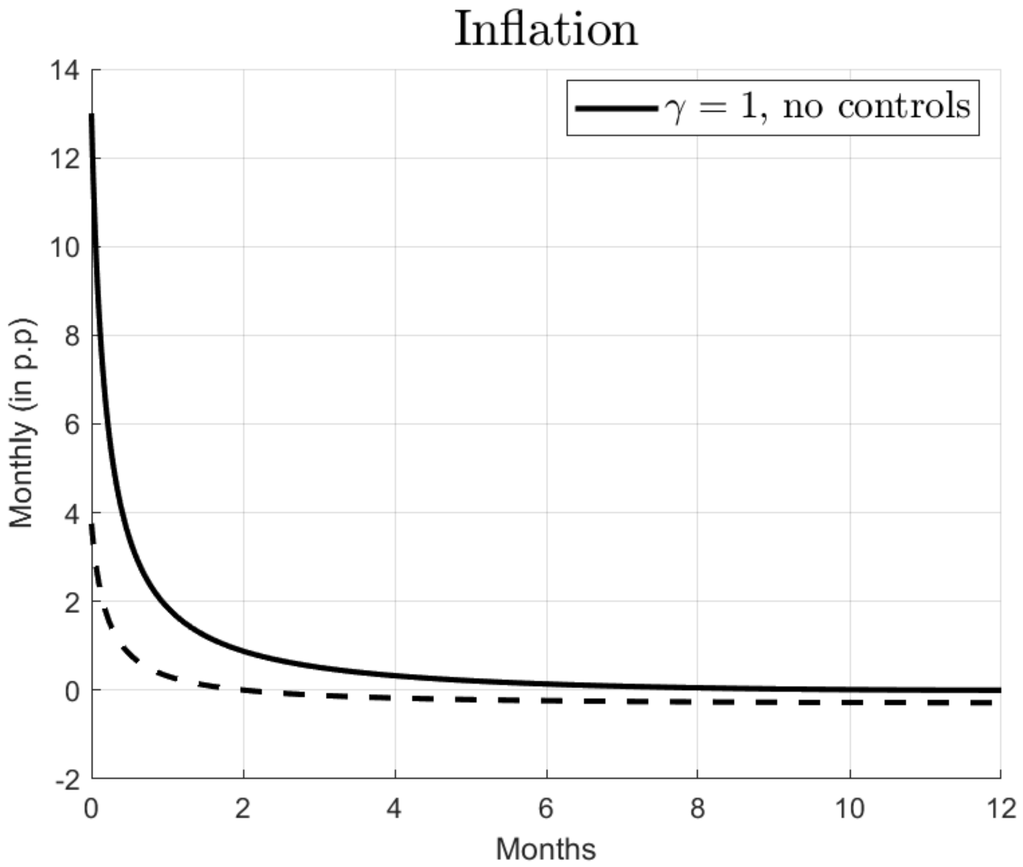
… SEMI LOG?

NOT ESTIMATION OF JOINT M,N SYSTEM

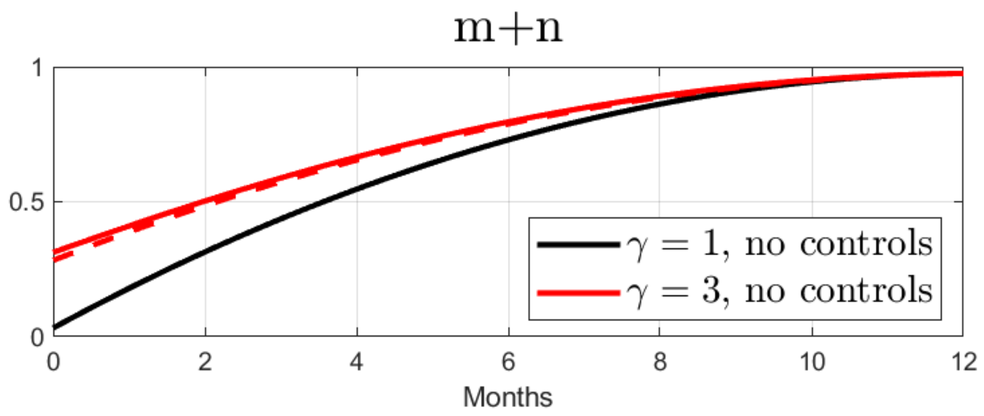
Taxing Money (m,n) Uniformly

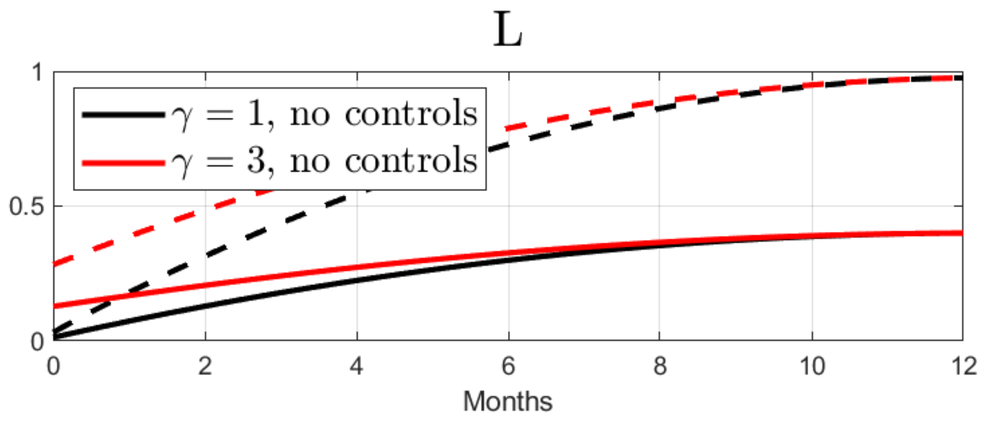


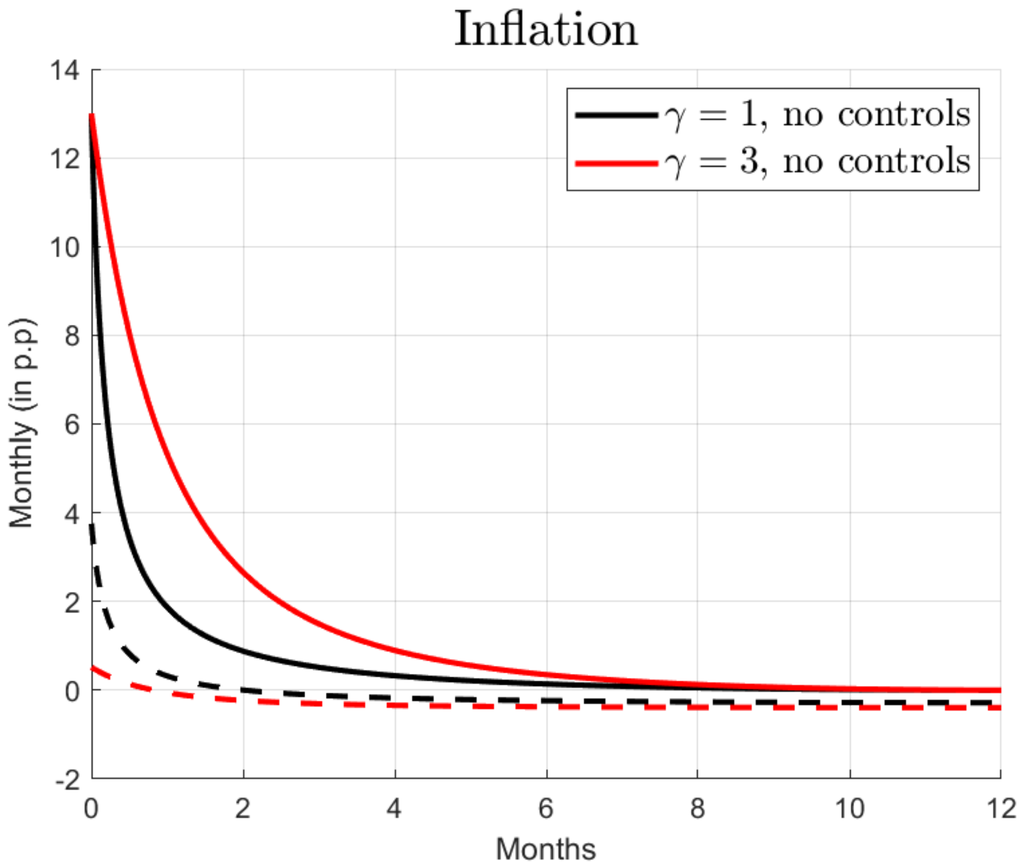




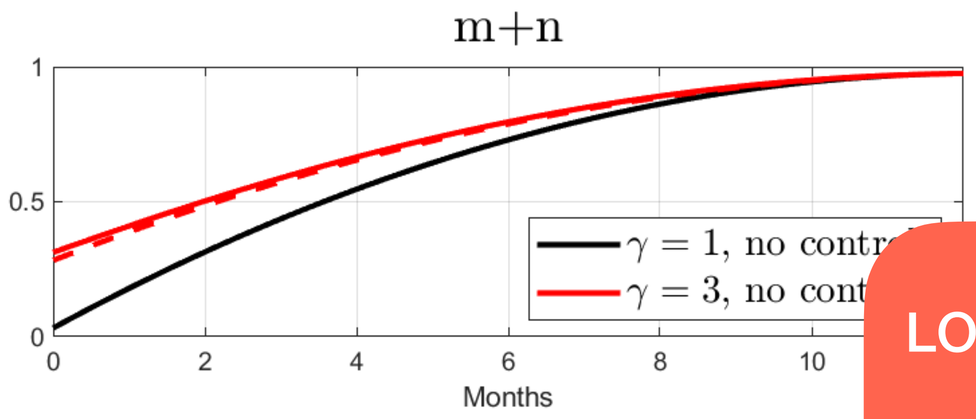
Taxing Money (m,n) Uniformly

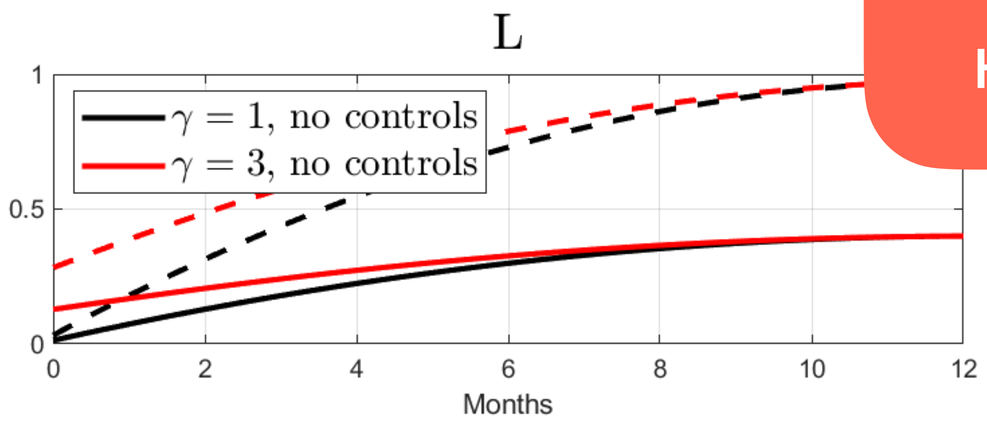






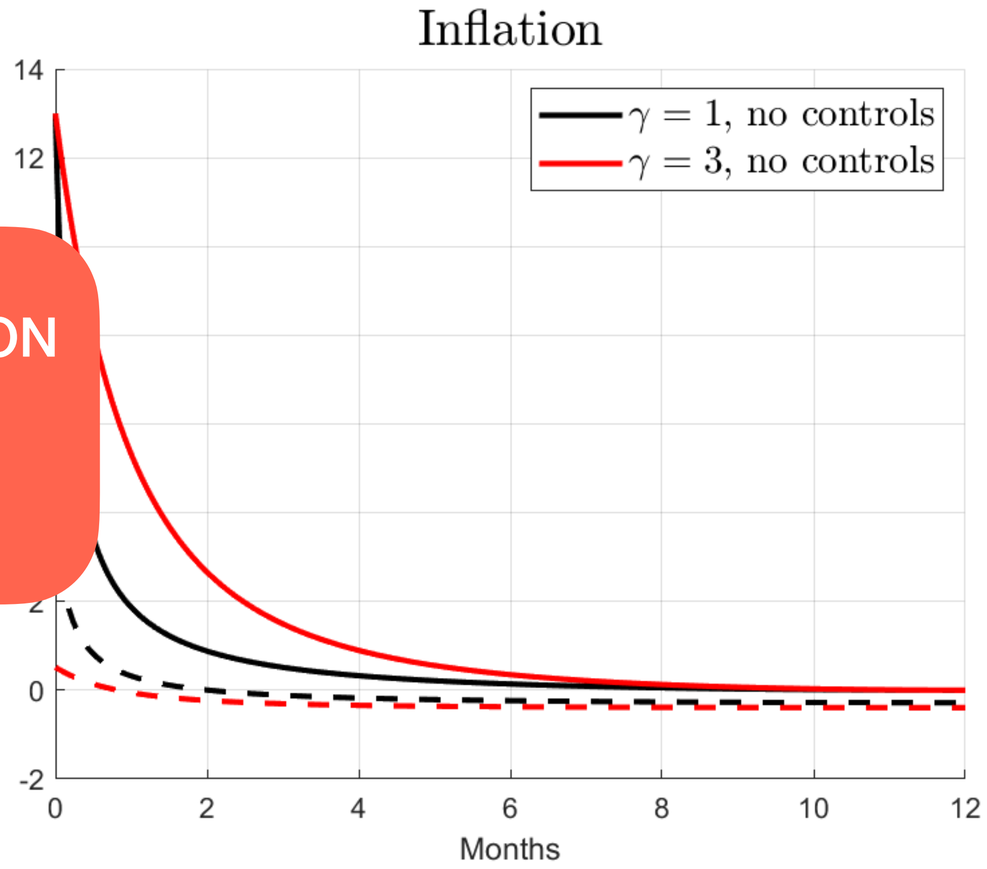
Taxing Money (m,n) Uniformly



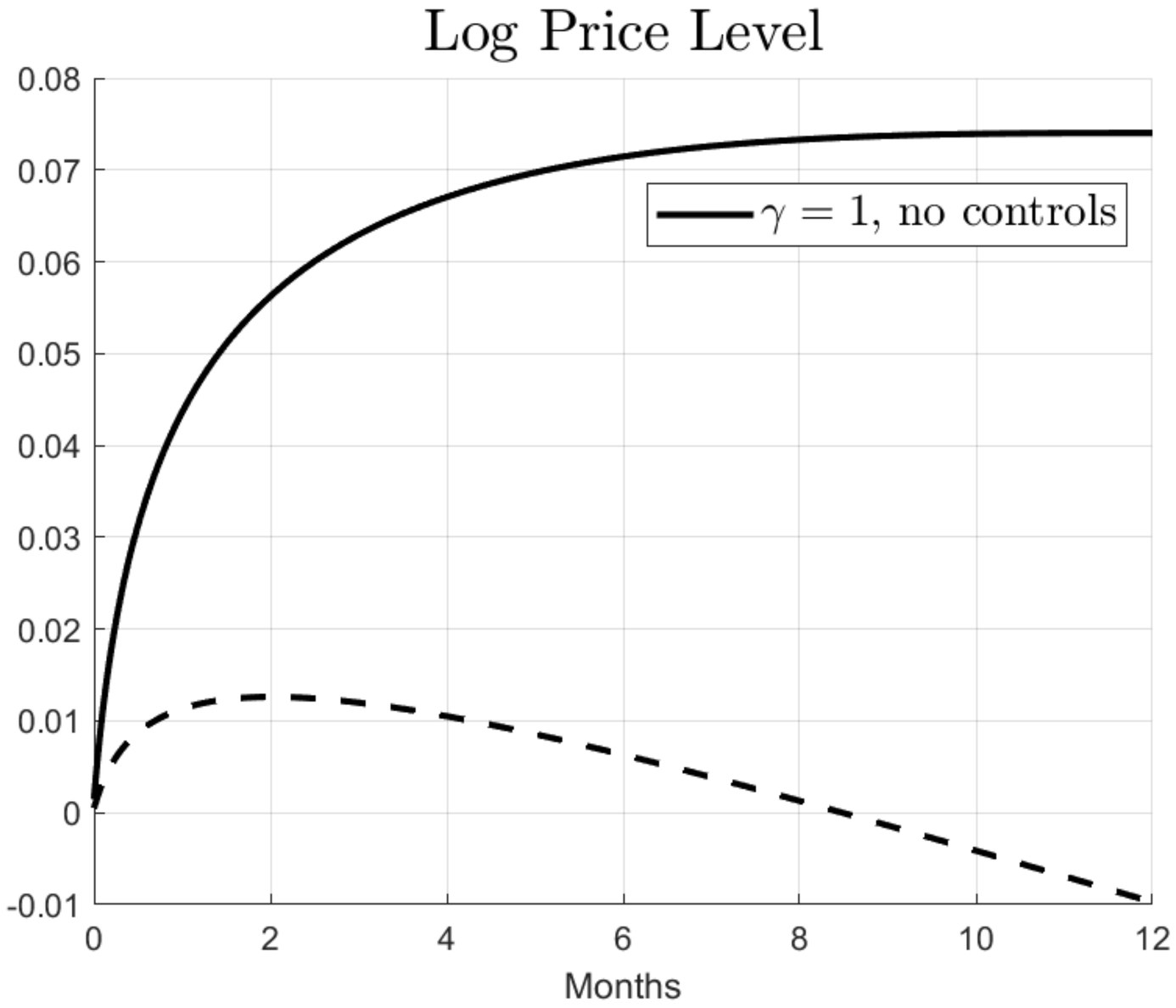


LOWER INFLATION

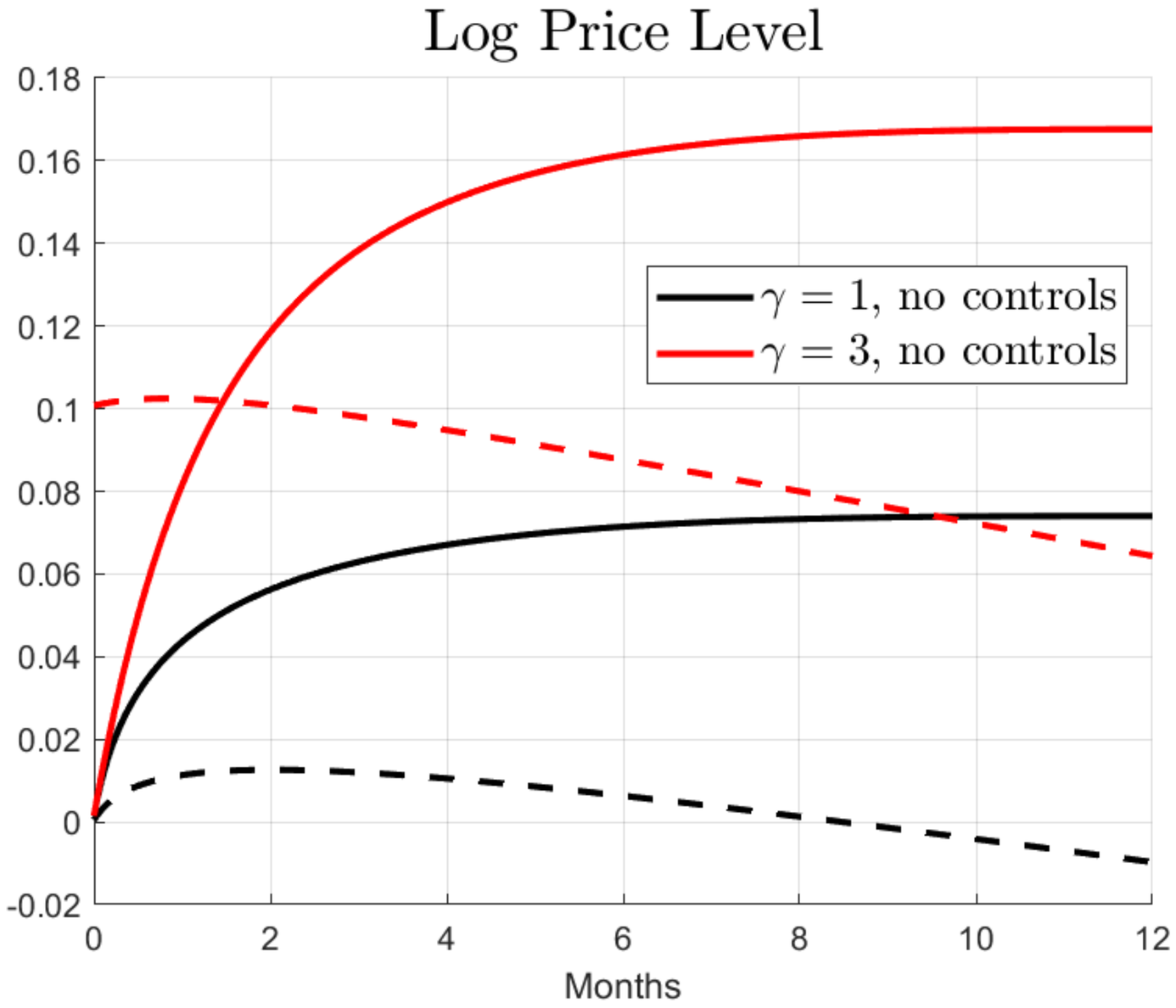
HIGHER M/P



Taxing Money (m,n) Uniformly

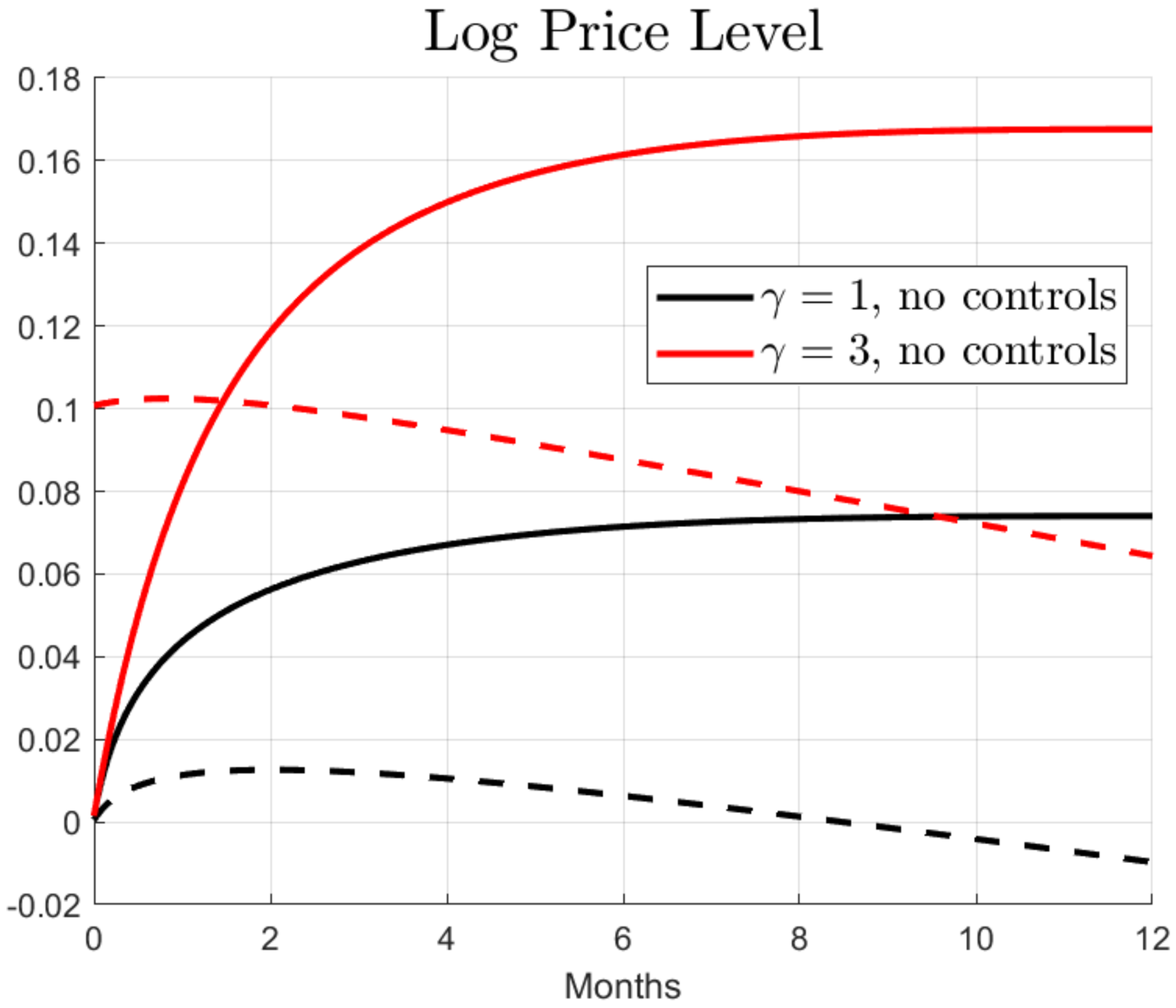


Taxing Money (m,n) Uniformly



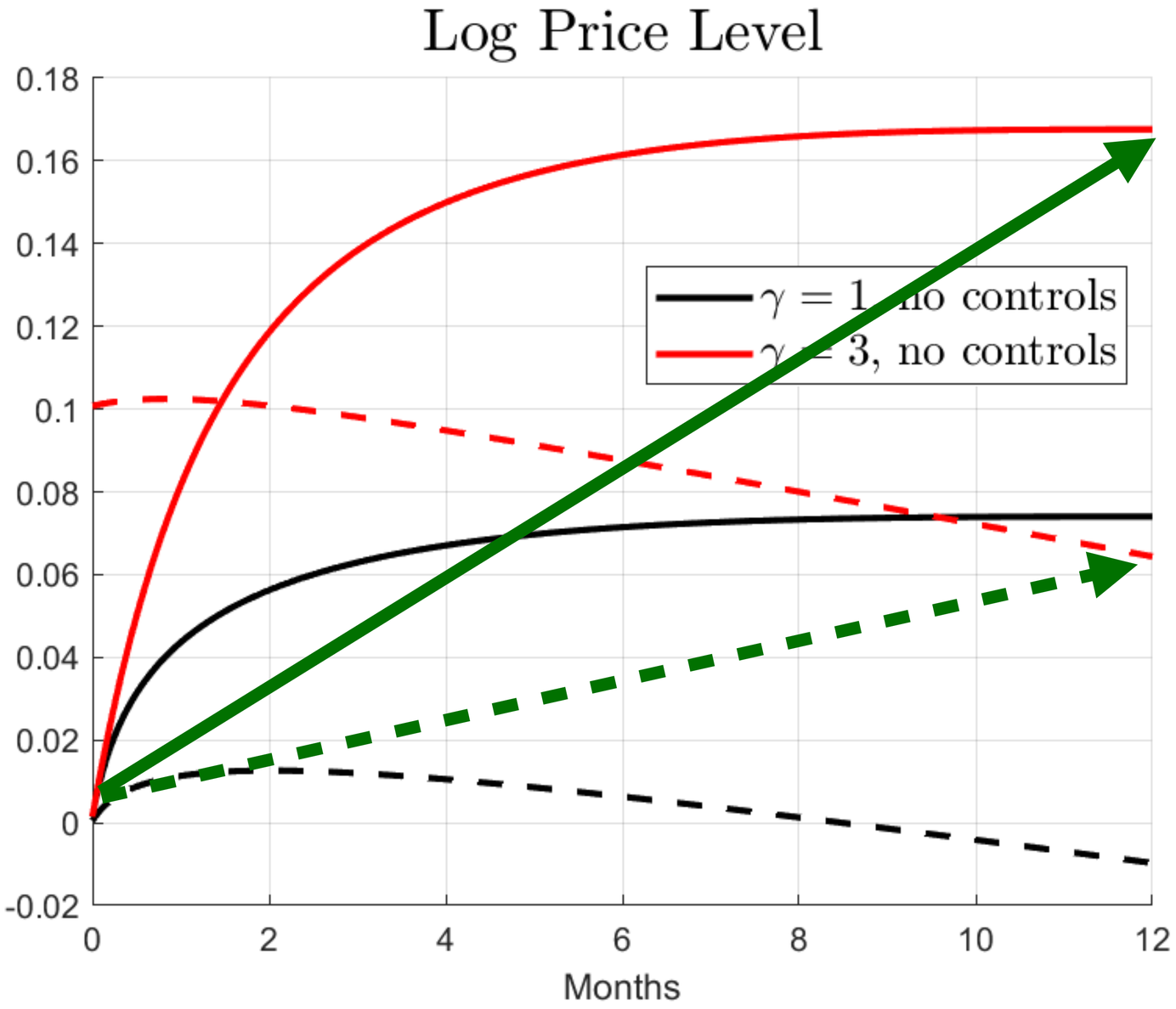
Taxing Money (m,n) Uniformly

Jump in price
Up or Down
(Depreciation or
Appreication



Taxing Money (m,n) Uniformly

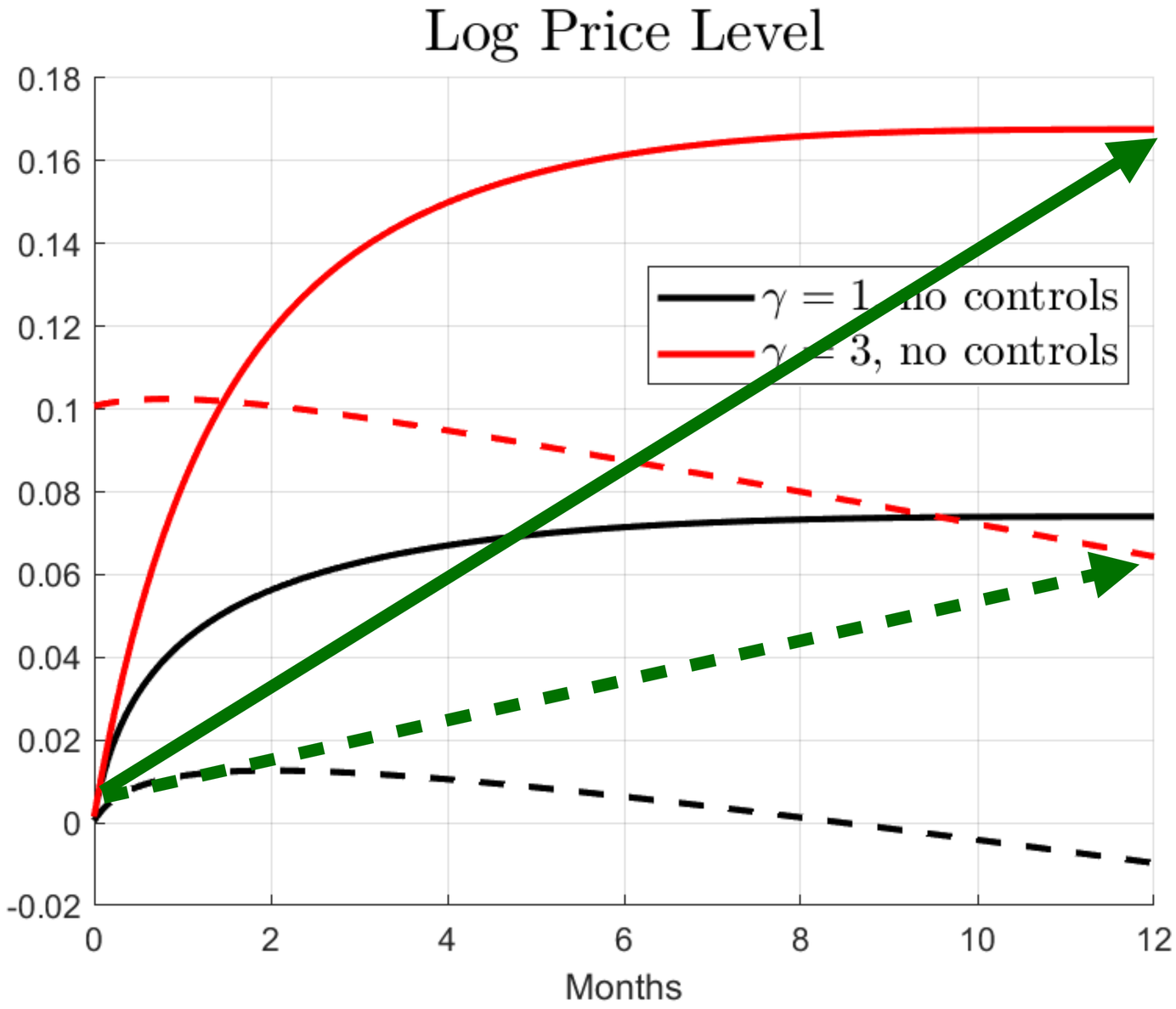
Jump in price
Up or Down
(Depreciation or
Appreication



Taxing Money (m,n) Uniformly

Jump in price Up or Down (Depreciation or Appreication

Lower Average Inflation $\rightarrow P_T$



Intuition: Static

$$\pi m(\pi)$$

Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, \tau_n) + \tau_n n(\pi, \tau_n)$$

Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, \tau_n) + \tau_n n(\pi, \tau_n)$$

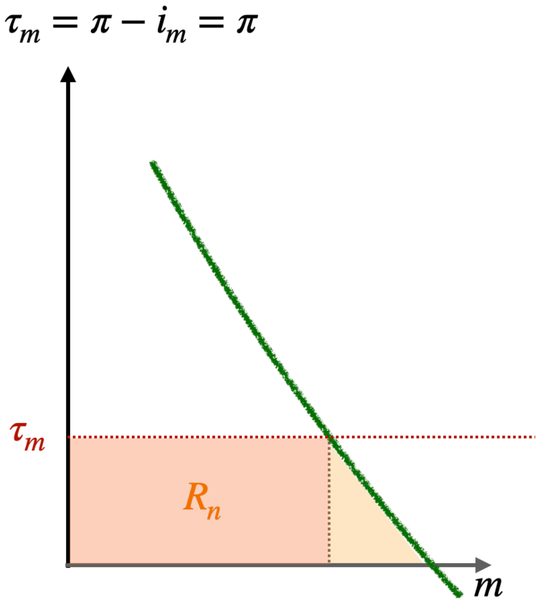
Extra Revenue

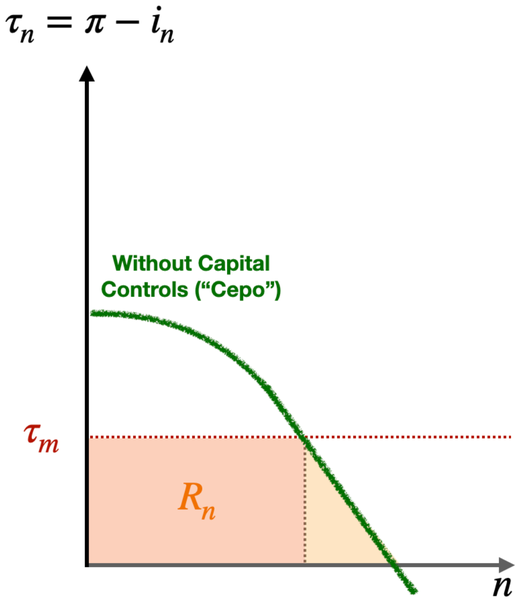
Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, \tau_n) + \tau_n n(\pi, \tau_n)$$

Demand Effect **Extra Revenue**



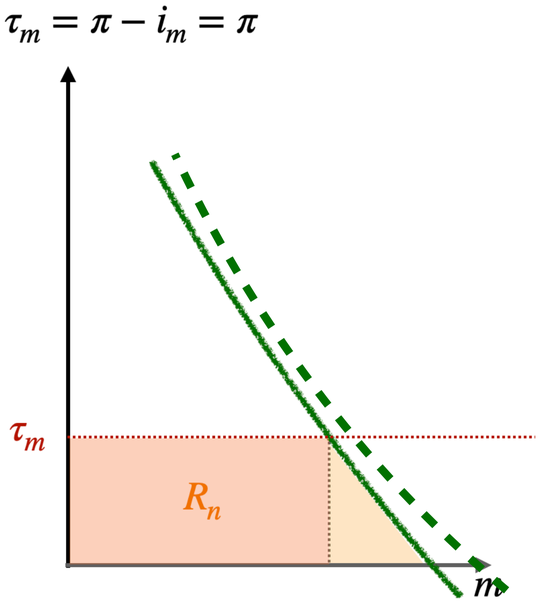


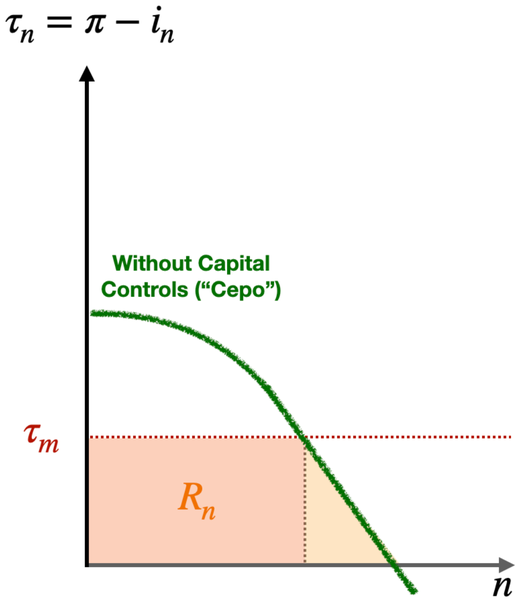
Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, \tau_n) + \tau_n n(\pi, \tau_n)$$

Demand Effect **Extra Revenue**





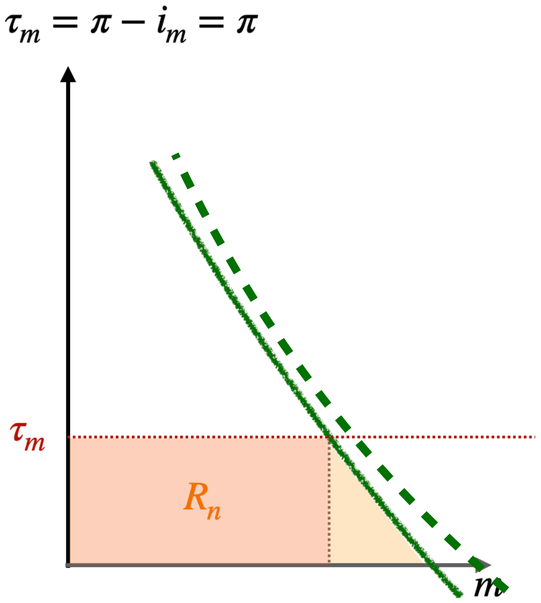
Intuition: Static

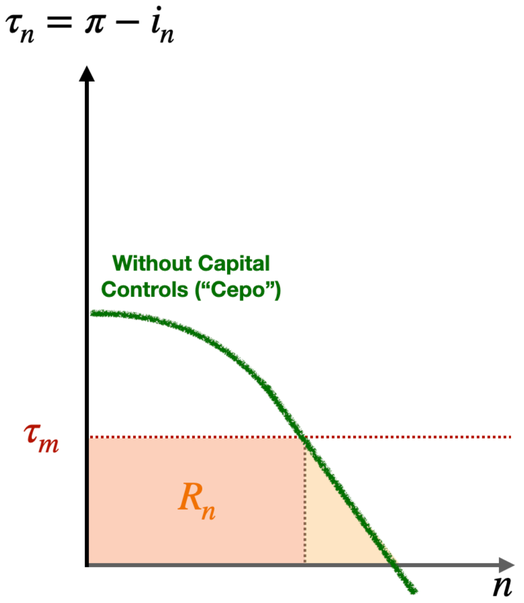
$$\pi m(\pi)$$

$$\pi m(\pi, \tau_n) + \tau_n n(\pi, \tau_n)$$

Demand Effect **Extra Revenue**

$$\uparrow \tau_n \longrightarrow \downarrow \pi$$





Planning Problem

$$V(m,n) = \frac{L(m,n)^{1-\gamma}}{1-\gamma}$$

L CRS

$$V(\bar{m}) = \bar{m}$$

$$\int_0^\infty e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

$$\dot{\bar{m}}_t = -R(L_t) + \rho\bar{m} + g_t$$

$$L_t \leq \bar{m}_t$$

$$V(m,n) = \frac{m^{1-\gamma_m}}{1-\gamma_m} + \frac{n^{1-\gamma_n}}{1-\gamma_n}$$

$$\gamma_n > \gamma_m$$

n more inelastic

Planning Problem

$$V(m,n) = \frac{L(m,n)^{1-\gamma}}{1-\gamma}$$

L CRS

$$V(\bar{m}) = \bar{m}$$

$$\int_0^{\infty} e^{-\rho t}\left(u(c_t) + \frac{L_t^{1-\gamma}}{1-\gamma}\right) dt$$

$$\dot{\bar{m}}_t = -R(L_t) + \rho\bar{m} + g_t$$

$$L_t \leq \bar{m}_t$$

$$V(m,n) = \frac{m^{1-\gamma_m}}{1-\gamma_m} + \frac{n^{1-\gamma_n}}{1-\gamma_n}$$

$$\gamma_n > \gamma_m$$

n more inelastic

$$0 < i_n^* < \pi$$

Model 2:
Optimal Capital Controls

Model 2: Capital Controls

- Model…
  - representative agent
  - single consumption good, endowment, flexible nominal price of good P
  - small open economy: private agents save or borrow at world interest rate
- Government: Cagan scenario…
  - financial autarky: no bonds
  - issues: M ~~and N (money/liabilities)~~
  - ~~sets interest rate on N~~
  - **regulates or taxes capital outflows; no direct revenue**

Planning Problem

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

Planning Problem

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$m = L(c, \tau)$$

Planning Problem

$$\max_{\{c_t, m_t, r_t\}} \int_0^{\infty} e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$m = L(c, \tau)$$

$$\tau = \tau^*(m, c)$$

Planning Problem

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$m = L(c, \tau)$$

$$\tau = \tau^*(m, c)$$

$$\dot{m}_t = r_t m_t - \tau^*(m_t, c_t) m_t + g_t$$

Planning Problem

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$m = L(c, \tau)$$

$$\tau = \tau^*(m, c)$$

$$\dot{m}_t = r_t m_t - \tau^*(m_t, c_t) m_t + g_t$$

$$r_t = \rho + \frac{1}{\sigma} \frac{\dot{c}_t}{c_t}$$

Planning Problem

$$\max_{\{c_t, m_t, r_t\}} \int_0^{\infty} e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$\dot{m}_t = r_t m_t - \tau^*(m_t, c_t) m_t + g_t$$

$$r_t = \rho + \frac{1}{\sigma} \frac{\dot{c}_t}{c_t}$$

NOTE: NO DIRECT TAX REVENUE

Planning Problem

RESULT.

$$r_t^* \neq \rho$$

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$\dot{m}_t = r_t m_t - \tau^*(m_t, c_t) m_t + g_t$$

$$r_t = \rho + \frac{1}{\sigma} \frac{\dot{c}_t}{c_t}$$

NOTE: NO DIRECT TAX REVENUE

Planning Problem

RESULT.

$$r_t^* \neq \rho$$

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$\dot{m}_t = r_t m_t - \tau^*(m_t, c_t) m_t + g_t$$

$$r_t = \rho + \frac{1}{\sigma} \frac{\dot{c}_t}{c_t}$$

$$r_t = \bar{r} = (1 - \tau)\rho$$

NOTE: NO DIRECT TAX REVENUE

Planning Problem

RESULT.

$$r_t^* \neq \rho$$

$$\max_{\{c_t, m_t, r_t\}} \int_0^\infty e^{-\rho t} \left(\frac{c_t^{1-\sigma}}{1-\sigma} + \frac{m_t^{1-\gamma}}{1-\gamma} \right) dt$$

$$\int e^{-\rho t}(c_t - y_t) = a_0^*$$

$$\dot{m}_t = r_t m_t - \tau^*(m_t, c_t) m_t + g_t$$

$$r_t = \rho + \frac{1}{\sigma} \frac{\dot{c}_t}{c_t}$$

RESULT. CONSTANT TAX > 0

$$r_t = \bar{r} \quad \rightarrow \quad \bar{r}^* < \rho$$

$$r_t = \bar{r} = (1 - \tau)\rho$$

NOTE: NO DIRECT TAX REVENUE

Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, r_n)$$

Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, r_n)$$

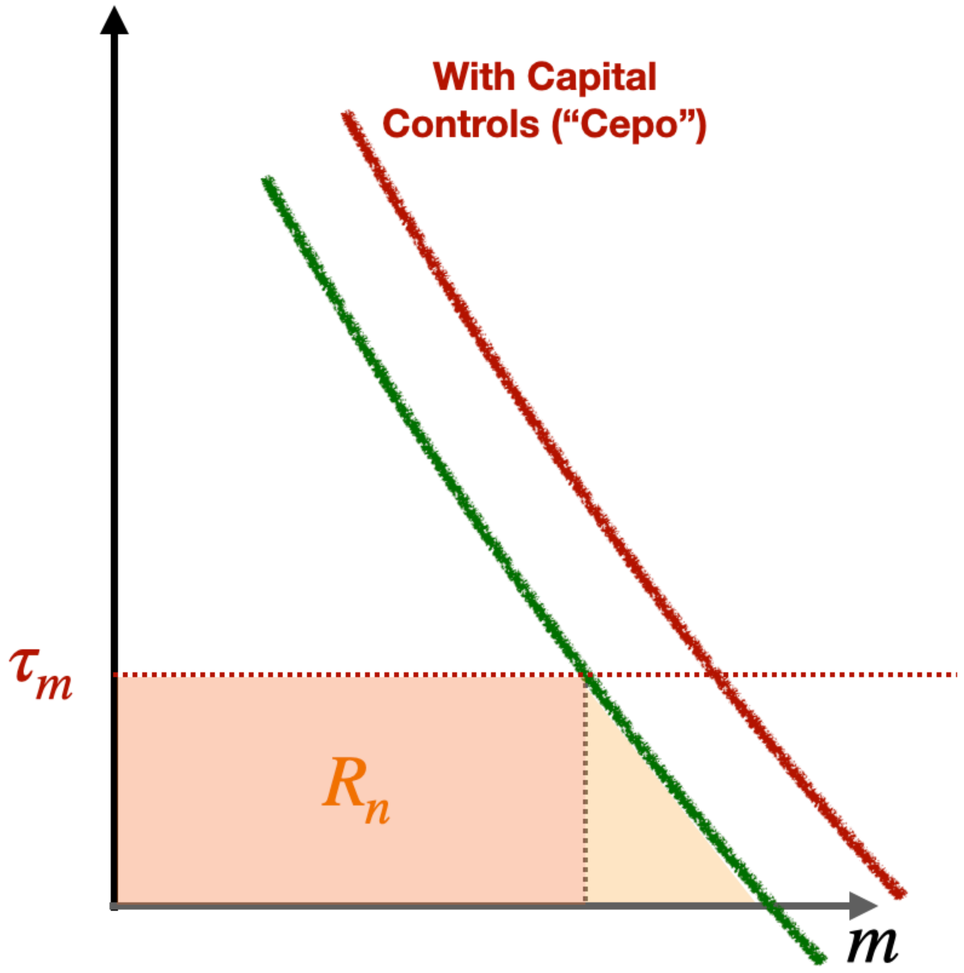
Demand Effect

Intuition: Static

$$\pi m(\pi)$$

$$\pi m(\pi, r_n)$$

Demand Effect



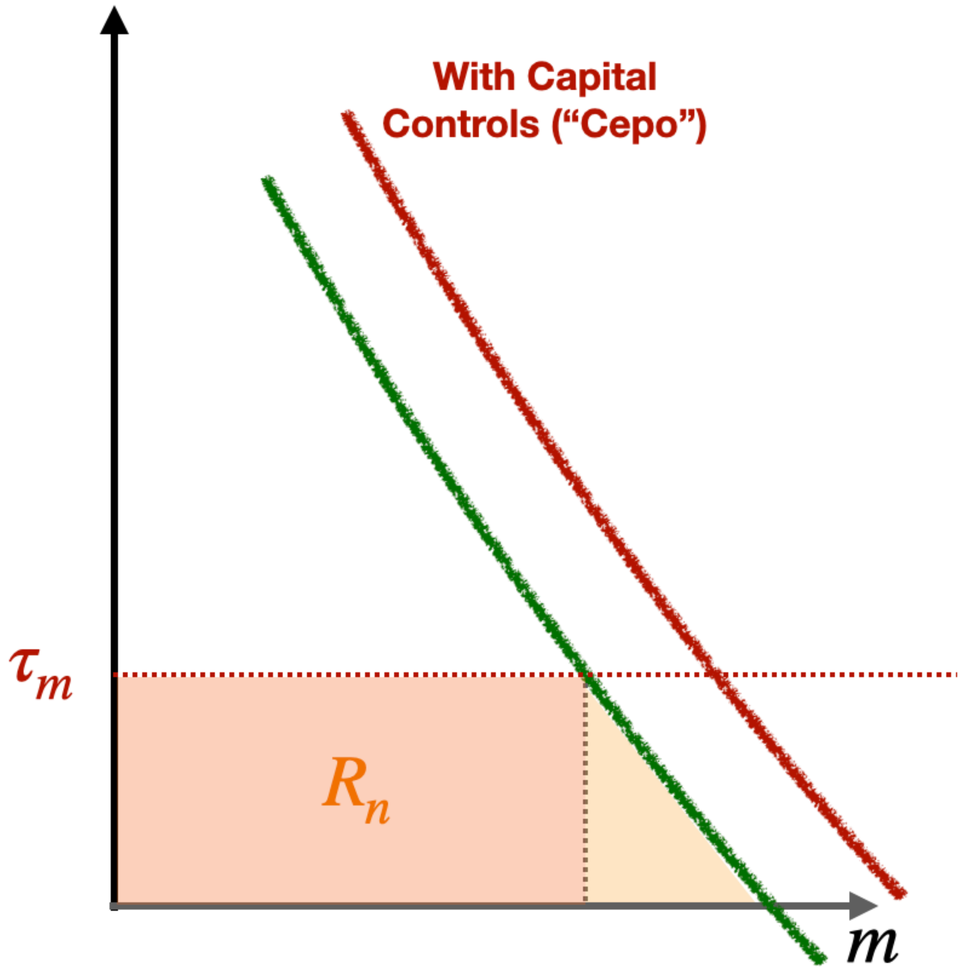
Intuition: Static

$$\pi m(\pi)$$

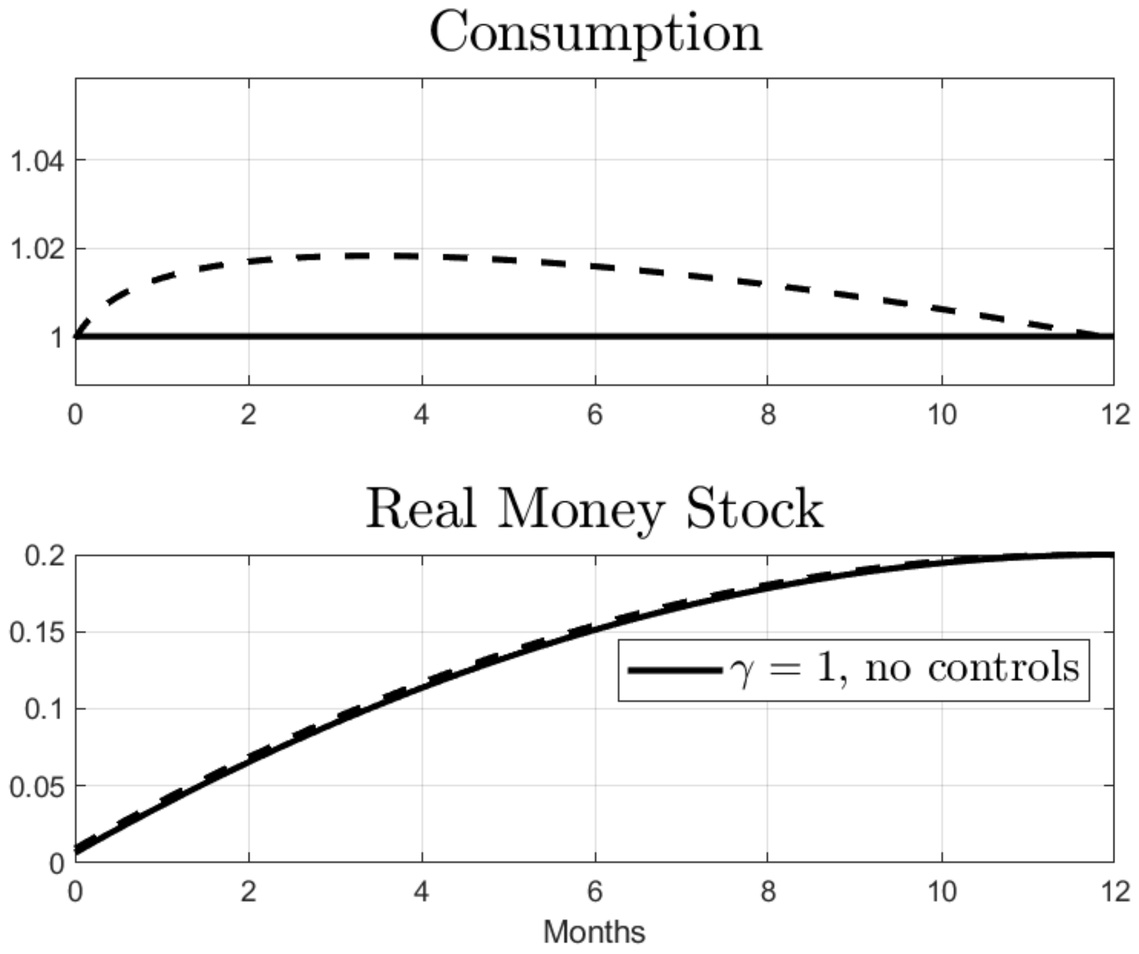
$$\pi m(\pi, r_n)$$

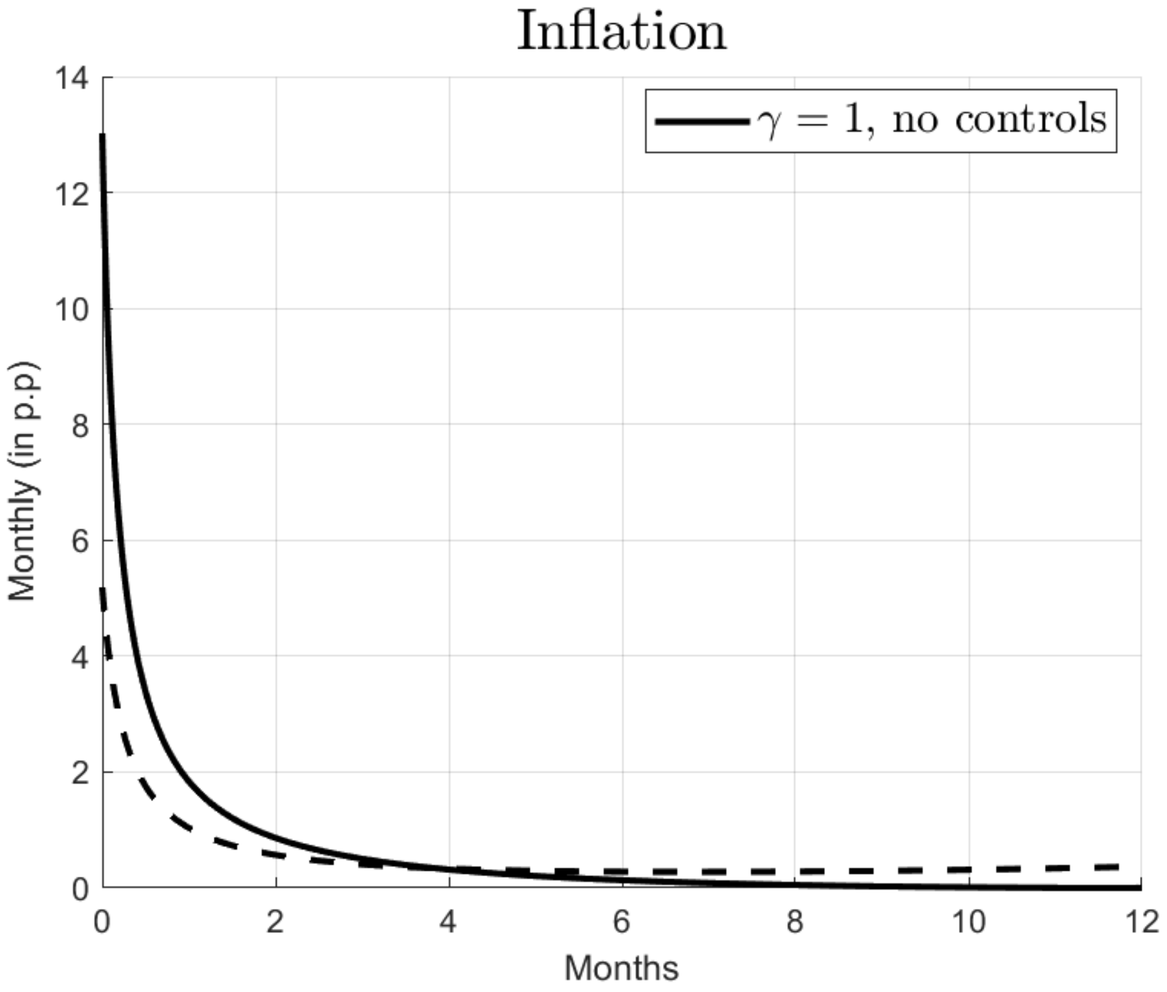
Demand Effect

$$\downarrow r \longrightarrow \downarrow \pi$$

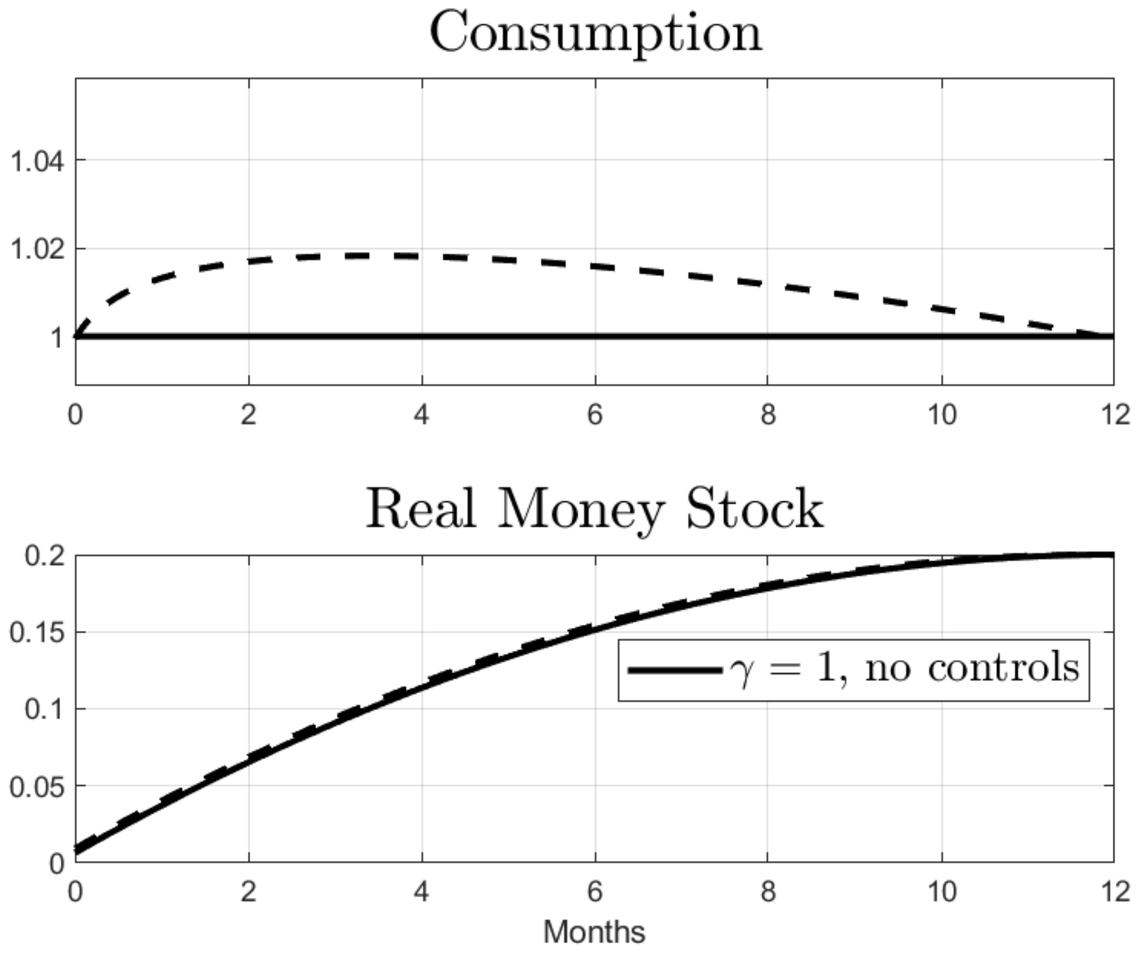


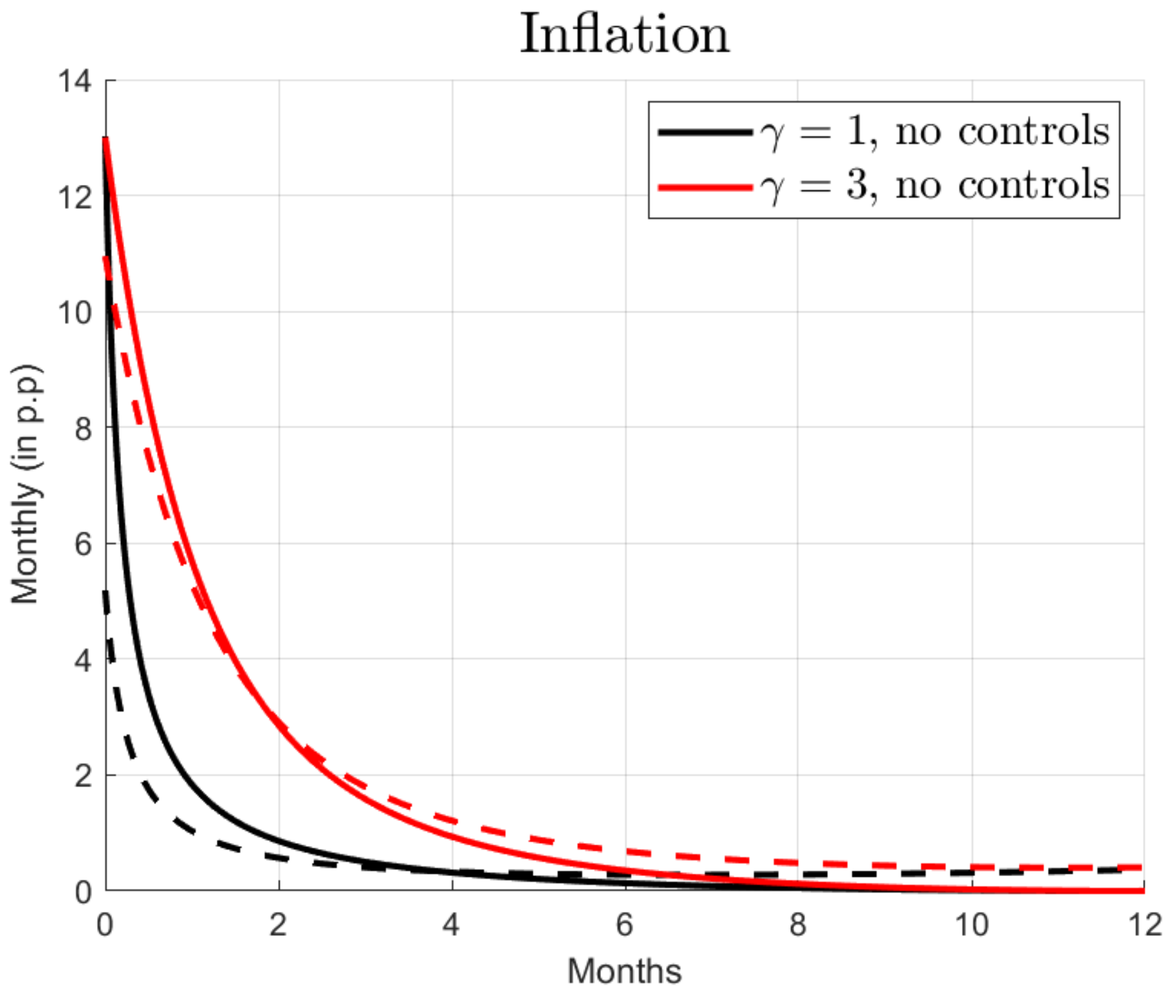
Optimal Non-Constant Capital Controls



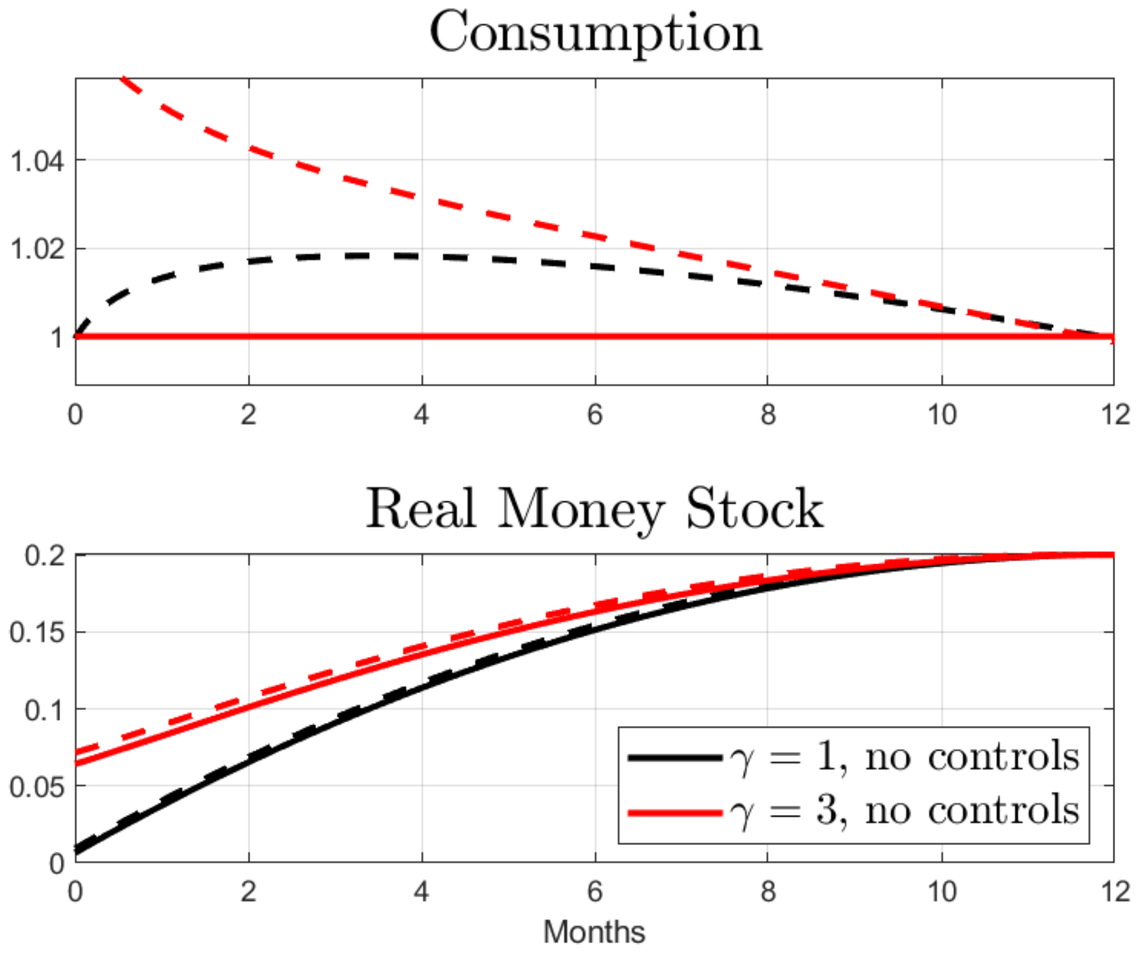


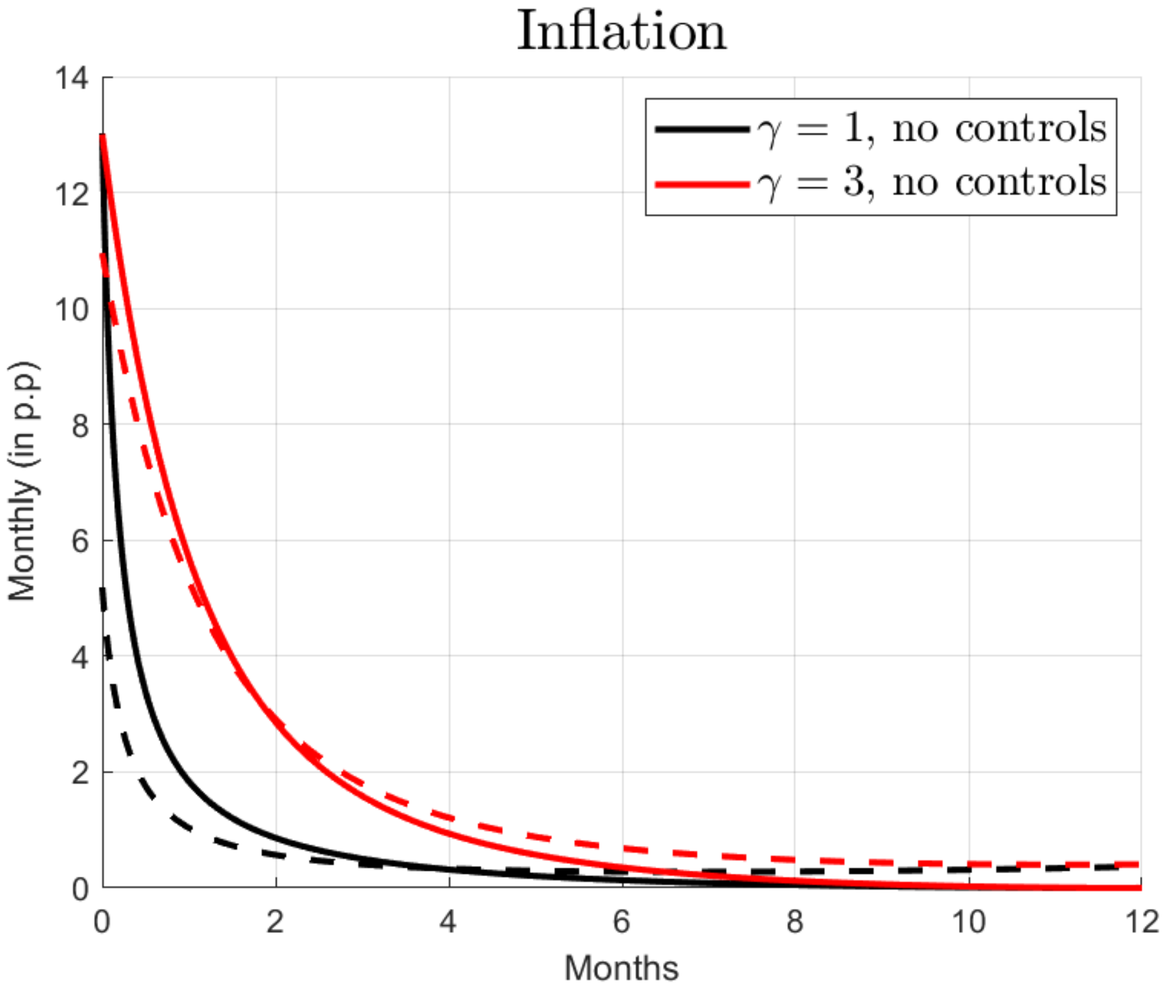
Optimal Non-Constant Capital Controls





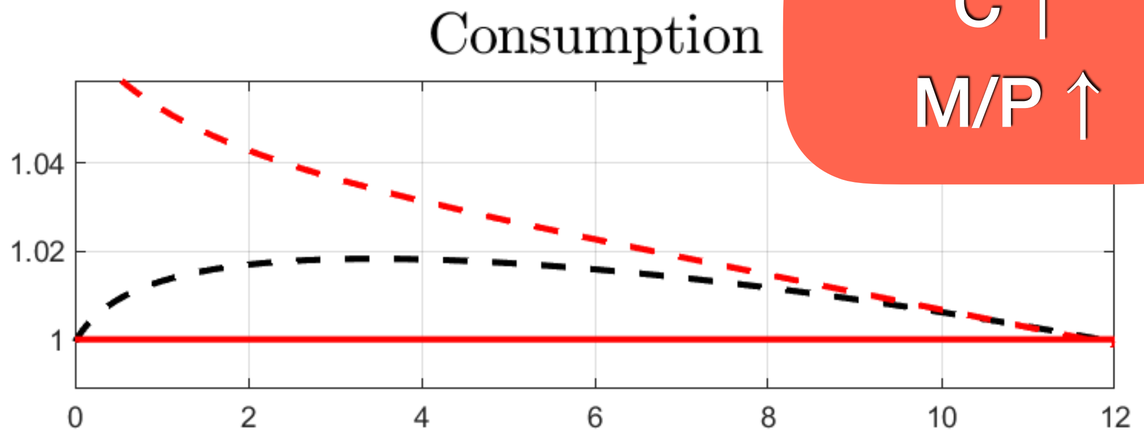
Optimal Non-Constant Capital Controls

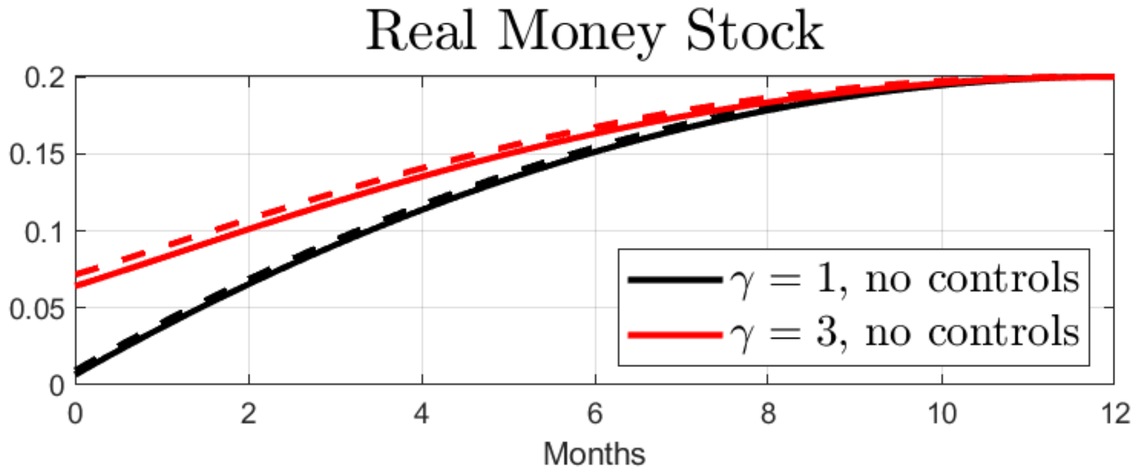


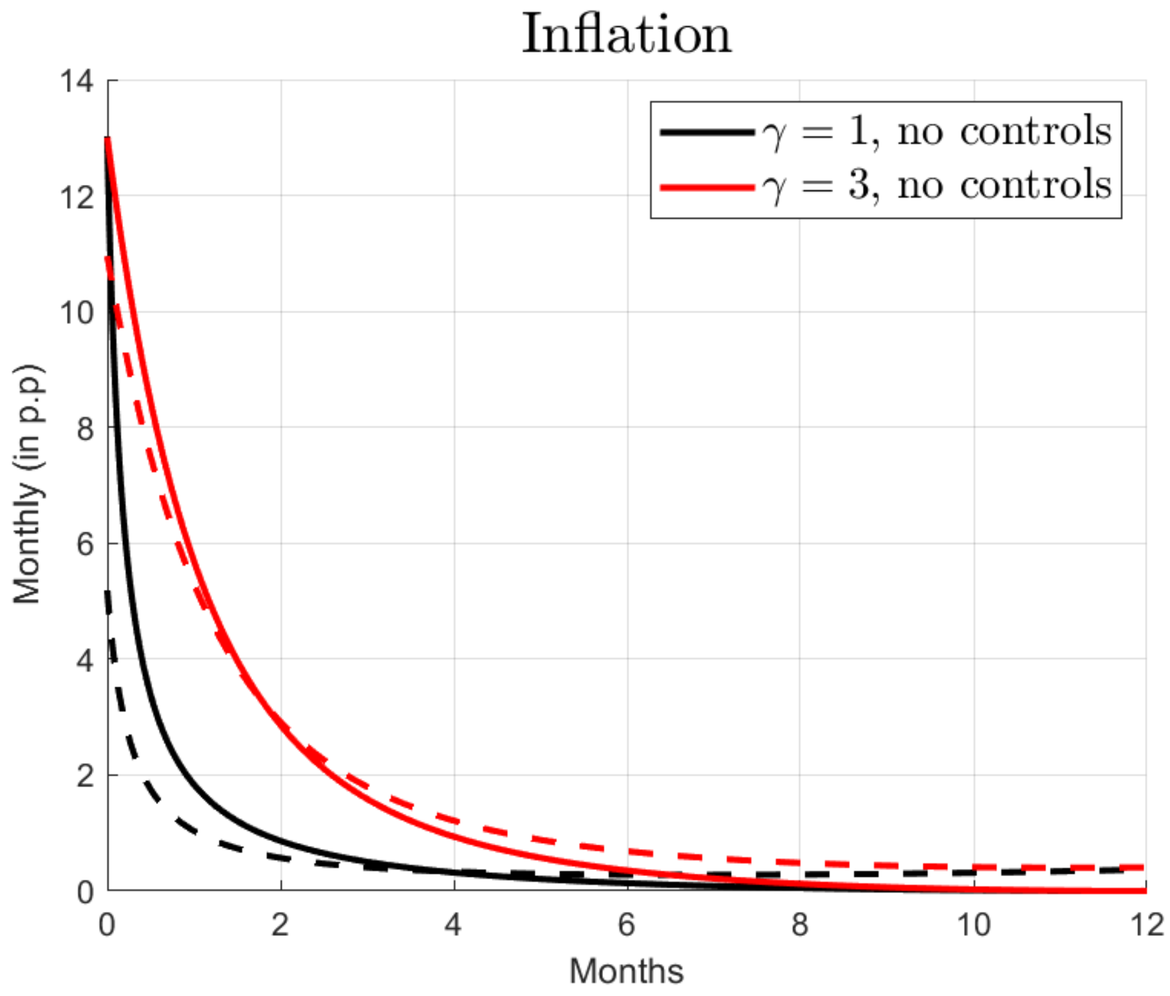


Optimal Non-Constant Capital Controls

C ↑
M/P ↑

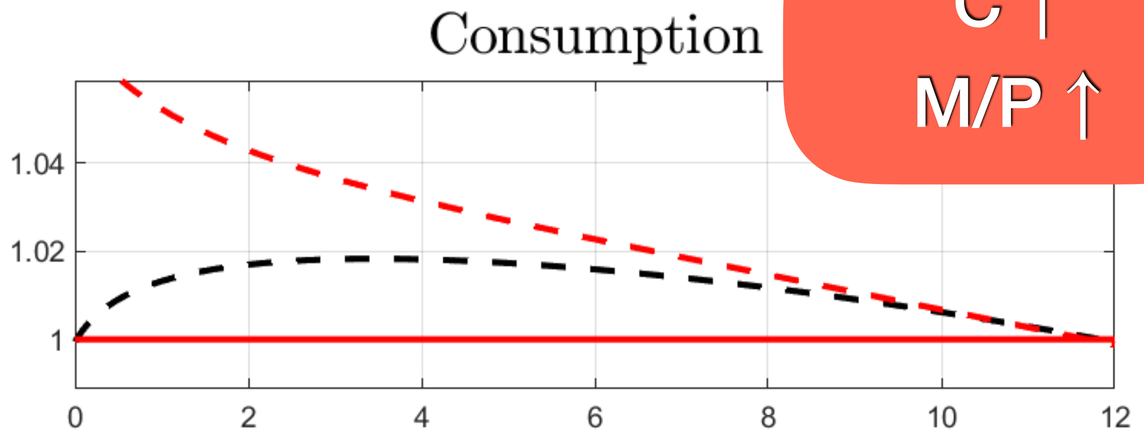


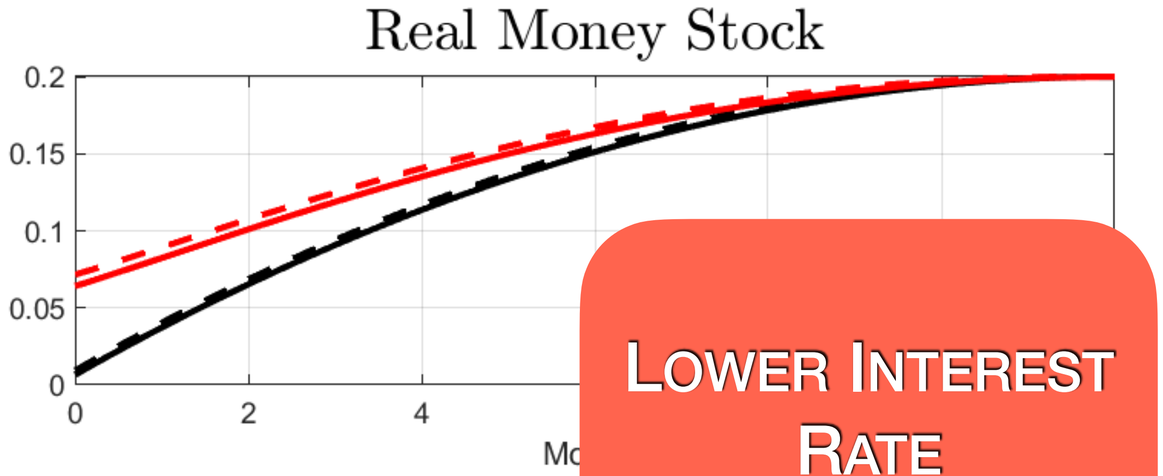




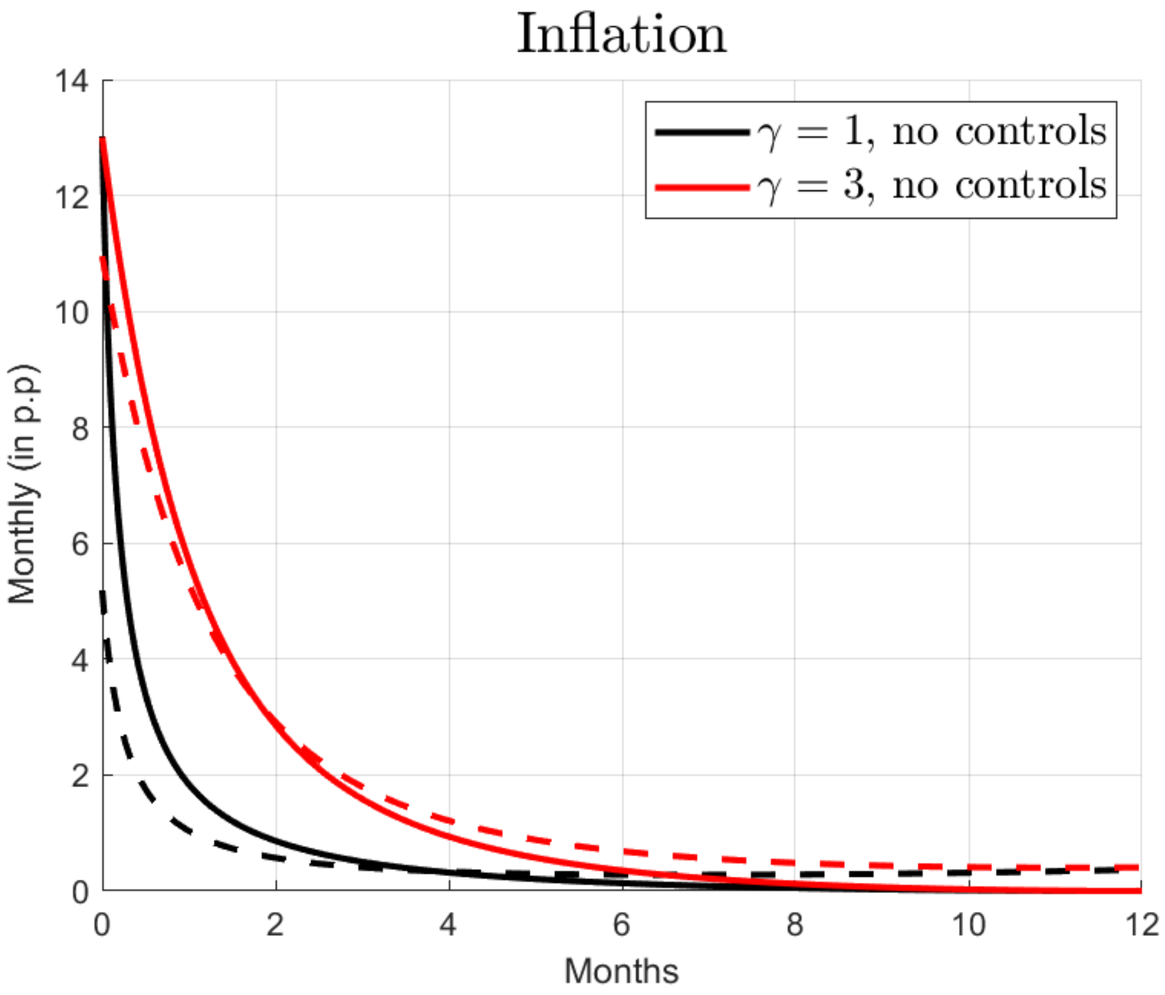
Optimal Non-Constant Capital Controls

C ↑
M/P ↑

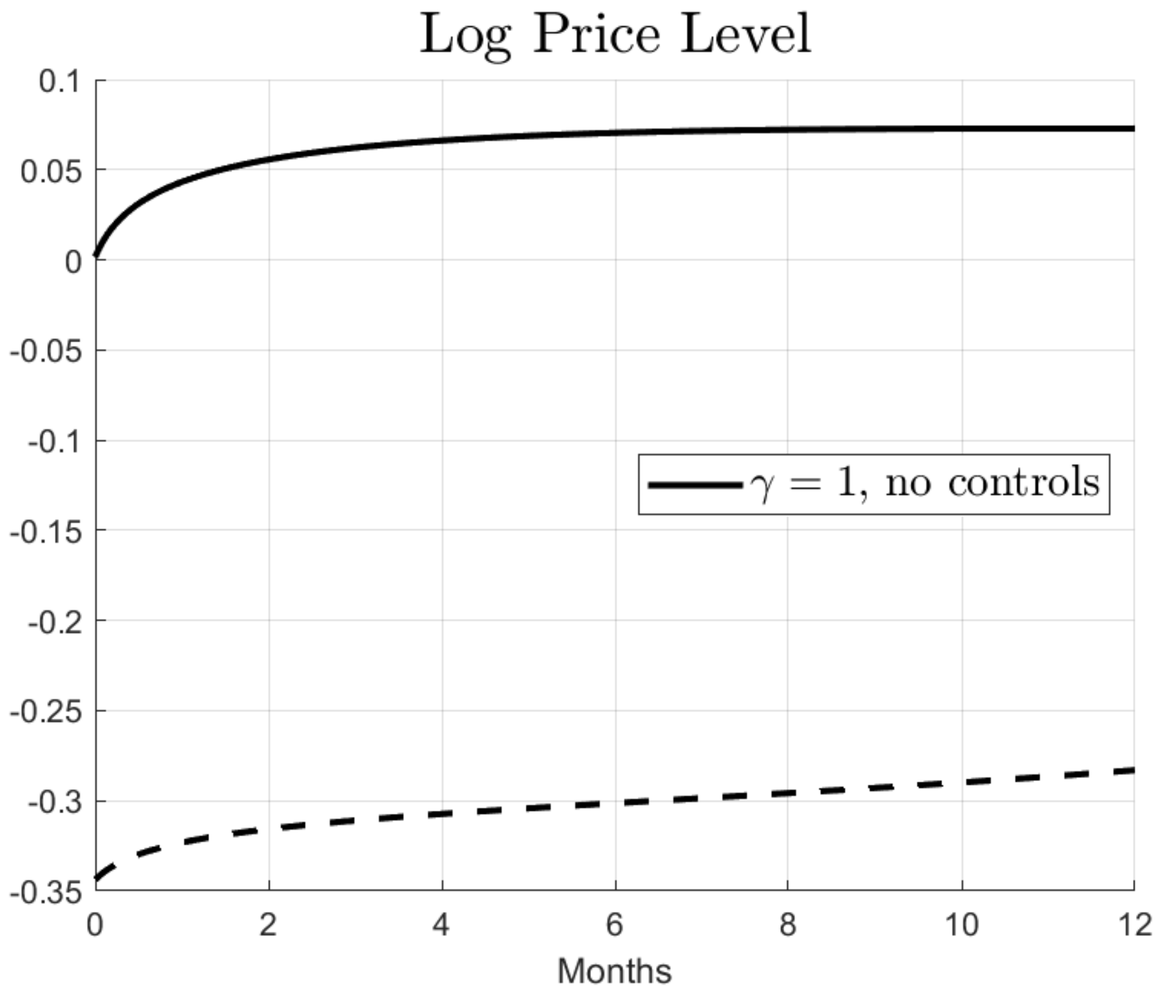




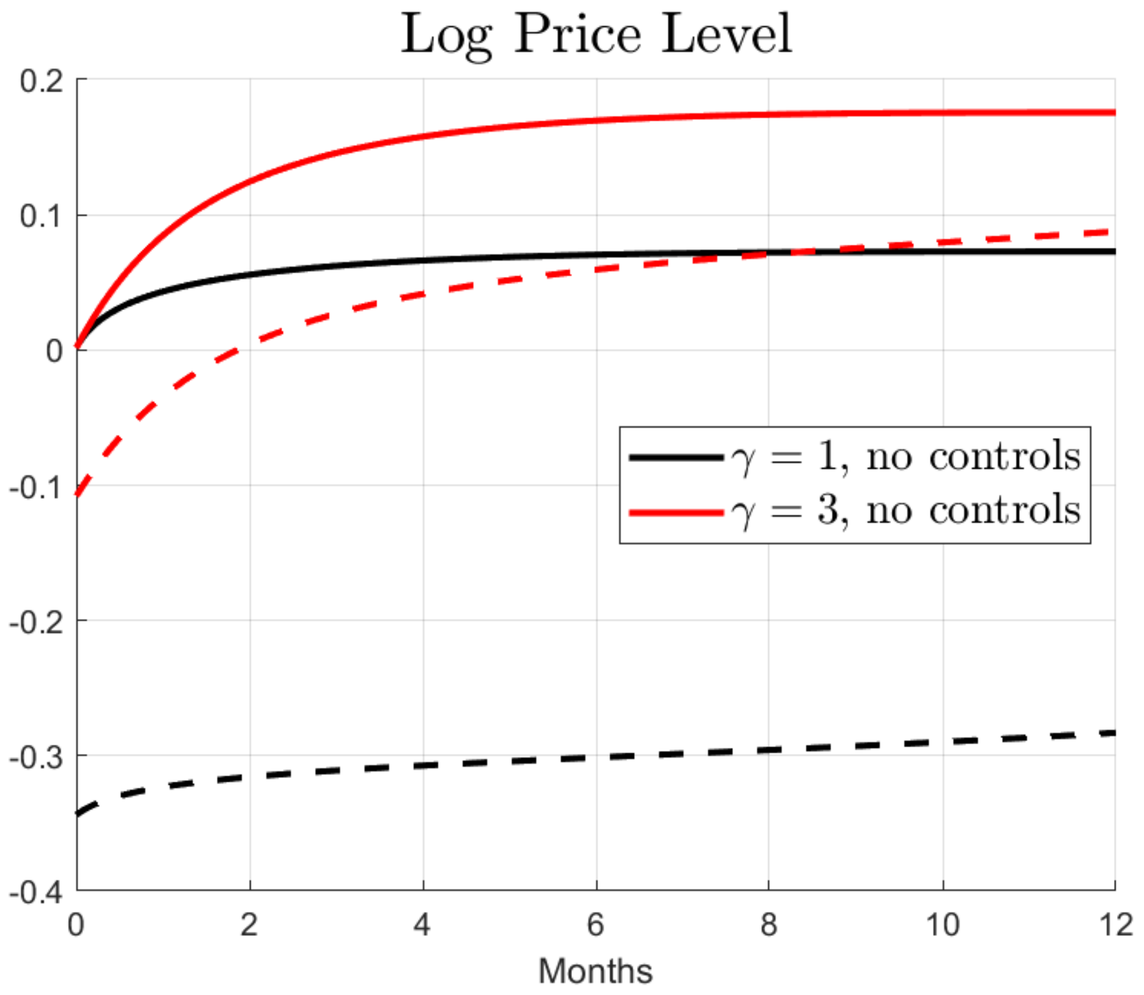
LOWER INTEREST RATE



Optimal Non-Constant Capital Controls

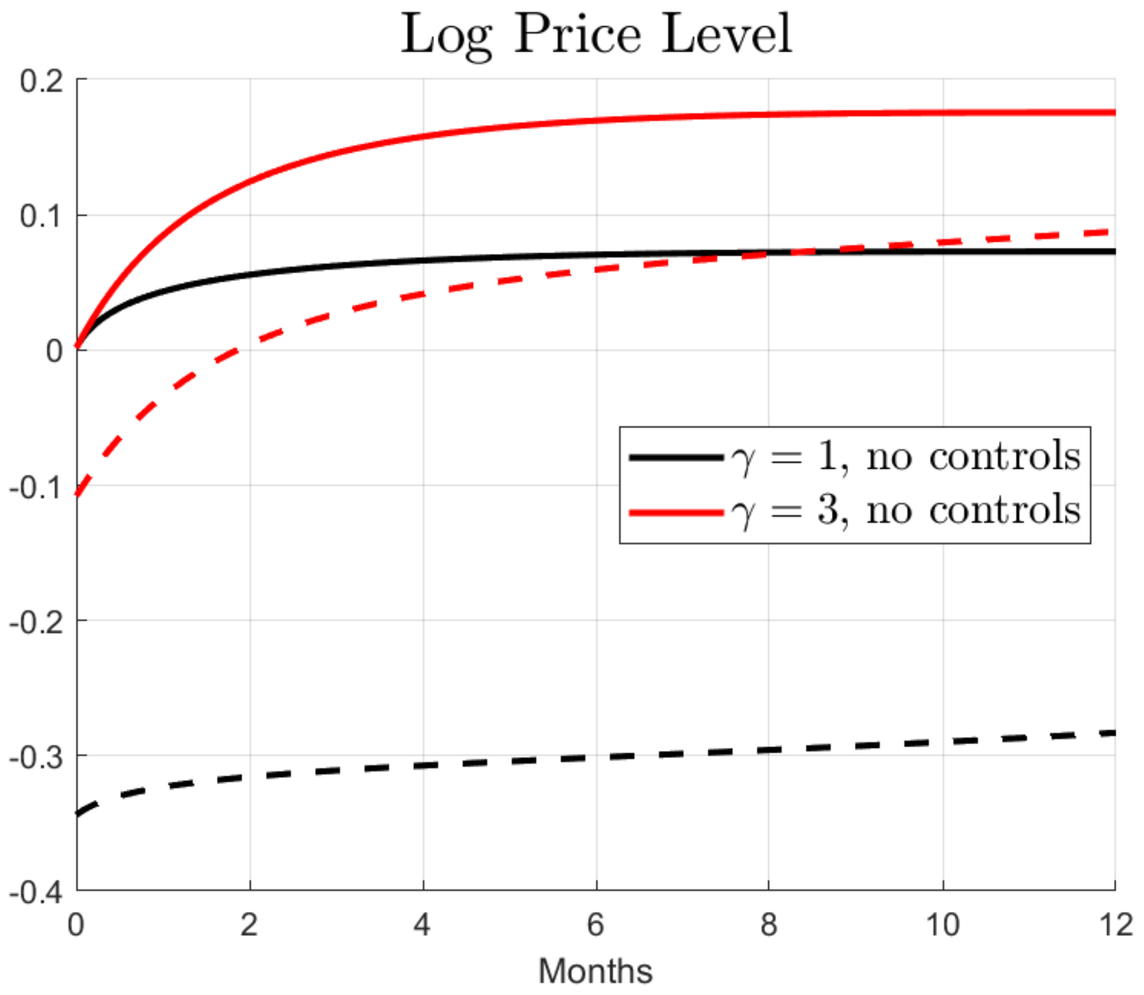


Optimal Non-Constant Capital Controls



Optimal Non-Constant Capital Controls

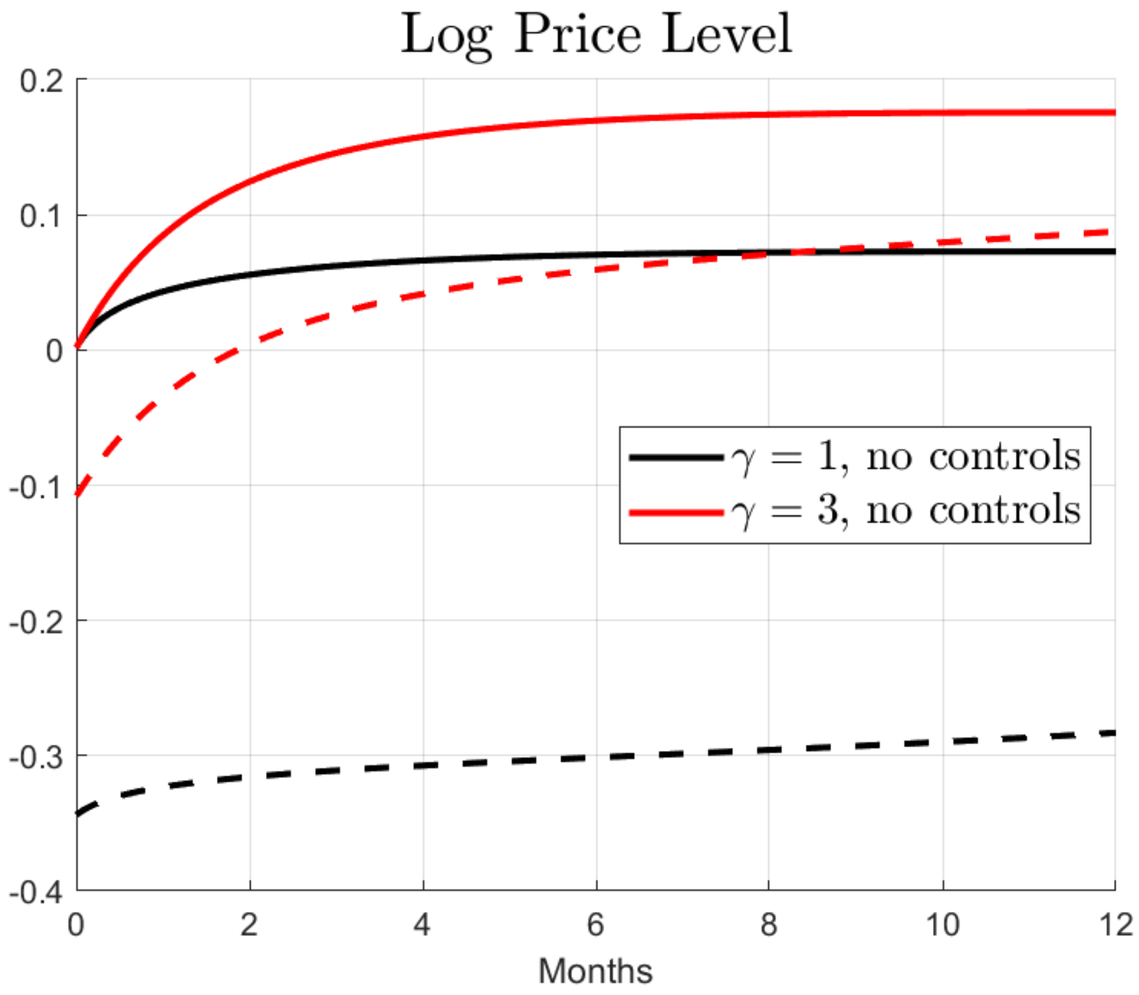
Downward Jump in Price Level…



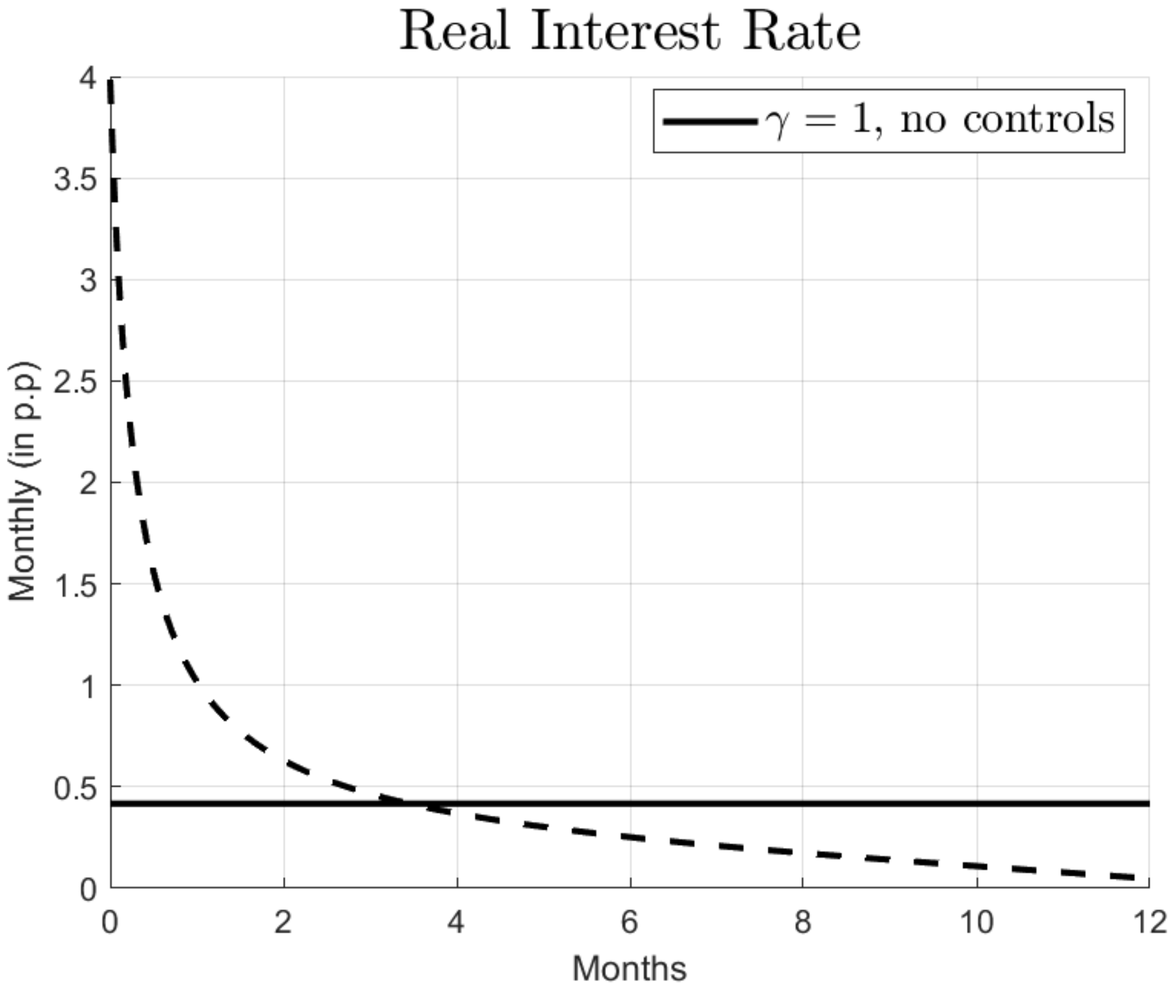
Optimal Non-Constant Capital Controls

Downward Jump in Price Level…

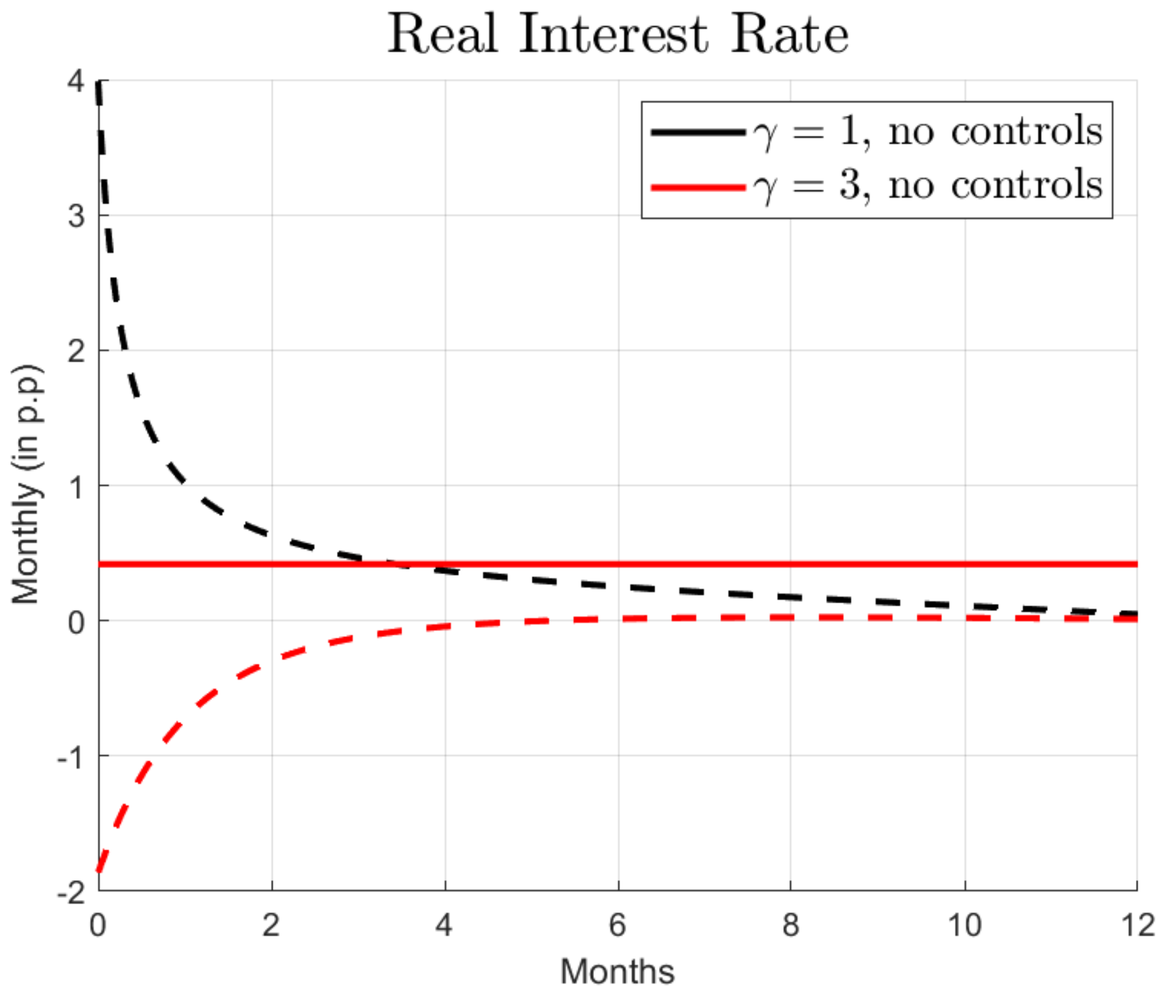
…Appreciation



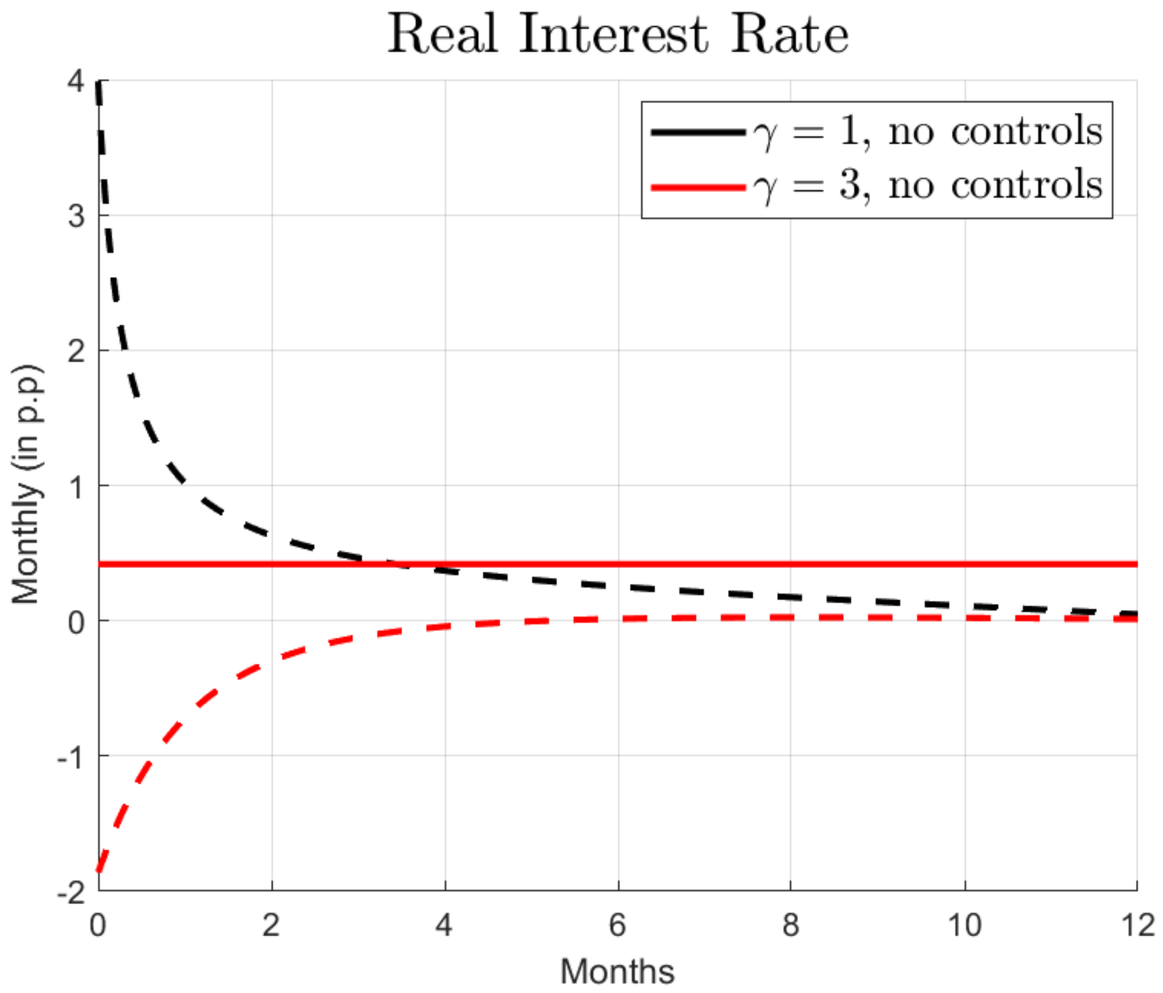
Optimal Non-Constant Capital Controls



Optimal Non-Constant Capital Controls



Optimal Non-Constant Capital Controls



NEGATIVE RATES

Model 1 + Model 2:
Optimal Interest + Capital Controls

Model 1 + Model 2

Model 1 + Model 2

- Both models → ↓ average inflation, ↑ Welfare

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

Model 1 + Model 2

- Both models $\rightarrow \downarrow$ average inflation, $\uparrow$ Welfare

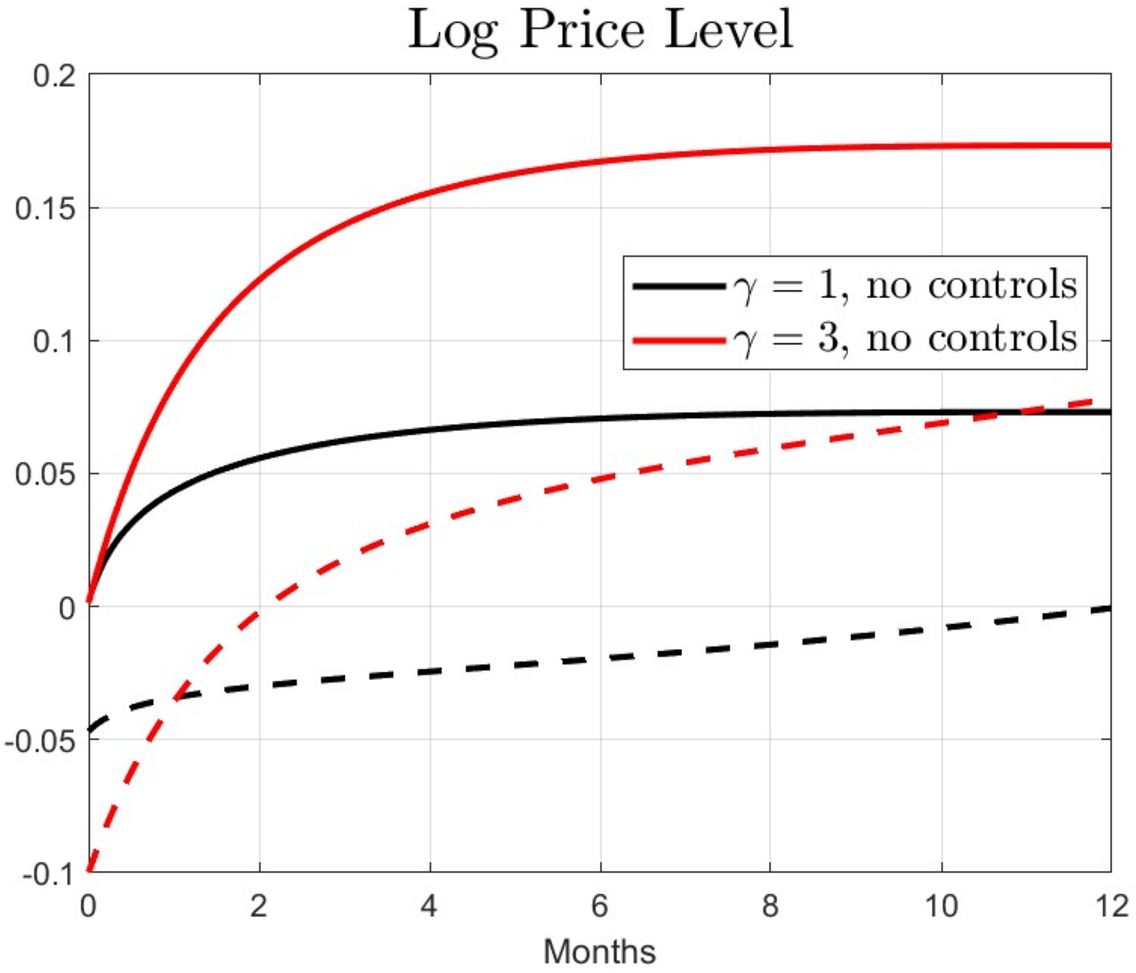
Model 1 (interest on money):
$\rightarrow$ possible depreciation at $t = 0$

Model 2 (capital controls)
$\rightarrow$appreciation at $t = 0$

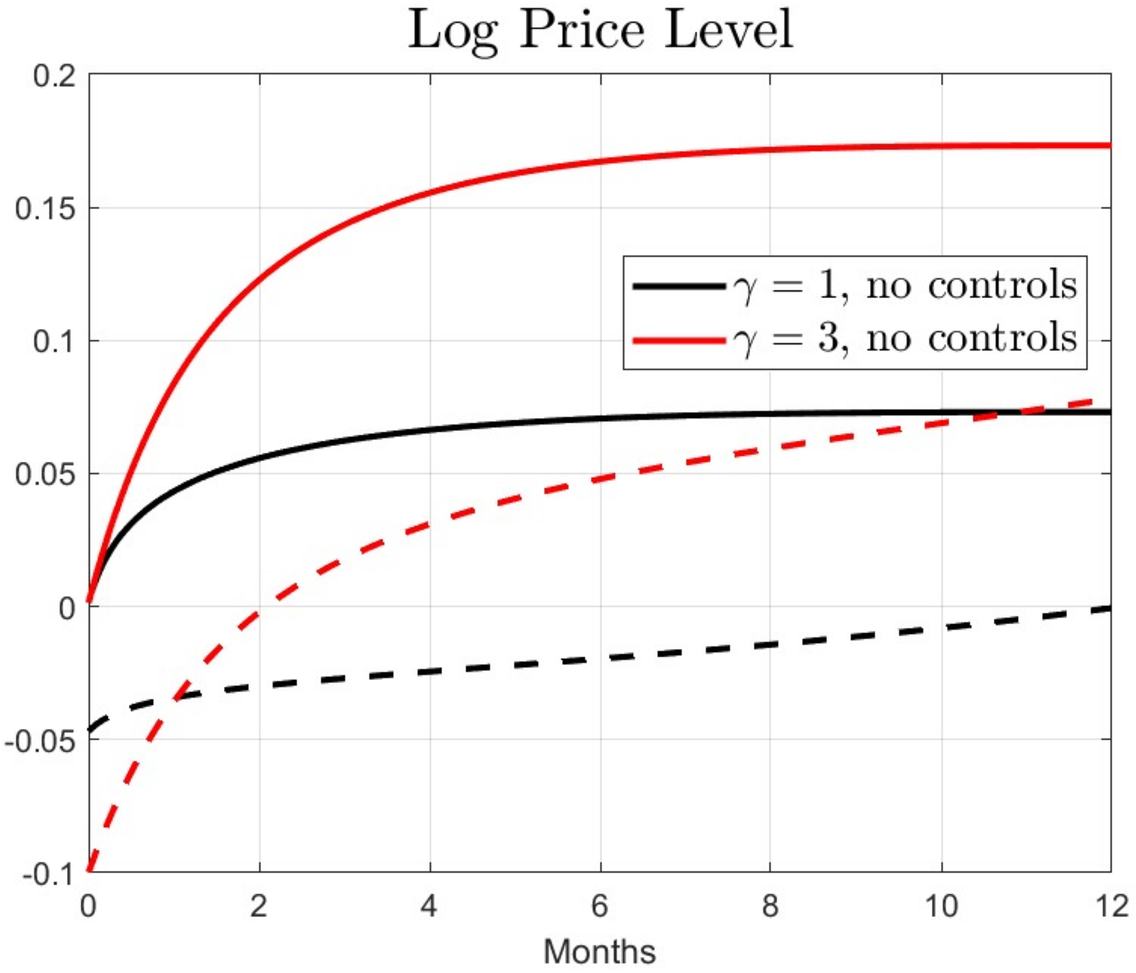
- Hybrid: Model 1 + Model 2…
  - complementary policies
  - make depreciation at $t = 0$ more likely

Model 1 + Model 2

Model 1 + Model 2



Model 1 + Model 2



DEVALUATIONS AVERTED FOR $\gamma > 1$...

Conclusions

Did It Happen?…

Did It Happen?…

- Difficult comparison: regulated prices, initial devaluation, etc.
- Yes…
  - nominal rates were lowered, but not to zero
  - real rates: negative
  - inflation fell
  - currency demand now on the rise
- Some questions…
  - real return in dollars positive, but…
    - ✦ ex post ≠ ex ante
    - ✦ lower than without controls (cepo), premia
  - inflation inertia? real exchange rate? (extensions)

But, wait…

But, wait…

- “Liabilities not an issue, in recent years…

But, wait…

- **“Liabilities not an issue, in recent years…**

  1. …real interest rate was near zero, so no cost”

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”

    - ex post ≠ ex ante return

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”
    - ex post ≠ ex ante return
    - maybe some past financial repression

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”

   - ex post ≠ ex ante return
   - maybe some past financial repression
   - nothing special about zero: improvement going lower!

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”
    - ex post ≠ ex ante return
    - maybe some past financial repression
    - nothing special about zero: improvement going lower!
2. …banks renewed principal + interest, so not a source of money printing”

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”
    - ex post ≠ ex ante return
    - maybe some past financial repression
    - nothing special about zero: improvement going lower!
2. …banks renewed principal + interest, so not a source of money printing”
    - this may be true in model! with inflation constant or rising n/m constant or rising

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”
   - ex post ≠ ex ante return
   - maybe some past financial repression
   - nothing special about zero: improvement going lower!
2. …banks renewed principal + interest, so not a source of money printing”
   - this may be true in model! with inflation constant or rising n/m constant or rising
   - remember: both M and N are money, so if N rises “we have printed”

But, wait…

- **“Liabilities not an issue, in recent years…**

1. …real interest rate was near zero, so no cost”
   - ex post ≠ ex ante return
   - maybe some past financial repression
   - nothing special about zero: improvement going lower!
2. …banks renewed principal + interest, so not a source of money printing”
   - this may be true in model! with inflation constant or rising n/m constant or rising
   - remember: both M and N are money, so if N rises “we have printed”
   - in any case: inflation and welfare improve by taxing N

Conclusions

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…

  - … **wake up, we are already in the repression business!** (news alert! sorry!)…

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…
  - … **wake up, we are already in the repression business!** (news alert! sorry!)…
  - … 3rd best… **Why single out m? Go after other assets! Financial repress optimally!**

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)
- **My Main argument…**
  - Cagan = financial repression on m only…
  - … **wake up, we are already in the repression business!** (news alert! sorry!)…
  - … 3rd best… **Why single out m? Go after other assets! Financial repress optimally!**
- **Two applications…**

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…
  - … **wake up, we are already in the repression business!** (news alert! sorry!)…
  - … 3rd best… **Why single out m? Go after other assets! Financial repress optimally!**

- **Two applications…**

  1. interest rate: lower interest on N, tax all money equally

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…

  - … **wake up, we are already in the repression business!** (news alert! sorry!)…

  - … 3rd best… **Why single out m? Go after other assets! Financial repress optimally!**

- **Two applications…**

  1. interest rate: lower interest on N, tax all money equally

  2. capital controls: tax or prevent savings abroad (outflows)
     (other: tax productive investment at home?)

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…
  - … **wake up, we are already in the repression business!** (news alert! sorry!)…
  - … 3rd best… **Why single out m? Go after other assets! Financial repress optimally!**

- **Two applications…**

  1. interest rate: lower interest on N, tax all money equally
  2. capital controls: tax or prevent savings abroad (outflows)
     (other: tax productive investment at home?)

- **Takeaway:** reaching Ramsey is a priority…
  … but **along a "Cagan transition" be smart!**

Conclusions

- **Received Wisdom:** Financial repression → **nasty! (decent economists stay away)**
  … optimal tax theory agrees! (e.g. Friedman Rule)

- **My Main argument…**

  - Cagan = financial repression on m only…
  - … **wake up, we are already in the repression business!** (news alert! sorry!)…
  - … 3rd best… **Why single out m? Go after other assets! Financial repress optimally!**

- **Two applications…**

  1. interest rate: lower interest on N, tax all money equally
  2. capital controls: tax or prevent savings abroad (outflows)
     (other: tax productive investment at home?)

↑ WELFARE

↓ INFLATION

- **Takeaway:** reaching Ramsey is a priority…
  … but **along a "Cagan transition" be smart!**