

Phases of Global Liquidity, Fundamentals News, and the Design of Macroprudential Policy *

JAVIER BIANCHI

Minneapolis Fed, University of Wisconsin & NBER

CHENXIN LIU

University of Wisconsin

ENRIQUE G. MENDOZA

University of Pennsylvania, NBER & PIER

June 15, 2015

PRELIMINARY

[Click for Latest Draft](#)

Abstract

The unconventional shocks and non-linear dynamics behind the high volatility of financial markets present a challenge for the implementation of macroprudential policy. This paper introduces two of these unconventional shocks, news shocks about future fundamentals and regime changes in global liquidity, into a quantitative non-linear model of financial crises. The model is then used to examine how these shocks affect the design and effectiveness of optimal macroprudential policy. The results show that both shocks contribute to strengthen the amplification mechanism driving financial crisis dynamics. Macroprudential policy is effective for reducing the likelihood and magnitude of financial crises, but the optimal policy requires significant variation across regimes of global liquidity and realizations of news shocks. Moreover, the effectiveness of the policy improves as the precision of news rises from low levels, but at high levels of precision it becomes less effective (financial crises are less likely, but the optimal policy does not weaken them significantly).

KEYWORDS: Financial crises, macroprudential policy, systemic risk, global liquidity, news shocks

JEL CLASSIFICATION CODES: D62, E32, E44, F32, F41

*We would like to thank the participants at the January 2015 closing Conference of the BIS CCA Research Network on Incorporating Financial Stability Considerations into Central Bank Policy Models for helpful comments and suggestions. Mendoza acknowledges also the hospitality and support of the Bank for International Settlements, particularly the BIS Representative Office for the Americas, where he was a visitor while working on part of this paper.

1 Introduction

There is wide consensus on the view that the goal of macroprudential policy is to hamper credit growth in periods of expansion in order to lower the frequency and magnitude of financial crises. There is much less agreement, however, on how to actually design and implement this policy. This is due in part to the lack of a well-established quantitative framework in which non-linear endogenous financial amplification mechanisms can produce infrequent financial crises with realistic features and nested within regular business cycles. Such a framework is a pre-requisite to build a platform that can be useful for evaluating the effectiveness of macroprudential policy tools.

One class of models that has made progress in this direction makes use of the Fisherian debt-deflation mechanism to amplify the effects of exogenous shocks in periods of financial distress, and thus generate nonlinear crisis dynamics. In models of this class, the market failure that justifies the use of macroprudential policy is a pecuniary externality that is ubiquitous in credit markets, because goods or assets used as collateral are valued at market prices: Private agents in a decentralized equilibrium do not internalize the large negative effects of individual borrowing decisions made in “good times” on collateral prices in “bad times,” when the debt-deflation mechanism induces large declines in relative prices. As a result, private agents borrow too much, relative to what is socially optimal, and leave the economy vulnerable to financial crises.

The literature on Fisherian models has shown that collateral constraints can produce substantial amplification and asymmetry in response to standard-size shocks hitting the typical driving forces of business cycles, such as TFP and terms-of-trade shocks (e.g. [Mendoza \(2010\)](#)), and more recently it has also demonstrated how these models can be used to study the characteristics and effectiveness of various financial policies, including macroprudential policy.¹ Despite this progress, however, most of the models developed to date study macroprudential policy assuming relatively simple structures of exogenous shocks and production technologies. Shocks usually affect TFP or interest rates following conventional, symmetric probabilistic processes known to agents.² As a result, two key sources of financial volatility that deviate from this treatment, noisy news about future economic fundamentals and regime shifts in global liquidity, are still absent from the analysis of macroprudential policy. In contrast, empirical studies of credit cycles and financial crises suggest that factors like these are important determinants of credit dynamics and their interaction with the real economy (e.g., [Calvo et al. \(1996\)](#), [Shin \(2013\)](#), [Bruno and Shin \(2014\)](#), [Mendoza and Terrones \(2012\)](#), [Borio \(2013\)](#), [Reinhart and Rogoff \(2014\)](#), [Schularick and Taylor \(2009\)](#)).

This paper aims to fill these gaps by introducing both news shocks and regime switches in

¹Some of these studies include [Bianchi \(2011\)](#), [Benigno et al. \(2013\)](#), [Bianchi and Mendoza \(2010 2013\)](#), [Bengui and Bianchi \(2014\)](#), [Jeanne and Korinek \(2010\)](#), [Korinek \(2011\)](#) (see the literature reviews by [Galati and Moessner \(2013\)](#), [Galati and Moessner \(2014\)](#) and [Korinek and Mendoza \(2014\)](#)). See also [Schmitt-Grohé and Uribe \(2013\)](#) and [Farhi and Werning \(2012\)](#) for a literature on prudential policy due to aggregate demand externalities.

²A few exceptions include the studies by [Boz and Mendoza \(2014\)](#), [Bianchi et al. \(2012\)](#) and [Martin and Ventura \(2014\)](#), which introduce informational frictions that lead to rational or irrational bubbles in asset valuation in models of credit cycles and macroprudential policy.

global liquidity into a Fisherian model of macroprudential policy. Noisy, but informative, news about future income shocks are introduced as a driving force of credit cycles following the recent macro literature on news and business cycles.^{3,4} Shifts in global liquidity are introduced as a regime-switching process in the evolution of world interest rates or leverage limits supported by world capital markets.⁵

The paper presents both theoretical and quantitative findings that highlight the effects of news shocks and global liquidity shifts on the design of optimal macroprudential policy. The results show that both news shocks and regime-switches in global liquidity contribute to strengthen the amplification mechanism driving financial crisis dynamics. Macroprudential policy is implemented as a state-contingent tax on debt that yields the same allocations and prices supported by a constrained-efficient social planner who internalizes the pecuniary externality. This optimal debt tax is an effective tool for reducing the likelihood and magnitude of financial crises, but it requires significant variation across regimes of global liquidity and realizations of news shocks. Moreover, the effectiveness of the policy improves as the precision of news rises from low levels, but at high levels of precision it becomes less effective. High predictive power of current news about future income reduces the probability of financial crises with or without policy intervention, but when crises do occur, the macroprudential debt taxes raised in earlier good times are much less effective at weakening their magnitude.

The rest of the paper is organized as follows. Section 2 describes the decentralized equilibrium of the model without policy intervention. Section 3 examines the problem solved by the financial regulator, the role of macroprudential policy in addressing market failure in the decentralized equilibrium, and the decentralization of optimal macroprudential policy as taxes on debt. Section 4 examines the quantitative predictions of the model. Section 5 provides conclusions and two appendices provide mathematical details and describe the solution toolkit.

2 Model

2.1 Household's problem

Consider a small open economy inhabited by a representative household who consumes tradable and nontradable goods, denoted c^T and c^N respectively, and who has a fixed endowment of hours \bar{h} that can be rented out as labor for production in each sector. Preferences are given by a standard

³For example, in the years leading to the recent European crisis, the prolonged boom of Southern Europe could be viewed as related to anticipated benefits from joining the EU.

⁴Notable papers on news and business cycles are [Beaudry and Portier \(2006\)](#), [Schmitt-Grohé and Uribe \(2012\)](#) [Jaimovich and Rebelo \(2009\)](#).

⁵The studies by [Calvo et al. \(1996\)](#) and [Shin \(2013\)](#) document the importance of fluctuations in global capital market conditions and world interest rates in driving domestic credit markets.

intertemporal utility function:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u(c). \quad (1)$$

In this expression, $\mathbb{E}(\cdot)$ is the expectation operator, and β is the discount factor. The period utility function $u(\cdot)$ is a standard concave, twice-continuously differentiable function that satisfies the Inada condition. The consumption basket c is a CES aggregator with elasticity of substitution $1/(\eta + 1)$ between c^T and c^N , given by:

$$c = \left[\omega (c^T)^{-\eta} + (1 - \omega) (c^N)^{-\eta} \right]^{-\frac{1}{\eta}}, \eta > 1, \omega \in (0, 1).$$

Since labor supply is in fixed supply, we ignore the disutility of labor without loss of generality.

Normalizing the price of tradable goods to 1 and denoting the relative price of nontradables by p^N , the agent's budget constraint is:

$$q_t b_{t+1} + c_t^T + p_t^N c_t^N = b_t + \pi_t^T + \pi_t^N + w_t \bar{h} \quad (2)$$

The representative agent has access to a global market of one-period, non-state-contingent bonds denominated in units of tradable goods sold at a price $q_t = 1/R_t$, where R_t is the exogenous gross world real interest rate. The stochastic process of the interest rate exhibits regime switches that characterize periods of high and low global liquidity, as explained below. The agent begins the period with bond holdings b_t and chooses b_{t+1} , it collects wages at a market wage rate w_t (which as we show below is equal across sectors) and also collects profits paid by firms, π_t^T and π_t^N in the tradables and nontradables sectors respectively, both valued in units of tradables.

The representative agent faces a credit constraint that limits its debt not to exceed a fraction κ of its total income in units of tradables:

$$q_t b_{t+1} \geq -\kappa (w_t h_t + \pi_t^T + \pi_t^N). \quad (3)$$

This collateral constraint can be viewed as resulting from enforcement or institutional frictions by which lenders are only able to harness a fraction κ of a borrower's income in case of non-repayment, or it can also be thought of as capturing observed practices in credit markets, such as the scoring algorithms used in household credit.

The representative agent chooses optimally the stochastic processes $\{c_t^T, c_t^N, b_{t+1}\}_{t \geq 0}$ to maximize the expected present discounted value of utility (1) subject to sequences of budget constraints (2) and credit constraints (3), taking b_0 and $\{p_t^N, w_t, \pi_t^T, \pi_t^N\}_{t \geq 0}$ as given. This maximization problem yields the following first-order conditions:

$$\lambda_t = u_T(t) \quad (4)$$

$$p_t^N = \left(\frac{1 - \omega}{\omega} \right) \left(\frac{c_t^T}{c_t^N} \right)^{\eta+1} \quad (5)$$

$$\lambda_t = \frac{\beta}{q_t} \mathbb{E}_t [\lambda_{t+1} + \mu_t] \quad (6)$$

$$b_{t+1} + \kappa_t (w_t h_t + \pi_t^T + \pi_t^N) \geq 0, \quad \text{with equality if } \mu_t > 0, \quad (7)$$

where u_T denotes the partial derivative of the utility function with respect to c_t^T , λ_t is the Lagrange multiplier on the budget constraint, and μ_t is the Lagrange multiplier on the credit constraint. Notice that regime switches in global liquidity will affect borrowing incentives via their effect on the marginal benefit of borrowing in the right-hand-side of the Euler equation (6), and that news about future values of dividends and wages will alter expectations of future borrowing capacity. Hence, changes in global liquidity and news shocks affect the volatility of capital flows and the economy's vulnerability to financial crisis.

2.2 Firms' problem

Production is undertaken by representative firms owned by the representative agent. These firms operate standard neoclassical production functions ($y_t^T = A^T h_t^{T\alpha}$, $y_t^N = A^N h_t^{N\alpha}$) and choose optimally their demand for labor so as to maximize profits.

Firms in the non-tradable sector solve

$$\max_{h_t^N} \pi_t^N = \max_{h_t^N} p_t^N A^N (h_t^N)^{\alpha_N} - w_t h_t^N$$

which results in the following FOC

$$p_t^N A^N \alpha_N (h_t^N)^{\alpha_N - 1} = w_t$$

We assume that firms in the tradable sector are subject to a working capital constraint.⁶ Before producing firms must obtain an intraperiod loan to pay salaries and dividends in advance subject to a borrowing constraint. Specifically, we assume that creditors impose a borrowing limit proportional to TFP so that firms' problem can be expressed as:⁷

⁶Benigno et al. (2013) also consider factor reallocation across sectors but without frictions on the firms's side.

⁷The borrowing constraint can be derived by using $\pi_t^T + w_t h_t^T \leq \tilde{\theta}_t$, substituting the expression for profits and using $\tilde{\theta}_t = \theta_t A^T$. An explicit microfoundation for this constraint is beyond the scope of this paper. We also note that an equivalent assumption in terms of the implications for the aggregate economy is to impose an upper bound on the amount of workers than can be employed in the tradable sector, which can be justified due to human capital considerations.

$$\begin{aligned} \max_{h_t^T} \pi_t^T &= \max_{h_t^T} A^T (h_t^T)^{\alpha_T} - w_t h_t^T \\ \text{st. } (h_t^T)^{\alpha_T} &\leq \chi \end{aligned}$$

The first-order conditions of these optimization problems are standard:

$$A^T \alpha (h_t^T)^{\alpha_T - 1} = w_t + \varphi_t$$

where φ_t is the Lagrange multiplier on the working capital constraint.

Notice that as long as $\alpha < 1$, the price of non tradables evolve endogenously and satisfies simultaneously two optimality conditions: From the producers' side it must equal the marginal rate of technical substitution of labor across the two sectors, and from the household's side it must be equal to the marginal rate of substitution in consumption of tradables v. nontradables. Hence, at equilibrium the following condition holds:

$$\frac{A^T \alpha_T (h_t^T)^{\alpha_T - 1} - \text{varphi}_t}{A^N \alpha_N (h_t^N)^{\alpha_N - 1}} = p^N = \left(\frac{1 - \omega}{\omega} \right) \left(\frac{c_t^T}{c_t^N} \right)^{\eta + 1}$$

It follows from the above arguments that, if a financial crisis is characterized by a collapse in the relative price of nontradables (i.e. in the real exchange rate), it will also result in a reduction in the value of the marginal product of labor allocated to nontradables, and hence in labor demand in that sector. Wages fall as a result of lower aggregate labor demand, and the lower wages lead to an equilibrium reallocation of the inelastic supply of labor from nontradables to tradables production. The working capital constraint, however, imposes a bound on the amount of reallocation and allows us to obtain in a simple way the costs of reallocation of factors of production.

2.3 News Shocks and Global Liquidity Regimes

The formulation of news shocks affecting the stochastic process of A_t^T follows the specification proposed by [Durdu et al. \(2013\)](#). In this formulation, news shocks appear as noisy signals about future output. The signal precision has the following form:

$$p(s_t = i | A_{t+1}^T = l) = \begin{cases} \theta & \text{if } i = l \\ \frac{1 - \theta}{N - 1} & \text{if } i \neq l \end{cases}$$

where s_t is the signal that the economy receives at date t , N is the number of possible realizations of A_t^T at any date t , and θ is the signal precision parameter. When $\theta = \frac{1}{N}$, the signals are uninformative because $p(s_t = i | A_{t+1}^T = l)$ simply assigns a uniform probability of $1/N$ to all values the signal can take, regardless of the value of A_{t+1}^T . When $\theta = 1$, the signals have perfect precision,

because they allow the agent to perfectly anticipate the value of A_{t+1}^T (i.e. a given value of $A_{t+1}^T = l$ will be expected to occur with perfect certainty when the signal $s_t = l$ is observed).

The Markov chain for the joint evolution of x and s is:

$$\begin{aligned}\Pi(A_{t+1}^T, s_{t+1}, A_t^T, s_t) &\equiv p(s_{t+1} = k, A_{t+1}^T = l | s_t = i, A_t^T = j) \\ &= p(A_{t+1}^T = l | s_t = i, A_t^T = j) \sum_m [p(A_{t+2}^T = m | A_{t+1}^T = l) p(s_{t+1} = k | A_{t+2}^T = m)],\end{aligned}$$

where the conditional forecast probability is derived following Bayes' theorem:

$$p(A_{t+1}^T = l | s_t = i, A_t^T = j) = \frac{p(s_t = i | A_{t+1}^T = l) p(A_{t+1}^T = l | A_t^T = j)}{\sum_n p(s_t = i | A_{t+1}^T = n) p(A_{t+1}^T = n | A_t^T = j)}$$

Fluctuations in global liquidity across high- and low-liquidity regimes are modeled as regime switches in the world real interest rate, using a standard two-point, regime-switching process with regimes R^h (low global liquidity) and R^l (high global liquidity) with $R^h > R^l$. The continuation transition probabilities are denoted $F_{hh} \equiv p(R_{t+1} = R^h | R_t = R^h)$ and $F_{ll} \equiv p(R_{t+1} = R^l | R_t = R^l)$, and the switching probabilities are simply $F_{hl} = 1 - F_{hh}$ and $F_{lh} = 1 - F_{ll}$. The long-run probabilities of the each regime are $\Pi^h = F_{lh}/(F_{lh} + F_{hl})$ and $\Pi^l = F_{hl}/(F_{lh} + F_{hl})$ respectively, and the corresponding mean durations are $1/F_{hl}$ and $1/F_{lh}$. The long-run unconditional mean, variance, and first-order autocorrelation of R are given by the standard formulae:

$$E[R] = (F_{lh}R^h + F_{hl}R^l)/(F_{lh} + F_{hl}) \quad (8)$$

$$\sigma^2(R) = \Pi^h(R^h)^2 + \Pi^l(R^l)^2 - (E[R])^2 \quad (9)$$

$$\rho(R) = F_{ll} - F_{hl} = F_{hh} - F_{lh} \quad (10)$$

We also studied the implications of representing global liquidity regime as changes in κ , instead of changes in R . The quantitative implications of following this approach are discussed later in the paper.

2.4 Competitive Equilibrium

The competitive equilibrium (in the absence of macroprudential policy) is given by sequences of allocations $\{c_t^T, c_t^N, b_{t+1}, h_t^N, h_t^T\}_{t \geq 0}$ and prices $\{p_t^N, w_t, \pi_t^T, \pi_t^N\}_{t \geq 0}$ such that: (a) the representative agent maximizes utility subject to the budget and collateral constraints taking prices as given, (b) firms maximize profits taking prices as given, and (c) the market-clearing conditions for the labor market and the market for nontradable goods hold:

$$\begin{aligned}\bar{h} &= h_t^T + h_t^N \\ c_t^N &= y_t^N\end{aligned}$$

These two conditions, together with the agents' budget constraint, imply that the resource constraint of the small open economy's tradables sector also holds: $c_t^T = y_t^T - q_t b_{t+1} + b_t$.

3 Planner's Problem & Macroprudential Policy

We follow [Bianchi \(2011\)](#)'s approach to characterize optimal macroprudential policy. In particular, we construct a constrained planner's problem in which a planner (or financial regulator) chooses directly the economy's holdings of non-state contingent bonds subject to the credit constraint, and lets all other markets clear competitively. The crucial difference is that, in contrast with private agents, the planner internalizes how borrowing decisions affect consumption and labor allocations, which in turn, affect the equilibrium price of non-tradables and the tightness of the credit constraint (i.e. the "borrowing capacity").

The planner's problem in recursive form is the following:

$$V(b, \mathbf{s}) = \max_{p^N, h^T, h^N, c^T, c^N, b'} \left[u(\omega (c^T)^{-\eta} + (1 - \omega) (c^N)^{-\eta - \frac{1}{\eta}}) + \beta \mathbb{E}V(b', \mathbf{s}') \right]$$

subject to

$$c^T + qb' = b + A^T (h^T)^\alpha \quad (11)$$

$$\bar{h} = h^T + h^N \quad (12)$$

$$(h^T)^{\alpha^T} \leq \chi \quad (13)$$

$$c^N = A^N (h^N)^\alpha \quad (14)$$

$$qb' \geq -\kappa (A^T (h^T)^\alpha + p^N A^N (h^N)^\alpha) \quad (15)$$

$$p^N = \frac{A^T \alpha_T (h_t^T)^{\alpha_T - 1} - \varphi_t}{A^N \alpha_N (h_t^N)^{\alpha_N - 1}} \quad (16)$$

$$p^N = \left(\frac{1 - \omega}{\omega} \right) \left(\frac{c^T}{c^N} \right)^{\eta + 1} \quad (17)$$

The state variables are the current bond holdings, b , and the realizations of the exogenous shocks denoted as $\mathbf{s} = (A^T, s, q)$. The constraints faced by the planner are: [equation \(11\)](#) the resource constraint for tradable goods, [equation \(12\)](#) the market-clearing condition in the labor market, [equation \(14\)](#) the market-clearing condition in the nontradable goods market, [equation \(15\)](#) the credit constraint, and the conditions that characterize optimal sectoral factor and consumption allocations ([equation \(16\)](#) and [equation \(17\)](#) respectively).⁸

⁸Notice that c^T pins down the labor allocation as follows $\frac{A^T}{A^N} \left(\frac{\bar{h} - h^T}{h^T} \right)^{1 - \alpha} = \left(\frac{1 - \omega}{\omega} \right) \left(\frac{c^T}{A^N (\bar{h} - h^T)^\alpha} \right)^{\eta + 1}$.

As shown in Appendix 1, the first-order conditions of the above problem (in sequential form) can be reduced to the following two expressions:

$$\begin{aligned}\lambda_t &= u_T(t) + \mu_t \psi_t \\ \lambda_t &= \frac{\beta}{q_t} \mathbb{E}_t [\lambda_{t+1} + \mu_t]\end{aligned}$$

where λ_t and μ_t denote respectively the Lagrange multiplier on the resource constraint (equation (11)) and credit constraint (equation (15)), and the term $\psi_t \equiv \kappa \left[\frac{A_t^T \bar{h}(1-\alpha)(h_t^T)^{\alpha-2}}{\alpha A_t^T (h_t^T)^{\alpha-1} - \phi(h_t^T)} \right]$ captures the effect of an additional unit of consumption on the borrowing capacity via general equilibrium effects on the price of non-tradable goods (i.e. on the value of collateral).⁹ In turn, the term $\mu_t \psi_t$ reflects the fact that, when the credit constraint binds, the social marginal benefit from consumption of tradable goods includes the gains resulting from how changes in consumption help relax the credit constraint, in addition to the marginal utility of tradables consumption.

From a macroprudential perspective, the focus is on how to affect credit allocations in “good times” because of what those allocations can cause in “bad times.” In these scenarios, the credit constraint is not binding at date t (i.e. $\mu_t = 0$) but may be binding at $t + 1$ ($E_t[\mu_{t+1}] > 0$), and the planner’s Euler equation takes this form:

$$u_T(t) = \frac{\beta}{q_t} \mathbb{E}_t [u_T(t+1) + \mu_{t+1} \psi_{t+1}]$$

Comparing this condition with the household’s Euler equation for bonds shows that, as in [Bianchi \(2011\)](#), there is a wedge between the private and social marginal cost of borrowing, given by the term $\mu_{t+1} \psi_{t+1}$. In particular, when the credit constraint is expected to bind, the planner faces a strictly higher marginal cost of borrowing than the representative agent. This is a pecuniary externality because it results from the fact that the planner makes borrowing choices at t taking into account that the credit constraint could bind at $t+1$, and if it does the Fisherian debt-deflation mechanism will cause a collapse of the relative price of nontradables that will shrink borrowing capacity. The representative agent takes prices as given at all times, and thus does not internalize these effects.

News about domestic fundamentals and regime-switching of global liquidity have important effects on the pecuniary externality. “Good news” at t about future domestic income lead to higher consumption, and since that increase in income has not been realized yet, this leads to an increase in borrowing which makes the economy more vulnerable to hitting the credit constraint. On the other hand, by increasing expected future income, the good news also increase on expectation the future borrowing capacity and at the same time reduce future borrowing needs. As a result, we

⁹The term in square brackets measures how total income in units of tradable goods, which equals the value of collateral, changes with the choice of b_{t+1} , because this choice alters consumption and production plans and the relative price of nontradables.

will show below that good news generate a larger fat tail in the distribution of capital flows, by generating an increase in capital inflows and exposing the economy to events where good news turn out not be realized ex post. The regime shifts in global liquidity affect the pecuniary externality because lower interest rates make borrowing cheaper, and lead the economy to take on more debt. A sudden increase in the interest rate, or an adverse income shock, can lead to a decline in consumption, which in turn makes the credit constraint tighter and leads to a sharp reduction in capital flows.

Labor reallocation also plays an important role in debt dynamics and interacts with news and the shocks to interest rates. When the economy experiences low interest rates, this leads to an increase in the demand for consumption and a reallocation of labor from the tradable to the non-tradable sector. As a result, the economy borrows more to sustain the level of tradables consumption and becomes more exposed to adverse shock. In a financial crisis, however, the drop in the relative price of nontradables induces the economy to reallocate labor to the tradables sector, which in turn mitigates the drop in prices and the contraction in the borrowing capacity.

It is also useful to contrast this analysis of labor reallocation with the mechanism examined in the work [Benigno et al. \(2013\)](#). The key difference is in that in our setup the planner does not control the allocation of labor, it only regulates credit markets. In [Benigno et al. \(2013\)](#), this leads to an additional instrument that allows to some extent credit constraints ex post and they show that this can lead the planner to borrow more. We can show, however, that in our setup even if we allow the planner to choose labor allocations, there would still be a strictly positive wedge between the social and the private marginal cost of borrowing.

The constrained-efficient allocations and prices that solve the planner's problem can be decentralized as a competitive equilibrium using various policy instruments, including taxes on debt, loan-to-value ratios, capital requirements or reserve requirements (see [Bianchi \(2011\)](#), [Stein \(2012\)](#)). Since the market failure is a pecuniary externality, the natural instrument to consider is a standard tax on the cost of the good associated with the externality, in this case the cost of borrowing. Taxing the cost of borrowing at a rate τ_t , the cost of purchasing bonds in the budget constraint becomes $[q_t/(1 + \tau_t)]b_{t+1}$. The optimal macroprudential tax can then be derived as the value of τ_t , which varies across time and states of nature, that equates the Euler equations of bonds of the social planner and the decentralized equilibrium with the tax. Hence, the tax induces private agents to face the social marginal cost of borrowing in the states in which this cost differs from the private cost in the absence of macroprudential policy (assuming in addition that the revenue of the tax is rebated to the household as a lump-sum transfer).¹⁰ The optimal macro-prudential tax can be expressed as follows when the credit constraint does not bind:

$$\tau_t = \frac{\mathbb{E}_t [\mu_{t+1} \psi_{t+1}]}{\mathbb{E}_t [u_T(t + 1)]} \quad (18)$$

¹⁰[Bengui and Bianchi \(2014\)](#) study the case where taxes on debt are not perfectly enforceable and show that while this creates a trade-off between the prudential benefits and allocative inefficiencies, taxes remain highly desirable.

Notice that this tax captures the pecuniary externality, which reflects the possibility of a financial crisis the following period, as analyzed above.¹¹

4 Quantitative Analysis

4.1 Calibration

The calibration follows closely [Bianchi \(2011\)](#), which was based on data for Argentina. The parameter values used to calibrate the model are shown in [Table 1](#). We use a constant-relative-risk-aversion utility function of the form: $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$. Note also that, to keep the set of exogenous shocks small, we assume that the nontradables endowment is constant. The mean endowment of tradables and the deterministic nontradables endowment are both normalized to 1 for simplicity. The coefficient of relative risk aversion is set to a standard value in the DSGE literature, $\gamma = 2$. For now, we set the value of the elasticity of substitution $1/(1 + \eta) = 1$.¹² In addition, we set $\alpha_T = 0.57, \alpha_N = 0.67$ to capture that non-tradable goods are relatively more intensive on labor.

The Markov processes of the tradables production TFP and news shocks are set as follows. First, we set the Markov process of A^T to include three realizations ($N = 3$), and determine the values of these realizations and their transition probability matrix using the Tauchen-Hussey quadrature algorithm. The algorithm uses the calibrated parameters $\rho_{A^T} = 0.57$ and $\sigma_{A^T} = 0.097$, which are set to match the first-order autocorrelation (0.54) and standard deviation (0.059) of tradables GDP in Argentina in the 1965-2007 period, defining the tradables sector as the sum of manufacturing and primary products. Second, to set the precisions of the date-t signals about y_{t+1}^T , consider that the signals also have three realizations. Hence, following the news framework described earlier, setting $\theta = \frac{1}{3}$ would imply that signals are completely uninformative, while setting $\theta = 1$ would make the signals a perfect predictor of y_{t+1}^T as of date t. In the calibration baseline we set θ to the mid point between these two extremes, so $\theta = \frac{2}{3}$. For simplicity, we also assume that the signal realizations and the vector of realizations of y^T are identical.

The regime-switching process of the world interest rate is calibrated to capture the global liquidity phases identified in the studies by [Calvo et al. \(1996\)](#) and [Shin \(2013\)](#), using data on the ex-post net real interest rate on 90-day U.S. treasury bills from the first quarter of 1955 to the third quarter of 2014 (see [Figure 1](#)). [Calvo et al. \(1996\)](#) identified in data for the 1988-1994

¹¹When the constraint binds, there is a range of taxes that implements the constrained efficient allocations. In particular, τ such that $u'(c_t) > \beta R(1 + \tau)Eu'(c_{t+1})$ with all variables evaluated at the allocations of the social planner would implement the same allocations. Notice that a zero tax implements these allocations as long as $u'(c_t) > \beta REu'(c_{t+1})$.

¹²As [Bianchi \(2011\)](#) reports, empirical estimates of the elasticity of substitution range between 0.40 and 0.83—we use a value of one for numerical reasons at this point. The value of η is important because it determines the elasticity of substitution in consumption of tradables and nontradables ($1/(1 + \eta)$), which in turn affects the response of the price of nontradables to changes in sectoral consumption allocations and hence the size of the pecuniary externality. A higher value is associated with a smaller pecuniary externality.

period a surge in capital inflows to emerging markets that coincided with a through of -1 percent in the net U.S. real interest rate in the second half of 1993. [Shin \(2013\)](#) found two global liquidity phases, one in the first half of the 2000s with a real interest rate through of around -5.5 percent in early 2004, and another one in the aftermath of the 2008 global financial crisis, with the net real interest rate also hovering around -3 percent since 2009. Taking the average over the troughs in the Calvo et al. sample and in the first of Shin’s global liquidity phases, we set a -3.28 percent real interest rate for the high liquidity regime, which in gross terms implies $R^l = 0.9672$. Given this, and the transition probabilities across regimes calibrated below, we set $R^h = 1.0145$ so that the mean interest rate of the regime-switching process matches the full-sample average in our data, which was 0.76 percent.

Constructing estimates of the duration of the global liquidity phases is more difficult, because the era of financial globalization, and hence global liquidity shifts, started in the 1980s, and of the three global liquidity phases observed since then, the third is heavily influenced by the unconventional policies used to contain the crisis. Using data from the first two phases, it follows that the duration of R^l was 10 quarters, which thus leaves a duration for R^h of 60 quarters starting the sample in 1980. Taking these as rough estimates of the mean durations of each regime yields $F_{hh} = 0.9333$ and $F_{ll} = 0.6$ for our annual model. In the baseline model, we set R at its mean of the estimated Markov chain, $R = 1.0077$, and use κ shocks to characterize global liquidity regime. We then study an alternative specification by fixing κ and using $R^l = 0.9672$ and $R^h = 1.0145$ to characterize global liquidity regime.

[Bianchi \(2011\)](#) also set the values of $\beta = 0.91$, $\omega = 0.32$ and $\kappa_L = 0.315$ so that three long-run moments of the decentralized equilibrium of the economy match three target moments of the data for Argentina: the share of tradables consumption in the CES aggregator, the average net foreign asset position-GDP ratio, and the observed frequency of financial crises. We use the same parameter values as in [Bianchi \(2011\)](#) since our model produces long-run moments which are similar to his. In addition, we set the working capital parameter to $\bar{h} = 0.5$. With this value the working capital constraint binds at about the same time as the credit constraint.

The model is solved using the time iteration method as in [Bianchi \(2011\)](#), but with the difference that we introduce the news shocks to tradables income as in [Durdu et al. \(2013\)](#), and the interest-rate shock has the regime-switching specification described earlier. Appendix B describes the solution method in detail and provides references to a Matlab code used to solved the model.

4.2 Long-run and Financial Crises Moments

Table 2 shows a subset of the moments that characterize the decentralized equilibrium without policy (DE) and the social planner’s equilibrium (SP) that reflects the optimal macroprudential policy. The top panel shows three key long-run moments, the mean net foreign asset position-GDP ratio, the standard deviation of the current account-output ratio, and the probability of a

financial crisis, and also the welfare gain of adopting the optimal policy.¹³ The mean debt ratios just under 30 percent are about the same in the two scenarios (recall the DE baseline calibration set $\beta = 0.91$ to match the average NFA-GDP ratio in the data for Argentina, which is 29 percent), but the variability of the current account in DE is roughly twice as large as in SP. Thus, the two economies support the same long-run debt position, but the optimal macroprudential policy reduces the volatility of capital flows by a half. The policy also reduces the probability of crisis from 3.4 percent in DE to 2 percent in SP.

The mid panel of Table 2 shows five moments that summarize the main features of financial crises: the drops in aggregate consumption (ΔC) and the real exchange rate (ΔRER), the reversal in the current account-output ratio ($\Delta CA/Y$), and the exogenous decline in the tradables endowment (Δy^T). These statistics are averages of the impact effects that occur when a financial crisis hits, and they are computed using the model's long run distribution of the state variables (b, z) conditional on the economy being in a financial crisis state. The Table also shows the average macroprudential tax before a crisis occurs ($E[\tau]$ *pre-crisis*), and a set of financial amplification coefficients (Ω^i for $i = C, RER, CA/y$). These coefficients measure the excess response of each variable in states with b such that a financial crisis occurs relative to states with b such that there are no financial crises, both with identical values of z .

The results in the DE column show that financial amplification in this model is powerful, resulting in significant declines in consumption and the real exchange rate, and large current-account reversals. Moreover, financial amplification coefficients are large, showing that the same shocks generate significantly larger responses in financial crises states than in non-crises states.¹⁴

Comparing across DE and SP columns shows that an average pre-crisis tax of 5.15 percent reduces significantly the effects of the financial amplification on consumption, relative prices and capital inflows. In short, the optimal policy is quite effective at reducing both the probability and the magnitude of financial crises.

The bottom panel of Table 2 isolates the effects of switches in the global liquidity regime, from high global liquidity (κ^h) to low global liquidity (κ^l). When they occur, financial crises are more severe, resulting in impact effects on consumption, the real exchange rate and the current account larger than on the average financial crisis. As a result, the average optimal tax pre-crisis is also higher than in the average crisis (7.5 v. 5.2 percent).

Figure 2 plots event-analysis windows that highlight the dynamics around financial crisis events. These windows span seven years and are centered on the year of the financial crisis. The movements that occur when financial crises hit emerge clearly as non-linear fluctuations relative to the pre- and post-crises patterns. The plots also compare the dynamics of the DE with those of the SP.

¹³A financial crisis is defined as a state in which the collateral constraint binds and the current account rises by more than two standard deviations (i.e. more than 7 percentage points of GDP).

¹⁴This finding extends to variants of this model that introduce the Fisherian mechanism into otherwise conventional RBC models of the small open economy. In particular, [Mendoza \(2010\)](#) found that real shocks of standard size generate effects several orders of magnitude larger when the credit constraints bind than when they do not.

The effectiveness of the optimal macroprudential policy at reducing the severity of financial crises is again visible in these event windows.

The effects of the pecuniary externality on borrowing choices, particularly the incentive to overborrow in the DE and the effectiveness of the macroprudential policy at containing it are both illustrated in the long-run distribution of bond holdings shown in Figure 3. The planner's distribution is clearly shifted to the right of the distribution in the DE.

Figure 4 shows the relevance of the three exogenous shocks at work in the model in the seven periods covered in the event windows. As one would expect, financial crises are periods that largely coincide with low liquidity and low income realizations. But what is more interesting, and captures the effects of the news shocks discussed in the previous section, is that financial crises only occur about half the time when bad news are received (i.e. at $t=0$ in the top panel of Figure 4, good or average news occur with about 0.5 frequency). Moreover, in the pre-crisis phase the global liquidity is more likely to be low and the income realization more likely to be average, but good news are likely to be received with about 40 percent frequency in the period before a financial crisis hits. Hence, financial crises in which news are good a year before and then turn bad (because the income realizations turn out to be low) are quite common.

Figure 6 shows the evolution of the optimal macroprudential tax in the seven-year crisis windows, and also compares the tax dynamics for the baseline value of θ with two alternatives, one where news are less informative (low news accuracy) and one in which news are very informative (high news accuracy). We discuss the effects of news precision later in this Section. In the baseline case, the plot shows the pro-cyclical nature of the optimal tax. The tax rises from about 4 to nearly 6 percent in the years before the crisis, and then drops at the time of the crisis. The tax rises rapidly again in the years after the crisis, which indicates that the policy is quite active most periods and entails significant variability across states of nature.

4.3 Effects of News and the Global Liquidity Regime

We study next the roles that news shocks and global liquidity regime switches play in the baseline results. To start the analysis, Table 3 reports how the moments reported for the baseline scenario in Table 2 change as the precision of the date- t news about A_{t+1}^T varies. The baseline precision was set to $\theta = 0.66$, and Table 3 compares this scenario with four alternatives, two with lower precision ($\theta = 0.35, 0.55$) and two with higher precision ($\theta = 0.75, 0.95$). Recall that the signals are completely uninformative for $\theta = 0.33$, and that for $\theta = 1$ the signal predicts perfectly the value of A_{t+1}^T as of date t . Hence, the values considered in Table 3 range from nearly completely uninformative signals to nearly perfectly informative.

Table 3 shows that the mean of b/y rises slightly and monotonically in both the DE and the SP as the signal precision improves. This is because as signals become more informative they reduce the uncertainty about tomorrow's income, and thus the incentive for self insurance weakens. The

effect is small because this reduction in uncertainty affects mainly the income realization at $t + 1$ expected as of date t , and hence has a much smaller effect on the overall income uncertainty. The variability of the current account also rises monotonically with the precision of the news in both economies. The probability of financial crises in the DE declines monotonically from about 6.5 percent with $\theta = 0.35$ to just 1.2 percent with $\theta = 0.95$, but for the SP the changes are not monotonic. The probability first rises with θ and then falls when θ rises from 0.66 to 0.95. These differences across DE and SP, and the non-monotonicity in the SP case reflect the net result of the offsetting effects of news on borrowing decisions discussed earlier: Good news at date t about A_{t+1}^T induce additional borrowing at t , increasing financial vulnerability, while at the same time the expected future borrowing capacity rises, and reduces future borrowing. In the DE the second effect always dominates, but in the SP the first effect dominates at first as θ rises, but at high θ the second effect dominates. The difference across the DE and SP results is because of the interaction of the effects of news with the removal of the overborrowing effect of the pecuniary externality in the SP allocations.

The mid panel of Table 3 shows an important result: Higher news precision produces significantly larger financial crises in both the DE and SP for precision values of less than 0.95. In the DE, the average consumption drop and current account reversal in a financial crisis are significantly larger with $\theta = 0.75$ than with $\theta = 0.35$ (-19.2 v. -13.8 percent for consumption, and 17.1 v. 9.8 percentage points for the current account-output ratio).

It worth noting that the effectiveness of the macroprudential policy displays a non-monotonic pattern as the precision of news improves. The differences in the drops in C and RER , and in the reversal in CA/Y across the DE and the SP all rise as θ rises from 0.35 to 0.75, but from 0.75 to 0.95 all three differences narrow significantly. The mean debt tax pre crisis is monotonically increasing with news accuracy from 4.91 percent to 6.03 percent. These results reflect the fact that both private agents and the planner observe and respond to the news shocks, and thus some of the financial instability that results from the effects of news on borrowing choices, and from the possibility that ex-post the news turn out to be wrong, is not something that the macroprudential policy can tackle. It can only tackle the amplification of these effects that occurs via the pecuniary externality.

Figure 5 illustrates different exogenous states around crisis for different news accuracy θ . We plot three-year crisis window: two periods before the crisis and crisis period. The first row plots the portion of bad news received, the second row plots the portion of high liquidity regime and the third row shows bad A_T shock. As we can see from the first row, the bad news consistently stays around one third across these three periods when news signal is not informative. When the news signal is very accurate, almost half of the crises are preceded by bad news. However, when the news exhibits some extent of predictability but not very accurate (average case), only a small portion of crises is preceded by bad news. For the global liquidity regime, all crises happen in low liquidity regime, but the majority of crises is triggered by the liquidity switch only when the news

signal is very accurate. Thus, the global liquidity becomes a dominant force in triggering financial crises only if there are less surprises in domestic income realization. When the news signal is less accurate, all crises coincide with bad A_T shock, and are preceded by less bad A_T shock. When the news signal is accurate, some crises happen with average A_T , possibly trigger by a global liquidity switch.

Figure 6 shows that, in the seven-year event windows, the debt taxes are generally higher at higher θ before and after a financial crisis, which is in line with the above finding that mean debt taxes pre-crises are higher at higher θ .

To illustrate the complexity of the optimal debt tax schedule, and how it varies with the three values that the signals can take in the baseline case (with $\theta = 0.66$), Figure 7 shows the schedule of debt taxes for bad, average and good news as a function of the value of b organized in four plots: (a) for low A^T and κ_l , (b) for high A^T and κ_l , (c) for low A^T and κ_h , and (d) for high A^T and κ_h . When the date- t income shock is high, debt taxes tend to be the highest when bad news about income at $t + 1$ arrive, and they fall as the news turn average or good (for both κ_h and κ_l). But the ranking changes when the income shock is low, and in this case the ordering also varies depending on whether b is relatively low or high. In particular, for sufficiently low b the ordering of debt taxes as news vary is exactly the opposite of what we obtained when A^T is high: Debt taxes are the highest when news is good, and fall as news turns average to bad. This pattern once again reflects the opposing forces affecting borrowing decisions with the news shocks, and their interaction with the actual income realization. What does remain the case in all scenarios is that, for sufficiently high b the tax is zero (this is the region where the credit constraint does not bind at t and is not expected to bind at $t + 1$), and that as b falls below a threshold value the debt tax always rises as b falls (i.e. the debt tax is increasing in debt).

Figure 8 shows a similar analysis of the debt tax as Figure 7 but now highlighting how debt taxes differ across global liquidity regimes. In this case, we find that debt taxes, when present, are slightly lower in states with high global liquidity (κ_h) than with low global liquidity (κ_l), and can be as high as more than 15 percent for low A^T , good news and high global liquidity. Moreover, there is always a range of debt positions for which the tax is zero and invariant if global liquidity is low, but positive and increasing as debt rises if global liquidity is high. Thus, these results show that optimal macroprudential policy also needs to incorporate significant variation in the policy instrument in response to changes in global liquidity.

Table ?? shows calibration parameters for an alternative specification. We target the same moment conditions: the share of tradables consumption in the CES aggregator, the average net foreign asset position-GDP ratio, the first order autocorrelation and standard deviation of tradables GDP. Table 5 shows that our results are qualitatively the same except that there are less crises resulting from global liquidity switch.

5 Conclusions

This paper introduced news shocks about future income and regime switches in global liquidity to a Fisherian model of financial crises and macroprudential policy. We characterized analytically an optimal tax on debt that removes the pecuniary externality causing credit market failure in the decentralized equilibrium without policy intervention. This pecuniary externality exists because debt is constrained not to exceed a fraction of the agents' income valued in units of tradable goods, and as a result private agents do not internalize the effects of their borrowing decisions on the equilibrium relative price of nontradables that determines their access to credit. The relative price of nontradables affects borrowing capacity both directly, since it determines the value of nontradables income in units of tradables, and indirectly, because it drives sectoral factor allocations and thus sectoral income.

Quantitative results from an experiment calibrated using data for Argentina show that both news shocks and global liquidity regimes have important effects on the Fisherian financial amplification mechanism. Macroprudential debt taxes are effective tools for reducing both the frequency and magnitude of financial crises, but the effectiveness of the policy varies in a non-monotonic fashion with the precision of the news about future income. At low levels of precision the effectiveness of the policy improves as precision rises, but when precision is high, the effectiveness of the policy falls sharply as precision improves further. At high precision levels, financial crises can be quite severe, but they occur with much lower probability. Moreover, the results also show significant variation of optimal debt taxes when news are good v. bad, when the precision of news varies, and when the regime of global liquidity shifts.

Overall, the findings of this paper illustrate the importance of considering unconventional sources of financial instability, such as news about future economic fundamentals and regime-switches in global liquidity, in the design and evaluation of macroprudential policies.

6 Appendix A: Planner's optimality conditions

Combine [equation \(12\)](#), [equation \(14\)](#), [equation \(16\)](#), and [equation \(17\)](#) to obtain $c^T = \left\{ \frac{\omega}{1-\omega} A^T (A^N)^\eta (h^T)^{\alpha-1} (\bar{h} - h^T)^{\alpha\eta+1} \right\}^{\frac{1}{\eta+1}}$. Rewrite this expression as a function of the labor allocated to tradables production: $c^T \equiv f(h^T)$ where $\phi(h^T) = f'(h^T)$. Notice also that the right-hand-side of the credit constraint [equation \(15\)](#) can be reduced to $-\kappa \{A^T \bar{h} (h^T)^{\alpha-1} + x\}$. To show this, first recall the firms' optimality conditions:

$$\begin{aligned}\pi^T &= (1 - \alpha) A^T (h^T)^\alpha \\ \pi^N &= (1 - \alpha) p^N A^N (h^N)^\alpha \\ w &= \alpha A^T (h^T)^{\alpha-1} \\ w &= \alpha p^N A^N (h^N)^{\alpha-1} \\ \bar{h} &= h^T + h^N\end{aligned}$$

It follows from the above that the household's total income at equilibrium can be expressed as: $\pi^T + \pi^N + w\bar{h} = A^T (h^T)^\alpha + p^N A^N (h^N)^\alpha$. Moreover, using the firm's condition equating the relative price of nontradables with the marginal rate of technical substitution of labor across sectors and the labor market-clearing condition, the right-hand-side of this expression can be simplified further as follows:

$$\begin{aligned}A^T (h^T)^\alpha + p^N A^N (h^N)^\alpha &= A^T (h^T)^\alpha + \frac{A^T}{A^N} \left(\frac{h^T}{h^N} \right)^{\alpha-1} A^N (h^N)^\alpha \\ &= A^T (h^T)^\alpha + A^T (h^T)^{\alpha-1} (\bar{h} - h^T) \\ &= A^T \bar{h} (h^T)^{\alpha-1}\end{aligned}$$

Hence, at equilibrium prices and allocations for which factor and goods markets remain competitive, the collateral constraint $qb' \geq -\kappa \{ \pi^T + \pi^N + w\bar{h} + x \}$ is equivalent to $qb' \geq -\kappa \{ A^T \bar{h} (h^T)^{\alpha-1} + x \}$.

Using $c^T \equiv f(h^T)$, the labor market-clearing condition, and the above result, the planner's

problem can be rewritten as:

$$\begin{aligned}
V(b, s) &= \max_{\{h^T, b'\}} U(C(f(h^T), A^N(\bar{h} - h^T)^\alpha)) + \beta EV(b', s') \\
s.t. \quad (\lambda) \quad & f(h^T) + qb' = b + A^T(h^T)^\alpha \\
(\mu) \quad & qb' \geq -\kappa \{A^T\bar{h}(h^T)^{\alpha-1} + x\}
\end{aligned}$$

$$\begin{aligned}
\text{where} \quad f(h^T) &= \left\{ \frac{\omega}{1-\omega} A^T (A^N)^\eta (h^T)^{\alpha-1} (\bar{h} - h^T)^{\alpha\eta+1} \right\}^{\frac{1}{\eta+1}} \\
C(c^T, c^N) &= \left[\omega (c^T)^{-\eta} + (1-\omega) (c^N)^{-\eta} \right]^{-\frac{1}{\eta}}
\end{aligned}$$

The optimality conditions of the above planner's problem are:

$$\begin{aligned}
(\partial h^T) \quad & u_T(t)\phi(h^T) - u_N(t)\alpha A^N (h^N)^{\alpha-1} \\
& + \lambda \{A^T \alpha (h^T)^{\alpha-1} - \phi(h^T)\} \\
& + \mu \kappa A^T \bar{h} (\alpha - 1) (h^T)^{\alpha-2} \\
& = 0
\end{aligned}$$

$$(\partial b') \quad \lambda = \frac{\beta}{q} \mathbb{E}[\lambda'] + \mu$$

The first-order condition for (∂h^T) can also be rewritten as follows:

$$\begin{aligned}
& u_T(t)\phi(h^T) - \underbrace{u_N(t)}_{=p^N u_T(t)} \alpha A^N (h^N)^{\alpha-1} \\
& + \lambda \left\{ \underbrace{A^T \alpha (h^T)^{\alpha-1}}_{=w} - \phi(h^T) \right\} \\
& + \mu \kappa A^T \bar{h} (\alpha - 1) (h^T)^{\alpha-2} \\
= & u_T(t)\phi(h^T) - u_T(t) \underbrace{p^N \alpha A^N (h^N)^{\alpha-1}}_{=w} \\
& + \lambda \{w - \phi(h^T)\} \\
& + \mu \kappa A^T \bar{h} (\alpha - 1) (h^T)^{\alpha-2} \\
= & -u_T(t) \{w - \phi(h^T)\} + \lambda \{w - \phi(h^T)\} \\
& + \mu \kappa A^T \bar{h} (\alpha - 1) (h^T)^{\alpha-2} \\
= & 0
\end{aligned}$$

Solving for λ from the above expression yields:

$$\lambda = u_T(t) + \frac{\mu \kappa A^T \bar{h} (1 - \alpha) (h^T)^{\alpha-2}}{w - \phi(h^T)}$$

where $w = \alpha A^T (h^T)^{\alpha-1}$

References

- Beaudry, P. and Portier, F. (2006). ‘Stock prices, news, and economic fluctuations’. *The American economic review*, vol. 96, no. 4, 1293–1307.
- Bengui, J. and Bianchi, J. (2014). ‘Capital Flow Management when Capital Controls Leak’. Mimeo, University of Montreal.
- Benigno, G., Chen, H., Otrok, C., Rebucci, A., and Young, E. R. (2013). ‘Financial crises and macro-prudential policies’. *Journal of International Economics*, vol. 89, no. 2, 453–470.
- Bianchi, J. (2011). ‘Overborrowing and Systemic Externalities in the Business Cycle’. *American Economic Review*, vol. 101, no. 7, 3400–3426.
- Bianchi, J., Boz, E., and Mendoza, E. G. (2012). ‘Macroprudential Policy in a Fisherian Model of Financial Innovation’. *IMF Economic Review*, vol. 60, no. 2, 223–269.
- Bianchi, J. and Mendoza, E. G. (2010). ‘Overborrowing, Financial Crises and ‘Macroprudential’ Policy’. NBER Working Paper No. 16091.
- Bianchi, J. and Mendoza, E. G. (2013). ‘Optimal Time-Consistent Macroprudential Policy’. Technical report, National Bureau of Economic Research.
- Borio, C. (2013). ‘The financial cycle and macroeconomics: What have we learnt?’ *Journal of Banking & Finance*.
- Boz, E. and Mendoza, E. G. (2014). ‘Financial innovation, the discovery of risk, and the US credit crisis’. *Journal of Monetary Economics*, vol. 62, 1–22.
- Bruno, V. and Shin, H. S. (2014). ‘Cross-Border Banking and Global Liquidity’.
- Calvo, G. A., Leiderman, L., and Reinhart, C. M. (1996). ‘Inflows of Capital to Developing Countries in the 1990s’. *The Journal of Economic Perspectives*, pages 123–139.
- Durdu, C. B., Nunes, R., and Sapriza, H. (2013). ‘News and sovereign default risk in small open economies’. *Journal of International Economics*, vol. 91, no. 1, 1–17.
- Farhi, E. and Werning, I. (2012). ‘Dealing with the trilemma: Optimal capital controls with fixed exchange rates’. NBER Working Paper No. w18199).
- Galati, G. and Moessner, R. (2013). ‘Macroprudential policy—a literature review’. *Journal of Economic Surveys*, vol. 27, no. 5, 846–878.
- Galati, G. and Moessner, R. (2014). ‘What do we know about the effects of macroprudential policy?’

- Jaimovich, N. and Rebelo, S. (2009). ‘Can News about the Future Drive the Business Cycle?’ *The American economic review*, vol. 99, no. 4, 1097–1118.
- Jeanne, O. and Korinek, A. (2010). ‘Managing Credit Booms and Busts: A Pigouvian Taxation Approach’. NBER Working Paper No 16377.
- Korinek, A. (2011). ‘The new economics of prudential capital controls: A research agenda’. *IMF Economic Review*, vol. 59, no. 3, 523–561.
- Korinek, A. and Mendoza, E. G. (2014). ‘From Sudden Stops to Fisherian Deflation: Quantitative Theory and Policy Implications’. *Annual Review of Economics*, vol. 6, no. 1.
- Martin, A. and Ventura, J. (2014). ‘Managing credit bubbles’. Technical report, National Bureau of Economic Research.
- Mendoza, E. G. (2010). ‘Sudden Stops, Financial Crises, and Leverage’. *The American Economic Review*, vol. 100, no. 5, 1941–1966. ISSN 0002-8282.
- Mendoza, E. G. and Terrones, M. E. (2012). ‘An anatomy of credit booms and their demise’. Technical report, National Bureau of Economic Research.
- Reinhart, C. M. and Rogoff, K. S. (2014). ‘Recovery from financial crises: evidence from 100 episodes’. Technical report, National Bureau of Economic Research.
- Schmitt-Grohé, S. and Uribe, M. (2012). ‘What’s news in business cycles’. *Econometrica*, vol. 80, no. 6, 2733–2764.
- Schmitt-Grohé, S. and Uribe, M. (2013). ‘Downward nominal wage rigidity, currency pegs, and involuntary unemployment’. Mimeo, Columbia University.
- Schularick, M. and Taylor, A. M. (2009). ‘Credit booms gone bust: monetary policy, leverage cycles and financial crises, 1870–2008’. Technical report, National Bureau of Economic Research.
- Shin, H. S. (2013). ‘The Second Phase of Global Liquidity and Its Impact on Emerging Economies’. Mimeo, Dept. of Economics, Princeton University, Keynote address at the Federal Reserve Bank of San Francisco Asia Economic Policy Conference, November 3-5, 2013.
- Stein, J. C. (2012). ‘Monetary policy as financial stability regulation’. *The Quarterly Journal of Economics*, vol. 127, no. 1, 57–95.

Table 1: Baseline Model Parameters

Parameter	Values
A_N	1
N_{A_T}	3
$E[A_T]$	1
ρ_{A_T}	0.57
σ_{A_T}	0.097
β	0.91
γ	2
η	0.001
α_T	0.57
α_N	0.67
κ_L	0.315
κ_H	0.45
ω	0.32
θ	$\frac{2}{3}$
R	1.00775
F_{hh}	0.9333
F_{ll}	0.6
κ	0.5

Table 2: Baseline Model Moments

Long-run Moments	(1) DE	(2) SP
$E[B/Y]$ %	-29.24	-28.50
$\sigma(CA/Y)$ %	3.59	2.34
Welfare Gain ¹ %	0.09	n/a
Prob of Crisis %	3.42	2.02
Financial Crisis Moments ²		
ΔC %	-17.64	-13.02
ΔRER %	-46.98	-31.29
$\Delta CA/Y$ %	14.91	8.76
Δy^T %	-13.93	-14.14
Δy^N %	-1.16	-1.05
Ω^C ³	3.34	2.55
Ω^{RER}	4.04	2.82
$\Omega^{CA/Y}$ %	15.00	9.17
$E[\tau]$ pre-crisis ⁴ %	5.15	n/a
Switch from High Liquidity to Low Liquidity		
Portion of HL Crisis in SS %	30.92	21.11
ΔC %	-17.87	-13.17
ΔRER %	-49.02	-32.51
$\Delta CA/Y$ %	15.39	9.10
Δy^T %	-13.93	-14.14
$E[\tau]$ pre-crisis %	7.47	n/a

¹ The welfare gain ω at state (b, y^T) is given by $(1 + \omega(b, y^T))^{1-\sigma} V^{DE}(b, y^T) = V^{SP}(b, y^T)$. The long-run average is taken over the entire ergodic distribution.

² Financial Crisis is defined as a period in which the constraint binds and the current account (CA/Y) exceeds two standard deviation of current account in the ergodic distribution of the decentralized economy.

³ Ω are financial amplification coefficients, which are ratios of these average impact effects over the average impact effects that shocks of the same magnitude produce when there are no financial crises.

⁴ The average τ in the period before crisis

Table 3: News Signal Comparison

θ	(1) 0.35		(2) 0.55		(3) 0.66		(4) 0.75		(5) 0.95	
Long-run Moments	DE	SP								
$E[B/Y]$ %	-28.62	-27.96	-28.88	-28.19	-29.19	-28.45	-29.58	-28.85	-30.55	-30.22
$\sigma(CA/Y)$ %	3.14	1.70	3.25	1.93	3.57	2.33	3.73	2.63	3.23	2.99
Welfare Gain %	0.09	n/a	0.09	n/a	0.08	n/a	0.08	n/a	0.02	n/a
Prob of Crisis %	6.50	1.18	4.22	1.88	3.43	1.95	2.70	1.88	1.19	0.53
Financial Crisis Moments										
ΔC %	-13.88	-9.79	-15.67	-11.32	-17.57	-12.90	-19.20	-14.54	-16.80	-14.20
ΔRER %	-33.25	-21.41	-39.52	-25.93	-46.82	-30.91	-53.56	-36.53	-49.79	-40.08
$\Delta CA/Y$ %	9.84	4.78	12.21	6.64	14.80	8.59	17.11	10.73	15.14	11.83
Δy^T %	-14.03	-14.30	-13.98	-14.22	-14.03	-14.24	-13.95	-14.13	-11.68	-11.69
Δy^N %	-1.14	-0.99	-1.13	-1.00	-1.16	-1.04	-1.18	-1.09	-1.17	-1.17
Ω^C	3.03	1.93	2.96	2.16	3.30	2.51	3.55	2.86	11.57	10.17
Ω^{RER}	3.05	1.88	3.32	2.27	4.01	2.76	4.61	3.33	18.93	15.20
$\Omega^{CA/Y}$ %	10.70	5.23	12.28	6.90	14.88	8.98	17.10	11.18	15.30	12.07
$E[\tau]$ pre-crisis %	4.91	n/a	4.96	n/a	5.16	n/a	5.36	n/a	6.03	n/a
Switch from High Liquidity to Low Liquidity										
Portion %	19.78	99.66	26.62	35.50	32.13	22.54	33.31	17.25	64.14	27.82
ΔC %	-18.07	-13.20	-17.46	-12.79	-17.92	-13.19	-17.72	-13.19	-13.56	-10.18
ΔRER %	-48.01	-31.66	-46.51	-30.77	-49.39	-32.60	-49.24	-33.08	-37.66	-25.42
$\Delta CA/Y$ %	15.35	8.87	14.68	8.49	15.45	9.10	15.25	9.21	10.71	6.50
$E[\tau]$ pre-crisis %	6.83	n/a	7.03	n/a	7.41	n/a	7.69	n/a	8.16	n/a

$\theta = 1$ means perfect signal, and $\theta = \frac{1}{3}$ means uninformative signal

Table 4: Alternative Model Parameters

Parameter	Values
A_N	1
N_{A_T}	3
$E[A_T]$	1
ρ_{A_T}	0.58
σ_{A_T}	0.097
β	0.91
γ	2
η	0.001
α_T	0.57
α_N	0.67
κ	0.325
ω	0.32
θ	$\frac{2}{3}$
R^h	1.0145
R^l	0.9672
F_{hh}	0.9333
F_{ll}	0.6
κ	0.5

Table 5: Alternative Model Moments

Long-run Moments	(1) DE	(2) SP
$E[B/Y]$ %	-29.69	-28.95
$\sigma(CA/Y)$ %	3.17	2.01
Welfare Gain %	0.08	n/a
Prob of Crisis %	3.02	2.16
Financial Crisis Moments		
ΔC %	-17.02	-12.33
ΔRER %	-43.53	-28.90
$\Delta CA/Y$ %	14.20	8.09
Δy^T %	-13.92	-14.11
Δy^N %	-1.10	-1.00
Ω^C	3.24	2.46
Ω^{RER}	3.84	2.61
$E[\tau]$ pre-crisis %	4.23	n/a
Switch from High Liquidity to Low Liquidity		
Portion of HL Crisis in SS %	6.33	7.33
ΔC %	-18.42	-13.46
ΔRER %	-48.73	-32.54
$\Delta CA/Y$ %	15.87	9.29
$E[\tau]$ pre-crisis %	4.90	n/a

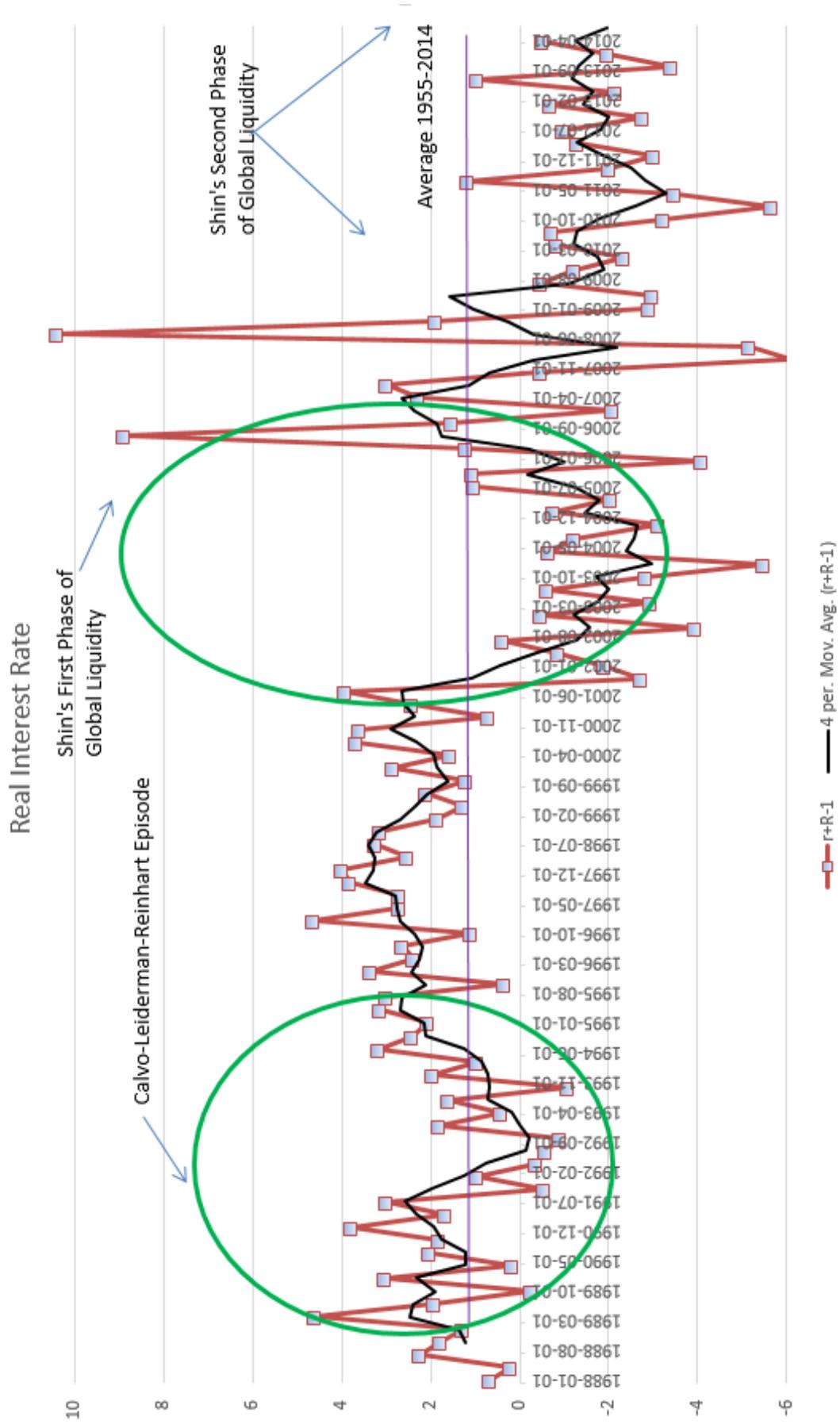


Figure 1: Global Liquidity Regimes

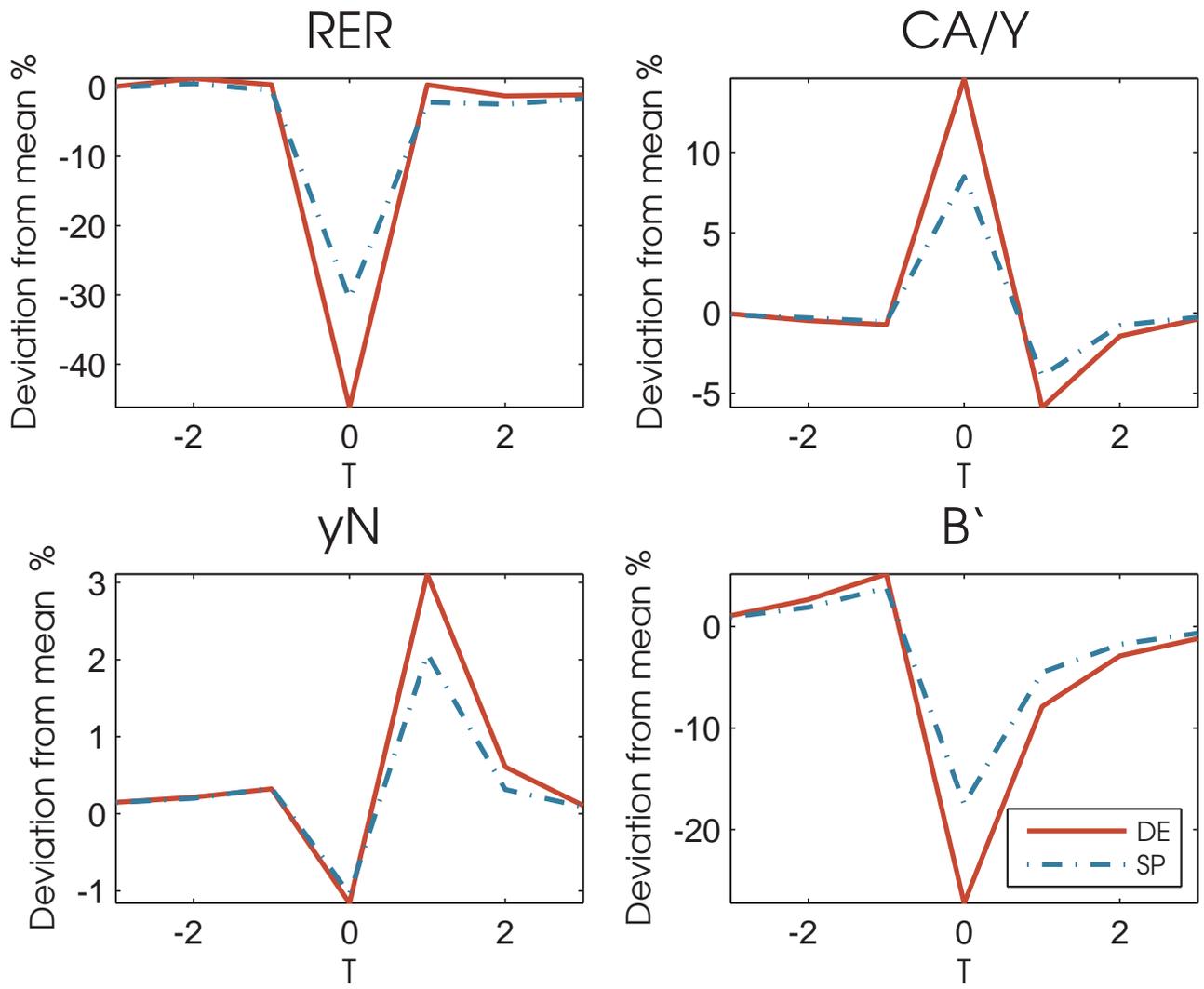


Figure 2: Baseline DE vs SP around Crisis

Bond Simulation

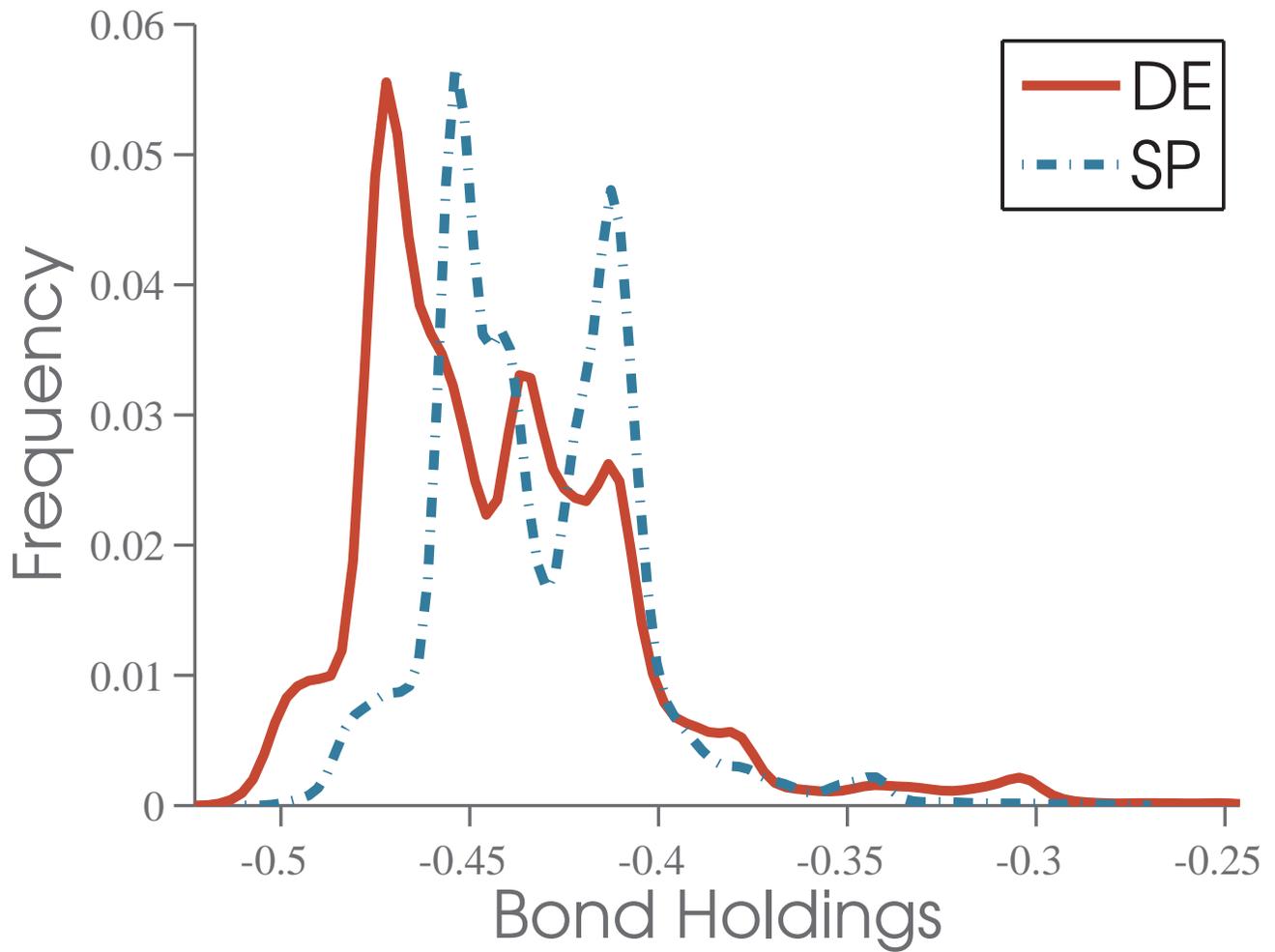


Figure 3: Baseline Ergodic Distribution of Bond Holdings

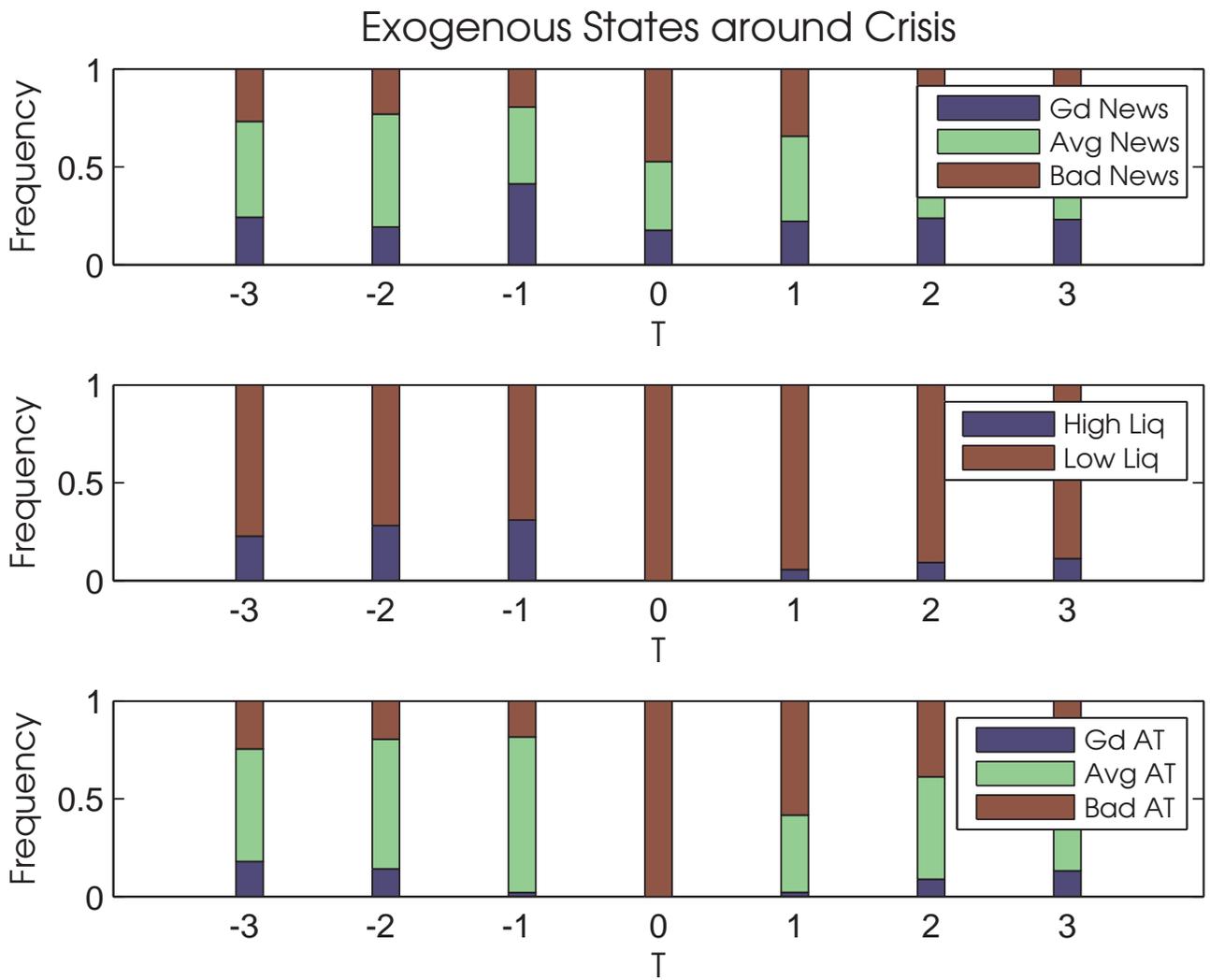


Figure 4: Baseline Exogenous States around Crisis

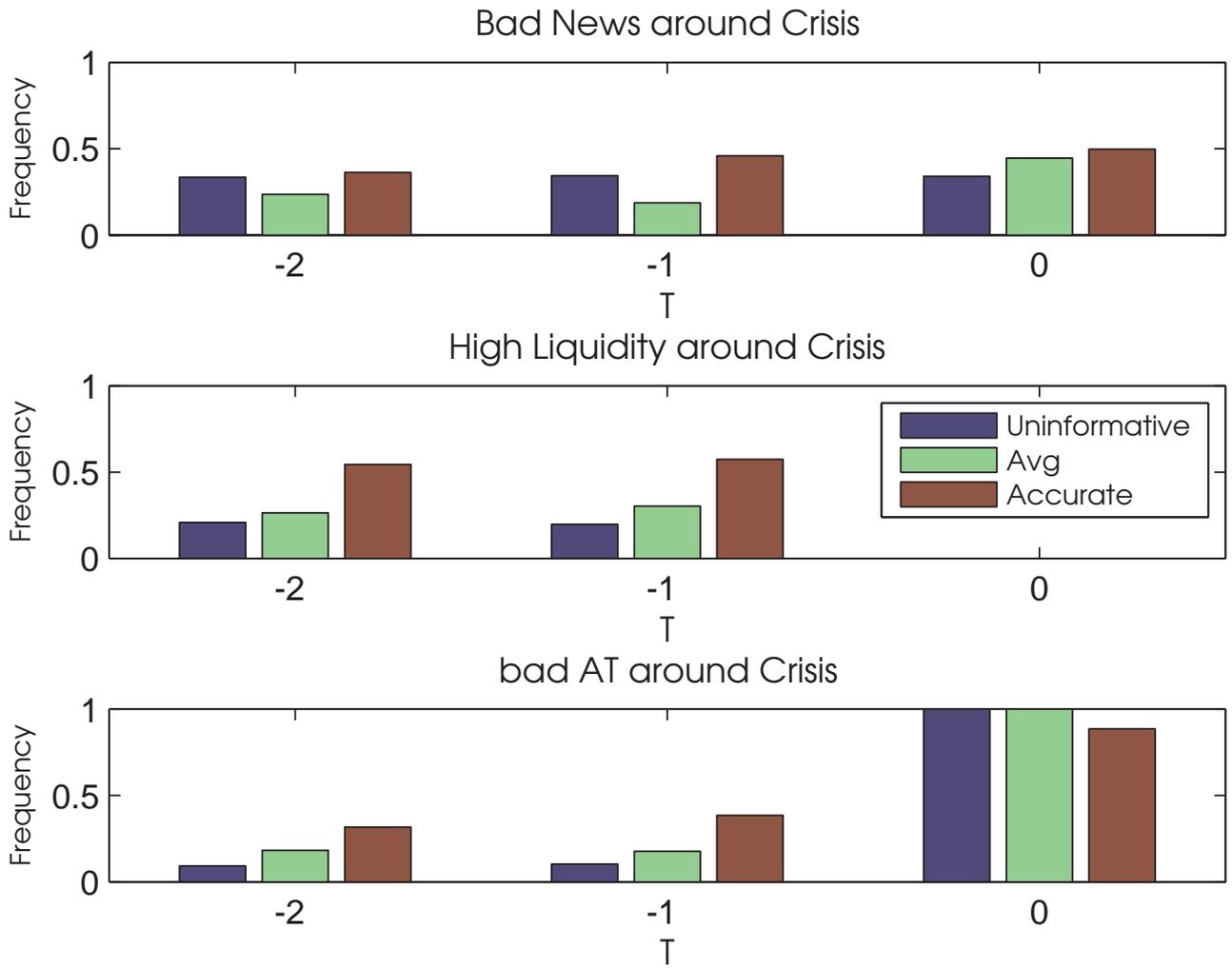


Figure 5: Exogenous States around Crisis for Different News Accuracy

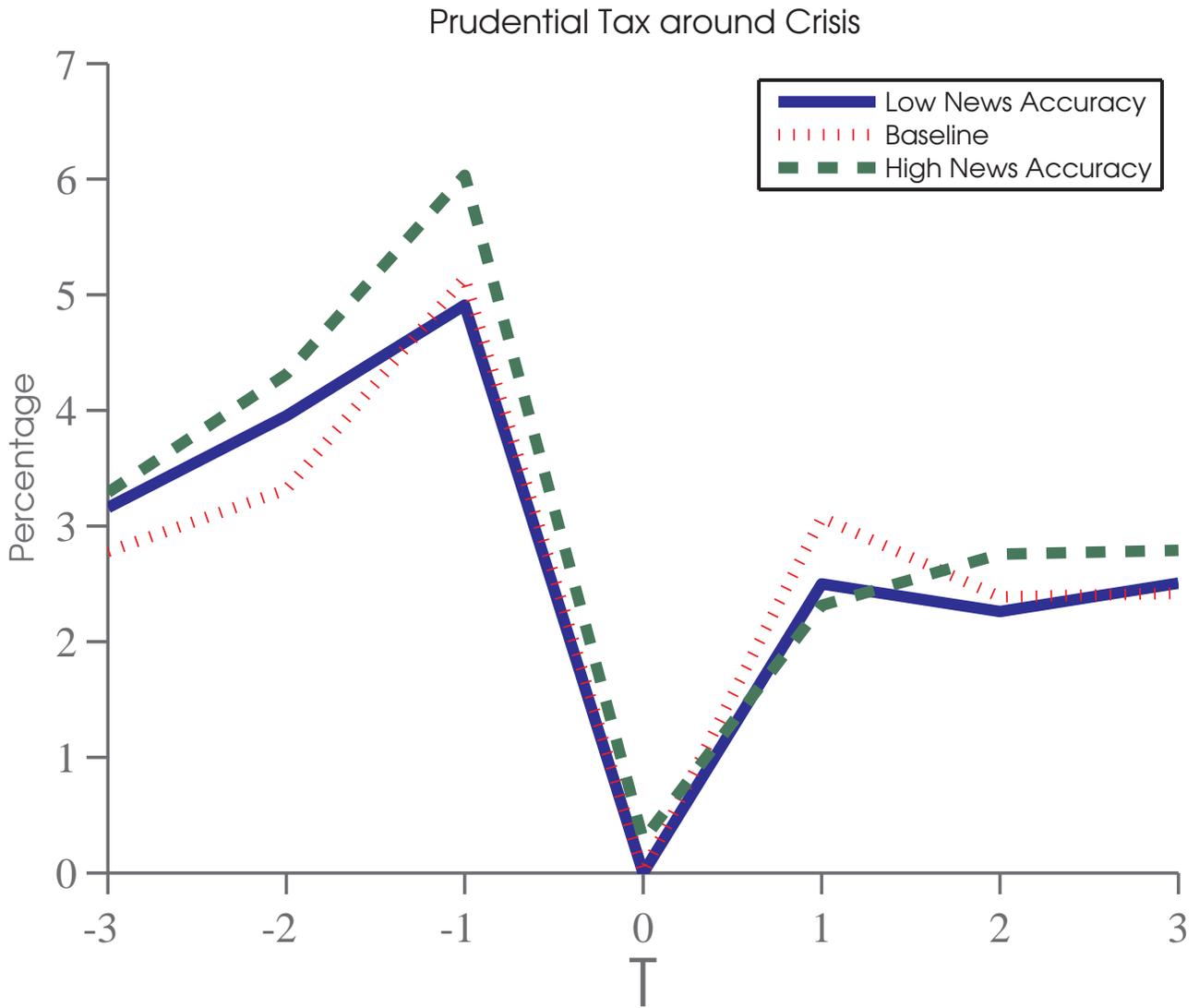


Figure 6: Optimal Macprudential Debt Tax around Crises

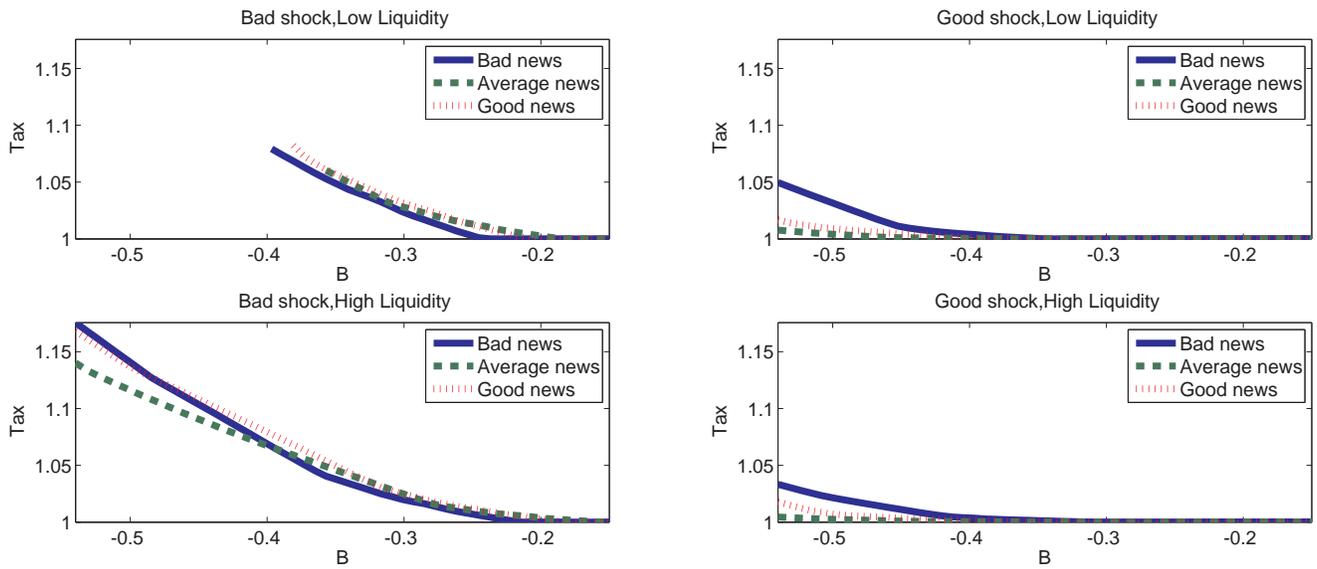


Figure 7: Baseline Debt Tax: Effect of News

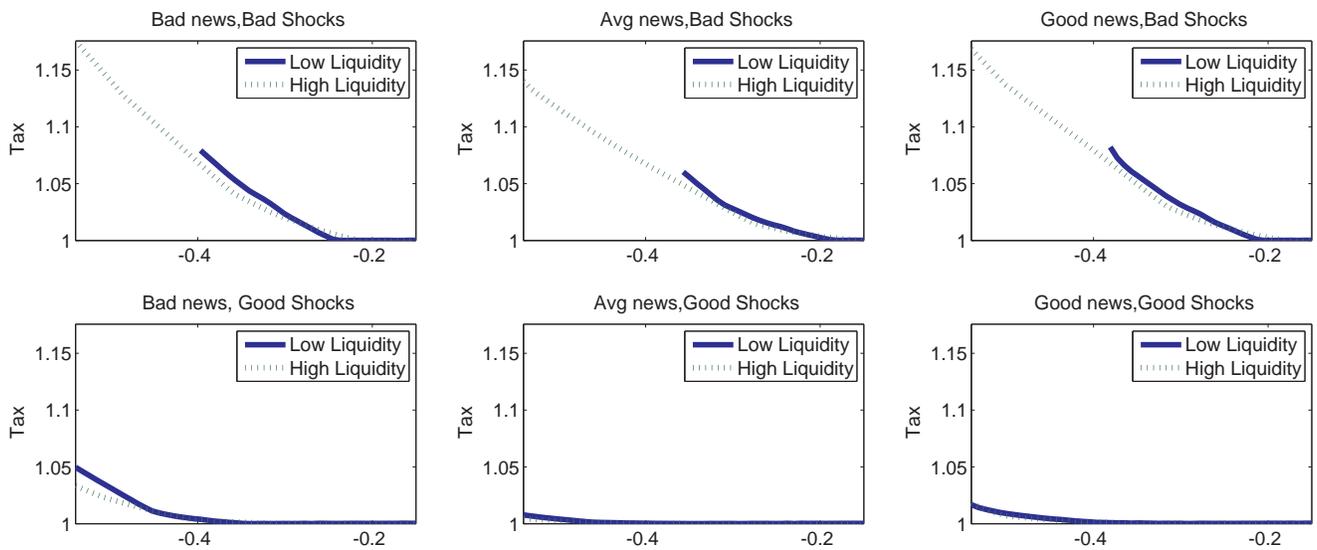


Figure 8: Baseline Debt Tax: Effect of Interest Rate