On Overborrowing: Trend Shocks and Capital Controls

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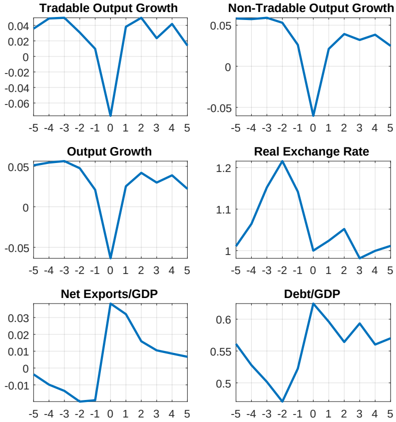
Motivation

- Sudden stops are macroeconomic crisis in open economies characterized by
  - Large output drops
  - Current account and trade balance reversals
  - Drop in asset prices, spikes in spreads.
- This type of crisis has been fairly common (and disruptive) in emerging economies since the early 80s.

28 Sudden Stops for 22 emerging economies

SS $\equiv$ 2% fall in GDP & 2 pp increase in net exports to output ratio.



Source: WDI

Questions

- What types of shocks generate sudden-stop like crisis in open economies subject to collateral constraints?
- What does optimal policy suggest for capital controls?

What we do

- Extend the DSGE small open economy model with occasionally binding borrowing constraint including:
  - Domestic demand shocks
  - Foreign investors' shocks
  - Transitory and permanent supply shocks
- Evaluate the qualitative features around the SS
- Calibrate our preferred model
- Overborrowing implications
- Policy recommendation: the role of capital controls.

Preview of findings

- Standard model has a hard time generating persistence after a sudden stop crisis.
- Model with trend shocks can account for the missing persistence.
- For our calibration, the model generates overborrowing.
- Associated optimal policy implies procyclical capital controls.
- Procyclicality (and average tax) tends to decrease with trend shocks volatility.

Contribution to the literature

- Quantitative models of sudden stop crisis: Mendoza (2001), Mendoza (2010), Bianchi (2011).
  - Credit frictions and liability dollarization as sources of volatility of EM.
  - Role of Fisherian debt deflation.
  - Optimality of equilibrium and macroprudential policies.

- Trend shocks: Aguiar and Gopinath (2006), Aguiar and Gopinath (2007), García-Cicco, Pancrazi, and Uribe (2010).
  - Permanent shocks versus transitory shocks as main drivers of EM business cycle.

- Capital controls: Bianchi (2011), Fernández, Klein, Rebucci, Schindler, and Uribe (2015).
  - Normative analysis.

Outline

Introduction

Baseline model

Trend shocks model

Overborrowing and capital controls

Conclusion

Baseline model

- Representative consumer in an endowment economy.
- Tradable and non-tradable goods, with preferences:

$$u(c_t^T, c_t^N) = \frac{\left[\omega \left(c_t^T\right)^{-\eta} + (1-\omega)\left(c_t^N\right)^{-\eta}\right]^{\frac{-(1-\sigma)}{\eta}} - 1}{1-\sigma}$$

- Small open economy with occasionally binding constraint on foreign lending.
- Collateral is given by the annual income of the economy measured in terms of tradable goods.

Household's problem

$$\max_{\{b_{t+1}, c_t^T, c_t^N\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t^T, c_t^N)$$

subject to

$$b_{t+1} + c_t^T + p_t^N c_t^N = b_t(1+r) + p_t^N y_t^N + y_t^T$$

$$b_{t+1} \geq -\kappa \left(y_t^T + p_t^N y_t^N \right)$$

Household's solution

$$u_1(c_t^T, c_t^N) = \lambda_t$$

$$p_t^N = \frac{1-\omega}{\omega} \left(\frac{c_t^T}{c_t^N} \right)^{\eta+1}$$

$$\lambda_t = \beta(1+r)E_t[\lambda_{t+1}] + \mu_t$$

$$b_{t+1} + c_t^T + p_t^N c_t^N = b_t(1+r) + p_t^N y_t^N + y_t^T$$

$$\mu_t \left[b_{t+1} - \kappa \left(y_t^T + p_t^N y_t^N \right) \right] = 0; \qquad \mu_t \geq 0$$

Calibration following Bianchi (2011)

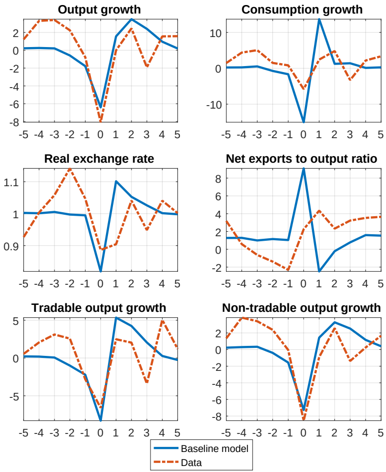
Parameters	Definition	Value
σ	Risk aversion coefficient	2
β	Discount factor	0.91
r	Risk free interest rate	0.04
κ	Borrowing constraint	0.32
ω	Share of tradable/non-tradable consumption	0.31
η	Elasticity of substitution between N and T	1/0.83-1

Income: $\log \mathbf{y}_t = \rho \log \mathbf{y}_{t-1} + \epsilon_t$, with $\mathbf{y} = [y^T \; y^N]'$, $\epsilon = [\epsilon^T \; \epsilon^N]'$, where $\epsilon \sim N(\mathbf{0}, \mathbf{V})$

$$\rho = \begin{bmatrix} 0.901, & 0.495 \\ -0.453, & 0.225 \end{bmatrix}, \;\; \mathbf{V} = \begin{bmatrix} 0.00219, & 0.00162 \\ 0.00162, & 0.00167 \end{bmatrix}.$$

Sudden Stops in the model and the data

- Post-crisis recovery is too fast in the model.



Immediate recovery in the model: Intuition

- The crisis is triggered by a negative shock on tradable income.
- This tightens the collateral constraint. Remember:

$$p_t^N = \frac{1-\omega}{\omega} \left(\frac{c_t^T}{c_t^N} \right)^{\eta+1}, \;\; b_{t+1} \geq -\kappa \left(y_t^T + p_t^N y_t^N \right)$$

- This makes the debt burden smaller one period after the crisis.
- Consumption recovers immediately.
- This makes the real exchange rate appreciate, relaxes the borrowing constraint even more.
- Bottom line: Tradable consumption drop is not persistent enough.

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Trend-driven crisis

- Permanent income shocks induce very different debt dynamics from transitory shocks. (Permanent Income Hypothesis)
- Follow Aguiar and Gopinath (2007), introduce a common trend, Γ_t s.t. for $j \in \{T, N\}$
$$y_t^j = z_t^j \Gamma_t.$$
- The trend is stochastic and its growth rate, $\frac{\Gamma_t}{\Gamma_{t-1}} = g_t$ follows
$$\log g_t = (1-\rho_g)\log \mu_g + \rho_g \log g_{t-1} + \nu_t,\ \nu_t \sim N(0, \sigma_g).$$

Empirical strategy

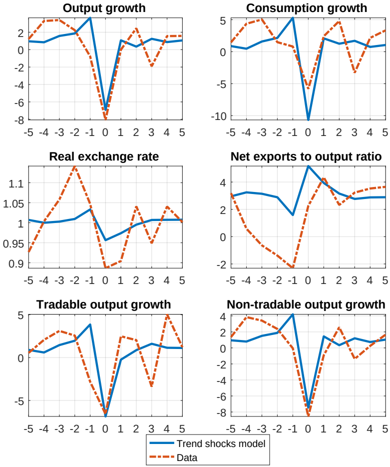
- We fix preference parameters to existing values in the literature.
- Calibrate the interest rate, discount factor, and borrowing constraint tightness
- Estimate the income process with a Bayesian strategy.

Parameter	Value	Basis
Calibrate for Argentina 1960-2015 (WDI)		
Risk free interest rate, r	0.09	Avg. return on new commitments
Discount factor, β	0.84	Avg. debt-to-output ratio = 30%
Borrowing constraint, κ	0.40	Sudden stop frequency = 5%
Estimate for Argentina 1876-2004 (Ferreres (2010))		
Trend persistence, ρ_g	0.54	
Tradable trans. pers., ρ_{z^T}	0.76	
Non-tradable trans. pers., ρ_{z^N}	0.76	
Trend variance, σ_g	0.035	
Tradable trans. var., σ_{z^T}	0.055	
Non-tradable trans. var., σ_{z^N}	0.049	

Bayesian estimation

Dynamics around sudden stops

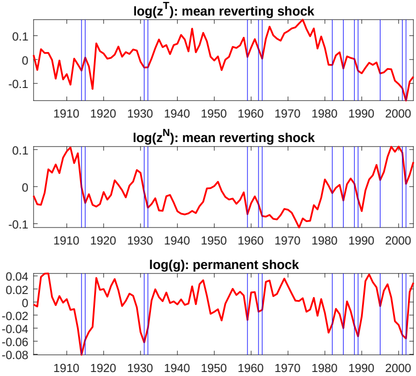
- With trend shocks, recovery is sluggish in the model.



Comparison without trend shocks

Testing the model implications

- We can recover our estimates for the path of the three components of the Argentinean output.
- There is no significant pattern with the transitory component.
- The trend exhibits large drops before the sudden stops.

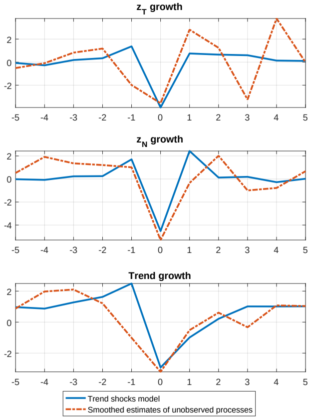


Note: Smoothed estimates for Argentina. Sudden Stops in blue vertical lines.

Testing the model implications (cont')

Similar paths for all the shocks in the model and in the data.

- 1 std decline in z_T and z_N.
- 2 std decline in g.



Note: Sudden Stops in Argentina and in the model. Percentages on the y-axis.

Unconditional moments

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Planner's problem

$$\max_{\{b_{t+1}, c_t^T, c_t^N\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c_t^T, c_t^N)$$

subject to

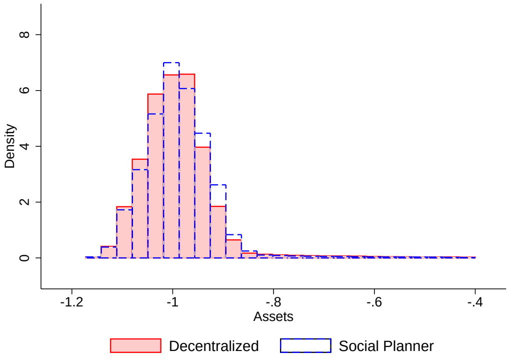
$$b_{t+1} + c_t^T = b_t(1+r) + y_t^T$$

$$b_{t+1} \geq -\kappa \left(y_t^T + \frac{1-\omega}{\omega} \left(\frac{c_t^T}{c_t^N} \right)^{\eta+1} y_t^N \right)$$

$$u(c_t^T, c_t^N) = \frac{\left[\omega \left(c_t^T \right)^{-\eta} + (1-\omega) \left(c_t^N \right)^{-\eta} \right]^{\frac{-(1-\sigma)}{\eta}} - 1}{1-\sigma}$$

Debt distribution for the C.Eq. and S.P.

- S.P. distribution features less mass on higher debt.



Achieving S.P. outcome in the decentralized economy

- We look for the tax on debt issuance

$$(1-\tau_t)b_{t+1} + c_t^T + p_t^N c_t^N = b_t(1+r) + y_t^T + p_t^N y_t^N$$

  that would give the planner's solution in the decentralized economy

- This can be recovered as:

$$\tau_t = \frac{\beta(1+r)g_t^{-\sigma}\mathbb{E}_t\left(\mu_{t+1}^{sp}\Psi_{t+1}\right) - \mu_t^{sp}\Psi_t}{u'_{T,t}}.$$

- $\Psi_t = \kappa \frac{\left(p_t^N y_t^N\right)}{c_t^T}(1+\eta) > 0.$
- Higher debt that makes constraint more likely to bind implies higher tax.

Decomposition of capital controls

- Optimal taxes decrease good times.
- However, trend shocks make them less cyclical.

Table: Implied optimal tax (%)

	Full model	Only trend shocks	Only transitory shocks
Overall, mean	3.52	4.31	3.35
Good times, mean	2.32	3.97	2.18
Bad times, mean	4.71	4.65	4.52
Good growth, mean	2.90	3.97	2.72
Bad growth, mean	4.13	4.64	3.98
Good trend shock, mean	3.40	3.96	-
Bad trend shock, mean	3.68	4.79	-
Corr. with GDP growth	-0.26	-0.15	-0.23

Not included today

- Alternative drivers of the crisis
  - Shocks to preferences Details
  - Shocks to the tightness of the borrowing constraint. Details
- Overborrowing and trend volatility Details

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Concluding remarks

- Mean reverting shocks to income have a hard time generating the persistence after a sudden stop crisis.
- Model with trend shocks can account for the missing persistence.
- A simple calibrated version of this model generates overborrowing.
- Pro-cyclical capital controls: tax on foreign debt issuance tends to be higher during good times than during bad times but trend shocks push it to be more counter-cyclical

Appendix

22 Emerging markets

Table: Samples from the World Development Indicators

Country	Sample	Country	Sample
Argentina	1965-2016	Indonesia	1960-2016
Bolivia	1970-2016	Korea	1960-2016
Brazil	1990-2016	Malaysia	1970-2016
Chile	1960-2016	Mexico	1965-2016
Colombia	1965-2016	Panama	1970-2016
Costa Rica	1965-2016	Peru	1960-2016
Ecuador	1965-2016	Philippines	1960-2016
Egypt	1987-2016	South Africa	1960-2016
Guatemala	1965-2016	Turkey	1968-2016
Honduras	1960-2016	Uruguay	1983-2016
India	1960-2016	Venezuela	1960-2016

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Demand-driven crisis

- Shock to the tradable consumption share in the consumption aggregator function

$$u(c_t^T, c_t^N) = \frac{\left[\omega_t \left(c_t^T\right)^{-\eta} + (1-\tilde{\omega}) \left(c_t^N\right)^{-\eta}\right]^{\frac{-(1-\sigma)}{\eta}} - 1}{1-\sigma}$$

- If the demand wedge is persistent this can induce a persistent drop in tradable consumption and in the price of non-traded goods.

$$p_t^N = \frac{1-\tilde{\omega}}{\omega_t} \left(\frac{c_t^T}{c_t^N}\right)^{\eta+1}$$

- Assume $\omega_t = \{0.9 \times 0.31, \;\; 1.1 \times 0.31\}$ and $\omega_t = \{0.75 \times 0.31, \;\; 1.25 \times 0.31\}$ with persistence at 0.95.

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Demand-driven crisis: $\uparrow \omega_t$

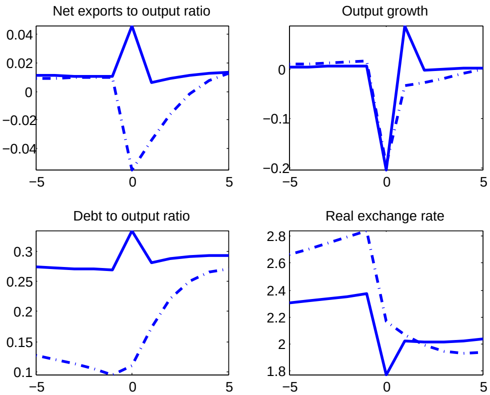

Figure: Dynamics after a ω_t increase

Note: this picture plots a one period shock to ω_t. Solid line denotes parametrization (1) and dashed line parametrization (2).

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Lending-driven crisis

- The small open economy setup minimizes the role of international investors.
- It is known however that investors' "sentiments", preferences towards risk, contagion, etc. are plausible drivers of crisis in emerging economies.
- A simple way of accounting for changes in investors' preferences in this setup is by allowing changes in κ_t:

$$b_{t+1} \quad \geq \quad -\kappa_t \left(y_t^T + p_t^N y_t^N \right).$$

- A persistent fall in κ_t is prone to inducing a persistent tightening in the borrowing constraint preventing tradable consumption from staying low for several periods.
- Assume $\kappa_t = \{0.9 \times 0.32, \quad 1.1 \times 0.32\}$ and $\kappa_t = \{0.75 \times 0.32, \quad 1.25 \times 0.32\}$ with persistence at 0.95.

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Lending-driven crisis

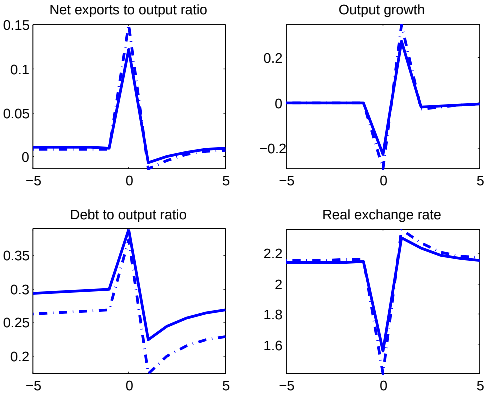

Figure: Dynamics after a κ_t drop

Note: this picture plots a one period shock to κ_t. Solid line denotes parametrization (1) and dashed line parametrization (2).

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Bayesian estimation

The income process with transitory and permanent components, in state space representation is,

$$\begin{bmatrix} \log(\gamma_t^T) \\ \log(\gamma_t^N) \end{bmatrix} = \begin{bmatrix} \log(z_t^T) - \log(z_{t-1}^T) + \log(g_t) \\ \log(z_t^N) - \log(z_{t-1}^N) + \log(g_t) \end{bmatrix},$$

and the state equation is

$$\begin{bmatrix} \log(z_t^T) \\ \log(z_{t-1}^T) \\ \log(z_t^N) \\ \log(z_{t-1}^N) \\ \log(g_t) \end{bmatrix} = \begin{bmatrix} \rho_{Z^T} & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & \rho_{Z^N} & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & \rho_g \end{bmatrix} \begin{bmatrix} \log(z_{t-1}^T) \\ \log(z_{t-2}^T) \\ \log(z_{t-1}^N) \\ \log(z_{t-2}^N) \\ \log(g_{t-1}) \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \sigma_T & 0 & 0 \\ 0 & \sigma_N & 0 \\ 0 & 0 & \sigma_g \end{bmatrix} \begin{bmatrix} \epsilon_t^T \\ \epsilon_t^N \\ \epsilon_t^g \end{bmatrix}$$

where γ_t^T and γ_t^N are growth rate of tradable and non-tradable income.

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Bayesian estimation

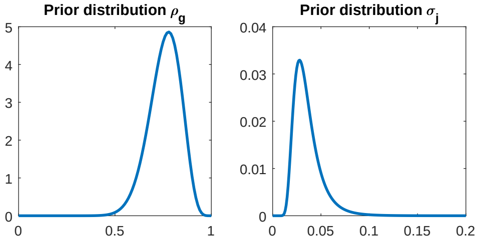

Figure: Prior distributions

Note: prior distributions for the persistence and standard deviations of all shocks. In the case of ρ_j is $B(0.7576, 0.0819)$ and for σ_j is $IG(0.0278, 0.0098)$. Here $B(\mu, \sigma)$ and $IG(\mu, \sigma)$ denote Beta and Inverse-Gamma distributions with mean μ and standard deviation of σ for all $j = \{z^T, z^N, g\}$.

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Bayesian estimation

Table: Descriptive moments of the posterior distribution

Parameter	Mean	St. Deviation
ρ_g	0.5439	0.0863
ρ_{z^T}	0.7574	0.0820
ρ_{z^N}	0.7567	0.0822
σ_g	0.0351	0.0069
σ_{z^T}	0.0548	0.0046
σ_{z^N}	0.0487	0.0048

Note: The table gives the mean and standard deviation of the posterior distribution for each parameter from 100,000 draws.

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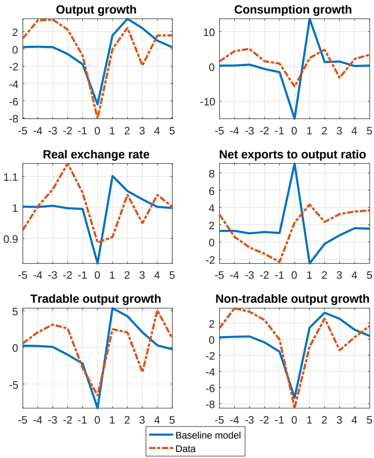
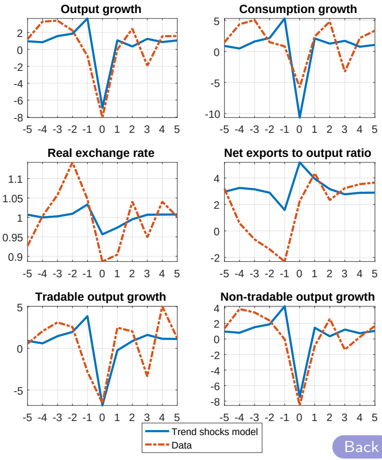
Dynamics around sudden stops





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Model comparisons of second moments

	Data	Benchmark	
		C.Eq.	S.P.
Average (%)			
Output growth	1.0	1.0	1.0
Current account / GDP	-1.7	0.0	-0.1
Trade balance / GDP	2.2	2.9	2.8
Standard dev. (%)			
Consumption growth	6.4	10.8	9.7
Real exchange rate (log)	47	14.5	13.3
Current account / GDP	4.8	4.3	3.5
Trade balance / GDP	4.4	4.8	4.0

Note: Annual data for Argentina period 1876-2004.

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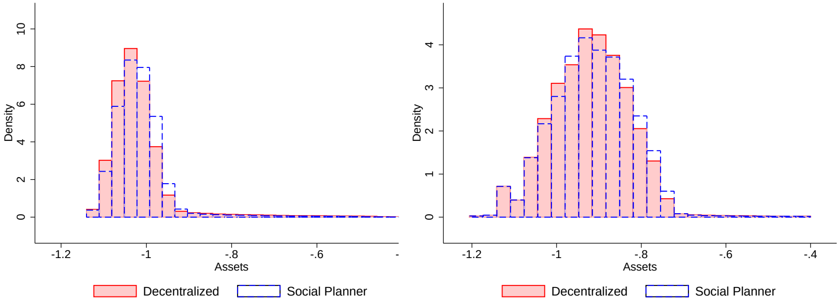
Implied optimal taxes and trend volatility



(a) Low volatility (b) High volatility

Figure: Debt distribution for the competitive equilibrium and the constrained optimal

Note: The debt levels in the x-axis are detrended. The left (right) panel corresponds to benchmark calibration with the exception of halving (doubling) the volatility parameter of the trend shocks, σ_g.

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Implied optimal taxes and trend volatility

Table: Overborrowing, capital controls and trend volatility

	Benchmark calibration	Low trend vol	High trend vol
Overborrowing measures (%)			
$\frac{F^{CE}_{10pc} - F^{SP}_{10pc}}{F^{SP}_{10pc}}$	0.39	0.51	0.02
$\frac{F^{CE}_{25pc} - F^{SP}_{25pc}}{F^{SP}_{25pc}}$	0.18	0.67	0.63
Implied optimal tax (%)			
Overall, mean	3.52	3.70	2.01
Good times, mean	2.32	2.31	1.27
Bad times, mean	4.71	5.10	2.75
Good growth, mean	2.90	3.07	1.55
Bad growth, mean	4.13	4.33	2.47
Good trend shock, mean	3.40	3.67	1.77
Bad trend shock, mean	3.68	3.75	2.34
Corr. with GDP growth	-0.26	-0.23	-0.26

Note: Good/bad growth refer to the case in which the economy grows at a rate higher/lower than the average growth rate of the economy. Good/bad times refer to the case in which the detrended GDP of the economy is at higher/lower than the median detrended GDP.

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