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News and sovereign default risk in small open economies*

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Abstract

This paper builds a model of sovereign debt in which default risk, interest rates, and debt depend not only on current fundamentals but also on news about future fundamentals. News shocks affect equilibrium outcomes because they contain information about the likelihood that the government repays its debt in the future. First, in the model with news shocks not all defaults occur in bad times, bringing the model closer to the data. Second, the news shocks help account for key differences between developing and more developed economies: as the precision of news improves, the model predicts lower variability of consumption, less countercyclical trade balance and interest rate spreads, as well as a higher level of debt more in line with the characteristics of more developed economies. Third, the model also captures the hump-shaped relationship between default rates and the precision of news obtained from the data. Finally, the news shocks have a nonmonotonic effect on the welfare.

JEL classification: F34, F41

Keywords: sovereign default risk; news shocks; endogenous borrowing constraints

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1 Introduction

The recent crisis in Europe has attracted renewed interest on the determinants of sovereign bond spreads. Some of the increase in sovereign bond spreads that occurred in Europe in 2008 (and after) did not seem to be solely determined by fundamentals at that time. Shifts in expectations regarding the future path of public sector expenditures and output growth have substantially influenced sovereign bond spreads and other asset prices in the euro area during the crisis. These movements reinforced the view that news about future fundamentals can be a relevant market driving force.[1]

Some statements by international credit agencies underscore the importance of news shocks during the European crisis. For instance, Greece's sovereign bond yields immediately increased following Standard & Poors (S&P) credit rating downgrade of the country on January 14, 2009. S&P pointed out that "...Following a relatively modest improvement in the general government deficit since 2004, Greek public finances are, in our opinion, entering the economic downturn with high deficits and gross debt... We believe that repeated failures to stick to budgetary plans and a longstanding over-reliance on the revenue side, aggravated by regular deficit-increasing one-offs and expenditure slippage, have led to structural weaknesses in fiscal management."[2] On March 24, 2010, Fitch Ratings cut Portugal's credit rating, underscoring, "...growing concern that Europes weakest economies will struggle to meet their debt commitments as finances deteriorate." Portuguese sovereign bond spreads increased following the announcement.[3] Similarly, in its downgrading of Spain's credit rating in 2010, S&P underscored that "...we cut Spain's credit rating because we expect the Spanish economy to grow only 0.7% on average until 2016, lower than previous forecast..."[4]

While news and default risk have been examined separately, there is very little work exploring the implications of their joint dynamics. By affecting the incentives to default, news changes the economy through the effects on interest rate spreads. Some of these forces were visibly at play in the European debt crisis, the credit rating agencies' announcements discussed above illustrated. In addition, Tomz and Wright (2007) show that a significant fraction of defaults have occurred in good times. These results suggest that current fundamentals may not be the sole determinant of

[1]We use the term "news" to refer to "news shocks."

[2]See `http://ftalphaville.ft.com/2009/01/14/51146/sp-downgrades-greece/`.

[3]About a month later, S&P also downgraded Portugal with a negative outlook arguing that "Fiscal and economic structural weaknesses in our view leave the Republic of Portugal in a comparably weak position to address the significant deterioration in its public finances and expected lackluster economic growth prospects over the medium term... We have revised downward our growth scenario for Portugal and now expect economic activity to stagnate in 2010. See `http://ftalphaville.ft.com/2010/04/27/213326/sp-cuts-portugals-ratings-two-notches-to-a/`.

[4]See Standard and Poor's Global Credit Portal RatingsDirect, Research Update, April 28, 2010.

defaults and credit spreads.

Our paper analyzes the extent to which changes in expectations—due to policy announcements or news in general—matter for macroeconomic fluctuations across countries. To pursue our goal, we build a quantitative dynamic small open economy model of sovereign debt and default subject to both contemporaneous and news shocks. Every period, the economy receives a stochastic total factor productivity (TFP) shock, as well as a noisy signal about next period's TFP. Households value private consumption and the government borrows from abroad to smooth consumption. Foreign lenders charge a risk premium that accounts for the default risk they face, so interest rate spreads reflect the time varying sovereign default risk. We examine the model implications quantitatively using direct data. Hence, we show the plausibility of our findings both from a theoretical and a quantitative perspective.

Our quantitative analysis delivers a number of novel findings. First, we find that the differences in the precision of news about future fundamentals help rationalize differences in the fluctuations of several macroeconomic variables between developing and more developed economies.[5] The model economy where there is no news largely captures the dynamics of macroeconomic variables in developing economies. As news becomes more informative, the model statistics get closer to those for more developed countries. Our first set of findings is consistent with the premise that while agents in more developed countries can generally rely on information systems that provide relatively accurate news, information is more scarce or less precise in most middle and low income countries.[6]

Second, introducing news can account for the empirical fact that not all defaults occur in bad times. We find that negative news can lead to a default, even if current output is high. Negative news regarding future fundamentals increases next period's default risk, which immediately raises the interest rate paid by the sovereign. As the sovereign faces tighter conditions to roll-over debt, it may default in the current period. This mechanism highlights that besides having direct effects, news may significantly impact default risk, which in turn alters the fluctuations of macro aggregates.

Third, the model predicts a hump-shaped relationship between default rates and the precision of news. More precise news enables agents to better manage the debt instrument used to smooth

[5] As earlier studies show, developing economies are more prone to crises, face higher interest rate spreads, and can only sustain lower debt-output ratios than their more developed counterparts (see Cantor and Packer (1996), Neumeyer and Perri (2005), Reinhart, Rogoff and Savastano (2003), and Uribe and Yue (2006), among others). In addition, these economies experience more countercyclical trade balances and sovereign interest rate spreads, making external credit more expensive in bad times.

[6] News is more precise in higher income per capita countries. In practice, higher income countries are more closely monitored and have more abundant and better quality data. See a formal analysis of this statement in Boz et. al. (2011). For an empirical study on international finance implications of transparency and quality of macroeconomic data, see Gelos and Wei (2005).

consumption, which lowers the country's default rate for any given amount of debt. At the same time, the lower risk profile allows the economy to sustain more debt in equilibrium, which leads to more defaults. As the precision of the news is enhanced from a non-informative case initially, the second effect dominates, resulting in higher observed default rates. As the signal conveys more information, the first effect gradually becomes more important, and equilibrium default rates decrease. Hence, default rates and the precision of news exhibit a hump-shaped relationship. This theoretical prediction is confirmed by the data. In particular, the finding is in line with the empirical regularity regarding the link between precision of news and historical default rates. Using data for 118 countries covering 1950-2003, we document a hump-shaped relationship between precision of news (proxied by opacity measures or the size of the forecast errors as we discuss later) and default rates. Finally, the model predicts that the news shocks have a nonmonotonic effect on the welfare. As the news precision increases, welfare initially declines slightly and then improves—compared to the no news scenario.

Our paper is related to several strands of literature. First, we borrow from the news and learning literature. Cochrane (1994) and Beaudry and Portier (2004) find that news about total factor productivity or stock prices can explain a significant portion of the forecast variance of consumption, output, and hours. Building on the real business cycle literature, Jaimovich and Rebelo (2008, 2009) and Schmitt-Grohe and Uribe (2012) explore the importance of news using log-linear approximation methods. Differently from these papers, we focus on how news shocks interact with default risk in a dynamic stochastic quantitative model of endogenous sovereign debt and default. In addition, unlike those studies, we employ nonlinear approximation methods, which are crucial in capturing changes in precautionary savings due to differences in news precision.

Building on the work of Aguiar and Gopinath (2007), Boz et al. (2011) examine the effects of trend growth and transitory shocks in small open economies. When the model economy is subject to greater uncertainty regarding the decomposition of total factor productivity to its trend growth and transitory components, the economy displays characteristics that are more similar to developing economies. Complementing these studies, our framework explores how news about future fundamentals affects sovereign default risk and macroeconomic fluctuations.

Second, our paper is related to the recent literature on quantitative models of sovereign debt. Following the seminal papers of Eaton and Gersovitz (1981) on international lending and Chatterjee, Corbae, Nakajima and Rios-Rull (2007) on unsecured consumer default, various studies have focused on how default risk affects economic fluctuations. A short list includes Aguiar and Gopinath

(2006), Arellano (2008), Bai and Zhang (2010, 2012), Cuadra and Sapriza (2008), Guimaraes (2011), Mendoza and Yue (2012), and Yue (2010), among others. Our paper advances on this literature by looking at the implications of news shocks on the behavior of sovereign spreads and international debt flows to small open economies.[7] To our knowledge, our paper presents the first effort to integrate news and endogenous default risk in a nonlinear dynamic stochastic quantitative model.

Our paper highlights the news shocks channel as a plausible mechanism to account for the finding by Tomz and Wright (2007) that a significant fraction of defaults have occurred in good times. We argue that adverse news regarding a government's future ability to repay its obligations may deteriorate the country's current borrowing conditions, which can trigger a rise in the country's risk premium before the fundamentals actually worsen.

The rest of the paper is organized as follows. Section 2 presents the economic environment and the theoretical framework. Section 3 analyzes the quantitative implications of the benchmark model and Section 4 concludes.

2 The model

We consider a small open economy model with households, government, and foreign lenders. We first describe the stochastic structure for the total factor productivity (TFP) shocks driving the output fluctuations and the news shocks about the one-quarter ahead realization of TFP shocks.

2.1 Stochastic structure TFP and news shocks

The TFP shock is assumed to follow an AR(1) process

$$\ln(z_t) = \rho \ln(z_{t-1}) + \varepsilon_t, \tag{1}$$

with $E(\varepsilon) = 0$ and $E\left(\varepsilon^2\right) = \sigma_\varepsilon^2$. The process is approximated using a discrete one-period Markov chain with probabilities $p(z_{t+1} = m | z_t = j)\ \forall m, j \in \Theta$, where Θ denotes the probability space for the TFP shock. We consider that in any period the government receives a signal (s) regarding next period's TFP shock. Due to the signal's predictive content, it will lead the government to revise its forecast.

Conditional on a future TFP shock (z_{t+1}) we need to specify the probability of receiving a given

[7] Mendoza (1991) and Correia, Neves and Rebelo (1995), among others analyze business cycles in small open economies but do not consider default risk.

signal (s_t) in the current period. In other words, we need to define $p(s_t = i|z_{t+1} = l)$, with $l \in \Theta$ and $i \in \Xi$, where Ξ denotes the probability space for the signal. The sets Θ and Ξ do not necessarily coincide. One may consider the case where the government only receives signals regarding some future TFP shocks with $|\Theta| > |\Xi|$, or the opposite case with $|\Theta| < |\Xi|$. Here, we consider that the probability spaces do coincide $\Theta = \Xi$.

The signal (s_t) is incorporated into the forecast of next period's TFP shock (z_{t+1}). Following Bayes' theorem, the forecast conditional on current information is given by:

$$p(z_{t+1} = l \mid s_t = i, z_t = j) = \frac{p(s_t = i \mid z_{t+1} = l)p(z_{t+1} = l \mid z_t = j)}{\sum_n p(s_t = i \mid z_{t+1} = n)p(z_{t+1} = n \mid z_t = j)} \tag{2}$$

with $l, j, n \in \Theta$ and $i \in \Xi$. For the quantitative analysis, it is convenient to express the Markov chain for the joint evolution of the TFP shock and the signal. This can be implemented with the following formula:

$$\begin{aligned} \Pi(z', s', z, s) = p(s_{t+1} = \kappa, z_{t+1} = l|s_t = i, z_t = j) =& p(z_{t+1} = l|s_t = i, z_t = j) \\ & \sum_m \left[p(y_{t+2} = m|z_{t+1} = l)p(s_{t+1} = \kappa|y_{t+2} = m) \right], \end{aligned} \tag{3}$$

with $l, j, m, l \in \Theta$ and $i, \kappa \in \Xi$. We examined different parameterizations and formulations regarding the signal precision. We first assumed that

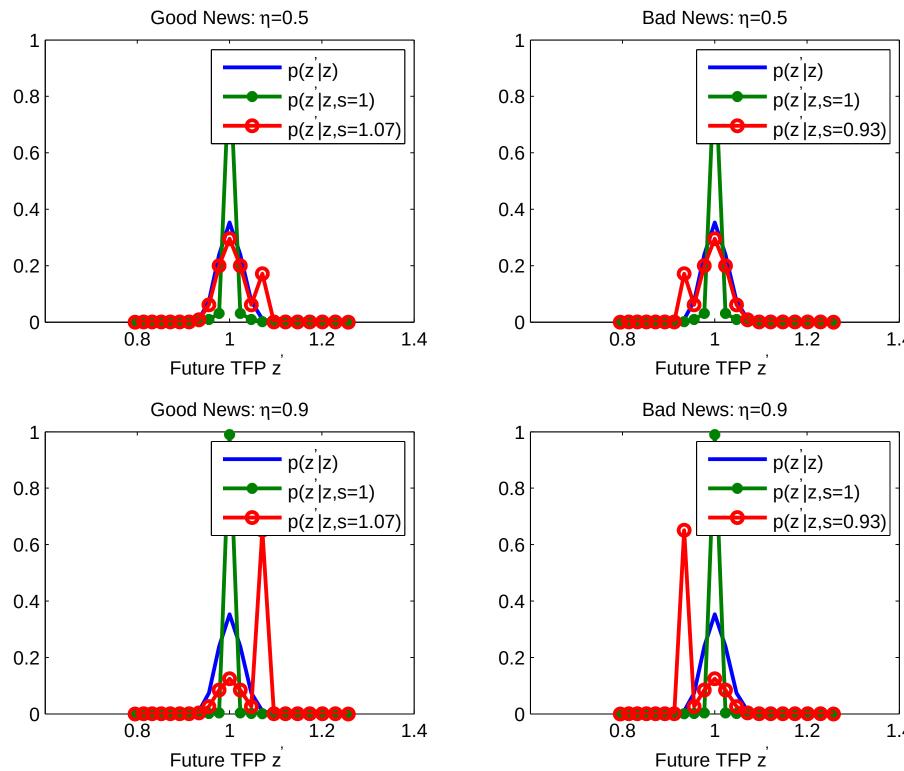
$$p(s_t = i|z_{t+1} = l) = \begin{cases} \eta & \text{if } i = l \\ (1-\eta)/(|\Xi| - 1) & \text{if } i \neq l \end{cases}. \tag{4}$$

When $\eta = 1/|\Xi|$ the signals are not informative, and when $\eta = 1$ the government can perfectly anticipate the TFP shock one period ahead. In the quantitative analysis, we explore several cases with $1/|\Xi| \leq \eta \leq 1$.[8] Note that even with $\eta = 1$ the economy faces uncertainty about the realization in two periods ahead and beyond. Also note that in the real world, private agents receive many signals about the developments at different future dates. But to keep the model tractable, we incorporate only signals regarding next period TFP shock and consider that signals regarding other future periods are not present.

News shocks can shift and reshape the probability density function for the TFP shock, and

[8] The results are robust to alternative specifications of the news signal, as described in the Appendix.

Figure 1: Probability Density Functions for TFP Shocks with Various News Shocks



Notes: Good news panel shows the conditional pdf of $z^{'}$ at $z = 1$, $s = 1$ and $s = 1.07$, and bad news panels show the conditional pdf of $z^{'}$ at $z = 1$, $s = 1$ and $s = 0.93$. The unconditional mean of the distribution is $\bar{z} = 1$.

their effect increases with the precision of the signal, as the panels in Figure 2 illustrate. The upper panels correspond to the case when $\eta = 0.5$. If a signal is received corresponding to the mean of the distribution (in this example, $s_t = 1$ and $\bar{z} = 1$), the standard deviation of the probability distribution is reduced drastically as the probability mass is reassigned toward the mean and the tails are thinned symmetrically. If the signal is positive, as the upper left panel shows, the mass of the probability distribution is reallocated from values close to the mean toward higher values, skewing the distribution to the right. Such a shift of probability mass results in a two-peaked probability density function for future TFP. Negative news has a symmetric effect, adding mass to the left. More precise news has a stronger impact on the shape of the probability density function of future TFP, as shown in the lower panels of Figure 2, which correspond to the case when $\eta = 0.9$.

We also assume that the signal is public information, i.e., the government, private agents, and external lenders all observe the same signal and adjust their actions accordingly. A model where some agents receive more precise signals is interesting, but raises issues of asymmetric information that are beyond the scope of this paper.

2.2 Households

The representative household chooses consumption and labor supply so as to maximize a time-separable utility function:

$$E_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t - g(L_t)\right). \tag{5}$$

The per-period utility $u(\cdot)$ is concave, strictly increasing and twice differentiable; $g(\cdot)$ is increasing, continuously differentiable and convex. The discount factor is $\beta \in (0,1)$ and the household derives utility from private consumption net of disutility from labor, $c_t - g(L_t)$. The per-period utility function features no wealth effect on labor supply, following Greenwood, Hercowitz and Huffman (1988) (GHH), and takes the functional form $u(c - g(L)) = \left(c - \frac{L^{\omega}}{\omega}\right)^{1-\sigma}/(1-\sigma)$, with $\omega > 1$ and $\sigma > 0$. The GHH specification helps the model generate realistic macroeconomic dynamics. A counterfactual dynamic arises with alternative specifications such as with Cobb-Douglas preferences. In particular, the wealth effect would lead labor to drop in response to a sharp rise in current TFP, or a positive news shock about future TFP or when consumption drops substantially. To prevent a counterfactual behavior of labor, Jaimovich and Rebelo (2008, 2009) proposes a hybrid preference that boils down to GHH in the limiting case. In their analysis of Mexico, the estimates of Jaimovich and Rebelo (2008) are such that the utility function is very close to the GHH specification. Thus their findings in conjunction with the international RBC literature justifies our use of GHH preferences.

The household faces the following budget constraint:

$$c_t = y_t + T_t \tag{6}$$

where $y_t = e^{z_t} k^{\alpha} L_t^{1-\alpha}$ is the amount of output produced in the economy using time-invariant capital stock k and time-variant labor supply, L_t. α is the capital share of output and its value is in $(0,1)$. T_t denotes the lump-sum taxes/transfers paid to/received from the government. In assuming time-invariant capital, we follow Mendoza and Yue (2012) and other sovereign debt models, which endogenize output but abstract from capital accumulation for simplicity. Because wealth is independent of labor supply and there is no capital that propagates shocks to the demand for labor over time, the role of endogenous production in this economy is limited. [9] Adding capital

[9] The results with an endowment economy are available in the working paper version Durdu et al (2010).

makes the recursive problem with default significantly harder to solve because it adds an additional endogenous state variable.

2.3 Government

The benevolent government maximizes the utility of the representative household. Financial markets are incomplete since the government can only save and borrow using a non-contingent, one-period bond traded in international capital markets.[10] Given the underlying state of nature, the signal for next period's income, and the amount of outstanding foreign assets, the government chooses, in each period, whether to repay the current debt or default. If the government chooses to repay, it continues to have access to the capital markets, and decides how much to borrow or to save. To be more precise, the state variables are the realization for TFP shock (z), the realization for the signal (s), the level of foreign assets, and whether the country has access to the credit markets or not (D), where $D = 1$ if the economy has access to credit markets and 0 otherwise.

The government optimization problem can be expressed in a recursive dynamic programming form. The value function when the government has access to international markets and begins the period with an amount of assets B and shocks (z, s) is given by $V_0(B, z, s)$. The value associated with paying back and remaining in the credit market is given by $V^c(B, z, s)$, whereas the value associated with defaulting and switching to temporary autarky is given by $V^d(z, s)$. The problem can be expressed in the following way:

$$V_0(B, z, s) = \max \left\{ V^c(B, z, s), V^d(z, s) \right\}, \tag{7}$$

and the optimal default decision of the government is characterized by

$$D(B, z, s) = \begin{cases} 1 & \text{if } V^c(B, z, s) > V^d(z, s) \\ 0 & \text{otherwise} \end{cases} . \tag{8}$$

The default policies determine a repayment set $\Gamma(B)$ defined as the set of values of the produc-

[10] Over the last 60 years, most external debt especially in developing countries represented government debt. For example, in 1995 during the Mexican financial crisis, sovereign external debt accounted for almost 70 percent of the total stock of foreign debt in Mexico. While the last decade has seen a significant increase in private sector debt, its increase was markedly uneven across countries. Despite these increases, government bond issuance in developing countries still accounted for at least half of the total in 2006 (IMF 2007 Financial Stability Report). Moreover, the 2007-2009 global crisis has made government obligations regain the center stage.

tivity and the news shock such that repayment is optimal given the level of foreign assets B,

$$\Gamma(B) = \{(z, s) \in \Upsilon : D(B, z, s) = 1\}. \tag{9}$$

The default set $\digamma(B)$ is defined as the set of values of the productivity and news shocks such that default is optimal given asset holding level B,

$$\digamma(B) = \{(z, s) \in \Upsilon : D(B, z, s) = 0\}. \tag{10}$$

If the government does not default, the economy can issue new debt and finance consumption subject to the following resource constraint:

$$c = y + B - q(B', z, s)B', \tag{11}$$

where $q(B', z, s)$ is the price of the bond.

When the sovereign borrows, it receives $q(B', z, s)B'$ units of consumption goods from foreign creditors in the current period and promises to pay B' units next period, conditional on not defaulting. Hence, the bond price reflects the probability of default, which depends on B', z, and s.[11] The government maximization problem can be formulated as follows:

$$\begin{aligned} V^c(B, z, s) &= \max_{B'} \left\{ U(y + B - q(B', z, s)B') + \beta \sum_{z', s'} V_0(B', z', s')\Pi(z', s', z, s) \right\} \\ \text{s.t.} \quad & c = y + B - q(B', z, s)B'. \end{aligned} \tag{12}$$

When the government defaults on its debt, the country is temporarily excluded from international credit markets. In addition, following Arellano (2008), the economy suffers a loss in productivity that lowers income to $y^{def} = e^{h(z)} k^{\alpha} L_t^{1-\alpha}$ so that consumption $c^d = y^{def}$.[12] More specifically, we assume the following specification

$$h(z) = \begin{cases} \phi E(z) & \text{if} \quad z > \phi E(z) \\ z & \text{if} \quad z \leq \phi E(z) \end{cases}, \tag{13}$$

[11] Notice that there is no commitment problem for the foreign creditors. If the foreign creditors borrow from the domestic government, they always repay their debt.

[12] The assumption that default reduces output can be rationalized by the fact that default episodes tend to be associated with disruptions in foreign trade and private sector's access to credit, which entail an output loss. See Rose (2005), Arteta and Hale (2006) and Mendoza and Yue (2012).

with $\phi \in (0,1)$. As discussed in Arellano (2008), this specification for the output cost allows a higher range for risky borrowing and helps bring the default rates closer to the data. Additionally, Mendoza and Yue (2012) provide a theoretical foundation for this type of exogenous output loss specification. They show that a sovereign default model with production generates an output cost of default that increases endogenously in the state of productivity and is consistent with the shape of the exogenous output cost outlined above.

The value function under default is given by:

$$V^d(z,s) = U(y^{def}) + \beta \sum_{z',s'} \left[\mu V_0(0,z',s') + (1-\mu) V^d(z',s') \right] \Pi(z',s',z,s). \tag{14}$$

While in autarky, the country may regain access to external markets with an exogenous probability μ. When the economy returns to financial markets, it does so with no debt burden, $B = 0$, and with a continuation value $V_0(0,z,s)$. Conversely, the country may stay in autarky with a probability $1-\mu$, and the continuation value $V^d(z,s)$.

2.4 Foreign Lenders

There is a large number of identical foreign creditors. Each lender can borrow or lend at the risk free rate r_f and participates in a perfectly competitive market. Lenders are risk-neutral and maximize expected profits as follows:

$$\Phi = -qB' + \frac{\lambda(B',z,s)}{1+r_f} 0 + \frac{(1-\lambda(B',z,s))}{1+r_f} B'.$$ [13]

The first term in the equation above shows that when creditors lend to the government in the current period, they buy the discount bond issued by the domestic government at a price q. Next period, the lenders may receive the face value of the bond depending on whether the government defaults or not. When it defaults, creditors get 0 units of the consumption good. The probability of default $\lambda(B',z,s)$ is endogenously determined as

$$\lambda(B',z,s) = \sum_{z',s' \in \digamma(B')} \Pi(z',s',z,s), \tag{15}$$

so that the default probability is zero when $\digamma(B') = \varnothing$ and is one when $\digamma(B') = \Upsilon$.

[13] We relax the risk-neutrality assumption in the sensitivity analysis.

Since there is perfect competition in the credit market, a zero profit condition holds for the foreign creditors.[14] The bond price is then

$$q(B', z, s) = \frac{(1 - \lambda(B', z, s))}{1 + r_f}. \tag{16}$$

2.5 Equilibrium Definition

A recursive equilibrium for this small open economy is characterized by a set of value functions for the government, V_0, V^c, V^d; a set of policy functions for household's consumption c, c^d; policy functions for government's default decision D; optimal asset holdings B'; and a bond price function q such that

1. Given the government policies and the bond price function, the consumption policy solves the household's problem,
2. Given the bond price function q and the optimal policies for the household, the government's value functions V_0, V^c and V^d and its policy functions D and B' solve (7), (12) and (14),
3. The equilibrium bond price $q(B', z, s)$ is such that zero expected profit condition for foreign creditors holds as described in equation (16).

3 Quantitative analysis

The calibration uses the no news case as a benchmark and the parameter values are set mainly to mimic the empirical regularities of developing countries, in particular, Argentina. For those parameters related to the production process, we follow the emerging market business cycle literature closely. Accordingly, we set the risk aversion parameter, σ to 2, a common value used in the literature. The discount factor, β, is set to 0.953 to match 3 percent default probability as estimated in Arellano (2008). Reentry probability is set to 0.282, the value consistent with the estimate of Gelos, Sahay, and Sandleris (2004). The default penalty, ϕ is set to 0.969 to help generate an output loss consistent with Arellano's estimate for Argentina. Risk-free rate is set to 1.7 percent, equal to the 5-year quarterly yield for US treasury bonds. The autocorrelation and the standard deviation of the TFP process are set to match the corresponding moments for Argentina's GDP.

[14] Alternatively, we could assume that foreign lenders have access to two instruments: a risky bond and a risk free bond. Since creditors are risk neutral, they are willing to buy the risky asset as long as its expected return R equals the return of the risk free asset: $(1 - \lambda)(1 + R) = 1 + r_f$, with $q = \frac{1}{(1+R)} = \frac{(1-\lambda)}{1+r_f}$.

The curvature parameter, ω, and the capital share of output, α, are taken from the literature (e.g., Mendoza (1991), Neumeyer and Perri (2005)). The steady state capital stock, k, is set to 1.62 to normalize the steady state output to 1.

Table 2 shows business cycle moments of key macroeconomic variables from the data.[15] We now turn to the simulation results and the statistical properties of the model. Table 3 displays a set of moments from the simulated model solved using the algorithm described in the previous section with 200 equidistant nodes on the bond grid, 61 nodes on the TFP shock grid and 61 nodes on the TFP shock grid.[16] The statistics reported are average values of 3000 simulations with 2000 periods each. The simulated series are logged and filtered.

Table 1: Calibration

Parameter	Notation	Value	Source
Risk aversion	σ	2	literature
Discount factor	β	0.953	3 % default probability
Reentry probability	μ	0.282	literature
Default penalty	ϕ	0.969	literature
Risk free interest rate	r_f	0.017	US 5-year bond quarterly yield
Autocorrelation of TFP	ρ	0.945	Argentina's GDP
Standard deviation of TFP	σ_ϵ	0.015	Argentina's GDP
Curvature parameter of labor supply	ω	1.65	literature
Capital share in output	α	0.35	literature
Steady state capital stock	k	1.62	normalization
News shock	η	$[1/\lvert\Xi\rvert, 0.95]$	

Table 2: Business Cycle Moments in the Data: Mean Across Countries

	Developing Countries	Developed Countries
$\sigma(c)/\sigma(y)$	1.32	0.97
$\rho(y, c)$	0.77	0.64
$\rho(y, tb/y)$	−0.46	−0.31
$\rho(y, spread)$	−0.25	−0.03

Notes: Moments are calculated using data for a sample of developing and more developed countries over the 1980:Q1 to 2007:Q4 period.

[15] Data details and sources are described in the Appendix.

[16] We performed several robustness checks. We experimented with different numbers of nodes on each grid—increasing the nodes on the bond grid, on the TFP shock grid, on the news shocks grid—as well as changing the interval the bond grid spans. We found that our results are robust to further increases in the nodes in each of these grids. We also conducted additional robustness checks with different news specifications as explained in Section 5.3, but our main results did not change.

Table 3: Simulation Results

	No News	With News, $\eta = 0.95$
$\sigma(c)/\sigma(y)$	1.06	0.99
$\rho(y, c)$	0.99	0.94
$\rho(y, tb/y)$	-0.27	0.19
$\rho(y, spread)$	-0.35	-0.17

3.1 No news case

The model economy without news is identical to the models of sovereign default analyzed in the literature (e.g., Arellano (2008), among others).[17] The no news economy experiences procyclical borrowing induced by changes in default incentives. The availability of external credit and the interest rate vary with the business cycle: foreign lenders respond to an improvement in the domestic macroeconomic conditions by demanding a lower risk premium, which leads the government to borrow.[18] Therefore, when debt carries default risk, the economy borrows more in booms than in recessions. This translates into countercyclical interest rates and trade balance. In addition, the variability of consumption is close to six percent higher than the variability of output (Table 3).

3.2 Effects of news

Figure 2 plots the bond price schedule as a function of assets for three values of the news shock and a given output/TFP realization.[19] For all levels of debt, the bond price is lower when the economy is hit by an adverse news shock. Since adverse news shocks about future productivity reveal information about potential difficulties that the government faces in repaying its debt, risk-neutral lenders charge a higher risk premium on impact.

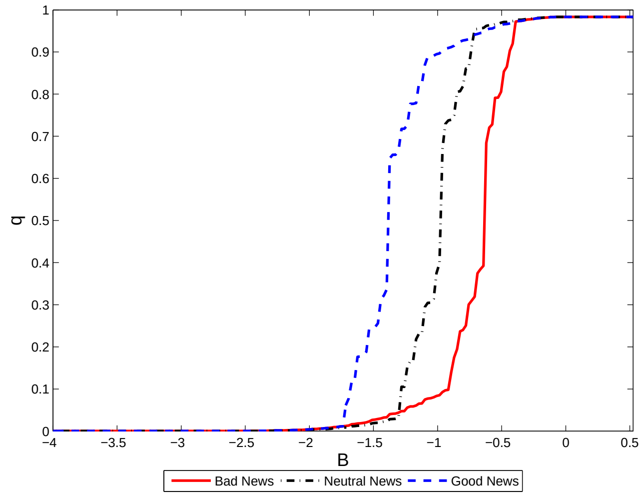
Figure 3 shows the borrowing policy function as a function of B and B', given y, for two values of the news shock. The dashed and solid lines show the borrowing policy with good and bad news, respectively. Good news reduces the default risk and lowers the cost of debt, which in turn induces the government to borrow more. Further, good news implies that current output is lower than tomorrow's, which leads the government to borrow more in the current period. Hence, the dashed

[17] The model without news refers to the case where no signal s_t is observed, or equivalently the signal s_t is observed but has no informational content ($\eta = 1/|\Xi|$).

[18] Additionally, since TFP shocks are persistent, higher future income also induces the government to borrow more.

[19] The bond price is an increasing function of foreign assets. As shown by earlier studies, for small levels of foreign debt, the government always pays back its debt and borrows from international markets at the world risk free interest rate. There is a threshold level of debt for which the bond price starts to decrease reflecting stronger incentives to default for indebted governments. At a sufficiently large debt level the government always defaults regardless of the output realization. At that point, the probability of default is one and the bond price is zero.

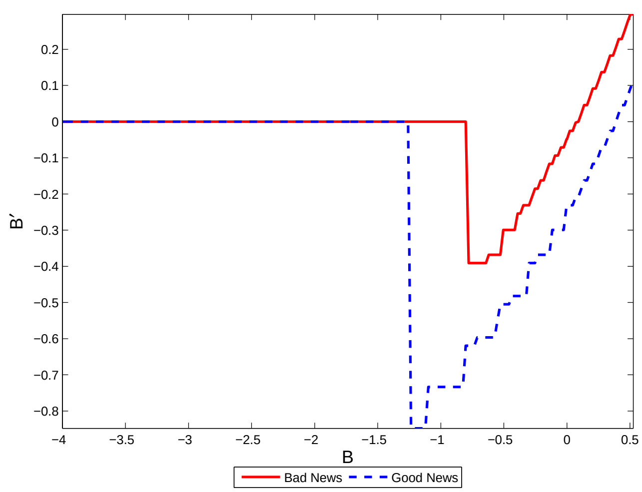
Figure 2: News and Bond Price Schedule



Notes: In the plot, $\eta = 0.5$ and the current TFP shock is at steady-state. The good and bad news cases refers to a signal of an increase and a decrease of 2.3 percent in the TFP shock, respectively.

line with good news remains below the solid line with bad news for all initial debt levels in the nondefault region.

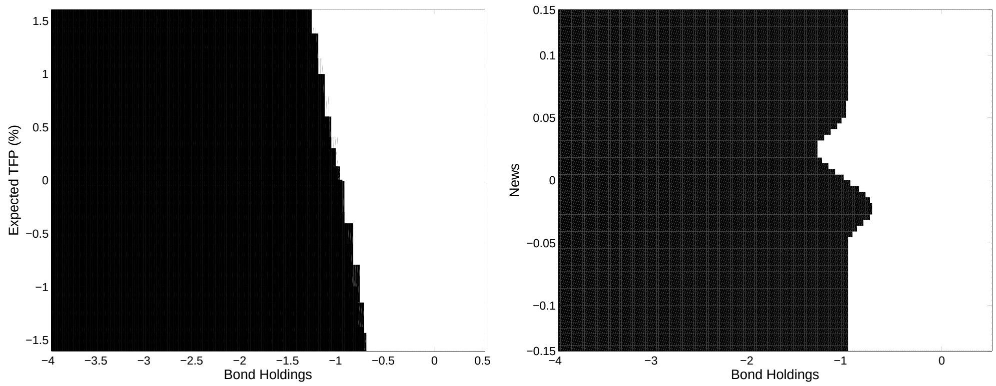
Figure 3: News and Savings Policy



Notes: See notes to Figure 2.

News shocks can affect the decision to default. The left panel of Figure 4 illustrates the shape of the default region as a function of current debt and expected future output/TFP when current output/TFP is at steady-state. Expected future output might change depending on the realization

Figure 4: News and Default Region



Notes: In the plot, $\eta = 0.5$ and the current TFP shock is at steady-state. The dark region indicates default. In both panels, the horizontal axis refers to bond positions. In the left panel, the vertical axis refers to expected value of TFP in deviation from steady-state $(E(ln(z_{t+1} \mid s_t, z_{ss})) - ln(z_{ss}))$ for different news s_t, and z_t fixed at steady-state. In the right panel, the vertical axis refers to the news signal s_t (signaling a future TFP shock in deviation from steady-state $ln(z_{t+1}) - ln(z_{ss})$.

of the news shocks. When a relatively low signal is received, expected output for the next period decreases and the default region (the dark area in the graph) increases. As we explain in more detail in Section 3.4, if the news signal is sufficiently negative and informative, the economy can experience default episodes even when the current output realization is above its trend value.

The right panel of Figure 4 also plots the default region, but in this case, the vertical axis refers to the realization of the news shock (s_t). The figure displays an S-shaped pattern. Signals (s_t) near the current TFP shock level impact the default decision, while extreme signals do not. This is because the output process in equation (1) may imply that, given z_t, certain levels of future output (z_{t+1}) might be unlikely to realize. If a signal points out to a realization of output that is very unlikely to occur, then that signal is effectively discounted. We can also see this mechanism in equation (2), where the posterior probability to observe an TFP shock next period depends on both the signal and the current output. If the prior in that equation assigns negligible probabilities for an extreme realization of a future TFP shock ($p(z_{t+1}|z_t)$), then the signal pointing out to the realization of such future TFP shock ($p(s_t|z_{t+1})$) would have a negligible impact on the posterior probabilities.[20]

Starting from a steady state output and a neutral signal (expected value of TFP shock equal to 0 in deviation from steady state), if the economy receives a signal that increases expected future

[20] This mechanism is absent in Jaimovich and Rebelo (2008) because the authors consider a process for output with only two states.

output, the default region decreases as shown on the left panel of Figure 4. This signal would correspond, for instance, to $s_t = 0.05$ in the right panel, where for that signal realization, the default region also shrinks. However, if the signal received is significantly higher than the current state, for example $s_t = 0.2$, the right panel shows that the default region does not change relative to the case of a neutral signal ($s_t = 0$). The reason is that the prior for the output process assigns a small probability to the realization of $z_{t+1} = 0.2$ and the posterior remains unchanged if the signal $s_t = 0.2$ is received. Therefore, the expected future output is also unchanged, corresponding on the left panel to an expected output equal to 0 in deviation from steady state.

3.3 News precision and the level of development

As countries become more developed, their business cycle statistics change along several dimensions. Table 2 shows some of the key changes these countries exhibit as they become more developed: the variability of consumption relative to output decreases, the correlation of consumption with output decreases, the correlation between interest rate spread and output becomes less negative, and the correlation between current account and output becomes less negative. In addition, information systems become more developed and monitoring improves.

How does the news precision change with economic development? We discuss two imperfect measures of news precision: forecast errors and opacity measures. Both suggest that higher level of development is associated with higher precision of news. Table 4 summarizes the RMSE of Consensus Forecasts' one quarter ahead forecast errors ($y_{t+1} - E_t y_{t+1}$) for quarterly GDP growth (at annualized rates) for a set of developing and more developed countries. The sample covers 1998:Q4-2007:Q3.[21] The table suggests that forecast errors for developing countries are systematically higher than those of more developed economies—as evidenced by the RMSE. On average, the RMSE of these errors are 0.95 percentage points for the former and 0.38 percentage points for the latter.[22] Thus, forecasts are subject to more uncertainty in developing countries than in more developed ones.

The comparison of RMSE of forecast errors in levels does not take into account the fact that GDP growth shocks in developing countries have a larger standard deviation. Thus, next we present a measure of relative predictability frequently used to compare the accuracy of forecasts

[21] The GDP growth data are taken from Bloomberg and refer to quarterly year-on-year growth rates. We report only those countries for which we have at least 10 quarters of forecasts available.

[22] The same result holds for the median country for both groups. The developing countries median value is 0.81 versus 0.39 for more developed countries.

Table 4: Moments of Forecast Errors in Developing vs. More Developed Economies

Country	# of obs.	Mean	RMSE	Theill's U
More Developed Countries				
Australia	33	-0.02	0.50	0.52
Denmark	23	0.11	0.39	0.30
Finland	11	0.35*	0.70	0.31
France	25	-0.02	0.30	0.37
Hong Kong	26	0.70*	0.80	0.21
Italy	18	-0.11	0.39	0.42
Netherlands	16	-0.02	0.36	0.23
Singapore	18	-0.37*	0.46	0.12
Spain	20	0.04	0.15	0.20
Switzerland	14	0.14	0.46	0.53
UK	36	0.05*	0.14	0.19
Average	**21.82**	**0.08**	**0.46**	**0.31**
Median	**20.00**	**0.04**	**0.39**	**0.30**
Developing Countries				
Argentina	26	-0.57	2.23	0.30
Brazil	28	-0.28*	0.83	0.38
Chile	14	0.10	0.28	0.23
China	21	0.30*	0.55	0.43
Colombia	17	0.23	0.87	0.52
India	21	0.30	0.85	0.46
Indonesia	20	0.18*	0.43	0.37
Korea	23	0.23	0.86	0.63
Malaysia	28	0.01	0.99	0.37
Mexico	33	0.05	0.59	0.26
Peru	61	0.43*	1.45	0.80
Philippines	17	-0.35*	0.65	0.66
South Africa	23	-0.01	0.80	0.47
Taiwan	22	-0.16	0.86	0.30
Thailand	18	-0.19*	0.42	0.16
Turkey	28	-0.13	3.12	0.51
Average	**24.67**	**0.01**	**1.02**	**0.43**
Median	**22.50**	**0.03**	**0.88**	**0.41**

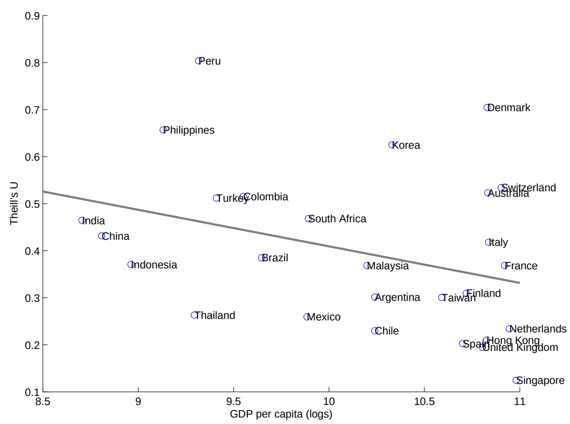
Source: Bloomberg. * Significantly different from 0 at 10 percent level.

across series with different variability. We use the Theill (1961) U_i indicator for country i, defined by:

$$U_i = \sqrt{\frac{\frac{1}{N}\sum_{t=1}^{N}\left(e_{i,t}-\bar{e}\right)^2}{\frac{1}{N}\sum_{t=1}^{N}\left(y_{i,t}-\bar{y}\right)^2}},$$

where the nominator is the RMSE of forecast errors and the denominator is the standard deviation of real GDP growth.

Figure 5: Theill's U vs. GDP per Capita



Notes: This figure shows the Theill's U estimates in relation to GDP per capita levels.

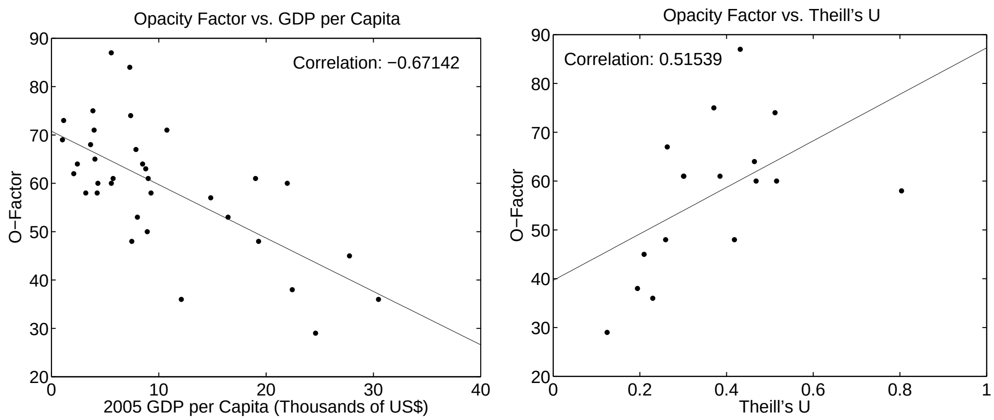
When this statistic is equal to 0, the forecast becomes perfect, whereas larger values imply less forecasting accuracy. We compute this statistic for all countries in our sample and present them in the last column in the table. As mean and median statistics show, developing countries have higher Theill's U than more developed countries. Note that both for RMSEs and Theill's Us, it is impossible to include very poor countries for which forecast data is not available. Including those countries would make the distinction between developed and developing countries to be starker.

To further examine the behavior of Theill's U, we plot its relationship with GDP per capita in Figure 5. As seen in the graph, there is a significantly negative correlation between Theill's U statistic and GDP per capita. The simple correlation coefficient between both variables is -0.46, significant at conventional levels of confidence. Overall, the figure provides further evidence that forecasting real GDP growth in less developed countries is less accurate, even in relative terms.

Next, we examine opacity measures. PwC conducted a survey of banks, firms, equity analysts, and in-country staff during the third and fourth quarters of 2000 to generate measures of opacity in five areas: bureaucratic practices (corruption), legal systems, government macroeconomic policies, accounting standards and practices, and regulatory regimes. PwC aimed at interviewing at least 20 CFOs, five bankers, five equity analysts, and five PwC employees in each country. Overall, this opacity measure appears to be a good proxy for the precision of news in each country in the sample.

The left panel of Figure 6 establishes a strong negative relationship between opacity measures

Figure 6: Composite Opacity Factor vs. GDP per Capita



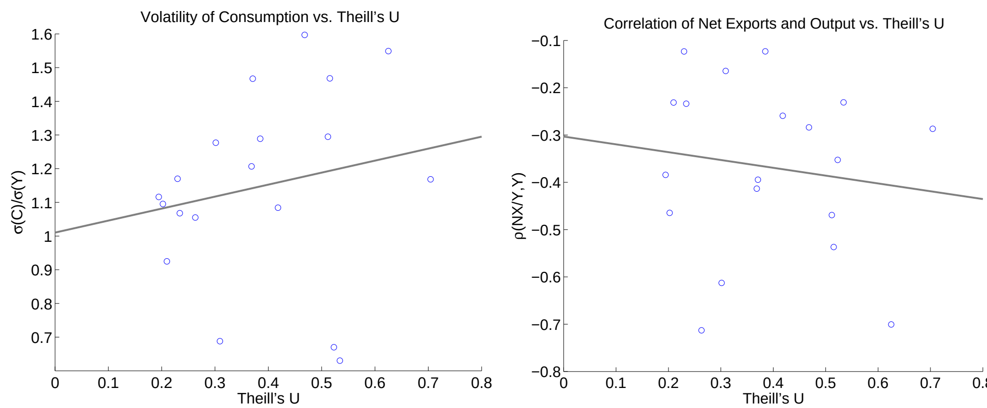
Notes: This figure shows the opacity measure for 35 countries collected by the accounting and consulting company PwC.

and GDP per capita based on 2005 levels. Further, the right panel of Figure 6 shows that these opacity measures also appear to be highly correlated with the Theill's U. These results seem to confirm that news precision is likely to be lower in developing countries compared to more developed ones.

How does the news precision or Theill's U affect equilibrium dynamics? The macroeconomic evidence we provided in Table 2 regarding the behavior of consumption and net exports appears to also hold when we compare countries with different Theill's U. Figure 7 shows that for countries with higher Theill's U, variability of consumption is higher and the countercyclicality of the net exports is more severe.

The relationship that we establish in Figure 7 regarding macroeconomic fluctuations and Theill's U also holds in the model. Before discussing the corresponding relationship in the model, it is useful to elaborate on how the precision of news and Theill's U are related in the model and how they affect macroeconomic fluctuations. When news shocks are more precise, agents in the economy can anticipate future fundamentals more accurately. As shown in Figure 8, forecast errors measured as Theill's Us decline as the news precision increases (note that Theill's U are plotted on an inverse scale). As a result, consumption smoothing becomes more effective, reducing the volatility of consumption relative to the volatility of output. Bond prices respond to news in addition to TFP shocks, dampening the correlations of consumption, trade balance and spreads with current output. To highlight these effects, Table 3 shows the long-run moments of the model with no news precision

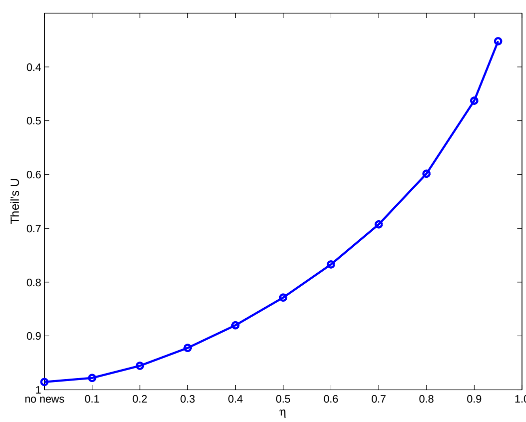
Figure 7: Macroeconomic Fluctuations vs. Theill's U



Notes: This figure shows how variability of consumption and correlation of net exports with GDP varies across countries with different Theill's U.

and $\eta = 0.95$. As η increases towards 0.95, all moments move closer to those characterized by more developed economies. The variability of consumption drops, the trade balance becomes less negatively correlated with output, and the spreads become less countercyclical.[23]

Figure 8: Precision of News vs. Theill's U



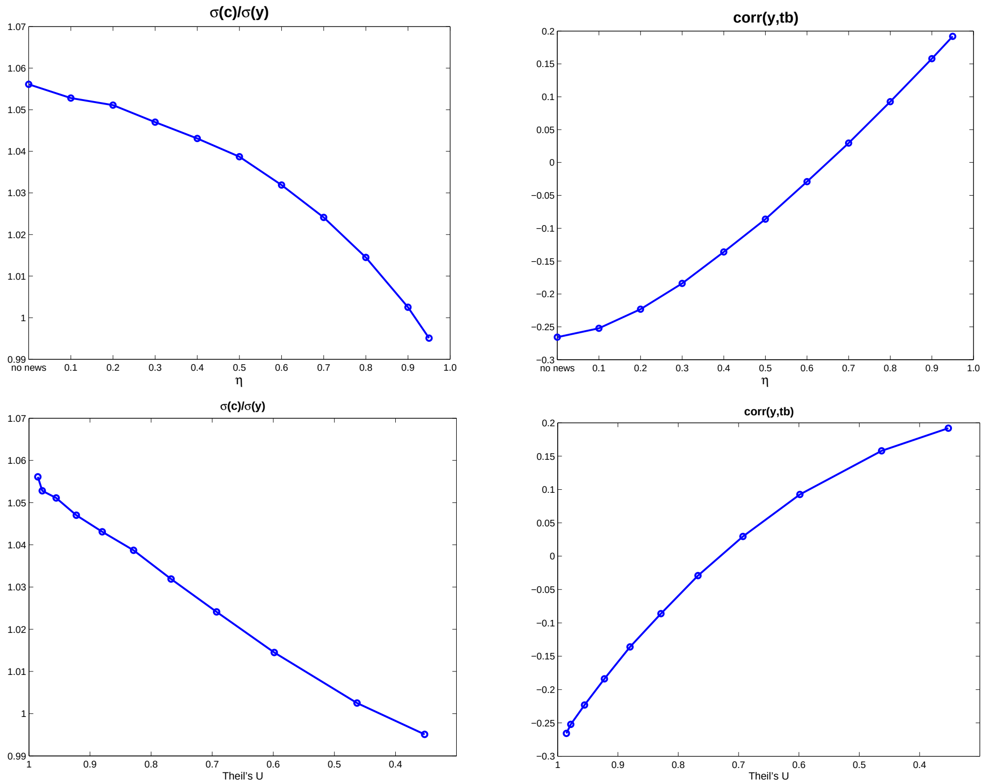
Notes: This figure shows the relationship between precision of news and model-implied Theill's Us. Theill's Us are plotted on an inverse scale, e.g., the higher values η implies lower values of Theill's U.

Table 3, however, shows these differences only with two different news precision levels. Figure 9 plots the variability of consumption and the correlation of trade balance with output for all possible values of news precision. Consistent with the findings in Table 3, Figure 9 shows that as the news

[23]While the model slightly overshoots in capturing the level of the correlation of the trade balance with output in developed economies, it captures the direction of the change in this variable. Moreover, some developed countries exhibit weakly procyclical trade balance.

precision increases, the variability of consumption relative to output and the correlation of trade balance with output get closer to those of more developed economies.[24]

Figure 9: The Effect of Precision of News on Macroeconomic Variables

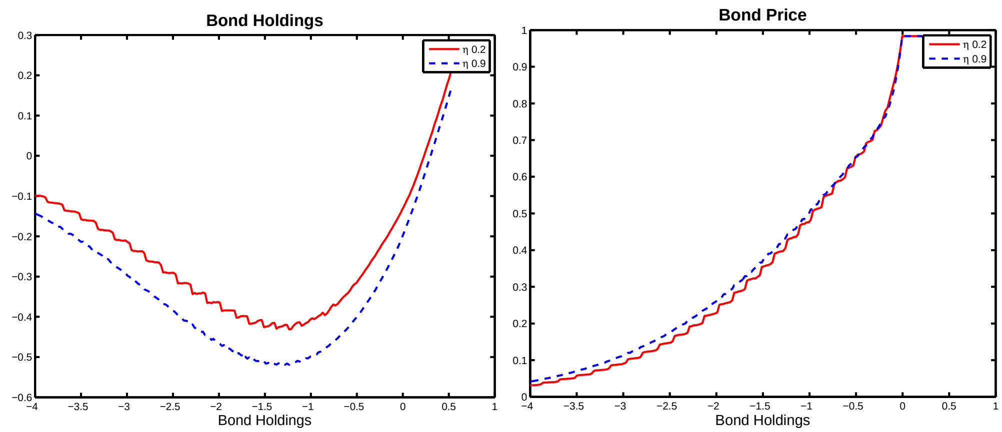


Notes: The graphs on the left show the variability of consumption relative to output, the graphs on the right show the correlation of trade balance with output. The graphs in the top panel plot variables as a function of the news precision, η, and the graphs in the bottom panel plot variables as a function of the Theill's U statistics estimated from the model. Note that Theill's Us are plotted on an inverse scale, e.g., the higher values η implies lower values of Theill's U.

The panels in Figure 10 show the unconditional bond policy functions and the bond price schedule for low and high precision of news ($\eta = 0.2$ and $\eta = 0.9$, respectively). Both panels underscore that, for any initial level of bond holdings, the economy with the more precise signal features, on average, lower interest rates, and is able to sustain more debt. With low news precision, the economy can only borrow a relatively small fraction of income. With high news precision, for a given debt level, the interest rate policy function shifts to the left, reflecting the better credit conditions available to the economy. With better credit conditions, the economy can increase its debt holdings to smooth consumption. However, in equilibrium, the increase in debt might lead to

[24]While the model slightly overshoots in capturing the level of the correlation of the trade balance with output in developed economies, it captures the direction of the change in this variable. Moreover, some developed countries exhibit weakly procyclical trade balance.

Figure 10: News Precision and Unconditional Policy Functions



Notes: The panel on the left shows the bonds policy function weighted by the implied long-run probabilities of TFP shock and news shocks for the two different precision levels. The panel on the right shows the bond price schedule for the same case. The figure illustrates how changes in news precision affect equilibrium decision rules.

an increase in interest payment.[25]

3.4 Default in good times

News shocks can also rationalize that a fraction of defaults occur when output is above trend, as shown in Levy-Yeyati and Panizza (2006) and Tomz and Wright (2007). Complementing these studies, we also examine the default patterns using annual data for 118 countries for the 1950-2003 period (section 5.4 of the Appendix includes the entire list of countries and default episodes in our sample). We calculate the trend income through various procedures to establish the robustness of the results.

Table 5: Proportion of Defaults in Good Times

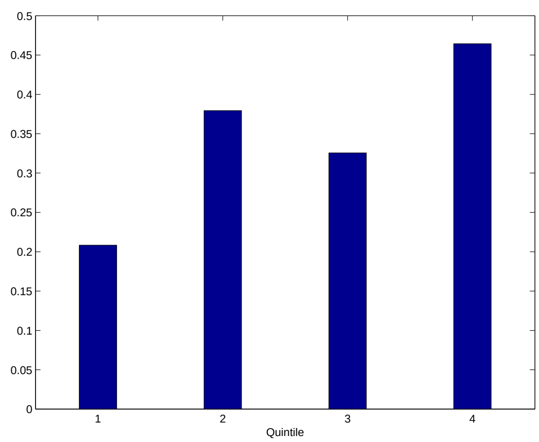
Filtering method	default probability
HP-filter over the entire sample	0.54
HP-filter up until the year before default	0.31
Linear-filter over the entire sample	0.25
Linear-filter up until the year before default	0.24

Notes: This table shows the percentage of defaults that occurred when income was above trend using data for 118 countries covering the 1950-2003 period.

[25] The left panel implies a decrease in debt holdings for initial bond holdings below -2. That is because the government defaults more frequently bringing bond holdings to zero, which, in turn, lowers the average debt level.

Table 5 summarizes the fraction of defaults that occurred when the income was above trend. When the trend income was calculated with the HP-filter (smoothing parameter of 100) over the entire sample, we find that 54 percent of the default episodes occurred when income was above trend. However, earlier research has shown that default episodes trigger severe output losses, implying a big decline in output after default. Thus, if post-default episodes were not excluded from the sample, output losses after default would bring down the trend growth, making the output right before default look above trend. To control for this, we calculate the default rates in good times by measuring the trend income using HP-filtering up until the period default occurs (line 2). We find that the default rates in good times drop to a still-significant 31 percent. Finally, using linear instead of HP-filtering does not overturn these results (line 3 and 4).

Figure 11: Proportion of defaults in good times by income (1950-2003)



Notes: This figure shows the percentage of defaults that occurred when income was above trend using data for 118 countries covering 1950-2003 period.

Next, we examine if the pattern of defaults occurring in good times differ depending on the level of development. Figure 11 displays default rates by income quintile.[26] Figure 11 suggests that the fraction of the defaults that occurred in good times becomes higher for countries with higher income per capita levels. Having said that, there is some randomness in the data because there are less defaults for higher income brackets. For that reason, we also checked empirically that worsening economic forecasts can in fact lead to default.

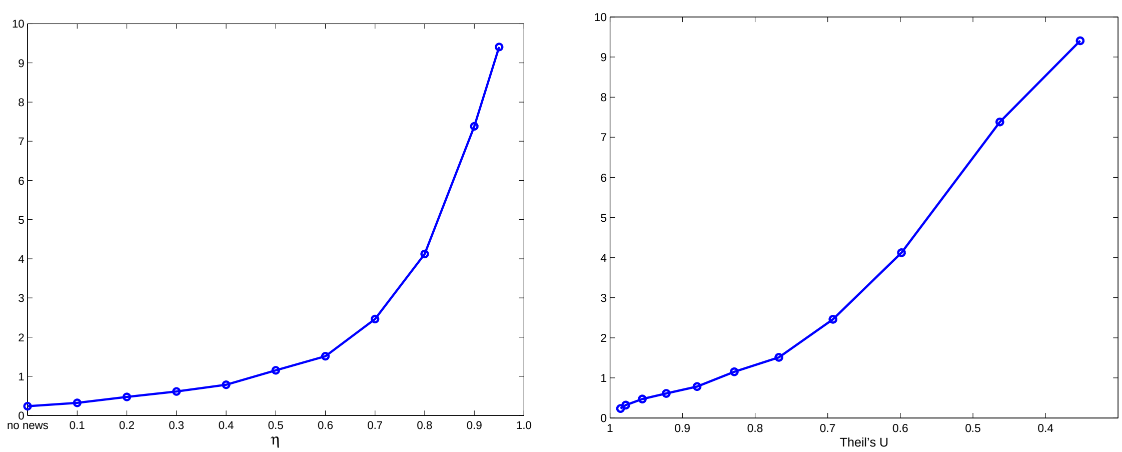
The quantitative results shown in Figure 12 indicate that our model helps rationalize the two stylized facts described above. The intuition relies on how news affects agents' perception of future

[26]In the figure, the fifth quintile is not shown, since the only default episode in that group corresponds to Slovenia in 1992, less than a year after its independence and with income below trend.

income level. In particular, bad news can lead to an immediate default because it predicts that future output will be lower, which will make current debt repayments more costly. Hence, bond prices fall, leading to a deterioration in the current financing decisions and bringing forward the default decision. This mechanism can lead the economy to default even though the current state of the economy is positive. As the news precision increases, this channel becomes more effective and leads to a higher proportion of defaults when output is above trend.

The reason why the model without news predicts default only in bad times is mainly because the penalty depends positively on output. If the penalty was independent from current output, the model could predict default in good times as well. For instance, Tomz and Wright (2011) among others, show that having a penalty equal to zero leads to some defaults occurring in good times. However, with such a feature, the model performs worse along multiple dimensions. Thus, the dynamics of the model without the punishment justifies the need for exploring other factors such as news shocks to capture default in good times.[27]

Figure 12: Percentage of Default in Good Times



Notes: This figure shows the percentage of defaults occurring in the model when income is above average. The graph on the left plots the precision of news, η, on the x-axis whereas the graph on the right plots the corresponding Theill's Us on the x-axis.

To illustrate that worsening economic forecasts may be associated with default decisions, in Table 6, we examine the behavior of GDP forecasts relative to trend GDP. We find that, in some cases, a worsening GDP outlook appears to have contributed to the default decision. In those cases,

[27]Note that the percentage of defaults in good times obtained in the model is lower than the percentage found in Tomz and Wright (2011). Therefore, reducing the asymmetry of the penalty would not adversely affect the percentage of default in good times the model can generate.

although output was above trend, the forecast for GDP pointed to a worsening outlook. In our framework, we focus on news shocks regarding future output/TFP. However, our analysis should not be read to imply that we narrowly focus only on this dimension.

Table 6: Defaults and Forecasts

Country	Date of Default	Forecast relative to trend
Brazil	Dec 1989	−2.75
Ecuador	Aug 1999	−0.71
Dominican Republic	Apr 2005	−0.70
Belize	Dec 2006	−2.93
Ecuador	Dec 2008	−3.64

Notes: This table shows the default episodes for those countries which defaulted in periods with GDP growth above trend (trend defined as five-year average GDP growth) and have publicly available forecasts of GDP at the time of default. The "Forecast relative to trend" column shows the deviation of the GDP forecast from the respective trend prior to the default. GDP forecasts are based on consensus for Brazil and Ecuador, and the IMF for other countries, and these forecasts are available only for 1988 onward.

Our paper sheds light that news and forecasts about future economic developments (not only TFP/GDP) can impact spreads and the default decision. For instance, forecasts regarding the expenditures of the public sector (and social security) have been a major determinant in Europe. This is also the case in the recent default of Ecuador in the last quarter of 2008; in addition to forecasts being lower than GDP trend, other news about the future performance of the Ecuadorian economy appears to have led to the default decision. More specifically, the announcement that the government would be running a fiscal deficit of 3.2 billion dollars in 2009 fueled a jump in interest rate spreads to about 4500 basis points on Ecuador's external debt obligations. Soon after these developments, the government announced its default.

The potential role of news shocks on default decision is also supported by other research. For example, Ferri, Liu and Stiglitz (1999) highlight the importance of the news content of sovereign rating changes on sovereign credit spreads. They document that credit rating agencies aggravated the East Asian crisis by downgrading those countries' ratings beyond what fundamentals would justify. The premature downgrading led agents to perceive that these economies would perform worse than previously anticipated, and that they would not be able to repay their debt obligations. This, in turn, exacerbated the cost of borrowing abroad and caused the supply of international capital to evaporate.[28]

[28] Parsley and Gande (2005) also analyze the news content and corresponding cross-country sovereign credit market

We do not claim that the news shocks mechanism is the only or the most important driving force explaining sovereign defaults in good times. While news and projections about future economic certainly matter, the exact timing of the default decision is a political decision that not always obeys an economic logic. Hatchondo, Martinez and Sapriza (2009) propose an alternative explanation for sovereign defaults in good times. The authors study a setup with political turnover between policymakers with different levels of impatience. Impatient governments are likely to be associated with unwillingness to repay obligations.

3.5 News precision and hump-shaped default pattern

How do the differences in precision levels affect debt and default dynamics? Figure 13 shows the default rates in different group of countries separated by various characteristics: income per capita, opacity measure, and Theill's U. All these measures suggest that there is generally a nonmonotonic relationship between default rates and the level of development. This relationship is clearly visible on the upper left panel, which groups countries based on their income per capita level, or on the right panel, which groups countries based on their opacity factor. The lower panel with Theill's U also points to a generally nonmonotonic relationship between default rates and the level of development, especially if the outlier country with Theill's U coefficient 0.8 is left out of the sample.[29]

In addition to the relationship between the level of development and default dynamics, earlier research established that more developed countries tend to sustain higher debt levels in equilibrium (see for example Mendoza and Oviedo (2006), Mendoza and Ostry (2008), Durdu et al. (2009)). Using data for 22 developed economies and 34 emerging markets over the 1970-2005 period, Mendoza and Ostry (2008) find that developed economies hold more debt than emerging economies. During that period, the average debt-to-GDP ratio for developed economies is about 10 percentage points higher than that in emerging economies.[30]

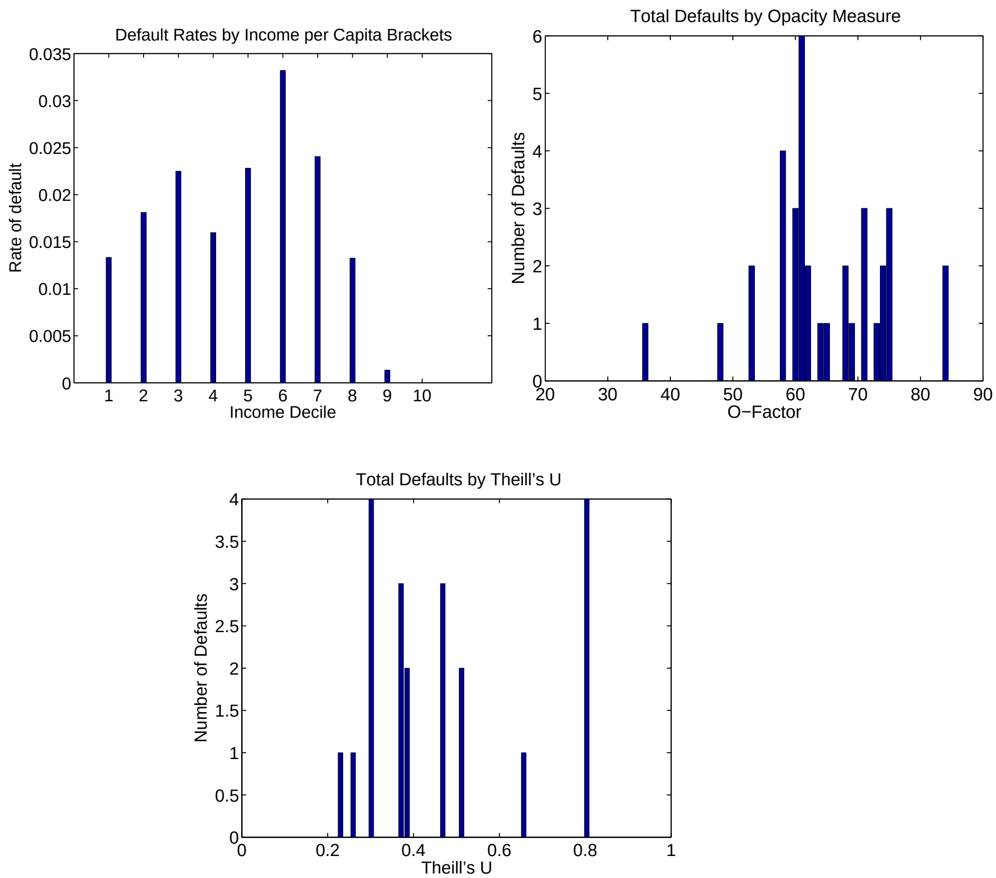
How do the differences in precision levels affect debt and default dynamics in our model? The left panels of Figure plot the debt level as a function of the news precision and corresponding Theill's Us in the upper and lower panels, respectively. As the news precision increases, after the initial drop with precision level 0.1, the debt levels move up markedly. The debt levels further move up as the news precision further increases. The right panels of Figure 14 plot the unconditional default probability—the proportion of periods in which default occurs—as a function of the news precision

spread implications due to sovereign credit rating changes.

[29]Notice that on the right panel of Figure 6 the country with Theill's U coefficient 0.8 (Peru) appears as an outlier.

[30]Reinhart, Rogoff and Savastano (2003) document evidence along the same lines.

Figure 13: Default Rates in Developing and More Developed Economies



Notes: The upper left panel shows the default rates by income decile that we estimate using data for 118 countries covering 1950-2003. The upper right and lower panels plot the number of defaults and the associated opacity or Theill's U measures. Note that the level of development decreases as the opacity measure or Theill's U increase. These measures are available only for a subset of the 118 countries and, therefore, we plot the number of defaults rather than the total rate of default.

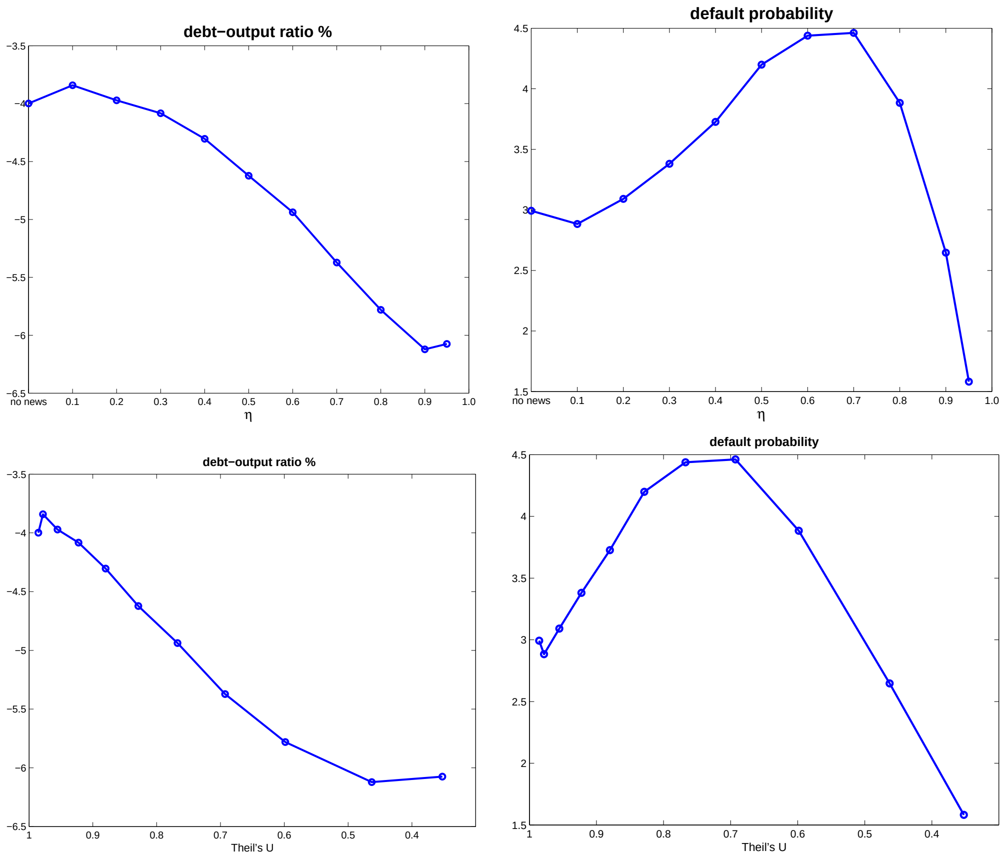
and corresponding Theill's Us in the upper and lower panels, respectively. The relationship between the unconditional default probability and news precision is non-monotonic.

When the economy receives more precise news, forecasts become more accurate. Since the signals are public information, international lenders can better assess the likelihood of default conditional on a given debt level. Therefore, the price of debt is more favorable and the government is induced to borrow more.[31] Further, the lower risk profile reduces the demand for precautionary savings, which also induces the economy to increase borrowing.

There are two particular opposing forces at play in our model concerning the effects of higher precision of news on the unconditional default rate. On the one hand, higher precision leads to

[31] Following the literature, the calibration of the discount factor and the risk free rate induces the economy into borrowing.

Figure 14: The Effect of News on Debt Dynamics

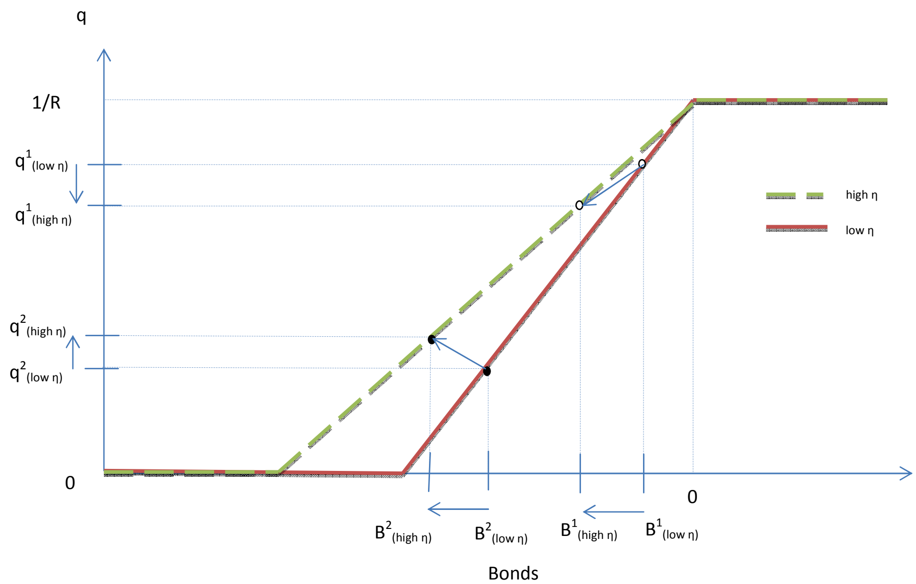


Notes: The graphs on the left show the debt-to-output ratios in percent, and the graphs on the right show the equilibrium default probabilities. The top panel plots the news precision, η on the x-axis whereas bottom panel plots the corresponding Theill's Us on the x-axis.

better forecasting, making the government more able to avoid costly defaults for a given debt level. On the other hand, an increase in the precision of news leads to higher debt, which in turn increases the unconditional default probability. The right panel of Figure 14 shows that for precision levels above 0.6, the former effect dominates the latter.

To examine how the hump-shaped default pattern might arise, Figure 15 illustrates bond price schedule for two news precisions; high and low η—the Figure is analogous to the right panel of Figure 10, which plots the same patterns in the calibrated economy. When the bond position is above zero, the bond price q equals the inverse of the gross risk-free rate and it is unaffected by having more or less precise news. If debt is close to zero, some differences between high and low η emerge. When debt is high, defaults can start to occur frequently and therefore more precise news becomes more valuable. With precise news shocks, the price schedule shifts to the left and becomes less steep–reflecting the fact that forecasts become more accurate and international lenders can better assess the likelihood of default. These effects translate in to a larger vertical distance between the bond price schedules for high and low ηs.[32]

Figure 15: Bond Price Schedule and News Precision



Notes: The figure characterizes how changes in precision affects bond prices.

Because of the low discount factor β the planner would like to increase government debt. However, due to a precautionary motive the planner wants to decrease government debt. Consider first an example where η is low and the equilibrium average bond position is $B^1_{\text{low }\eta}$.[33] Then η is increased and the planner can accumulate more debt because the precautionary savings motive is smaller. The economy moves into the equilibrium average bond position $B^1_{\text{high }\eta}$. Because the two bond price schedules are close, the new prevailing price becomes lower than the initial price—$q^1_{\text{high }\eta} < q^1_{\text{low }\eta}$—, which is associated with $Def.Rate^1_{\text{high }\eta} > Def.Rate^1_{\text{low }\eta}$. This mechanism reflects the movements in Figure 14 when η goes, for instance, from 0.3 to 0.6.

Consider now a second example, where the precision of news is increased as well but the initial equilibrium average bond position is higher $\left(B^2_{\text{low }\eta}\right)$. When the precision of news increases the economy goes into an even higher equilibrium debt level $B^2_{\text{high }\eta}$ as well. But now the new prevailing price becomes higher than the initial price–$q^2_{\text{high }\eta} > q^2_{\text{low }\eta}$, which is associated with $Def.Rate^2_{\text{high }\eta} < Def.Rate^2_{\text{low }\eta}$. This mechanism captures the movements observed in Figure 14 when η goes from 0.6 to 0.9.[34]

[32]Obviously when debt is very high, there is always default and the precision of news again does not affect the bond price.

[33]Variables with superscript of 1 relate to this first example.

[34]These illustrative description does not constitute a proof that the hump-shaped pattern will always arise. Indeed, as shown in Figure 15 one could perfectly observe movements where the default rate would only decrease.

3.6 Welfare implications of news shocks

We compute welfare as the equivalent variation in consumption net of disutility from labor, as is standard with GHH preferences, and take the no news case as the benchmark:

$$E_0 \sum_{t=0}^{\infty} \beta^t u \left((1+\lambda) \left(c_t \left(\eta_0 \right) - g(L_t \left(\eta_0 \right)) \right) \right) = E_0 \sum_{t=0}^{\infty} \beta^t u \left(c_t \left(\eta \right) - g(L_t \left(\eta \right)) \right) \tag{17}$$

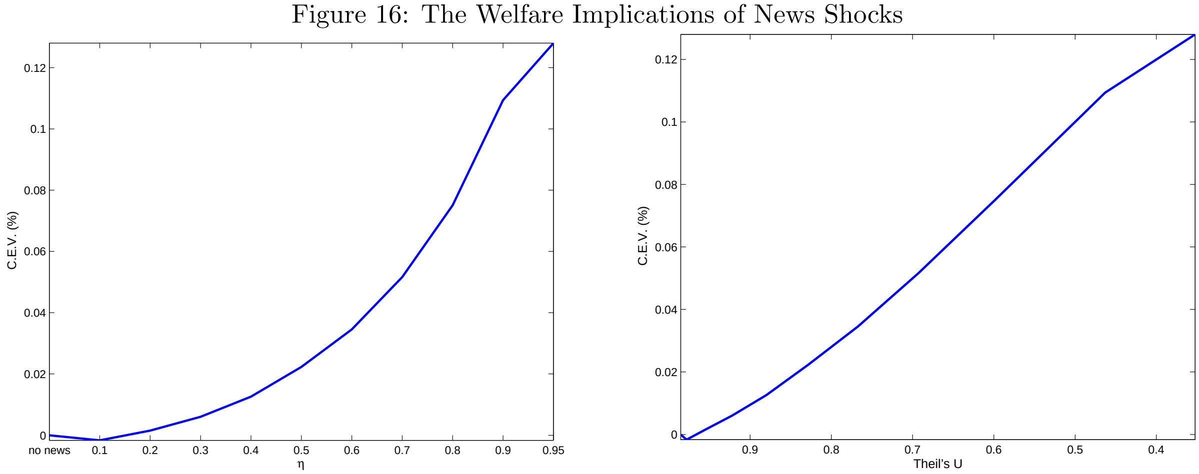
where η_0 refers to the no news case and η is any precision level. For the utility function being considered in this paper, this expression simplifies to:

$$\lambda = \left(\frac{V_0 \left(\eta \right)}{V_0 \left(\eta_0 \right)} \right)^{1/(1-\sigma)} - 1 \tag{18}$$

where V_0 is expected lifetime utility as defined in equation [35]

News shocks have a nonmonotonic effect on welfare in our model. We find that as we move from the no news scenario, welfare initially declines slightly (at precision level of 0.1) and then improves as the precision of news increases (Figure 16). The nonmonotonicity in welfare arises due to two separate forces. First, higher precision of news allows the planner to smooth consumption more effectively, and thus increase welfare regardless of the debt level.

Figure 16: The Welfare Implications of News Shocks



Notes: The figure shows the welfare implications of news shocks as a function of news precision (on the left) and corresponding Theill's Us (on the right).

There exists a more subtle, second force, which may affect welfare positively or negatively

[35]We have also integrated welfare according to the ergodic distribution of the exogenous shocks. We keep the same debt level in order to keep initial debt conditions comparable. The results are very similar for different initial conditions of the debt level. The ergodic distribution (d) of exogenous shocks was computed by solving the matrix system $[\Pi' - I|\mathbf{1}']' \, d = [\mathbf{0}|1]'$, where Π is the transition matrix (see Kim and Nelson (1999) for details)

depending on the debt level. When debt is close to zero, the bond price is close to the inverse of the gross risk-free interest rate. Around that range of low debt, since the bond price is already close to the upper bound, positive news would have a limited room to improve the bond price. Conversely, negative news can lower the bond price significantly. Due to this asymmetry, at low levels of debt, increasing the precision of news might lead to a reduction in welfare. This asymmetry is reversed at high levels of debt. Around that range of high debt, since the bond price is already close to the lower bound, negative news would have a limited room to further lower the bond price. Conversely, positive news can improve the bond price significantly.[36] Thus, at high debt levels, increasing the precision of news would always increase welfare.

When the precision of news is low, the equilibrium debt is also low (see Figure 14), and the equilibrium bond price is close to the inverse of the gross risk-free rate. Hence, the economy is in the region where an increase in the precision of news produces an asymmetric effect leading to a potential welfare loss. In fact, welfare declines when news precision increases to 0.1. As the precision of news increases after that point, the debt level increases and moves to the region where the asymmetric effect of news shocks implies a positive effect on welfare. Combined with the first welfare effect due to better consumption smoothing, welfare monotonically rises as the precision level continues to increase.[37]

3.7 Risk averse pricing of sovereign bonds

In our benchmark analysis, we assumed that foreign investors are risk-neutral, thus the pricing of bonds is actuarially fair. In this section, we relax this assumption by incorporating an endogenous risk premium that reflects variation in foreign investors' marginal utility. To do this, we follow Arellano (2008), Arellano and Ramanarayanan (2012), Cochrane and Piazessi (2008), and consider a pricing kernel as a function of the borrower's income, $M(z_t, z_{t+1})$. With this modification, the pricing equation becomes:

$$q(B', z, s) = \int \int_{\Gamma(B')} M(z, z') f(z, s, z', s') dz' ds'. \tag{19}$$

[36] Note that in the intermediate ranges of debt levels, both positive and negative news shocks would have equally strong–on, net, a neutral–effect on welfare. Thus the consumption smoothing channel dominates and welfare increases.

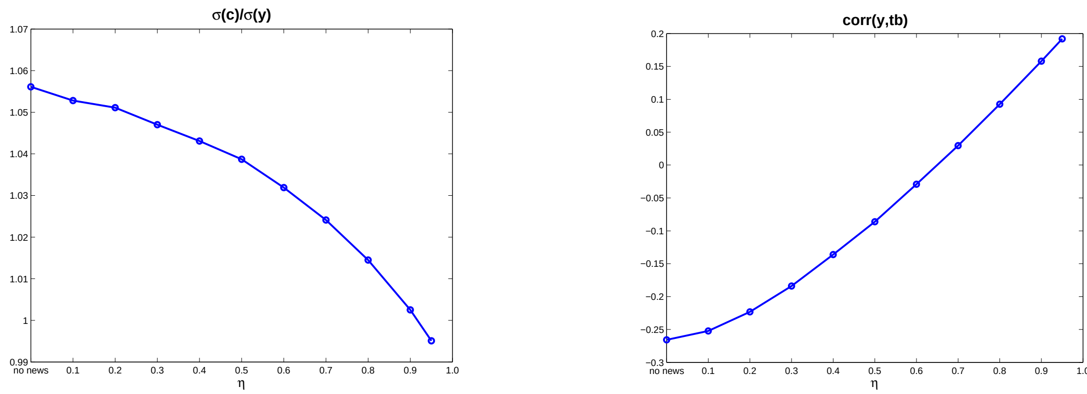
[37] The observed non-monotonicity of welfare is similar to the findings in Morris and Shin (2002). However, the mechanism is different. In Morris and Shin nonmonotonicity arises because of the possible detrimental effect of public information from the coordination costs that may be imposed on private agents, who have their own private signals but may instead put too much weight on public information.

The pricing kernel takes the following form:

$$M(z_t, z_{t+1}) = \exp\left(-r^* - \gamma\varepsilon_{t+1} - \frac{1}{2}\gamma^2\varsigma^2\right), \tag{20}$$

where r^* is the risk-free rate, $\varepsilon_{t+1} = \log z_{t+1} - \rho \log z_t$ is the TFP shock and ς^2 is the variance of the TFP shock.[38] We set $\gamma = 4$, following the approach in Arellano (2008). Note that news shocks affect bond pricing decision through its effect on the transition probability matrix, $f(\cdot, \cdot)$, that foreign investors use to form their expectations.

Figure 17: The Effect of Precision of News on Macroeconomic Variables with Risk Averse Lenders



Notes: The graph on the left shows the variability of consumption relative to output, the graph on the right shows the correlation of trade balance with output as a function of the news precision, ς.

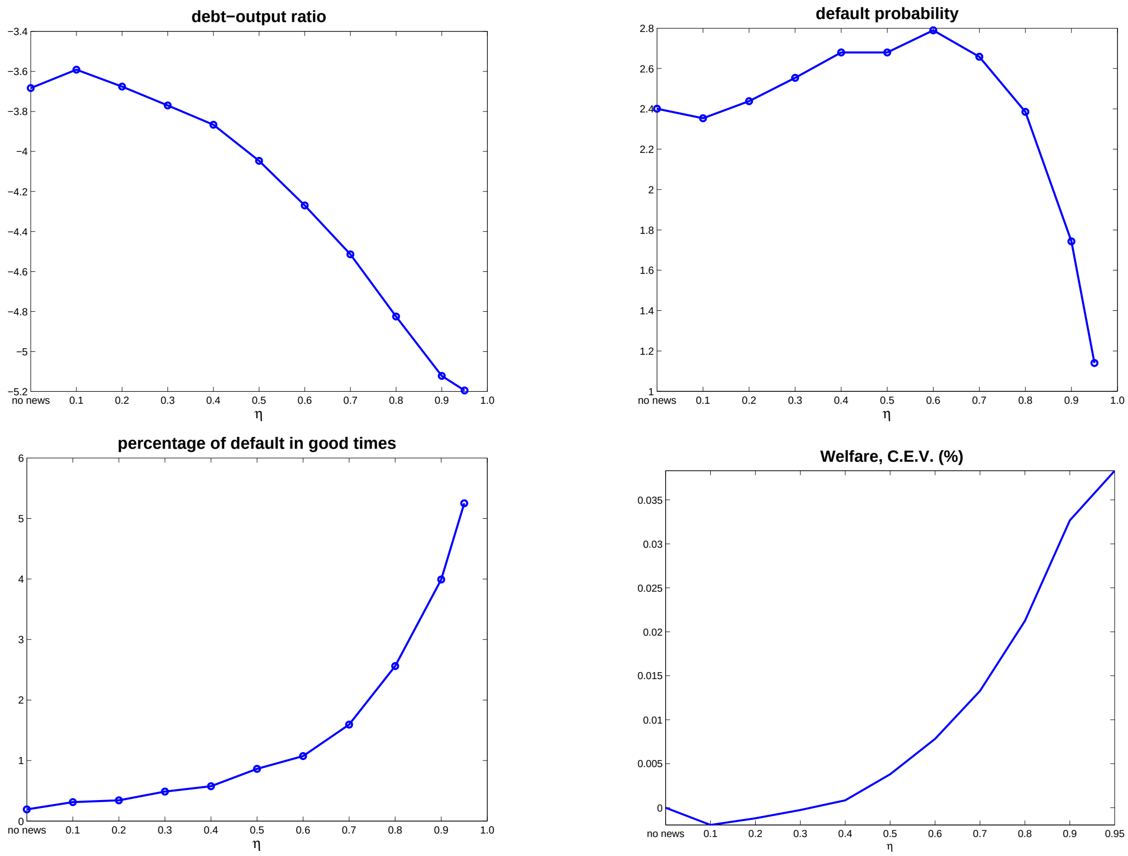
Our baseline findings qualitatively hold with risk averse pricing of the sovereign bonds. As Figures 17 and 18 illustrate, as the news precision increases in the model with risk averse pricing, one observes a lower consumption variability and higher correlation of the trade balance with output. Further, the hump-shaped behavior of the default rates and debt-GDP ratio is also preserved. Last, the model still performs well in generating higher proportion of default rates in good times when the news precision increases.[39]

Risk averse pricing implies some quantitative differences compared to risk neutral pricing. Since borrowing is more costly with risk averse pricing, agents accumulate more wealth. This translates into lower equilibrium debt-gdp ratio and lower equilibrium default rates (see the difference in the

[38] Note that the pricing kernel depends only on the borrower's income. Alternatively, we could model a pricing kernel that incorporates foreign investors' consumption as in Lizarazo (forthcoming). However, this alternative approach would require us to keep track of the foreign investors' demand as an additional state variable, which would further deepen the curse of dimensionality our model runs into. Further, findings of Arellano (2008), and Arellano and Ramanarayanan (2012) show that the formulation we employ performs equally well in capturing the variation in pricing kernel due to default risk.

[39] These results are also preserved when we plot the figures as a function of corresponding Theill's Us instead of the precision of news. However, we excluded these results in the interest of space.

Figure 18: The Effect of News on Default Dynamics and Welfare with Risk Averse Lenders



Notes: The figure shows how our baseline result change with risk averse pricing of sovereign bonds.

top panels of Figures 18 and 14). Defaults in good times also become less frequent (compare the lower left panel in the figure with the left panel of Figure 12). Finally since agents have more wealth, news shocks lead to a more modest effect on welfare (compare the lower right panel in the figure with the left panel of Figure 16).

3.8 Are news shocks equivalent to trend shocks?

Aguiar and Gopinath (2006, 2007) emphasize the role that trend shocks might play in macroeconomic fluctuations in developing countries. Since trend shocks also inform agents about a change in income profile that would realize in subsequent periods, one could perhaps think that trend and news shocks are equivalent. A common feature of both of these shocks is that in a setup with endogenous labor choice and Cobb-Douglas preferences, they imply similar behavior of labor supply due to similar effect of these shocks on wealth. Below we show that trend and news shocks are in fact different.

Trend shocks primarily have a contemporaneous effect, which, then, carries into the future because it affects the path for trend growth. The dichotomy the news literature has been focusing on, however, is markedly different: nothing happens today to fundamentals but agents learn about the future. This fundamental difference between trend and news shocks also has implications on how those shocks should be interpreted. Trend shocks are more easily associated with structural changes, political regime changes, and deep and sudden economic reforms. These type of events are more typical and frequent in developing economies.[40] Differently, news shocks are related to the flow of information, the accessibility and reliability of data in a certain country. Clearly, news shocks should be more frequent and precise in more developed economies as the data in such countries are more reliable and accessible. This feature is independent of the absence or predominance of trend shocks.

After highlighting the conceptual differences between news and trend shocks, we examine what facts news shocks may explain that trend shocks cannot. In table 7, we report the statistics from the model of Aguiar and Gopinath (2006). Comparing Tables 2, 3, and 7, it is clear that trend shocks have different effects from news shocks. Trend shocks increase the volatility of consumption relative to output, while news shocks reduce it. Trend shocks also bring the correlation of output and spreads from 0.28 to -0.23; news shocks have the opposite effect, they increase this correlation from -0.25 to -0.03.

Table 7: Statistics of transitory and trend shocks

	Transitory shocks	Trend shocks
$\sigma(c)/\sigma(y)$	1.01	1.09
$\rho(y,c)$	0.99	0.99
$\rho(y,tb/y)$	-0.31	-0.49
$\rho(y,spread)$	0.28	-0.23

Notes: Transitory shocks and trend shocks model statistics correspond to Model I and II with endogenous labor in Aguiar and Gopinath (2006).

In a nutshell, the comparison of Tables 2 and 3 highlights that news shocks bring the model statistics closer to those of developed economies. The comparison of Tables 2 and 7 does not suggest that trend shocks have the same effect. In fact, Aguiar and Gopinath (2007) emphasize that trend shocks bring the models closer to developing economies. In short, trend and news shocks

[40] In fact Aguiar and Gopinath (2007) determine empirically that trend shocks are more predominant in developing economies.

are different and drive most of the statistics in opposite directions.[41]

4 Conclusions

The European financial crisis has highlighted the importance of news shocks regarding macroeconomic fundamentals. To explore the implications of such shocks, we propose a model of sovereign debt in which default risk, interest rates and debt are affected by current fundamentals and news about future fundamentals. In our framework, news shocks affect equilibrium outcomes because they contain information about the future ability of the government to repay its debt.

The analysis shows that news shocks contribute to explaining key differences in business cycle stylized facts between developing and more developed economies. As the precision of news improves, the model predicts lower variability of consumption, less countercyclical trade balance and interest rate spreads, as well as a higher debt level more in line with the characteristics of more developed economies. The setup also captures the hump-shaped relationship between default rates and the precision of news obtained from the data. In addition, the framework with news shocks can generate default episodes in good times, bringing the model closer to the stylized facts established in the literature.

[41]This aspect does not imply that our results are in contradiction with those of Aguiar and Gopinath (2006, 2007) since more developed economies could feature both more precise news shocks and a smaller predominance of trend shocks.

5 Appendix

5.1 Algorithm

We assume an initial function for the price of the bond $q_0(B', z, s)$, as well as initial values for V_0 and V^d. To calculate the initial value of the bond, we use the inverse of the risk free rate. For the initial values of the value functions, $(V_0)_0$ and $(V^d)_0$, we start with null matrices. We use 61 points for the TFP shock grid, 61 points for the news shock grid and 200 points for the bond grid, and checked that the results are robust to further increases in the number of points in each grid. Then we employ the following algorithm:

1. Use q_0 to express the per period utility as a function of B, B', y and s, then use $(V_0)_0$ and $(V^d)_0$ and equations (7), (12) and (14) to get $(V_0)_1$, $(V^d)_1$, the policy function, $B'(B,\ z, s)$ and default function $D(B,\ z, s)$.

2. Given the default function $D(B, z, s)$, and the repayment and default sets $\Gamma(B)$ and $\digamma(B)$, compute the probability of default $\lambda(B',\ z, s)$ using (15).

3. Update the price of the bond using the following equation:

$$q_1 = \frac{(1 - \lambda(B', z, s))}{1 + r_f}.$$

4. Use the updated price of the bond q_1 and the value functions $(V_0)_1$ and $(V^d)_1$ to repeat steps 1, 2, 3 and 4 until the following conditions are satisfied:

$$\begin{aligned}
\max\left\{q_0\left(B', z, s\right) - q_1\left(B', z, s\right)\right\} &< \epsilon \\
\max\left\{(V_0\left(B, z, s\right))_0 - (V_0\left(B, z, s\right))_1\right\} &< \epsilon \\
\max\left\{(V^d\left(z, s\right))_0 - (V^d\left(z, s\right))_1\right\} &< \epsilon,
\end{aligned}$$

where ϵ is a small number.

In this formulation, we assume that international lenders cannot sustain other types of equilibria based on trigger strategies.[42] In doing so, we follow a formulation and solution algorithm in the spirit of Arellano (2008) and Aguiar and Gopinath (2007), which is also widely used in the subsequent sovereign debt literature. To the best of our knowledge, the sovereign debt literature

[42] This assumption can be rationalized by assuming that international lenders are atomistic and, therefore, unable to coordinate on trigger strategies. Alternatively, international lenders may be unable to sustain long-term relationships because they exit the market after the defaultable debt contract expires at the end of each period.

has not provided a proof of equilibrium uniqueness, and doing so is beyond the scope of this paper. Since the calibration implies a negative utility, we initialize $(V_0)_0$ and $(V^d)_0$ as null matrices such that the contraction property of the Belman equation guarantees convergence to the highest welfare ranked equilibrium.[43]

5.2 Data

Cross-country stylized facts on consumption and net exports are taken from Aguiar and Gopinath (2007). The data on sovereign interest rate correlations with macroeconomic aggregates are taken from Neumeyer and Perri (2004). The statistics on default rates by income deciles for the period from 1950 to 2003 and the statistics on the proportion of sovereign defaults that occurred above trend by income deciles for the period 1950-2003 (Figure 13) are constructed using the database of sovereign defaults by Beim and Calomiris (2001) and income data from the IMF.

5.3 Alternative parametrization for the news signal

In the parametrization for the signal described in Section 2.1, it is more likely to receive a certain signal than any other. For instance, if the TFP shock (z_{t+1}) is high there is a corresponding high signal (s_t) that is more likely to be observed. However, conditional on a high TFP shock (z_{t+1}), the signals (s_t) corresponding to extremely low or very low TFP shocks are observed with equal probability. We also considered an alternative formulation where it would be more likely to observe signals closer to the TFP shock:

$$p(s_t = i | z_{t+1} = l) = \begin{cases} \eta & \text{if } i = l \\ f(i,l) & \text{if } i \neq l \end{cases}, \tag{21}$$

where $f(i,l)$ is a function satisfying the property $f(i,l) > f(j,l) \Leftrightarrow |i-l| < |j-l|$. In particular, we considered the formula:

$$p(s_t = i | z_{t+1} = l) = \eta / e^{a|i-l|^{b_l}}, \tag{22}$$

where a, b_l are positive constants. The precision of the signal is still determined by $1/|\Xi| \leq \eta \leq 1$. The results are qualitatively and quantitatively robust across formulations, and for brevity we only report the first set.

[43] Additional details are provided in Rustichini (1998).

The reason why the two alternative specifications deliver very similar results is analogous to the explanation provided for Figure 4. If a signal is received that pertains to a position very distant from the current TFP, then this signal does not affect expectations. The reason is that the TFP process is such that such movements are very unlikely, and therefore the signal is discounted when forming expectations. This discounting of signals as a function of the distance from the current TFP position already occurs because of the TFP process. It is not really necessary to consider a discounting of signals as a function of the distance through the news process.

5.4 Default Episodes and Income per Capita Brackets Dataset: 1950-2003

		Above Trend				
Country	**Year of Default**	**HP-Filter entire sample**	**HP-Filter before default**	**Linear Filter entire sample**	**Linear Filter before default**	**Income Decile**
Czechoslovakia (Former)	1959	1	1	1	1	8
Cuba	1960	0	0	0	0	6
Costa Rica	1962	0	0	0	0	7
Zimbabwe	1965	0	0	1	1	3
Korea, Dem. Rep.	1974	1	1	1	1	6
Peru	1976	1	1	1	1	7
Congo, Dem. Rep.	1976	1	0	0	0	2
Iran, Islamic Rep.	1978	1	0	0	0	7
Jamaica	1978	0	0	0	0	6
Peru	1978	0	0	0	0	6
Turkey	1978	1	1	0	0	7
Nicaragua	1979	1	0	0	0	5
Sudan	1979	1	1	0	0	2
Togo	1979	1	1	1	1	3
Bolivia	1980	1	0	0	0	5
Mozambique	1980	0	0	0	0	4
Peru	1980	1	0	1	1	6
Uganda	1980	0	0	0	0	1
Central African Republic	1981	0	0	0	0	1
Cape Verde	1981	1	1	1	1	2
Costa Rica	1981	1	0	0	0	7
Honduras	1981	1	0	0	0	4
Jamaica	1981	0	0	0	0	6
Madagascar	1981	1	1	0	0	2
Poland	1981	0	0	0	0	7
Romania	1981	1	0	0	0	6
Senegal	1981	0	0	0	0	4
Argentina	1982	0	0	0	0	8

Cuba	1982	1	1	1	1	6
Dominican Republic	1982	1	0	0	0	5
Ecuador	1982	1	0	1	0	6
Haiti	1982	1	0	0	0	3
Mexico	1982	1	1	1	1	8
Malawi	1982	0	0	0	0	1
Nigeria	1982	0	0	0	0	3
Togo	1982	1	0	0	0	2
Turkey	1982	0	0	0	0	6
Burkina Faso	1983	0	1	0	0	2
Brazil	1983	0	0	0	0	7
Central African Republic	1983	1	0	0	0	1
Chile	1983	0	0	0	0	7
Côte d'Ivoire	1983	1	0	0	0	4
Congo, Rep.	1983	1	1	1	1	5
Costa Rica	1983	0	0	0	0	7
Guinea-Bissau	1983	1	1	1	1	2
Morocco	1983	1	1	1	1	5
Mozambique	1983	1	1	0	0	3
Niger	1983	1	0	0	0	2
Panama	1983	1	1	1	1	7
Philippines	1983	1	0	0	0	5
Sierra Leone	1983	1	1	0	0	3
Uruguay	1983	0	0	0	0	7
Yugoslavia (former)	1983	0	0	0	0	8
Zambia	1983	1	0	0	0	2
Costa Rica	1984	0	0	0	0	7
Peru	1984	0	0	0	0	6
Tanzania	1984	0	0	0	0	1
Angola	1985	0	1	0	0	2
Cameroon	1985	1	1	1	1	4
Vietnam	1985	1	1	1	1	2
Yemen, Rep.	1985	1	0	0	0	5
South Africa	1985	1	0	1	1	6
Bolivia	1986	0	0	0	0	5

Gabon	1986	1	0	0	0	7
Guinea	1986	0	0	0	0	1
Gambia, The	1986	0	0	0	0	2
Morocco	1986	0	0	1	1	5
Nigeria	1986	0	0	1	1	3
Paraguay	1986	0	0	0	0	6
Romania	1986	1	0	0	0	6
Sierra Leone	1986	0	0	0	0	3
Ghana	1987	0	1	1	1	3
Iraq	1987	1	0	0	0	6
Jamaica	1987	0	1	0	0	6
Liberia	1987	0	1	1	1	3
Panama	1987	1	0	0	0	7
São Tomé and Principe	1987	0	0	0	0	4
Uruguay	1987	0	1	1	1	8
Malawi	1988	1	0	0	0	1
Togo	1988	0	1	0	0	2
Trinidad and Tobago	1988	0	0	0	0	8
Argentina	1989	0	1	0	0	8
Bolivia	1989	0	1	1	1	5
Brazil	1989	1	0	0	0	7
Guatemala	1989	0	0	0	0	6
Jordan	1989	1	0	0	0	6
South Africa	1989	1	1	1	1	6
Bulgaria	1990	1	0	0	0	7
Senegal	1990	1	0	0	0	4
Albania	1991	1	1	0	0	4
Algeria	1991	0	0	0	0	5
Ethiopia	1991	1	0	0	0	1
Guinea	1991	1	1	0	0	1
Russian Federation	1991	1	0	0	0	8
Togo	1991	1	1	0	0	1
Bosnia and Herzegovina	1992	1	0	0	0	5
Croatia	1992	0	0	0	0	7
Macedonia, FYR	1992	1	0	0	0	6

Mauritania	1992	0	0	0	0	2
Nigeria	1992	1	1	1	1	3
Senegal	1992	0	0	0	0	3
Slovenia	1992	0	0	0	0	9
Serbia and Montenegro (former)	1992	1	0	0	0	6
Serbia and Montenegro (former)	1992	1	0	0	0	6
South Africa	1993	0	0	0	0	6
Kenya	1994	0	0	0	0	3
Myanmar	1997	1	1	1	1	3
Indonesia	1998	1	0	1	1	5
Moldova	1998	0	1	1	1	4
Pakistan	1998	1	0	0	0	4
Russian Federation	1998	0	1	1	1	6
Ukraine	1998	0	0	0	1	5
Ecuador	1999	1	0	0	0	6
Gabon	1999	1	1	1	0	6
Pakistan	1999	0	0	0	0	4
Côte d'Ivoire	2000	1	1	0	0	3
Indonesia	2000	0	0	0	0	5
Seychelles	2000	1	0	0	0	7
Zimbabwe	2000	1	1	0	0	3
Argentina	2001	1	0	0	0	8
Argentina	2001	1	0	0	0	8
Indonesia	2002	0	0	0	0	5
Moldova	2002	0	1	1	1	4
Nigeria	2002	0	0	0	0	3
Paraguay	2003	0	0	0	0	5
TOTAL		**67**	**39**	**31**	**30**	

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