Equilibrium Sovereign Default with Endogenous Exchange Rate Depreciation

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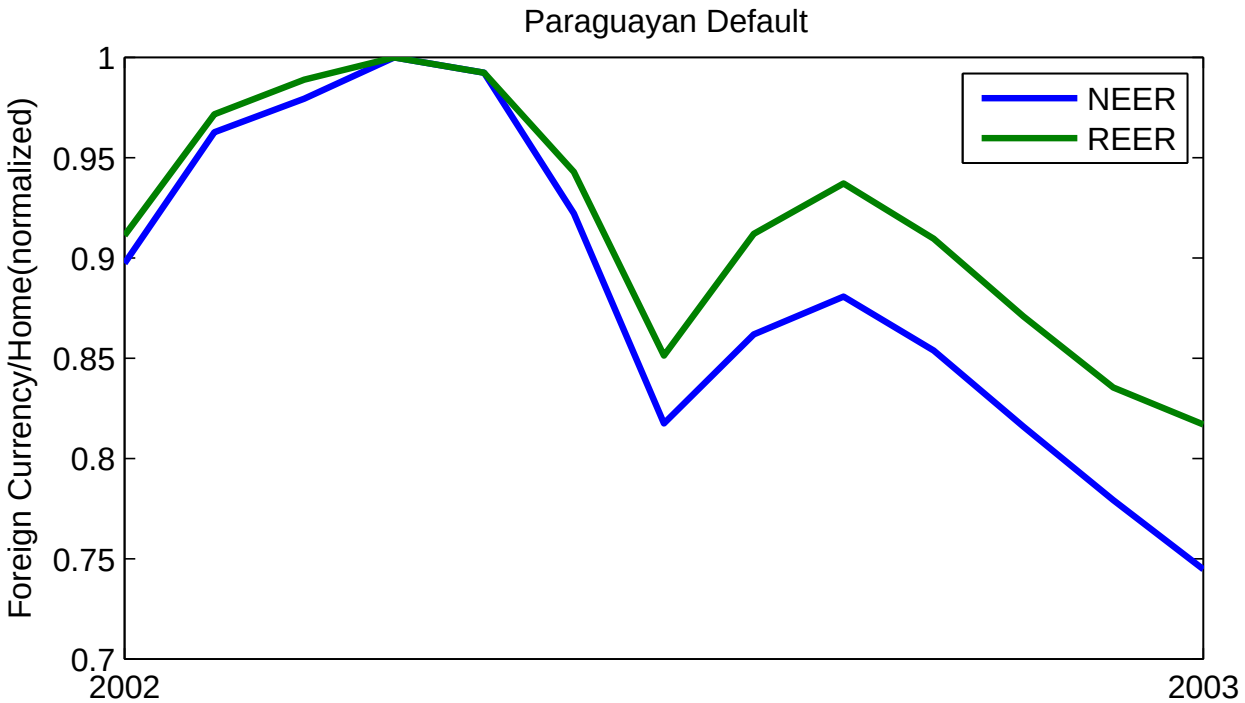
Stylized Facts

- Countries default (250 default episodes in 106 countries since 1824, according to Tomz(2007)).
- After default, country's currency is depreciating (De Paoli and Hoggarth (2006)).

Stylized Facts: Currency Depreciates



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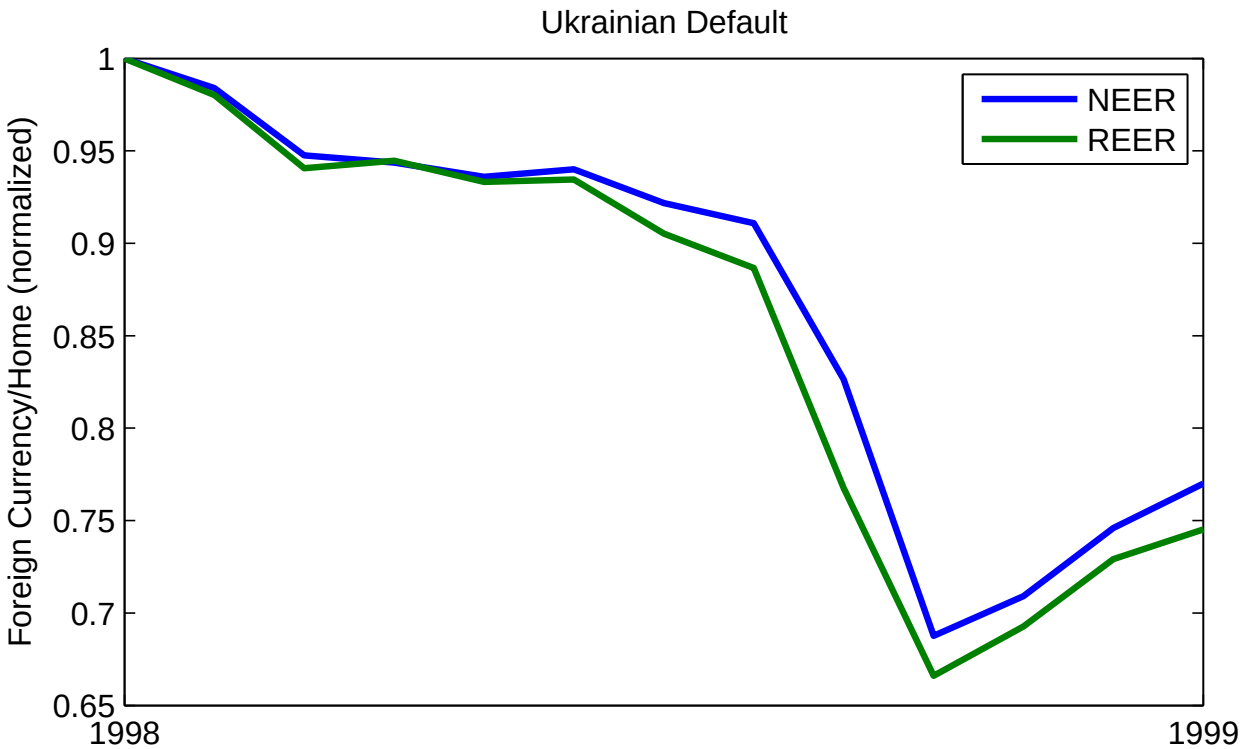

Defaults Examples

	Δ rGDP	Δ LCU/USD	Δ REER
Ukraine, 1998	0.05%	59.32 %	78.88 %
Argentina, 2001	-10.56%	30.20%	84.70%
Paraguay, 2003	0.38%	86.72%	91.17%
Egypt, 1984	2.67%	100%	71.16%
Russia,1998	-6.41%	27.66%	68.79%

Δ rGDP is the change of real GDP.

Δ LCU/USD is the change of nominal exchange rate.

Δ REER is the change of real effective exchange rate.

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- Is it purely nominal effects and financial flows?

We want to show

- Terms of Trade penalty explains it, and more.

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Modeling The Default

We want: countries borrow until threshold, default if borrowed too much.

- Bulow and Rogoff (1989): temporary exclusion from credit markets does not return acceptable borrowing.
- Arellano (2008): exclusion plus progressive penalty on income returns acceptable borrowing.
- Aguiar and Gopinath (2007): exclusion plus proportional penalty on income with persistent shocks returns acceptable borrowing.
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All have no explanation for international trade changes.

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Trade Disruptions

Gross change	NEER	REER	Export Prices	I/Y
Mean	0.8492	0.8900	0.9184	0.8968
20% Q	0.6835	0.7861	0.8291	0.7773
40% Q	0.8729	0.8688	0.8984	0.8978
Median	0.9102	0.9220	0.9075	0.9211
60% Q	0.9505	0.9429	0.9269	0.9436
80% Q	1.0168	0.9755	1.0068	1.0070

Note: Exchange rate listed as foreign goods per home currency unit. IMF's IFS database; defaulters since 1975, as identified by Standard&Poor's (2003) research report by Beers and Chambers.

Table: One year effect of sovereign default.

Default Disrupts Trade

- Rose (2005): default reduces international trade volume by 8%.
- Arteta and Hale (2008): private firms cannot find international credit.

In the 1861 Mexican default, creditors actually seized the port of Veracruz (see Todd (1991)).

- Hummels (2001): a day of procrastination adds 1% to real costs.

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Mechanism

- Country can default.
- If default happens, lenders can make imports costlier.
- Thus, others being equal, price of foreign goods goes up.
- Questions are:
  - How would that affect consumption and imports?
  - Is trade channel penalty a good default deterrent?
  - How robust are predictions?

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The Environment

- Country is represented by an infinitely-lived agent.
- Every period, agent has
  - y - endowment for this period.
  - b - borrowed amount that agent needs to repay.
  - status of "being punished" or not.
- Agent chooses whether to default on total borrowed amount or not.
- If agent defaults, she
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How People Trade?

- Agent has home production.
- Other countries like it.
- Agent trades home production for production of abroad (import).

$$m = f(x)$$

- If agent defaults, she has worse terms of trade.

$$m = (1 - \pi) f(x)$$

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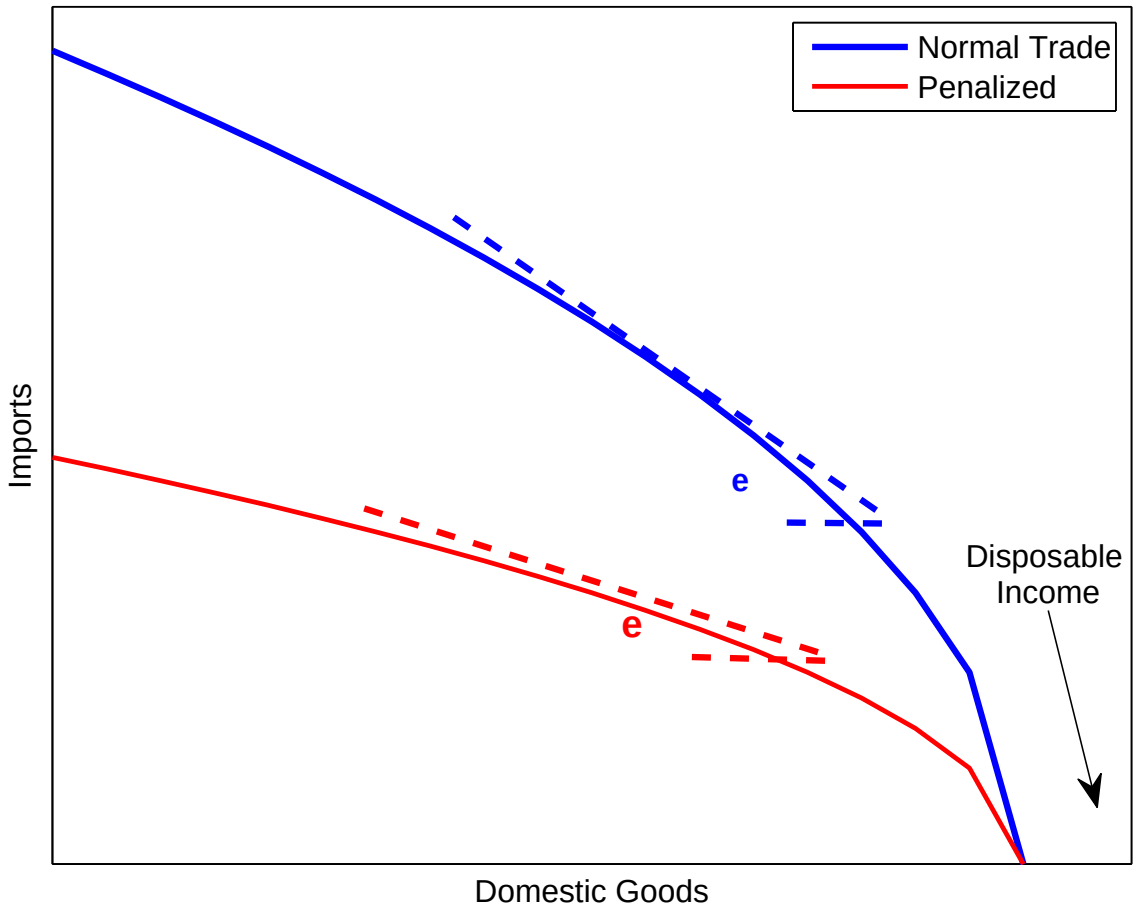
How Penalty Affects Exchange Rate?



The Model - Don't Default

$$U(y,b) = \max(V(y,b), W(y))$$

$$V(y,b) = \max_{c,b',m,x} u(c,m) + \beta EU(y',b')$$

s.t.

$$c + x = y - b + q(y,b')b'$$

$$m = f(x)$$

$$\ln y' = \rho \ln y + \epsilon,\ \epsilon \sim \mathcal{N}(0, s^2)$$

The Model - Default

$$U(y,b) = \max(V(y,b), W(y))$$

$$W(y) = \max_{c,x,m} u(c,m) + \beta E\left(\phi W(y') + (1-\phi)EU(y',0)\right)$$

s.t.

$$c + x = y$$

$$m = (1-\pi)f(x)$$

$$\ln y' = \rho \ln y + \epsilon,\ \epsilon \sim \mathcal{N}(0, s^2)$$

The Model - Borrowing

- There is an infinite supply of lending.
- It has interest rate of R.
- Lenders have to account for probability of default.

Default-adjusted price of debt is

$$q(y, b') = \frac{P\left(V(y', b') > W(y')|y\right)}{1 + R}$$

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Base Parameters

Arellano (2008) calibrations:

Name	Parameter	Value
Risk aversion	σ	2
Risk-free interest	R	0.017
Autocorrelation	ρ	0.985
Variance	s^2	0.026
Discount factor	β	0.953
Prob of staying punished	ϕ	0.718

Utility Function

Aggregate consumption is

$$u(c, m) = (\alpha c^{\kappa} + (1 - \alpha) m^{\kappa})^{1/\kappa}$$

Based on INDEC and European Bank data, regressions of Argentina time series:

Name	Parameter	Value
Relative preference	α	0.586
Elasticity parameter	κ	0.845

Lifetime utility is a usual CRRA-based vNM utility function.

Our Import-Export Mechanism

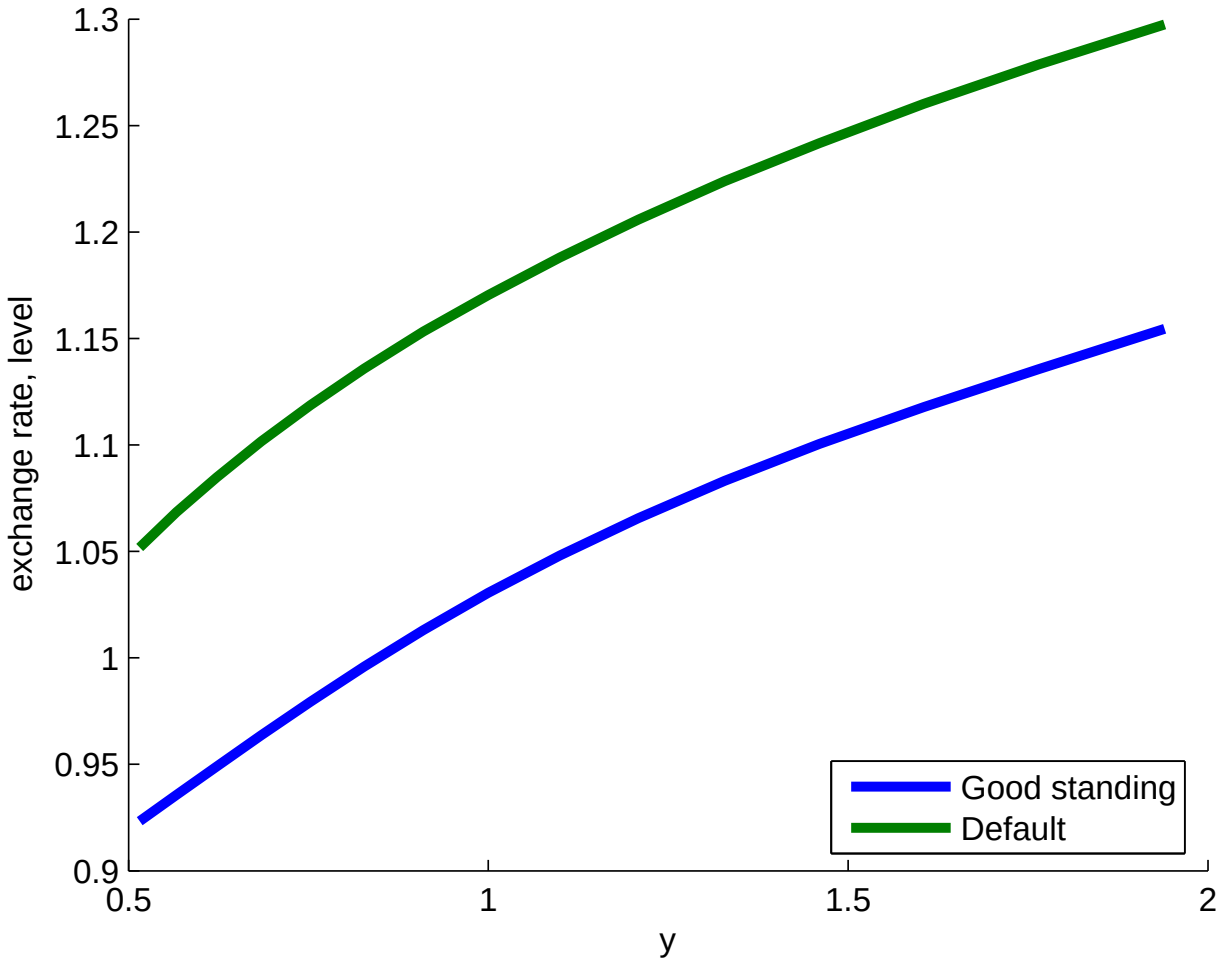
Production function is

$$m = \theta_1 (x - \theta_0)^{\theta}$$

Based on INDEC and European Bank data, regressions of Argentina time series:

Name	Parameter	Value
Fixed costs	θ_0	0.047
Scale	θ_1	0.196
Curvature	θ	0.208
Import penalty	π	0.500

Predictions: Countercyclical Exchange Rate



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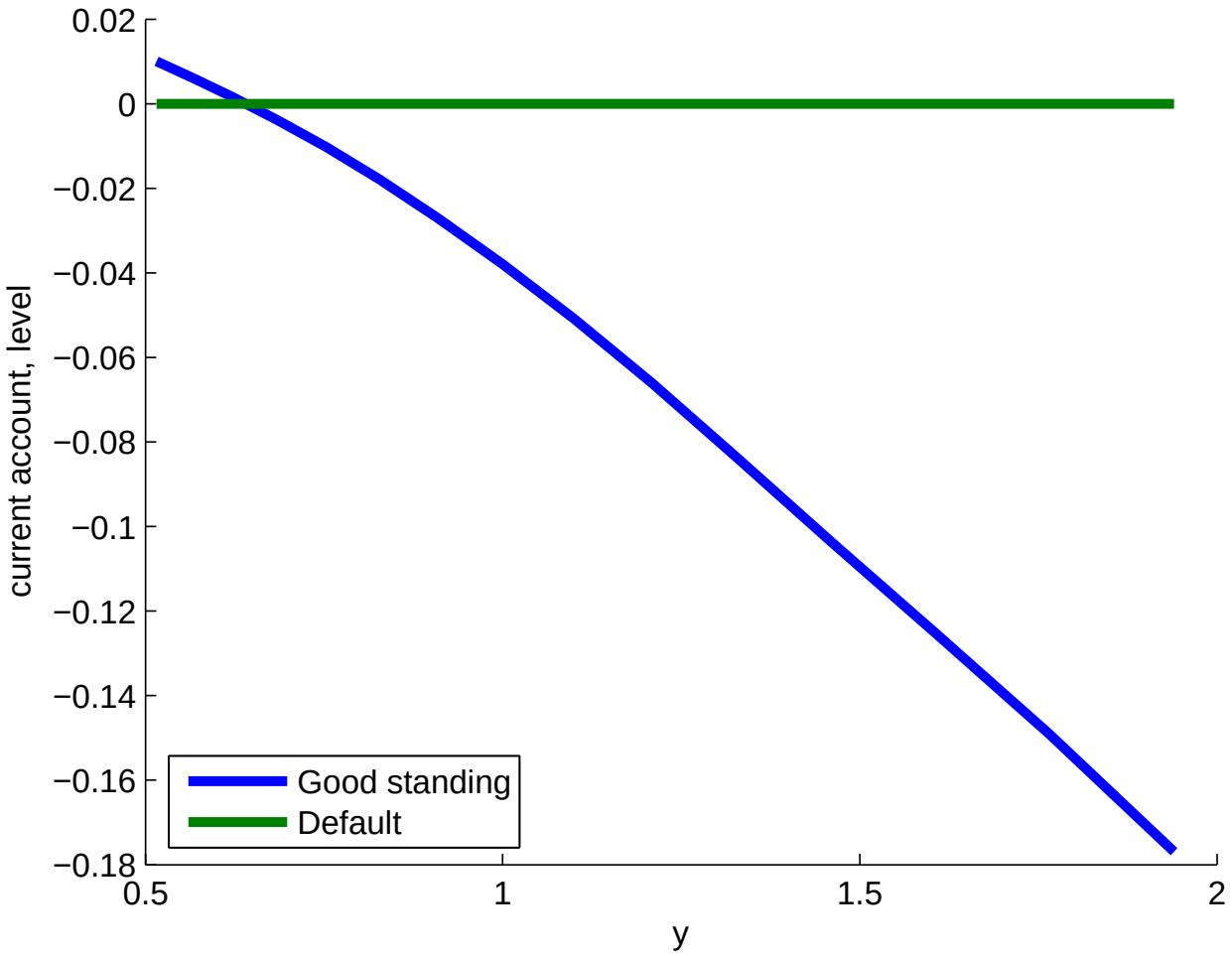
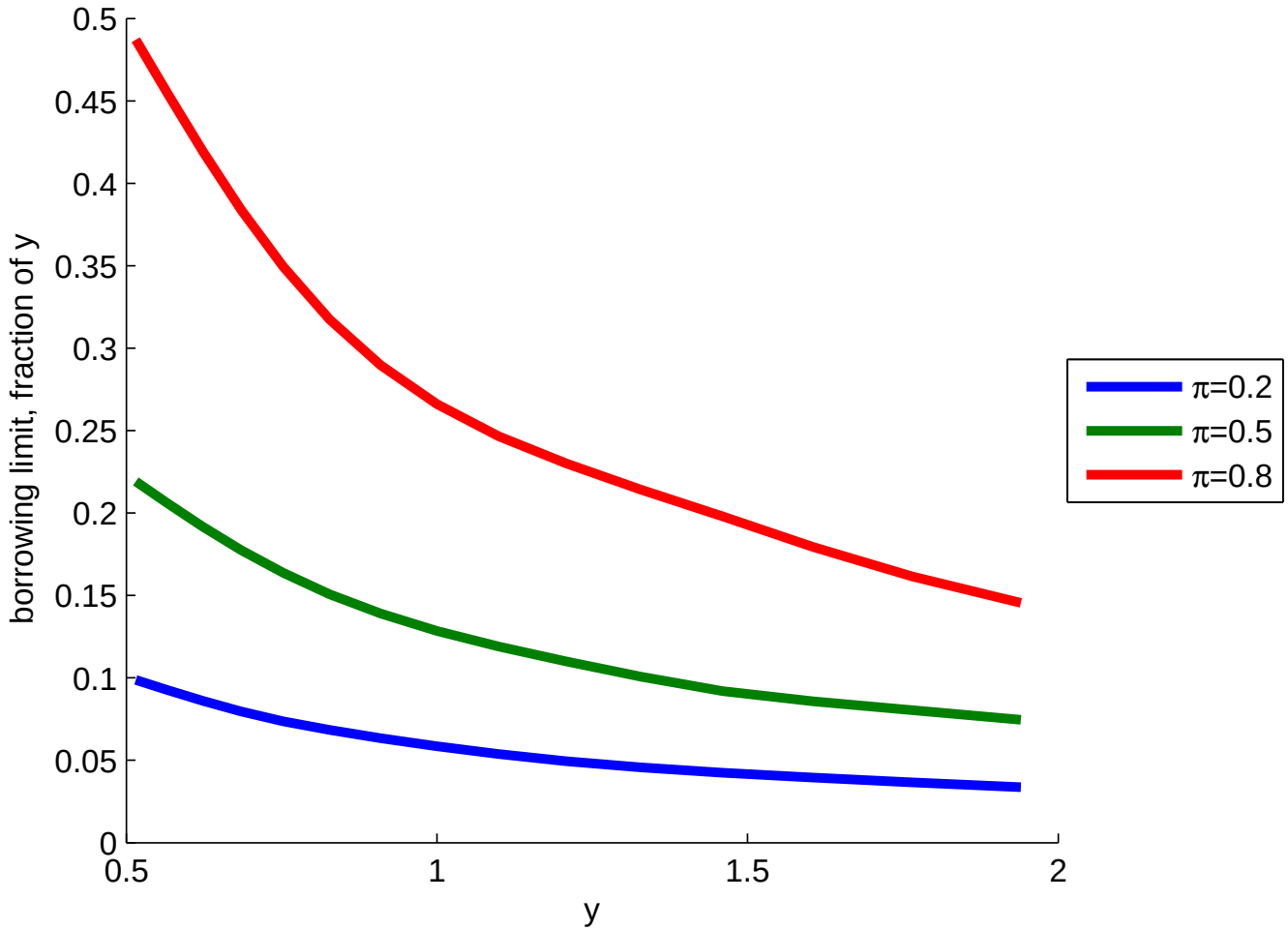
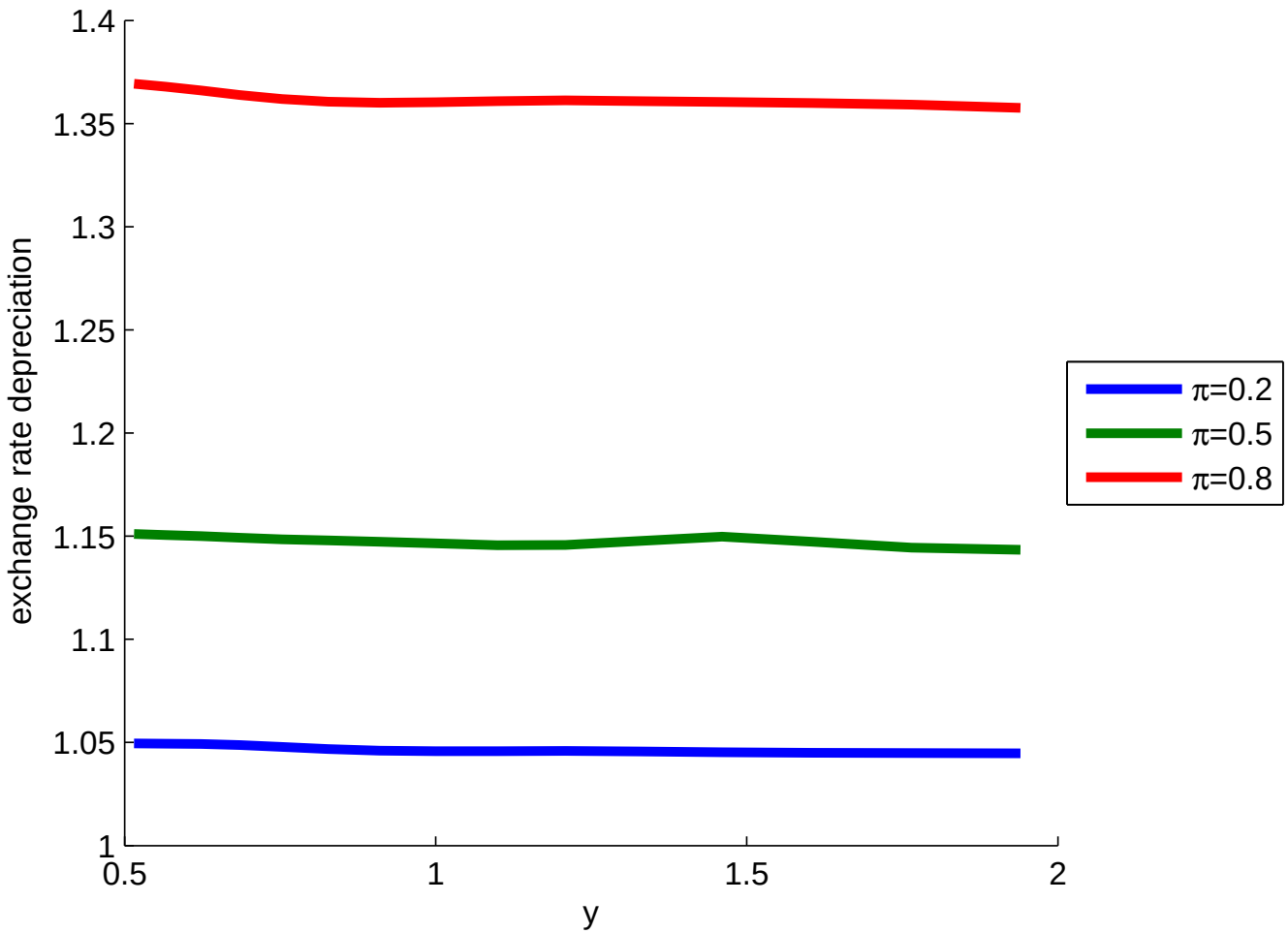


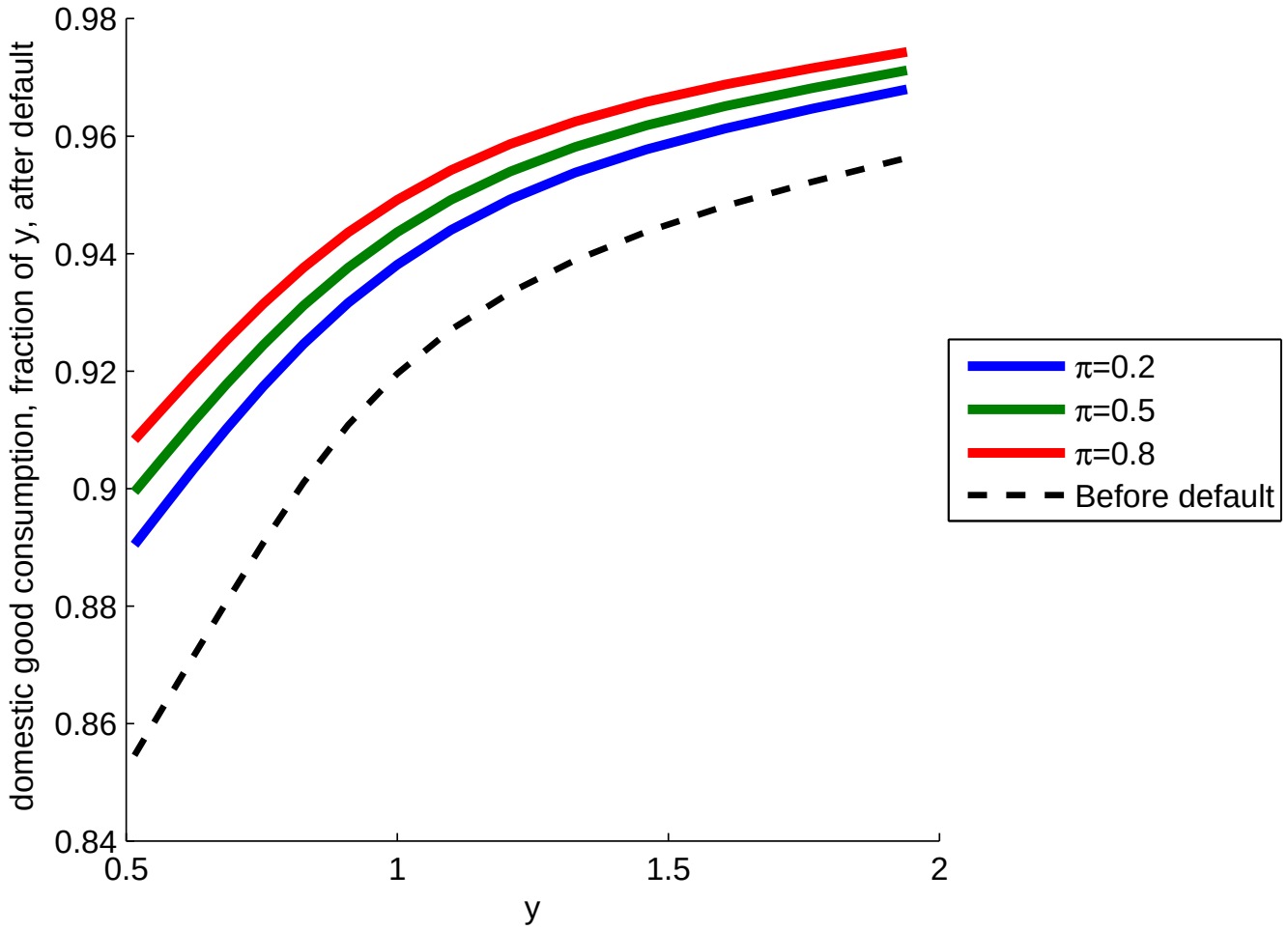
Penalty: Borrowing Threshold



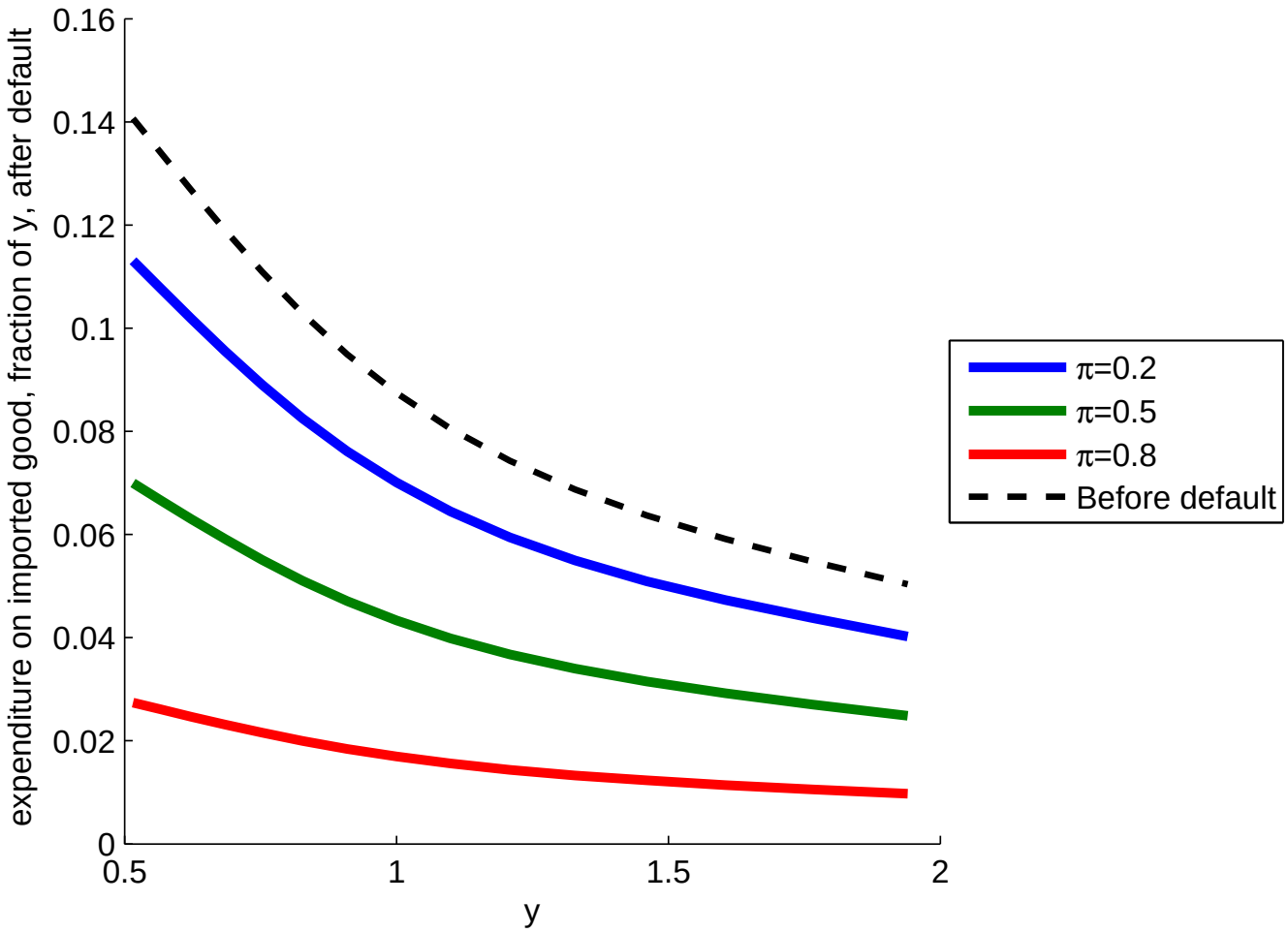
Penalty: Exchange Rates



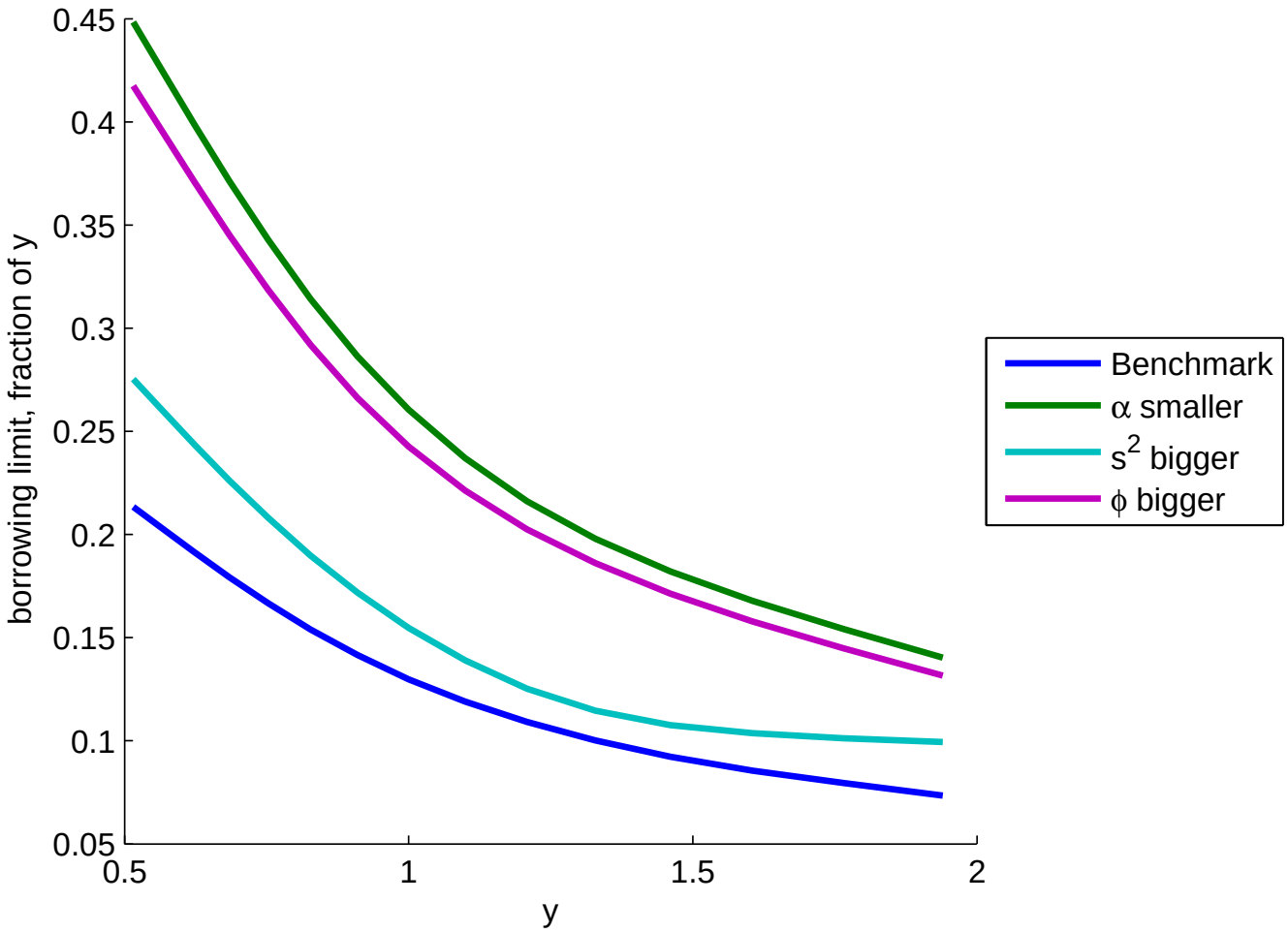
Penalty: Consumption



Penalty: Consumption of Imports



Comparative Statics: Limits



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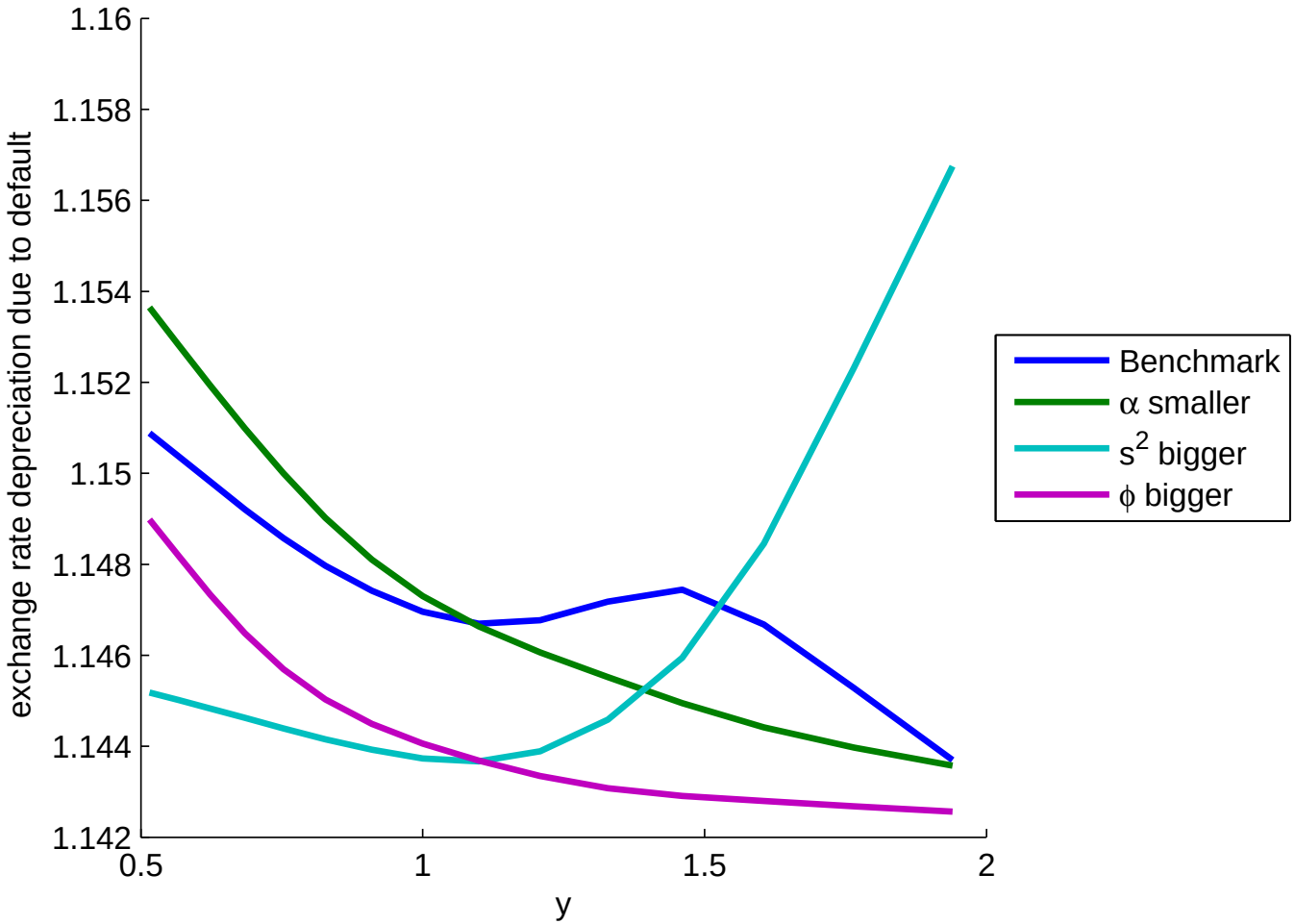
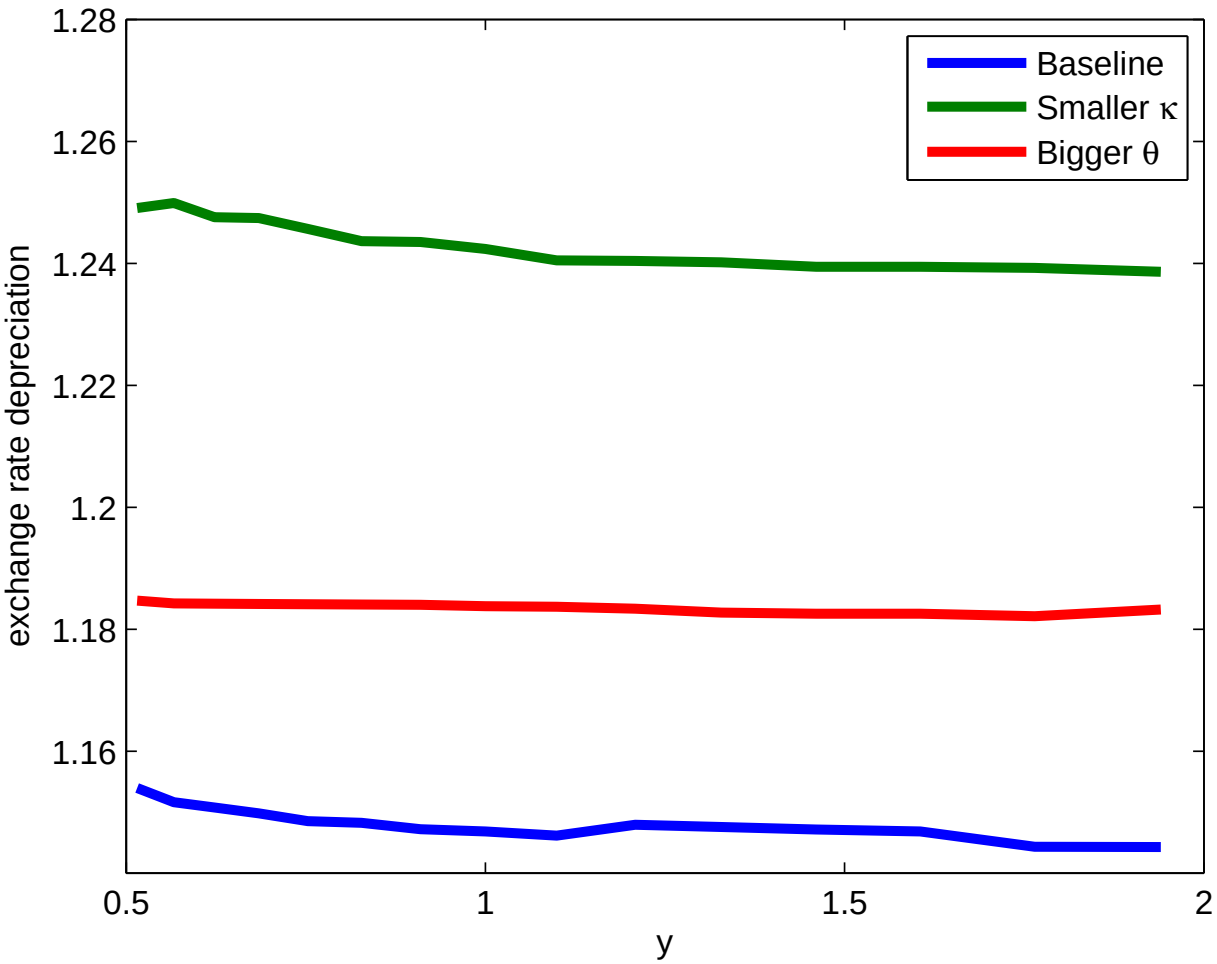


What Governs Exchange Rates?



Summing Up

- Real reasons for exchange rate fluctuations are significant.
- We offer a sovereign default model with explicit international trade.
- We have a pretty good fit without calibration.
- Predictions of statics are coherent with common sense.
- Trade is important when making predictions about default decisions.