Information Frictions, Partial Defaults, And Sovereign Spreads ⋆

JUAN M. MORELLI
Federal Reserve Board

MATÍAS MORETTI
Princeton University

July 28, 2021

Abstract. This paper quantifies how the market prices a government's reputation. We lay out a reputational model in which the type of government is time varying and private information. Agents adjust their beliefs about the government's type (i.e., reputation) using noisy signals about its policies. We focus on a setting in which reputation is first order: debt repayment. Changes in reputation affect the market's perceived probability of default, which ends up affecting sovereign spreads. In the empirical analysis, we use the 2007-12 Argentine episode of (noisy) inflation misreport, which implied a partial default on the stock of inflation-linked bonds. We find that the misreports significantly increased the spreads of nominal (dollar-denominated) bonds. Given that coupon payments of nominal bonds were not directly affected by the misreports, we argue that the effects can be rationalized by a loss in Argentina's reputation. We use the empirical estimates to discipline our quantitative model. We show that a government's reputation can have large and persistent effects on its borrowing costs, particularly during a recession.

Keywords: Sovereign Default, Reputation, International Lending.

JEL Codes: F34, F41, G14, G15, L14

⋆ Morelli (juan.m.morellileizagoyen@frb.gov): Federal Reserve Board. Moretti (mm4373@princeton.edu): Department of Economics, Princeton University. We thank Michele Cavallo, Alessandro Dovis, Felicia Ionescu, Ricardo Lagos, Pablo Ottonello, Diego Perez, Thomas Philippon, Venky Venkateswaran, and Adrien Verdelhan for useful comments. Disclaimer: The views expressed here are our own and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of anyone else associated with the Federal Reserve System.

1. Introduction

It is a commonly held view in policy circles that a government's reputation can significantly shape the effectiveness of the policies it implements. For instance, a government's history of achieving inflation or fiscal targets may affect how agents form their expectations about future monetary or fiscal policies. Similarly, honoring past debt obligations may affect a government's current borrowing costs in foreign credit markets and access to different sources of credit. Given this, policy circles usually perceive a country's reputation as an important type of gained capital to be kept over time. A crucial aspect of this argument is quantifying how a government's reputation is affected by the policies it chooses, and how policies are, in turn, shaped by the government's reputation.

To answer these questions, we focus on a particular setting for which reputation may be a first-order concern: debt repayment. We develop a reputational model of default and provide new empirical evidence on the link between a government's reputation and its borrowing costs. We define reputation as the market's belief about a government's willingness to repay its debt given a set of macroeconomic fundamentals. In the model, agents adjust their beliefs using noisy signals based on the government's policies. Governments care about their reputation because it directly affects their cost of funding. Guided by the model, we then go to the data and analyze a unique experiment that allows us to study the effect of a government's reputation on its borrowing costs. We use the Argentine 2007-12 episode of inflation misreport as a case study, which implied a de facto partial default on inflation-indexed bonds (IIBs). We show that the market priced the misreport, as reflected in a significant increase in the spreads of (dollar-denominated) nominal bonds. Given that coupon payments of nominal bonds were not directly affected by the misreport of inflation, we argue that the documented effects can be attributed to changes in the government's reputation. Finally, we use these empirical estimates to discipline our quantitative model and show that a government's reputation can have long-lasting effects on borrowing costs. In a counterfactual analysis, we show that Argentina's loss of reputation can explain a large share of the increase in its sovereign spreads during the financial crises.

We begin by laying out a two-period reputational model of sovereign default. The model is in the spirit of Kreps and Wilson (1980) and Milgrom and Roberts (1982) with uncertainty about the government type. We assume two types of governments: a commitment type and a strategic opportunistic type. While the former has commitment and never defaults, the latter has two policies to dilute its stock of debt. The first policy is an outright default on the entire stock of debt. The second is a policy that indirectly dilutes its real stock of debt.[1] Importantly, we assume that lenders do not perfectly observe this policy and only receive a noisy signal about it.[2] Lenders then use this signal to update their belief about the government's type. Although the model is general enough to accommodate different policies, motivated by the Argentine episode, we interpret this policy as a misreport of the inflation rate that dilutes the real value of IIBs. The optimal policy involves a stochastic trade-off between present and future consumption. On the one hand, by underreporting the inflation rate, the strategic government reduces the debt burden of IIBs in the second period. On the other hand, by misreporting the inflation rate, the strategic government may reveal its type, which increases lenders' perceived probability of an outright default, thus borrowing costs in the first period.

The two-period model provides two main insights. The first is that the costs of losing reputation are state-contingent. In good economic times, changes in reputation do not significantly impact borrowing costs because the government is far from its default boundary. In bad economic times, however, spreads are significantly more sensitive to lenders' beliefs, which resembles the result in Cole and Kehoe (2000). The second insight is that the strength with which lenders update their beliefs about the type of government depends on the degree of information frictions. For instance, an increase in the noise of the signals that agents receive leads to a lower adjustment of beliefs, and therefore to a milder change in a government's borrowing costs.

Guided by the model's predictions, we provide evidence on the importance of a government's reputation for its borrowing cost. To this end, we use the Argentine 2007-12 episode of inflation misreport as a case study. During these years, the official Consumer Price Index (CPI) was intentionally underreported by the national government (see, Cavallo (2013) and Cavallo et al. (2016) for a detailed discussion). At the time, the amount outstanding of Argentina's IIBs accounted for almost a quarter of its stock of debt, so that the underreport of inflation had a great impact on the government's stock of debt.[3] Our hypothesis is that this policy provided (noisy) information to lenders regarding the type of government, affecting its reputation. We

[1]As is standard in the literature, we assume that an outright default triggers output losses. However, the indirect partial-default policy does not trigger output losses.

[2]The assumption captures the idea that this type of policies may be hard to identify. For the Argentine example, this can be interpreted as follows. Agents observe the inflation rate announced by the government but they cannot perfectly observe the "true" inflation rate. Cavallo et al. (2016) show that the lack of reliable official data led to the creation of several unofficial inflation indicators. Agents can then use these alternative indicators to get a noisy signal about the government's misreport.

[3]By misreporting its inflation rate, Argentina decreased its IIBs payments by nearly \$3.2 billion, which accounts to around 1% of its GDP.

focus on this episode for three main reasons. First, Argentina was not excluded from debt markets as a consequence of this policy, so we can quantify the effect of the misreport on Argentina's sovereign spreads. Second, since the misreports occurred frequently, it allows us to work with a relatively sizable number of observations. Third, the misreport only affected coupon payments of IIBs. By studying the effects of this policy on other types of bonds (e.g, nominal bonds), we can thus isolate the reputational effects of the misreport.

There are two main challenges in assessing the causal effect of inflation tampering on Argentina's spreads. The first is measurement, given that lenders cannot perfectly observe the "true" inflation rate, and hence the magnitude of the misreport. Moreover, based on our reputational model, only unexpected changes in the misreport should have an effect on prices. If the market was already expecting the misreport, that effect should already be priced. To address this concern, we consider changes in the break-even (BE) inflation rate as a proxy for the unexpected misreport.[4] Embedded in the BE inflation rate is the market's expectation about the inflation announced by the government, since these announcements directly affect the returns of IIBs. Changes in the BE rate around days on which the government reported the inflation rate can therefore be used to infer the market's surprise.

The second challenge is reverse causality, since inflation tampering may be the government's response to a rise in spreads. If that is the case, a simple OLS regression would yield biased point estimates. To address this concern, we adopt a heteroskedasticity-based identification strategy (Rigobon and Sack (2004)) and exploit changes in the volatility of the BE inflation rate around days on which the government reported the inflation rate. The main identifying assumption is that the volatility of shocks to the BE inflation rate is significantly higher around these announcements, but the variance of shocks to sovereign spreads (and other common shocks) remains the same.

We show that the sequence of misreports significantly increased the spreads of dollar-denominated bonds issued by the Argentine government. In particular, we find that a 1–s.d. decrease in the BE inflation rate leads to a rise in spreads that accounts for about $50\% - 70\%$ of their daily dispersion. Interpreted through the lens of our reputational model, given that coupon payments of dollar-denominated bonds were not directly affected by the misreports, these results suggest that a government's reputation can play an important role in the pricing of sovereign bonds.

[4] The BE inflation rate is the level of inflation that renders an investor indifferent between holding nominal bonds or IIBs.

In the quantitative section, we extend our stylized two-period model by considering an infinite-horizon model with incomplete markets, limited commitment, alternating governments' types, and noisy signals. We discipline the model with our empirical estimates and use the model to quantify the long-run costs of losing reputation. Our model, solved with global solution methods, is consistent with key moments of Argentine business cycles and spreads. The model delivers persistent dynamics of reputation, which are relevant to replicate the observed evolution of Argentina's spreads after 2007. In particular, we show that the loss of reputation is key in matching the observed excess sensitivity of Argentina's spreads during the Great Financial Crisis and, to some extent, its posterior decoupling from the rest of the region.

Literature Review

Our paper relates to a large literature on how the presence of asymmetric information about a government's type affects its policies and different macroeconomic outcomes. Backus and Driffill (1985); Barro (1986); Persson and Tabellini (1997); Phelan (2006); and Dovis and Kirpalani (2020) examine the role of a government's reputation in the design of fiscal, monetary, and regulatory policies. In particular, our article contributes to a growing body of work that studies reputation dynamics when players' actions are not perfectly observable (Bohren (2021); Faingold (2020); Board and Meyer-Ter-Vehn (2013); Faingold and Sannikov (2011); Ekmekci (2011); and Cripps, Mailath, and Samuelson (2004)). A close study in this regard is Dovis and Kirpalani (2021), who analyze the optimal transparency of governments' rules in a context in which the type of government is private information. We contribute to this literature by providing a framework that links a quantitative analysis of the role of a government's reputation with a relevant empirical counterpart.

Our paper contributes to the literature on sovereign defaults and governments' reputation. Four close studies are Cole, Dow, and English (1995); Alfaro and Kanczuk (2005); D'Erasmo (2011); and Amador and Phelan (2021). As in our study, these papers analyze a sovereign debt model with limited commitment à la Eaton and Gersovitz (1981), in which the type of government is time varying and private information.[5] Our contribution to this literature is twofold. By using the 2007-12 Argentine misreport of inflation, we provide new empirical evidence on the links between a government's reputation and its borrowing costs. Also, motivated by the Argentine case, we provide a model in which the government's actions are not perfectly

[5]Related studies, such as Phan (2017b); Sandleris (2008); and Dovis (2019), analyze models in which the type of government is public information, but in which the government uses debt and default policies as a signaling device about the economy's fundamentals.

observable and study how the presence of noisy signals affects the government's incentives to default.

Our paper is related to a large empirical literature that estimates the effects of a government's history of (outright) defaults on its borrowing costs (see, for example, English (1996); Özler (1993); Reinhart et al. (2003); Borensztein and Panizza (2009); Cruces and Trebesch (2013); Benczur and Ilut (2016); and Catao and Mano (2017)). A shortcoming of these papers is that they do not disentangle whether the rise in sovereign spreads after a sovereign default can be attributable to a punishment or reputational effect.[6] Moreover, given that an outright sovereign default typically takes a long time to resolve, the default history may not be a good predictor of the current government's reputation in debt markets.

We address these shortcomings by providing a high-frequency identification using financial markets data. In terms of methodology, three close studies are Bernanke and Kuttner (2005); Rigobon and Sack (2004); and, particularly, Hebert and Schreger (2017).[7] Our work contributes in this dimension by estimating the short-run effect of indirect partial-default policies on a particular set of assets (inflation-indexed bonds) on the sovereign spreads of dollar-denominated bonds. We argue that the documented effects are mainly due to changes in the government's reputation, and we provide a quantitative model to formalize the mechanism and measure the possible long-run effects of such policies.

Lastly, our paper is related to the literature on sovereign partial defaults. Arellano et al. (2019) provide a model in which a government can partially default on its debt obligations directly. Du and Schreger (2021); Ottonello and Perez (2019); Engel and Park (2018); Phan (2017a); and Aguiar et al. (2013) formulate models in which a government can partially default on its stock of nominal bonds by increasing the inflation rate. All of these studies assume either an exogenous output loss or exclusion from the markets as a punishment for partial default.[8] We contribute to this literature by providing a micro-foundation for the costs of partial defaults, based on a government's reputation in international debt markets.

[6]An exception is Benczur and Ilut (2016), who pose a structural-form asset pricing regression to disentangle the role of reputation.

[7]Bernanke and Kuttner (2005), Rigobon and Sack (2004) estimate the effects changes in the federal funds rate have on stock prices. Hebert and Schreger (2017) estimate the effect of news affecting the likelihood of an outright sovereign default on domestic equity returns.

[8]The exception is Du and Schreger (2021). In this case, the cost is endogenous and depends on the foreign currency mismatch on corporate balance sheets.

The rest of the paper is structured as follows. Section 2 presents some motivating evidence and the two-period reputational model. Section 3 describes the empirical analysis, based on the Argentina inflation-tampering episode. Section 4 presents the quantitative model. Section 5 concludes.

2. Macroeconomic Fundamentals, Reputation, and Sovereign Spreads

2.1. *Illustration: The Role of Macroeconomic Fundamentals*

Are the economy's fundamentals enough to explain sovereign spreads? Or is there room for other factors? To motivate the analysis, this subsection analyzes to what extent a combination of macroeconomic fundamentals and external factors can explain the behavior of sovereign spreads in emerging markets. To this end, we consider a simple panel regression that jointly accounts for macroeconomic variables and global factors. Our sample consists of 28 emerging markets that are part of the Emerging Markets Bond Index (EMBI), at daily frequency for the period 2003-13.

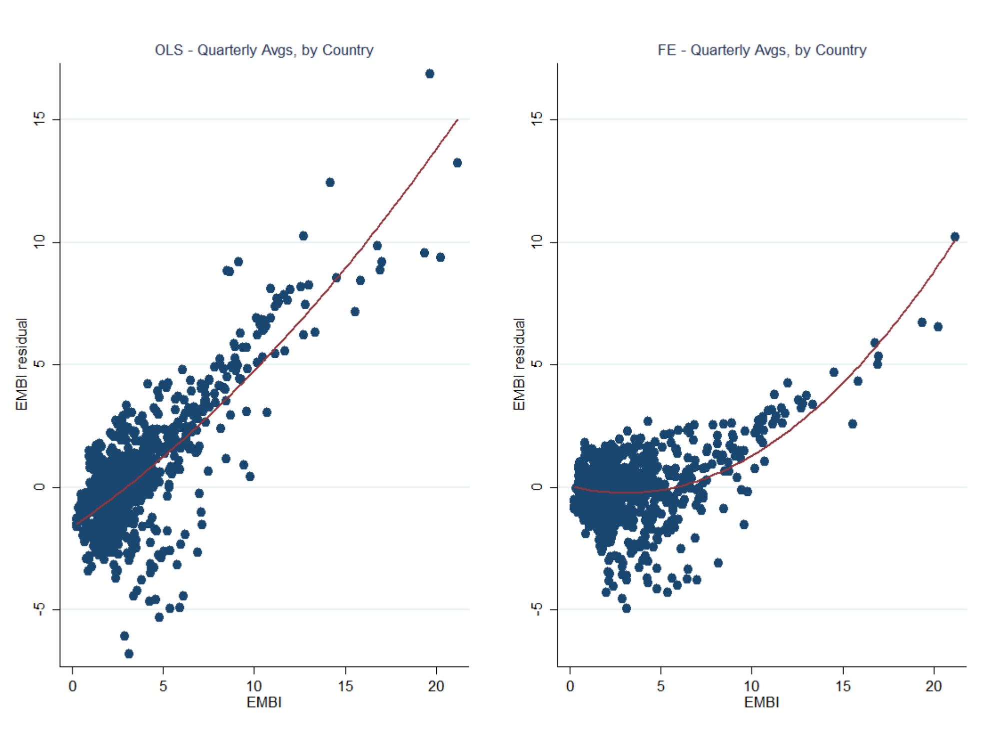
Equation (1) describes our main specification. The variable SP_{it} captures the EMBI spread for country i at time t. Regarding the set of regressors, $\left(\frac{D}{Y}\right)^{q-1}_{i,t}$ and $Y^{q-1}_{i,t}$ are the one-quarter-lagged country's debt-to-GDP ratio, and the country's (log) real GDP HP cycle, respectively. The variable X_t includes different global factors. In particular, we include the VIX index to control for lenders' risk aversion, and the S&P 500 and the MSCI Emerging Markets ETF (EEM index) to control for aggregate credit market conditions. The variable $\mathrm{FE}_{i,t}$ are country, regional, quarter, and region-by-quarter fixed effects.[9]

$$SP_{it} = \beta_0 + \beta_1 \left(\frac{D}{Y}\right)^{q-1}_{i,t} + \beta_2 \mathrm{Y}^{q-1}_{i,t} + \mathrm{FE}_{i,t} + \mathrm{X}_t + \epsilon_{it} \tag{1}$$

Figure 1 shows the residuals $\hat{\epsilon_{it}}$ for different levels of the dependent variable, SP_{it}. The left panel shows the results for a specification without country fixed effects and the right panel includes those controls. The two panels show that the predicted residuals are large and positive for higher values of the EMBI spread (that is, during periods in which the default probability is higher). During these periods, macroeconomic fundamentals and global factors cannot fully explain the observed spreads, suggesting that there may be another factor at play: a missing

[9] Default periods are excluded from the sample. See Appendix B.1 for details on the sample, variables, and other specifications.

FIGURE 1. Panel Regression: EMBI Residuals



Notes: Figure shows the observed EMBI spreads and EMBI residuals for the panel of countries in our sample. Results are quarterly averages by country. The residuals are computed from the specification in Equation (1) .

state. Moreover, the fact that the results hold after controlling for country fixed effects suggests that the impact of this missing state on sovereign spreads is time variant.[10]

To sum up, the previous analysis suggests that countries' fundamentals are not enough to explain their sovereign risk. There seems to be a missing state variable behind the pricing of sovereign risk, whose explanatory power increases during periods of distress. We argue that a government's reputation can account for this missing link. Next, we formulate a simple two-period reputational model of sovereign default in which neither the type nor the actions of the government are observable by lenders. The goal of this model is to build intuition that helps us design both our empirical and quantitative analysis.

[10]In Appendix B.1 we show that all of these results hold for different specifications of Equation (1), including a specification in which the dependent variable is in logs and a specification with interactions and quadratic terms for $\left(\frac{D}{Y}\right)_{i,t}^{q-1}$ and $Y_{i,t}^{q-1}$. Results are also robust to the inclusion of credit ratings-time fixed effects, which controls for changes in risk aversion.

2.2. *A Stylized Model of Reputation*

Consider a two-period small-open economy with incomplete markets. Assume a representative consumer that faces an increasing and concave utility function. Let (y_1, y_2) denote the deterministic endowment output for periods 1 and 2, respectively. A benevolent government maximizes the expected utility of the representative consumer. The government faces a deterministic legacy stock of debt, B, that matures at the end of period 2. The government is also subject to an exogenous short-term debt issuance obligation, b, that occurs at the end of period 1.[11] We assume that the government's debt is traded by risk-neutral, perfectly competitive, and deep-pocketed international lenders.

In the model, there are two types of government: a commitment type (C) and a strategic opportunistic type (S). The type is not publicly observable. The C-type has commitment so it never defaults. The S-type has two default policies. The first is an outright default on its entire stock of debt. As is standard in the literature, we assume that this policy leads to a random output cost given by $\phi_S \sim G(.)$. The second policy, denoted by $\tilde{\pi}$, captures any government policy that affects repayment of the legacy debt B. We assume that $\tilde{\pi} \in [\underline{\pi}, 0]$, with the interpretation that $\tilde{\pi} < 0$ implies a partial default on behalf of the government.[12] Importantly, we assume that lenders cannot perfectly observe $\tilde{\pi}$ and they only receive a noisy signal about it.[13]

The policy $\tilde{\pi}$ can be interpreted in different ways, depending on the underlying bond. For instance, if B are nominal bonds denominated in domestic currency, then $\tilde{\pi} < 0$ would represent an increase in the economy's inflation rate intended to dilute this debt. If B are inflation-indexed bonds, $\tilde{\pi} < 0$ represents an underreport of the "true" inflation rate. Under this interpretation, notice that $\tilde{\pi}$ can be understood as the difference between the (observed) inflation announced by the government, $\hat{\pi}$, and the unobserved "true" inflation rate, π. Moreover, in this scenario, it is natural to assume that lenders cannot perfectly observe $\tilde{\pi}$, since they only observe the inflation announced by the government.

[11] This exogenous amount can be interpreted as if the government has some level of public expenditures to finance via taxes and debt.

[12] We impose a restriction on the minimum possible value of $\tilde{\pi}$ to ensure that the default on B is, at most, partial. In reality, a complete default may generate other costs for the government, such as output losses or sanctions from the international community.

[13] For completeness, Appendix C.2 describes the case in which $\tilde{\pi}$ is perfectly observable.

FIGURE 2. Timing of Events: The Two-period Model

$t = 1$				$t = 2$	
	Stage 1		Stage 2		
Government starts with (B, ζ). Lenders have conjecture $\tilde{\Pi}_S$.	Government chooses $\tilde{\pi}$.	Message m is realized. Lenders update their posterior: $\zeta'\left(m, \tilde{\Pi}^{\star}_S\right)$.	Government issues b.	Default cost ϕ_S is realized.	Government chooses to default or not.

Although the type of government is private information, lenders have some prior ζ about the government's being a commitment type. Moreover, lenders have conjecture $\tilde{\Pi}^*_S$ regarding the optimal partial-default policy, $\tilde{\pi}$.

Figure 2 depicts the timing of events. The first period is divided into two stages. In the first stage, the government starts with a stock of legacy debt B and chooses $\tilde{\pi}$. Based on the chosen $\tilde{\pi}$, lenders observe a noisy message $m = \{L, NL\}$, where L (lie) means the government partially defaulted on B.[14] We assume that the probability of receiving message L is increasing in the size of the partial default, $\mid \tilde{\pi} \mid$. Based on the observed message m and conjecture $\tilde{\Pi}^*_S$, lenders then update their posterior ζ' using a Bayes-induced function: $\zeta' \equiv \zeta'(m, \tilde{\Pi}^*_S)$. In the second stage, the government issues an exogenous amount of short-term debt, b. At the beginning of period two, the government observes the realization of default cost ϕ_S and decides whether to default or not.

Based on these timing assumptions, we can write the government's budget constrains as

$$c_1 = y_1 + q\,(.) \times b$$

$$c_2 = \begin{cases} y_2 - b - B\,(1 + \tilde{\pi}) & \text{if gov. does not default} \\ y_2 - \phi_S & \text{if gov. defaults} \end{cases}$$

where $q\,(.)$ represents the bond-pricing kernel and is defined below. As it will become clear in the description of the period 1 problem, the optimal choice of $\tilde{\pi}$ involves a stochastic trade-off between present and future consumption. On the one hand, by increasing $\mid \tilde{\pi} \mid$, the strategic

[14]For instance, for the case of inflation-indexed bonds, a message $m = L$ would imply that the government underreported the inflation rate.

government reduces the debt burden in the second period, which allows it to increase consumption in that period. On the other hand, a larger $\mid \tilde{\pi} \mid$ may reveal the government's type, which would reduce the bond price, $q(.)$, and consumption in period one.

We now describe the problem of the two types of governments, starting from the last period backward.

Period 2

Let $u(.)$ denote the government's utility function. At the beginning of the second period, after the default cost is realized, the strategic government chooses to default or not in order to maximize that period's utility:

$$\max \left\{ u\left(y_2 - \phi_S\right), u\left(y_2 - b - B\left(1+\tilde{\pi}\right)\right) \right\} \tag{2}$$

Assuming that $u(.)$ is strictly increasing, the strategic government does not default if and only if $\phi_S \geq b + B\left(1+\tilde{\pi}\right)$. Thus $1 - G\left(b + B\left(1+\tilde{\pi}\right)\right)$ is the probability of no default for the strategic government. Notice that this probability does not depend on the specific shape of the utility function, but only on the total stock of debt and the distribution of the default cost. Therefore, the information provided by m and the conjecture $\tilde{\Pi}_S^{\star}$ are sufficient for lenders to be able to price the government's debt.

Period 1 - Stage 2

After the government chooses $\tilde{\pi}$ and after message m is realized, the government issues an exogenous amount of bonds b. Given $\left(b, m; \tilde{\Pi}_S^{\star}\right)$, the value function for the commitment type is given by

$$\begin{aligned} W_C\left(b, m, \tilde{\pi} = 0; \tilde{\Pi}_S^{\star}\right) &= u\left(c_1\right) + \beta u\left(c_2\right) \\ \text{with} \quad c_1 &= y_1 + q\left(b, m, \tilde{\Pi}_S^{\star}\right) b \\ c_2 &= y_2 - b - B \end{aligned} \tag{3}$$

Similarly, given $\left(b, m, \tilde{\pi}; \tilde{\Pi}_S^{\star}\right)$, the value function for the strategic type is given by

$$\begin{aligned} W_S\left(b, m, \tilde{\pi}; \tilde{\Pi}_S^{\star}\right) &= u\left(c_1\right) + \beta \left\{ \int_{b+B(1+\tilde{\pi})}^{\bar{\phi}} u\left(c_2\right) dG\left(\phi_S\right) + \int_{\underline{\phi}}^{b+B(1+\tilde{\pi})} u\left(y_2 - \phi_S\right) dG\left(\phi_S\right) \right\} \\ \text{with} \quad c_1 &= y_1 + q\left(b, m, \tilde{\Pi}_S^{\star}\right) b \\ c_2 &= y_2 - b - B\left(1+\tilde{\pi}\right) \end{aligned} \tag{4}$$

Period 1 - Stage 1

Let $P(m|\tilde{\pi})$ be the exogenous probability of receiving message m given $\tilde{\pi}$. At the beginning of period 1, given the lenders' conjecture $\tilde{\Pi}_S^\star$, the strategic government solves the following problem:

$$\tilde{\pi_S}^* \left(\tilde{\Pi}_S^\star\right) = \arg\max_{\tilde{\pi}} \left\{P(m=L|\tilde{\pi}) \times W_S\left(m=L, \tilde{\pi}, \tilde{\Pi}_S^\star\right) + P(m=NL|\tilde{\pi}) \times W_S\left(m=NL, \tilde{\pi}, \tilde{\Pi}_S^\star\right)\right\}$$
$$s.t. \quad \tilde{\pi} \in [\underline{\pi}, 0] \tag{5}$$

Once the government chooses $\tilde{\pi}$, lenders observe the message m and update their belief about the government type using Bayes' rule. For simplicity, we assume that both messages have positive probability for any $\tilde{\pi} \leq 0$, so Bayesian updating is well behaved and there are no off-path information sets. Let $l\left(m; \tilde{\Pi}_S^\star\right)$ be the updated log-likelihood ratio after message m is realized. The lenders' update of beliefs is given by

$$\begin{aligned} l\left(m; \tilde{\Pi}_S^\star\right) &= l_0 + \ln \frac{P\left(m|\tilde{\Pi}_C^\star = 0\right)}{P\left(m|\tilde{\Pi}_S^*\right)} \\ \zeta'\left(m; \tilde{\Pi}_S^\star\right) &= \frac{exp\left\{l\left(m, \tilde{\Pi}_S^\star\right)\right\}}{1 + exp\left\{l\left(m, \tilde{\Pi}_S^\star\right)\right\}} \end{aligned} \tag{6}$$

where l_0 is such that $\zeta = \frac{exp(l_0)}{1+exp(l_0)}$. Given the posterior ζ', the pricing kernel is given by

$$q\left(b, m; \tilde{\Pi}_S^\star\right) = \frac{1}{1+r}\left[\zeta' + (1-\zeta')\left[1 - G\left(b + B\left(1 - \tilde{\Pi}_S^\star\right)\right)\right]\right] \tag{7}$$

Notice that the price is increasing in the posterior ζ' and decreasing in the default probability. If lenders strongly believe that the government is of the commitment type, they will be willing to offer a higher price for the bond because the C-type never defaults. Furthermore, there is an interactive effect between the government's reputation and the default probability. In particular, notice that bond prices are less sensitive to fluctuations in ζ' when the default probability is low. This implies that the strategic government has larger incentives to set a larger $\mid \tilde{\pi} \mid$ in "good" economic times (i.e., when the default probability is small) than in "bad" times.

Definition **1.** *Perfect Bayesian Equilibrium - Two-Period Economy*
Given an initial pair (ζ, B) and an exogenous bond policy b, a perfect Bayesian equilibrium (PBE) is a collection of value functions, $\{W_S(.), W_C(.)\}$ policy functions $\{\tilde{\pi}_S^\star(.)\}$, a conjecture

about the strategic government's optimal partial-default policy $\left\{\tilde{\Pi}_S^\star\right\}$, *and a system of beliefs* $\left\{\zeta'\left(m;\tilde{\Pi}_S^\star\right)\right\}$ *such that*

(1) *Given* $\tilde{\Pi}_S^\star$, *the posteriors* $\zeta'\left(m;\tilde{\Pi}_S^\star\right)$ *for* $m \in \{L, NL\}$, *are derived from Equation (6).*
(2) *Given* $\left(b, m, \tilde{\pi}; \tilde{\Pi}_S^\star\right)$, $W_j(.)$ *is the associated value function for the* j*-type.*
(3) *Given value function* $W_S(.)$, $\tilde{\pi}_S^\star$ *solves the problem in Equation (5).*
(4) *The conjecture coincides with the optimal partial-default policy:* $\tilde{\Pi}_S^\star = \tilde{\pi}_S^\star$.

Proposition 1 below states that in the absence of other output costs, the strategic government will always find it optimal to partially default on B.

Proposition 1. *(No Pooling Equilibrium) If* $\tilde{\pi}$ *is not perfectly observable by lenders, then* $\tilde{\pi}^\star < 0$ *for any* $B > 0$.

Proof. Conjecture that $\tilde{\Pi}_S^\star = 0$ is an equilibrium. In such a case, notice from Equation (6) that $\zeta'\left(m;\tilde{\Pi}_S^\star = 0\right) = \zeta$ for any message m. Therefore, although the probability of receiving message $m = L$ is increasing in $\mid \tilde{\pi} \mid$, any deviation from $\tilde{\pi}^\star = 0$ will have no impact on lenders' beliefs or prices $q(.)$. Thus, there is no cost (or penalty) in setting $\tilde{\pi} < 0$. Hence, the strategic government finds it optimal to set $\tilde{\pi} = \underline{\pi}$, a contradiction. □

Characterization of the Solution

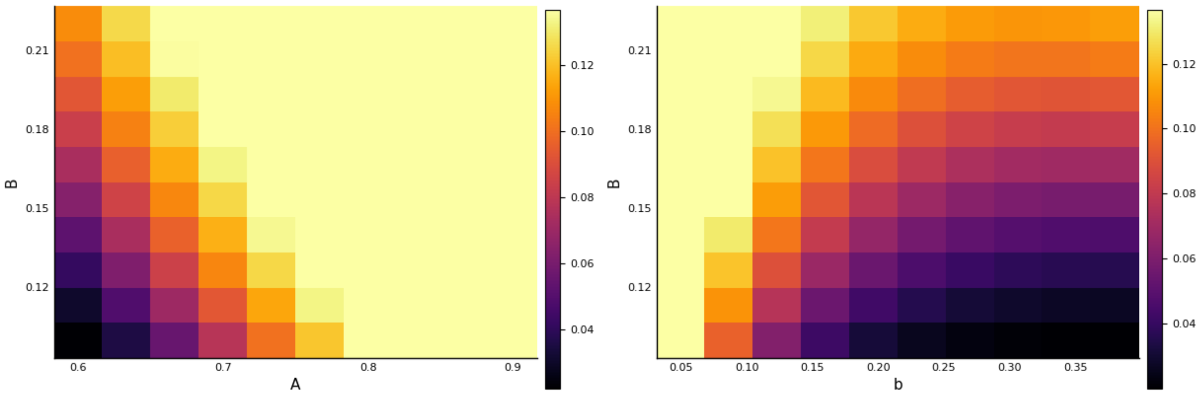
We now characterize the strategic government's optimal choice of $\tilde{\pi}$ and provide a simple numerical exercise. From now on, we follow the interpretation that $\tilde{\pi}$ represents a misreport of the inflation rate that dilutes the stock of inflation-indexed bonds (B). We follow this interpretation, since it provides a suitable mapping to our empirical work.

Using Leibniz rule, it is easy to show that an interior solution is characterized by the following first-order condition:

$$\underbrace{\frac{\partial P(m = L|\tilde{\pi})}{\partial \tilde{\pi}}}_{<0} \times \left\{ \overbrace{u\left(y_1 + q\left(b, m = L; \tilde{\Pi}_S^\star\right) b\right)}^{\text{utility if } m = L} - \overbrace{u\left(y_1 + q\left(b, m = NL; \tilde{\Pi}_S^\star\right) b\right)}^{\text{utility if } m = NL} \right\} = \tag{8}$$
$$B\beta\left[1 - G\left(b + B\left(1 + \tilde{\pi}\right)\right)\right] \times u'\left(y_2 - b - B\left(1 + \tilde{\pi}\right)\right).$$

The left-hand side of the equation represents the expected cost of misreporting inflation. It is given by the cost of lower consumption in period one if message $m = L$ is realized, weighted by the change in the probability of receiving that message as the misreport increases. The lower consumption is explained by the fact that bond prices are smaller under message $m = L$, given

FIGURE 3. Optimal $\tilde{\pi}$: Combinations of B, A, and b



Notes: Optimal $\tilde{\pi}$ policy. The left panel shows results for different parameterizations of (B, A). The right panel shows results for different combinations of (B, b). Lighter areas represent a larger $\mid \tilde{\pi} \mid$.

that lenders assign a higher probability to the event that the government is of the strategic type.[15] The right-hand side of the equation represents the expected benefit of misreporting. For each unit of B, by misreporting the inflation rate, the government can increase its consumption in period two, which is valued by its marginal utility, weighted by the repayment probability, and discounted by β.

In what follows we show an illustrative quantitative solution of the model.[16] We assume CRRA preferences given by $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$. For the endowments, we assume $y_2 > y_1$ so that the government is willing to accumulate debt in the first period. Default costs are assumed to be $\phi_S \sim \mathcal{N}(A, \eta)$. For simplicity, we assume a linear specification for the exogenous probability of receiving message L:

$$P(m = L|\tilde{\pi}) = \frac{(1-\lambda)}{\underline{\pi}} \times \tilde{\pi} + \frac{\lambda}{2} \tag{9}$$

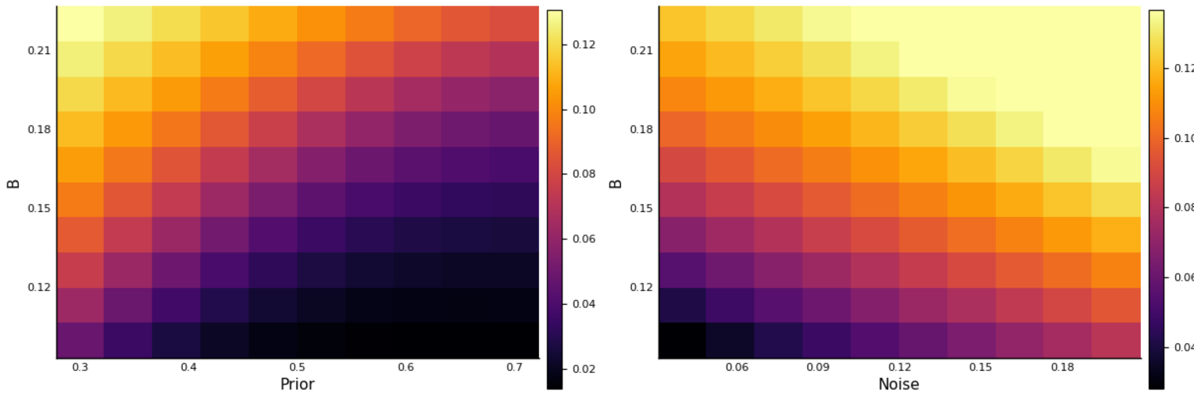
where $\lambda \in (0, 1)$ is the noise of the signal.

Figure 3 shows the optimal $\tilde{\pi}$ for different values of B, b, and A. Lighter areas represent a higher underreport of inflation. The magnitude of the underreport is increasing in B, given that the expected benefits of the misreport are increasing in B (as shown on the right-hand side of Equation (8)). The left panel shows that incentives to misreport are increasing in the mean default cost, A. From Equation (7) we observe that when the default probability is high (which

[15]This is because bond prices are increasing in the posterior ζ' (see Equation 7) and (from Equation 6) the posterior is always smaller under $m = L$, given that $\tilde{\Pi}_S^\star < 0$ in any equilibrium (Proposition 1).

[16]Appendix Table B.1 shows the parameters used to solve the model. Since this is just an illustration, the model is not calibrated to match the data.

FIGURE 4. Optimal Misreport: Combinations of B, ζ, and λ



Notes: Optimal $\tilde{\pi}$ policy. The left panel shows results for different parameterizations of (B, ζ). The right panel shows results for different combinations of (B, λ). Lighter areas represent a larger $\mid \tilde{\pi} \mid$.

is the case when A is small), the realization of $m = L$ can have a significant impact on the bond price, therefore reducing consumption in period 1. The right panel shows that the underreport is decreasing in the stock of short-term debt, b. This is because a higher b increases the cost to the strategic government of revealing its type (as shown on the left-hand side of Equation (8)).

Figure 4 shows the results for different combinations of B, the prior ζ, and the noise of the signal λ. The left panel shows that the government's optimal underreport increases as the prior decreases. In words, as the government's initial reputation worsens, the costs of revealing the type become lower; thus the S-type has stronger incentives to underreport. It is then clear that the government's actions are heavily influenced by the beliefs of market participants, a result that resembles that of Cole and Kehoe (2000). The right panel of Figure 4 shows that as the noise of the signal decreases, the government finds it optimal to decrease the magnitude of the underreport. This is intuitive since, for a given value of $\tilde{\pi} < 0$, the probability of observing message $m = L$ increases with the precision of the signal.

To summarize, the main finding of this stylized two-period model is that incentives to misreport are state-contingent. The underreport of inflation is higher in good times (when the default probability is small) and when the government's initial reputation is small.

3. Empirical Analysis: The Case of Argentina

In this section, we provide evidence about the effect of a government's reputation on its borrowing cost. To this end, we use the Argentine 2007-12 episode of inflation misreport as a case study. During this period, the official CPI was intentionally underreported by the national government. The sequence of misreports directly affected the coupon payments of IIBs, and therefore it can be interpreted as an indirect partial default on these bonds.

We focus on the Argentine government's systematic misreport of inflation for three reasons. First, at the beginning of 2007, the amount outstanding of Argentina's IIBs accounted for almost a quarter of its debt. By lowering interest payments and principal, the underreport of inflation had a great impact on the government's stock of debt and implied an indirect partial default on the stock of IIBs.[17] Second, given that Argentina was not excluded from international debt markets, we can quantify the contemporaneous effect of this policy on the spreads of nominal bonds (denominated in dollars), which account for the vast majority of Argentina's debt. Given that coupon payments of dollar-denominated bonds are not directly affected by the misreport of inflation, we argue that the documented effects can be attributed to changes in the government's reputation. Third, since misreports occurred frequently, it allows us to work with a relatively sizable number of observations.

For the most part of the first half of the 2000s, Argentina's inflation rate was relatively low compared with its historical values, but it peaked in 2005 at more than 10%.[18] The response of the government was to impose a series of price controls in 2006, and to pressure the staff of the National Statistics Institute (INDEC) to manipulate the computation of the price index elaborated on the institution. In February 2007, the government directly intervened with the INDEC and fired its highest ranked members, including the statistician in charge of elaborating the CPI.[19]

The left panel of Figure 5 shows the announced inflation rate for the period under analysis. The reported inflation was consistently lower than other (private) measures of inflation, which we regard as noisy signals for market participants. The magnitude of the underreport—the difference between alternative measures and the official measure—was sizable and persistent.

The right panel of Figure 5 shows that in tandem with the government's systematic misreport of inflation, the Argentine spreads for dollar-denominated bonds started to decouple from that of the rest of Latin America. This is surprising for at least three reasons. First, Argentina's

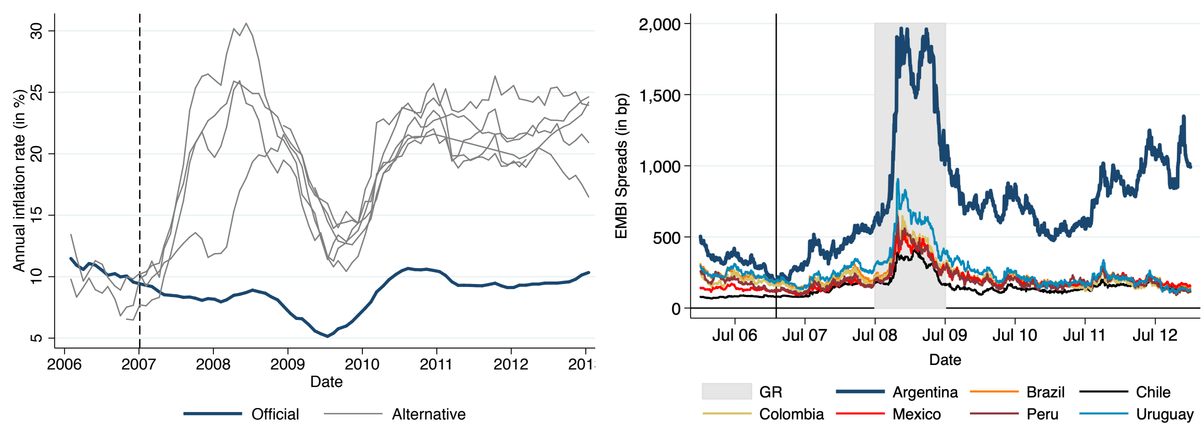
[17]By misreporting its inflation rate, Argentina decreased its IIBs payments by nearly \$3.2 billion, which accounts to around 1% of its GDP.

[18]The average annual inflation rate for 1984-2004 was 74% and the median rate was 11.4%. In contrast, the average annual inflation rate for 2000-2004 was 7.6% and the median was 3.5%.

[19]See Cavallo et al. (2016) for a complete timeline of all events from 2006 to 2015.

Figure 5. Argentina's Misreport of Inflation and Decoupling of Spreads

(a) Argentina's measures of inflation (b) Latin America's bond spreads



Notes: The eft panel shows the (annualized) official inflation rate announced by the Argentine government and alternative measures of inflation. The right panel shows EMBI spreads for several Latin American countries. Vertical lines denote the first month in which the Argentine government underreported the inflation rate. The gray area highlights the period of the global financial crisis.

fundamentals were in line with those of other Latin American countries.[20] Second, the coupons for dollar-denominated bonds were not directly affected by the misreport of inflation. Third, by underreporting the inflation rate, the Argentine government significantly decreased the real value of its stock of IIBs. In the absence of a reputational type of channel, the lower real stock of debt should decrease the spreads of nominal bonds denominated in dollars.[21] In what follows, we measure the extent to which this increase in spreads can be attributed to the partial default on inflation-linked bonds.

3.1. *Identification Strategy*

Our main hypothesis is that the underreporting of inflation is informative for lenders regarding the government's willingness to default on its obligations, and should then affect sovereign spreads. However, there are two main challenges to the identification of this effect: (i) measurement and (ii) reverse causality.

[20]In Appendix D.1, we provide some figures to show that if anything, GDP growth in Argentina was higher than the average growth rate for the region. Argentina's stock of external debt, moreover, displayed a downward trend during this period.

[21]In canonical models of sovereign debt (e.g., Arellano (2008) or Chatterjee and Eyigungor (2012)), sovereign spreads are decreasing in the stock of a government's real stock of debt.

To the extent that agents had anticipated the underreport, the government's announcement of inflation does not provide the market with additional information, and sovereign spreads should not react upon that announcement. In other words, only unexpected movements in inflation misreport provide information to agents. The first main challenge is thus to quantify the unexpected misreport of inflation.

Following the notation of our two-period model, the unexpected misreport is given by: ${\tilde{\pi}_t}^u \equiv \tilde{\pi}_t - \tilde{\Pi}_t$, where $\tilde{\pi}_t$ is the government's misreport and $\tilde{\Pi}_t$ is the misreport expected by the market (i.e., a conjecture).[22] Although ${\tilde{\pi}_t}^u$ is an unobservable variable, our premise is that changes in the break-even inflation rate around days on which the government reported the inflation rate can be used as a proxy for ${\tilde{\pi}_t}^u$.

The break-even inflation, BE_t, is the level of inflation that renders an investor indifferent between holding nominal bonds or IIBs. It can be computed as $BE_t = YLD_t^{\mathcal{NB}} - YLD_t^{\mathcal{IIB}}$, where $YLD_t^{\mathcal{NB}}$ is the yield of a nominal bond denominated in local currency (pesos) and $YLD_t^{\mathcal{IIB}}$ is the yield of an inflation-linked bond with similar maturity.

Embedded in BE_t is the market's expectation regarding the inflation announced by the government, since these announcements directly affect the returns of the IIBs.[23] The day before the government's announcement of inflation, absent a liquidity-premium component, $BE_{t-1} \simeq \hat{\pi}_t^E$, where $\hat{\pi}_t^E \equiv \mathbb{E}_{t-1}(\hat{\pi}_t)$ is the market's expected announcement at time t.[24] After the government reports $\hat{\pi}_t$, the change in the BE inflation rate should thus be close to $\Delta BE_t \simeq \hat{\pi}_t - \hat{\pi}_t^E$. Lastly, notice that the right-hand side of the previous expression can be written as $\hat{\pi}_t - \hat{\pi}_t^E = (\hat{\pi}_t - \pi_t) - (\hat{\pi}_t^E - \pi_t) = \tilde{\pi}_t - \tilde{\Pi}_t \equiv {\tilde{\pi}_t}^u$.

Changes in the BE are thus a good proxy for the unexpected misreport. The main advantage of using the ΔBE_t as a proxy is that it is a high-frequency variable that allows us to study the effects of inflation tampering on narrow windows around the report of inflation.

A key implication from our two-period model is that incentives to misreport the inflation rate are state contingent and depend on the fundamentals of the economy. Therefore, a second challenge behind the identification is reverse causality. That is, the underreport of inflation may be the government's optimal response to a change in sovereign spreads, SP_t. The reverse

---

[22]Remember that a negative value of $\tilde{\pi}$ implies an underreport of inflation.

[23]This is because the coupon payment of IIB is increasing in the inflation reported by the government.

[24]This argument implicitly assumes a frictionless market. The BE rate may also reflect a liquidity or risk premium component. To the extent that this premium is constant across time, changes in the BE rate are still a good proxy for the unexpected misreport of inflation.

causality problem is aggravated by the fact that we are using ΔBE_t as a proxy for the unexpected misreport. For instance, it may be the case that an exogenous change in SP_t leads investors to rebalance their portfolios and, under frictional markets, this may end up affecting the BE rate. In addition, there may be (potentially unobserved) common factors driving, at the same time, changes in BE_t and SP_t, such as a change in risk aversion, flight-to-liquidity, or flight-to-safety type of events.

To address these concerns, we adopt a high-frequency heteroskedasticity-based identification strategy (Rigobon and Sack (2004)) and exploit changes in the volatility of ΔBE_t around days on which the government reported the inflation. The formal identifying assumption is that the volatility of shocks to ΔBE_t is significantly higher around these announcements, but the variance of shocks to sovereign spreads and other common shocks remain the same.

This type of identification allows us to tackle both the reverse causality and common factors concerns. First, by focusing on changes in SP_t in narrow windows around the inflation announcement, we can ameliorate the concern that the misreport was an optimal response to an increase in SP_t. This is because the process of measuring and announcing the inflation rate takes time (even if it is not correctly measured), and it is therefore unlikely that the current (daily) change in SP_t is behind the misreport. Moreover, the heteroskedasticity-based identification strategy does not require the complete absence of common shocks—an assumption that would be too strong in our setup. Instead, it relies on the weaker assumption that the volatility of these common factors is not driven by the government's announcement of inflation.

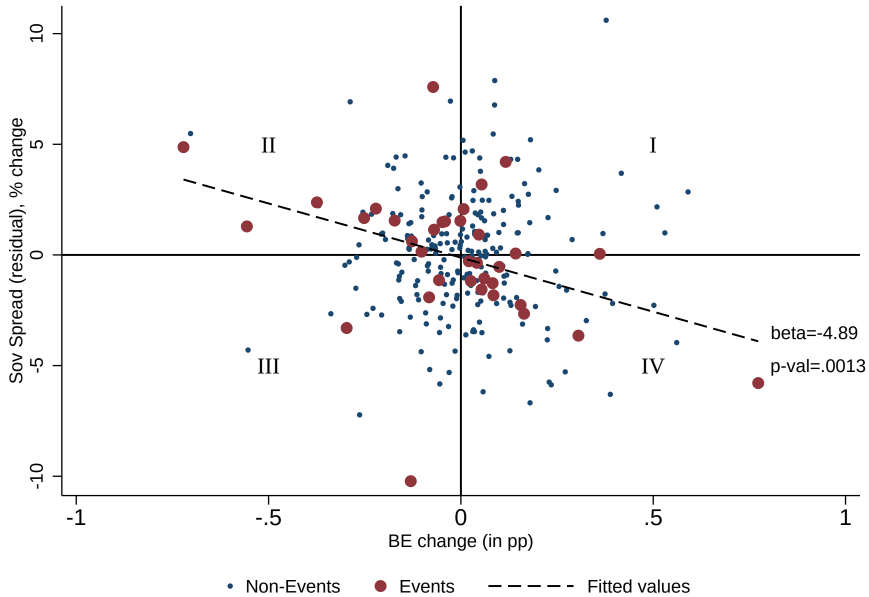
3.2. *Data and Summary of Events*

For our main analysis, we focus on the period January 2007 to March 2008. Although the misreport of inflation continued during and after the global financial crisis, we exclude this period from the analysis to avoid possible structural breaks.

We use the J.P. Morgan EMBI spread as a measure of the Argentine government's spreads. This index captures the spreads for bonds denominated in foreign currency. We use changes in the break-even inflation rate as a proxy for the unexpected misreport of inflation, as explained in Section 3.1. A problem with the Argentine case during the period of study is the lack of bonds denominated in local currency.[25] To circumvent this issue, we use dollar-denominated bonds, adjusting their yields using the expected depreciation rate of the Argentine peso implied by currency future contracts; see Appendix D.3 for details.

[25] There is only one bond denominated in pesos for which we have data during 2007, and the first observation is for the month of July—i.e., 6 months after the government started misreporting the inflation rate.

FIGURE 6. Break-even Inflation Rate



Notes: The figure shows the daily change in BE_t and the daily log change in Argentina's sovereign spreads, SP_t, after controlling for global factors. Global factors include the VIX index and returns on the S&P 500 and the MSCI Emerging Markets ETF index. Sample period: Jan 2007 - Mar 2008.

Figure 6 shows the relation between ΔBE_t and changes in Argentina's sovereign spreads after controlling for global factors. Red dots indicate windows around the days on which the Argentine government reported the inflation rate; this is described in Appendix D.2. We name these days event days (E). All other days are classified as non-event days (NE). For non-event days (blue dots), the relation is not significant. On the other hand, during the event days (red dots), the relation is negative and significant, indicating that an increase in the unexpected underreport of inflation is associated with an increase in sovereign spreads.

Table 1 reports summary statistics for a symmetric 3-day window around event days. Importantly, notice that the volatility of ΔBE_t is larger on event days. In the next subsection, we will use this difference in volatility to identify the effect of the misreport on sovereign spreads.

Table 1. Summary Statistics

Moments	Non-Event	Event
Mean $\Delta ln(SP)$	0.291	0.098
SD $\Delta ln(SP)$	3.361	3.621
Mean ΔBE	0.010	-0.029
SD ΔBE	0.180	0.250
Cov($\Delta ln(SP)$,ΔBE)	-0.023	-0.234
Observations	244	37

Notes: The table reports the mean and standard deviation of the daily change in BE_t, the mean and standard deviation of the daily log change in SP_t, and their covariance during the event and non-event windows. Event-window days are defined as the 3-day symmetric window around the days on which the Argentine government reported the inflation rate. Non-event days are all the others. Sample period: Jan 2007 - Mar 2008.

3.3. *Framework and Results*

In this section, we estimate the causal effect of inflation misreport on sovereign spreads, SP_t. As discussed above, we use ΔBE_t as a proxy for the unexpected misreport of inflation, $\tilde{\pi}_t{}^u$. To allow for the possibility that (i) sovereign spreads may affect ΔBE_t and (ii) the presence of unobserved common factors, we consider the following system of equations:

$$\Delta \ln SP_t = \alpha_0 + \alpha_1 \Delta BE_t + \alpha_2 X_t + \epsilon_t \tag{10}$$

$$\Delta BE_t = \beta_0 + \beta_1 \Delta \ln SP_t + \beta_2 X_t + \eta_t \tag{11}$$

where $\Delta \ln SP_t$ is the log change in sovereign spreads for bonds denominated in dollars and X_t are potentially unobserved common factors. We further assume that the shocks ϵ_t and η_t have no serial correlation and are uncorrelated with each other (and with the common shock X_t).

Our coefficient of interest is α_1. According to our two-period reputational model, we should expect α_1 to be negative. That is, an increase in the unexpected underreport of inflation (i.e., a decrease in ΔBE_t) should have a a negative effect on the government's reputation, leading to a rise in its sovereign spreads.

If we simply run OLS in Equation (10), there are two potential sources of bias: simultaneity and omitted variables. The former appears if $\beta_1 \neq 0$. The latter exists if $\alpha_2 \neq 0$ and $\beta_2 \neq 0$. In order for the OLS estimate of α_1 to be unbiased, an exogenous change in $\Delta \ln SP_t$ must have no effect on ΔBE_t and there must be no omitted common shocks. As previously explained, these two assumptions are implausible in our context.

To tackle these problems, we follow a heteroskedasticity-based identification approach. The formal identifying assumption is that the variance of shocks to ΔBE_t, η_t, is higher around days on which the government announces the inflation rate, while the variances of the common factors, X_t, and of the shocks to $\Delta \ln SP_t$, ϵ_t, remain invariant. That is,

$$\begin{aligned} \sigma_{\eta,E} &> \sigma_{\eta,NE} \\ \sigma_{\epsilon,E} &= \sigma_{\epsilon,NE} \\ \sigma_{X,E} &= \sigma_{X,NE} \end{aligned} \tag{12}$$

Let Φ_j be the var-cov matrix between $\Delta \ln SP_t$ and ΔBE_t for $j = \{E, NE\}$. If the identifying assumptions hold, it is easy to show that

$$\Delta\Phi = \left(\frac{1}{1-\alpha_1\beta_1}\right)^2 \left[\sigma^2_{\eta,E} - \sigma^2_{\eta,NE}\right] \begin{bmatrix} \alpha_1^2 & \alpha_1 \\ \alpha_1 & 1 \end{bmatrix} \tag{13}$$

where $\Delta\Phi \equiv \Phi_E - \Phi_{NE}$. From the expression above, it is clear that we can estimate our coefficient of interest in at least two different ways:

$$\hat{\alpha}_1 = \frac{\Delta\Phi_{1,2}}{\Delta\Phi_{2,2}} \tag{14}$$

$$\tilde{\alpha}_1 = \frac{\Delta\Phi_{1,1}}{\Delta\Phi_{1,2}} \tag{15}$$

As shown in Rigobon and Sack (2004), these estimators are consistent even if the shocks have heteroskedasticity over time. They also show that they can be implemented in an instrumental variables framework. As explained by Hebert and Schreger (2017), under the null hypothesis $\Delta\Phi_{1,2} = 0$, which renders the $\tilde{\alpha}_1$ estimator inappropriate. For the remainder of the analysis, all results are based on the $\hat{\alpha}_1$ estimator. As is clear from Equation (13), this instrument is relevant only under the assumption that $\lambda \equiv \sigma_{\eta,E} - \sigma_{\eta,NE} > 0$.

Appendix Table D.3 shows that for the period under analysis, we can reject the null that $\lambda = 0$. Interestingly, we cannot reject the null hypothesis during and after the Great Financial Crisis. We interpret this as evidence suggesting that the market was no longer surprised by the sequences of misreports after mid-2008.

Table 2 shows the results based on the IV estimator for $\hat{\alpha}_1$. Each column provides the estimates for a different definition of the event and non-event windows. In all of our instrumented regressions, we include a set of global factors to control for aggregate credit market conditions. In particular, we include daily changes in the VIX index, the S&P 500 index, and the MSCI Emerging Markets ETF index. While the addition of these controls is not necessary, given

Table 2. Effects of Inflation Misreport on Sovereign Spreads

	(1)	(2)	(3)	(4)
ΔBE	-9.922***	-9.627**	-7.870***	-7.834***
95perc CI	[-15.31, -4.72]	[-17.80, -2.34]	[-11.78, -3.40]	[-11.39, -3.30]
Observations	260	260	78	66
Events	3-day window	5-day window	3-day window	2-day window
Non-events	All other days	All other days	4-day window	4-day window
Controls	Yes	Yes	Yes	Yes

Notes: This table shows results for the heteroskedasticity IV estimator. The dependent variable is $\Delta lnSP_t$. Definitions of "events" vary across the four columns. Controls include the VIX index, the S&P 500 index, and the MSCI Emerging Markets ETF index. Standard errors and confidence intervals are computed using a stratified bootstrap procedure. 95% confidence intervals are in brackets. ***, **, *, denote significance at 1%, 5%, and 10%, respectively.

our identifying assumptions, their inclusion allows us to reduce the magnitude of our standard errors.

In all specifications, the point estimate $\hat{\alpha}_1$ is negative and statistically significant. Our estimates show that a 1 pp decrease in ΔBE_t (i.e., an increase in the unexpected underreport of inflation) leads to an $8\% - 10\%$ rise in sovereign spreads. In terms of economic magnitudes, the reported estimates imply that a 1–sd decrease in ΔBE_t can account for about 50%-70% of the daily dispersion of $\Delta \ln SP_t$ (during the 3-day event windows).

As supportive evidence, Appendix E.1 reports the OLS estimates for the system of equations (10)-(11). For narrow windows around the inflation announcement, the OLS estimates are similar to the ones presented in this table. Interestingly, OLS results for the period after mid-2008 are not significant. In terms of our two-period reputational model, we can interpret these results as evidence suggesting that after 2007, the lenders' prior (ζ) reached its lower bound, and therefore the sequence of misreports no longer affects sovereign spreads, since they are uninformative. This results are consistent with our quantitative analysis from Section 4.

In Appendix E.2, we follow a standard event-study approach to examine the effects of misreports on sovereign spreads. We classify events as a "good news event" (GNE) or a "bad news event" (BNE) based on the change in BE_t around the government's inflation announcement. For instance, event window j is classified as a BNE if $\mu^{E,j}_{\Delta BE} < \mu_{\Delta BE}$, where $\mu^{E,j}_{\Delta BE}$ is the median daily change in BE_t across the event window j and $\mu_{\Delta BE}$ is the median change across all days in the sample. The main drawback of this analysis is the small sample size. Results should thus be interpreted as suggestive evidence only.

Results based on 3- and 5-day windows around the announcements show that after controlling for global factors, Argentina's sovereign spreads increased on average $0.7\% - 1.0\%$ (daily) during BNE. Given that between January 2007 and March 2008 Argentina's sovereign spreads increased 120%, a simple back-of-the-envelope calculation suggests that our estimates can account for up to a quarter of that increase.[26]

3.4. *A Reputational Channel?*

The negative sign of our estimate for α_1 is consistent with the insights of our two-period model outlined in Section 2.2. According to the model, an increase in the unexpected underreport of inflation should have a negative effect on the government's reputation, leading to a rise in sovereign spreads. However, there might be other operating channels unrelated to reputation. In this section we consider various alternative explanations and provide empirical evidence that supports our reputation channel.

A potential mechanism that could be driving our results is that the inflation misreport may induce distortions in the real economy. Regardless of its sign, inflation misreport could increase uncertainty and reduce the country's productivity, investment, and economic growth. All of these factors may end up affecting the default risk of the government, regardless of its reputation. But then, under this channel, we would expect a U-shaped relation between ΔBE_t and $\Delta \ln SP_t$. This is at odds with Figure 6, in which the majority of the observations within event days lie in quadrants II and IV. This mechanism is also at odds with results from the event-study analysis presented in Appendix Tables E.3 and E.4, in which we show an asymmetric response of spreads to good news events vs bad news events.

A second potential mechanism is based on the fact that changes in the BE_t may be capturing not only news regarding the misreport but also news about the true inflation rate; see, for instance, Nakamura and Steinsson (2018). For example, a positive ΔBE_t may indicate a higher than expected ("true") inflation rate. Under this interpretation, the effect of ΔBE_t on $\Delta \ln SP_t$ depends on the nature of the (unexpected) shock. A contractionary supply shock, for instance, should increase the inflation rate, inducing a rise in BE_t. The exact opposite would happen after a contractionary demand shock. With either type of shock, we would expect a fall in output and a consequent rise in SP_t. Moreover, in a high-inflation economy such as Argentina, a higher

[26] For the 5-day window case, there are 7 bad news events. The cumulative effect for the entire sample is thus $5\% \times 7 = 35\%$, which accounts for about a quarter of the total increase.

Table 3. Effects of Inflation Misreport on Stock Returns

	(1)	(2)	(3)	(4)
ΔBE	0.169	0.678	-0.323	0.027
95perc CI	[-1.56, 1.96]	[-1.65, 3.25]	[-2.22, 1.38]	[-1.63, 2.02]
Observations	243	243	73	61
Events	3-day window	5-day window	3-day window	2-day window
Non-events	All other days	All other days	4-day window	4-day window
Controls	Yes	Yes	Yes	Yes

Notes: This table shows the results for the heteroskedasticity IV estimator. The dependent variable is R_t. Controls include the VIX index, the S&P 500 index, and the MSCI Emerging Markets ETF index. Standard errors and confidence intervals are computed using a stratified bootstrap procedure. 95% confidence intervals are in brackets. ***, **, *, denote significance at 1%, 5%, and 10%, respectively.

than expected inflation rate may be interpreted as a "bad" signal of economic prospects, which may end up increasing SP_t.

We formally jointly address these alternative explanations by estimating the effects ΔBE_t may have on the real economy, and through this channel on sovereign spreads. To this end, we use the daily return (R_t) of an index of publicly traded Argentine firms (MERVAL) to proxy for the changes in the real economy. We extend our baseline system of equations (10)-(11) as follows:

$$\Delta BE_t = \beta_0 + \beta_1 \Delta \ln SP_t + \beta_2 R_t + \beta_3 X_t + \eta_t \tag{16}$$

$$\Delta \ln SP_t = \alpha_0 + \alpha_1 \Delta BE_t + \alpha_2 R_t + \alpha_3 X_t + \epsilon_t \tag{17}$$

$$R_t = \gamma_0 + \gamma_1 \Delta BE_t + \gamma_3 X_t + \nu_t, \tag{18}$$

where we assume that η_t, ϵ_t, ν_t, and X_t are uncorrelated. In Appendix E.3, we show that the heteroskedasticity-based approach allows us to identify the parameters γ_1 and $\tilde{\alpha_1} \equiv \alpha_1 + \alpha_2\gamma_1$. The parameter γ_1 measures the effect of ΔBE_t on R_t. The parameter $\tilde{\alpha_1}$ measures the *full* effect of ΔBE_t on $\Delta \ln SP_t$. Notice that α_1 accounts for the "direct" (causal) effect, while $\alpha_2\gamma_1$ accounts for the "indirect" effect—i.e., the effects that are driven by R_t. Notice that a $\gamma_1 \neq 0$ may not only invalidate our reputation channel, but it also creates a bias on the estimates reported in Table 2.

Table 3 shows the IV estimates for γ_1. Point estimates are small in absolute value, their sign varies with the specification, and none is statistically significant. Based on these results, the misreport of inflation does not seem to have a direct effect on the Argentine stock market. We take this as further evidence to support our reputational channel.

We further extend the system of equations in (16)-(18) to allow for the possibility that the stock market is directly affected by changes in sovereign spreads (see Appendix E.3). This specification is motivated by Hebert and Schreger (2017), who find that an increase in a sovereign's default risk significantly decreases the stock returns of the domestic market. Under this setup, we analytically show that our point estimate for γ_1 (of Equation 18) would have a positive bias. This implies that if anything, our estimate for α_1 is downward biased (in terms of magnitudes).[27] Our results, therefore, may be interpreted as a lower bound.

In Appendix E.4, we consider an alternative empirical approach to further study the different mechanisms through which inflation misreport may end up affecting sovereign spreads. In particular, we estimate a monthly structural VAR as in Mertens and Ravn (2013) and Gertler and Karadi (2015). The VAR incorporates the interactions between inflation misreport, spreads, and a measure of economic activity. Considering the changes in misreport as a policy variable, we identify structural shocks to the misreport equation using high-frequency changes in break-even inflation during event windows. The analysis shows that upon a 1–sd structural shock to misreport, spreads increase by 6% on impact. The figure also shows that the response of economic activity, albeit negative, is lagged and not statistically significant.

4. Quantitative Analysis

In the previous section, we provide new evidence on the short-run costs of a deterioration in a government's reputation. In this section we show that these costs can add up in the long run, especially during times of crisis. To this end, we now consider an infinite-horizon version of the two-period stylized model described in Section 2. The quantitative model is briefly described in Subsection 4.1, and details can be found in Appendix F. Subsection 4.2 discusses the model's calibration and its ability to account for observed business-cycle patterns. In Subsection 4.3, we use the model to quantify the long-run costs of losing reputation.

4.1. *The Infinite-horizon Economy*

We formulate an infinite-horizon reputational model that contains the main elements of our two-period model: (i) uncertainty about the government type, (ii) noisy signals, and (iii) sovereign defaults.

[27]This is under the assumption that $\alpha_2 < 0$, which is consistent with a large sovereign debt literature. See Appendix E.3 for details.

There is a benevolent government that chooses its debt and default policies to maximize the expected utility of the representative consumer. We assume two types of government (commitment type C and strategic type S) and the type is not observable. As in our two-period model, agents infer the government's type using noisy signals about its policies. For the context of repeated games, a well-known result of Cripps, Mailath, and Samuelson (2004) is that even with noisy signals, in a model with *fixed* types, reputation is a short-run phenomenon. Any model of long-run reputation should thus include some mechanism by which the uncertainty about types is continually replenished. To this end, we assume that the government's type exogenously changes over time, based on a stochastic Markov process.[28] We denote with T the Markov's transition matrix across the two types.

We assume that the government faces a (deterministic) legacy stock of debt. For simplicity, we assume that this debt is a perpetuity, whose coupon payments are denoted by B. In addition to this debt, the government can issue long-term (non-contingent) bonds, b. For these bonds, we assume long-term debt contracts that mature probabilistically, as in Chatterjee and Eyigungor (2012). Each unit of b matures in the next period with probability m_b. If the bond does not mature and the government does not default, it pays a coupon z_b. As in Amador and Phelan (2021), we assume that issuances of b' are determined by the C-type. That is, we impose that the S-type always chooses a level of borrowing that is identical to that which would have been chosen by a C-type facing the same debt and price schedule. Under this assumption, debt policies are uninformative about the type of government.[29]

We assume that the S-type can default on its debt obligations in two ways. The first is an outright default on b. Let $d = \{0, 1\}$ denote this policy. As is standard in the literature, we assume that an outright default leads to a temporary exclusion from debt markets and an exogenous output loss, $\phi^S(y)$.[30] The second policy, denoted by $\tilde{\pi} \in [\underline{\pi}, 0]$, captures any government action that affects the coupon payments of the legacy debt B. Regarding the C-type, we maintain the assumption that it can commit to $\tilde{\pi} = 0$. However, to better match the

[28]In this regard, our study is similar to Mailath and Samuelson (2001) and Holmstrm (1999) because it features both noisy signals and alternating types. See Board and Meyer-Ter-Vehn (2013); Ekmekci (2011); or Bohren (2021) for different ways the uncertainty can be replenished.

[29]We follow this assumption for computational tractability. In a continuous-time infinite-horizon model with perfectly observed actions, Amador and Phelan (2021) show that this restriction is without loss of generality. This is because the S-type does not have incentives to completely reveal itself by choosing a level of borrowing different from the C-type, without simultaneously defaulting.

[30]We also make the standard assumption that the stock of non-indexed debt is zero after exiting a default.

FIGURE 7. Timing of Events: Infinite-period Model

	If default	If no default	
Stage 0	Stage 1	Stage 1	Stage 2
- Initial $\mathbf{S} = (y, b, \zeta)$	- Temporary exclusion from debt markets	- Choice of $\tilde{\pi}$	- Debt issuance b'
- Default choice $d = \{0, 1\}$	- Output cost $\phi^j(y)$	- Message $m = \{L, NL\}$	
- First update of beliefs $\tilde{\zeta}(d, \zeta)$		- Second update of beliefs $\hat{\zeta}(m, \tilde{\zeta})$	

data, we now assume that the C-type can default on b. We assume that $\phi^C(y) \geq \phi^S(y)$ for all y, meaning that the S-type faces (weakly) larger incentives to default.[31]

The government's debt is traded by risk-neutral, perfectly competitive, and deep-pocketed international lenders. Market participants use the government's policies to infer its type. We assume that an outright default is perfectly observable by all agents in the economy. As in our two-period model, however, we assume that agents cannot perfectly observe $\tilde{\pi}$. Based on the government's choice for $\tilde{\pi}$, lenders receive a noisy message $m = \{L, NL\}$. We assume that the probability of receiving message L is increasing in the magnitude of $\tilde{\pi}$. Let ζ denote the lender's prior about the government being C-type. After observing the government's default choice and the realization of message m, lenders update their beliefs, using a Bayes-induced function.

Based on these assumptions, if the country is not currently in default its resource constraint is given by

$$c = y - b\left[(1 - m_b)\, z_b + m_b)\right] + q\left(y, b', \zeta'\right)\left[b' - (1 - m_b)b\right] - B\left(1 + \tilde{\pi}\right),$$

where c is today's consumption, y is the economy's exogenous endowment, and $q(y, b', \zeta')$ is the pricing kernel of non-indexed bonds. We assume that y evolves stochastically, following a Markov chain with transition matrix T_y. If the county is in a default, its resource constraint is simply given by $c = y - \phi^j(y)$.

Figure 7 describes our timing assumption. Let $\mathbf{S} = (y, b, \zeta)$ be the state at the beginning of the period. Each period is divided into three stages. In stage 0, the government chooses to default or not $((d = \{0, 1\}))$ on b. Lenders observe this action and update their beliefs accordingly $(\tilde{\zeta})$. If the government does not default, at stage 1, the S-type chooses $\tilde{\pi}$. Message

[31]In Alfaro and Kanczuk (2005) and D'Erasmo (2011), the commitment type differs from the strategic type in the discount factor parameter β. Our specification of different default costs is similar to that in Barret (2016) and it can also be interpreted as differences in preferences.

$m \in \{L, NL\}$ is realized based on $\tilde{\pi}$, and lenders once again update their beliefs $(\hat{\zeta})$. The end-of-period posterior is given by $\zeta' = T_{CC} \times \hat{\zeta} + T_{SC} \times (1 - \hat{\zeta})$, where T_{ij} denote the element i, j of the Markov transition across the two types. At stage 2, the government issues b', taking as given the price schedule $q(y, b', \zeta')$.

Under this setup, the trade-off faced by a (strategic) government is similar to the one in our two-period model. By setting $\tilde{\pi} < 0$, the government can increase current consumption. However, this may affect its reputation (i.e., lower ζ'), which ends up affecting its borrowing costs, q.

In Appendix F we provide all of the details regarding the update of beliefs, as well as the government's recursive problem, pricing kernels, and the definition of the equilibrium.

Inflation Misreport, Noisy Signals, and Updating Beliefs

We now describe how agents use noisy signals about $\tilde{\pi}$ to infer the government's type. For the remainder of this section, and based on our empirical analysis, we interpret B as the coupon payments on inflation-indexed bonds (IIBs). Policy $\tilde{\pi}$ represents the government's misreport of the "true" inflation rate. Notice that $\tilde{\pi} < 0$ implies an underreport of the inflation rate that dilutes coupon payments of IIBs.

Although for tractability our model is in real terms and does not include nominal rigidities, for the sake of intuition assume that π is the (true) inflation rate. We assume that lenders do not observe π; however, they receive a noisy signal of it, π^o. We assume that $\pi^o \sim N(\pi, \sigma)$, where σ can be interpreted as the precision of the signal.

Let $\tilde{\pi}^o \equiv \hat{\pi} - \pi^o$ denote the perceived misreport of inflation, where $\hat{\pi}$ is the inflation rate announced by the government. Conditioning on $\tilde{\pi}$, we have that $\tilde{\pi}^o \mid \tilde{\pi} \sim N(\tilde{\pi}, \sigma)$. We assume that lenders "detect" a misreport (i.e., $m = L$) if $\tilde{\pi}^o < \alpha$. We interpret α as the parameter governing the market's attention to the government's misreports. Under these assumptions, we have that

$$\begin{aligned} Prob\,(m = L \mid \tilde{\pi}) =& Prob\,(\tilde{\pi}^o < \alpha \mid \tilde{\pi}) \\ =& \Phi_{(\tilde{\pi},\sigma)}\,(\alpha)\,, \end{aligned} \tag{19}$$

where $\Phi_{(\tilde{\pi},\sigma)}$ is the cumulative distribution function of a normal random variable with mean $\tilde{\pi}$ and standard deviation σ.

4.2. *Calibration and Quantitative Performance*

In what follows, we outline the calibration of the model and its quantitative performance in terms of targeted and untargeted moments. In Appendix F.4, we describe the (global solution) algorithm we use to solve the model.

We calibrate the model for the Argentine economy at quarterly frequency. The calibration follows a two-step procedure. First, we fix a subset of parameters to values that are either standard in the literature or based on historical Argentine data. Then we calibrate the remaining parameters to match relevant spreads and business-cycle moments.

In terms of functional forms, we assume a CRRA utility function: $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$, with risk aversion parameter γ. The endowment process follows an AR(1) as given by $ln(y_t) = \rho\, ln(y_{t-1}) + \epsilon_{y,t}$, with $\epsilon_{y,t} \sim N(0,\sigma)$. As in Chatterjee and Eyigungor (2012), the exogenous default cost on income is modeled as $\phi_j(y) = \max\{(\bar{\chi_0} + \chi_j)\, y + \bar{\chi_1} y^2, 0\}$, where $j = \{C, S\}$, $\bar{\chi_0} < 0$, and $\bar{\chi_1} > 0$. We set $0 > \chi_S = -\chi_C = \epsilon_\phi$ in order to get a larger default set for the strategic type.

Panel A of Table 4 describes the set of parameters we fix in the calibration. We set the risk aversion, $\gamma = 2$, as usually seen in the literature. The real rate is set to $r = 1\%$, in line with the observed average real rate in the United States. The reentry parameter is set to $\theta = 0.0385$, which implies an average exclusion period from international markets after a default of 6.5 years.[32] We set $m_b = 0.05$ to match an average debt maturity of 5 years and $z_b = 0.03$ to match the debt service, as in Chatterjee and Eyigungor (2012). Parameters for the endowment process are set to $\rho = 0.93$ and $\sigma = 0.02$. Regarding the frequency at which the government's type changes, we fix $\Pi_{CC} = \Pi_{SS} = 0.937$ to reflect an election cycle of 4 years. Lastly, we set $\sigma = 0.011$ to match the (quarterly) volatility of the alternative measures of inflation (as shown in Figure 5).

We calibrate the remaining parameters of our model (Panel B of Table 4) to match key data moments of the Argentine economy, detailed in Table 5. A first group of moments are standard targets in the sovereign debt literature—namely, the average external borrowing, average default rate, average spread, and volatility of spreads. To compute these data moments, we use Argentine data from 1990 to 2007.[33] Appendix A details the data sources. We target the

[32]This measure is taken from Chatterjee and Eyigungor (2012) and is constructed as an average of the time it took Argentina to reach settlement on the defaulted debt in different default episodes, based on data provided by Beim and Calomiris (2000); Benjamin and Wright (2009); and Gelos et al. (2011).

[33]For moments on spreads, we exclude the default period from December 2001 to September 2005.

Table 4. Calibration of the Model

Panel A: Fixed Parameters			Panel B: Calibrated Parameters		
Param.	Description	Value	Param.	Description	Value
γ	Risk aversion	2.00	β	Discount rate	0.957
z_b	Coupon payments	0.03	d_0	Default cost—level	−0.174
m_b	Debt maturity	0.05	d_1	Default cost—curvature	0.248
r	Risk-free interest rate	0.01	ϵ_ϕ	Default cost—differential	−0.02
Π_{jj}	Persistence j-type	0.937	B	Inflation-indexed debt service	0.0137
ρ_Y	Endowment, autocorrelation	0.93	α	Probability threshold	−0.012
σ_Y	Endowment, shock volatility	0.02			
θ	Reentry probability	0.0385			
σ	Precision of signal	0.011			

observed average external-debt-to-GDP ratio of 71%, the average default frequency of 3.0%, the average spread of 623 basis points (bps), and the standard deviation of spreads of 289 bps.[34,35] These moments are particularly informative about the discount factor (β) and default costs (d_0, d_1, ϵ_ϕ). Lastly, we set $B = 0.0137$ to match the share of Argentina's debt services attributed to IIBs in 2007 (about 25%).

A key parameter in our model is α, since it governs the probability of message $m = L$ being realized and therefore the updating of beliefs. We discipline this parameter based on our empirical results from Section 3.3. In particular, we set $\alpha = -0.012$ to match the semi-elasticity between Argentina's sovereign spreads and changes in the break-even (BE) inflation. To have a tight link between model and data, we first compute the price for an auxiliary IIB with the same maturity and payment structure as our non-indexed bond, b. We then use that price to compute the BE inflation rate. The price of this auxiliary bond depends on the market's conjecture regarding $\tilde{\pi}$. Thus, changes in the BE inflation rate are informative about the market's belief regarding the type of government.

[34]We match only a portion of debt because we do not model repayment. In Argentina's case, the repayment of debt defaulted on has been around 30%.

[35]In the model, annualized spreads are given by $SP = \left(\frac{1+r_b(y,b',\zeta')}{1+r}\right)^4 - 1$, where $r_b\left(y,b',\zeta'\right)$ is the internal rate of return, as implied by $q\left(y,b',\zeta'\right) = \frac{[m_b+(1-m_b)z_b]}{m_b+r_b(y,b',\zeta')}$.

Since the empirical elasticity is measured at a high frequency, we extend the model to allow for two instances of trading in secondary markets within a period. In this way, we capture the immediate change in the BE inflation rate and spreads induced by an update in beliefs coming from the realization of the message m. This model extension nests the baseline model and is described in Appendix F.2.

4.2.1. *Targeted and Untargeted Moments*

We now asses how well the model can accurately approximate both targeted moments (Table 5) and selected untargeted moments (Table 6). Overall, the model performs well in matching all of the targeted moments. In particular, we are able to replicate the empirical semi-elasticity of changes in the BE inflation rate to sovereign spreads ($\eta_{BE,SP}$). This is key to our analysis, because we will use that elasticity to back up our model-implied measure of reputation. We can then use the model to study how changes in reputation affect the government's borrowing costs in both the short and long run. Figure 8 shows the sensitivity of this elasticity to different values of α. Overall, there is an increasing monotone relation between α and $\eta_{BE,SP}$, suggesting that the parameter is well identified in the model. As shown in Table 6, our calibrated model is also consistent with key untargeted moments regarding comovements of Argentine spreads and business cycles (see, for example, Neumeyer and Perri (2005) and Aguiar and Gopinath (2007)). First, our model is consistent with the correlation between spreads and GDP cycle, which is well known to be negative in several EM economies (see Morelli, Ottonello, and Perez (2021)). The model also closely approximates the relative volatility of consumption and its

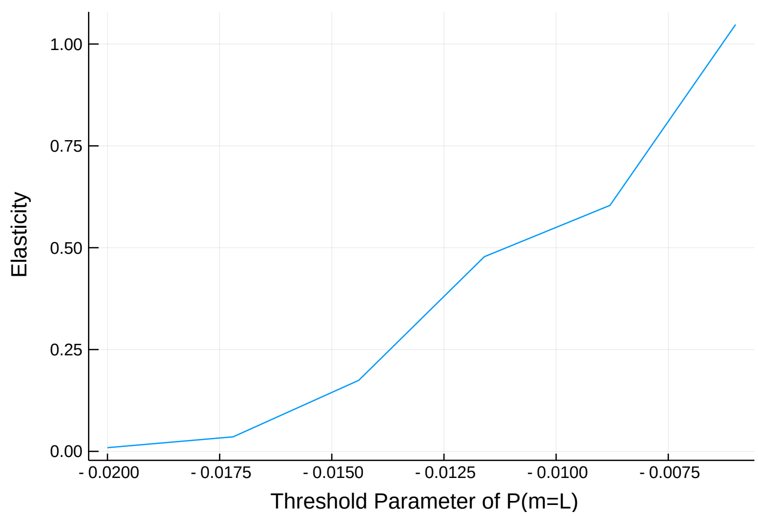
Table 5. Targeted Moments

Target	Description	Data	Model
$\mathbb{E}[D/Y]$	Average debt	71%	48%
$\mathbb{P}[DF]$	Default frequency	3.0%	3.0%
$\mathbb{E}[SP]$	Average bond spreads	623bps	656bps
$\sigma(SP)$	Volatility spreads	289bps	228bps
IIB_s/TD_s	Inflation-indexed debt relative service	25%	28%
$\eta_{BE,SP}$	Semi-elasticity BE to spreads	0.50	0.48

Table 6. Untargeted Moments

Target	Description	Data	Model
corr(SP, log$Y$)	Correlation spreads & endowment	-48%	-67%
$\sigma(\log C)/\sigma(\log Y)$	Relative volatility consumption	1.48	1.44
corr(log$C$, log$Y$)	Correlation consumption & endowment	98%	91%
$\sigma(TB/Y)$	Volatility trade balance	0.03	0.02
corr(TB/Y, log$Y$)	Correlation trade balance & endowment	-72%	-41%

Figure 8. Identification of α by Elasticity



Notes: Semi-elasticity between changes in the BE inflation rate and sovereign spreads. The x-axis shows different values for the α parameter. See Appendix F.2 for a description of how we construct this elasticity.

correlation with GDP cycles. The model also yields a volatility of trade balance that is close to the data, although its correlation with output, while negative, is underestimated.

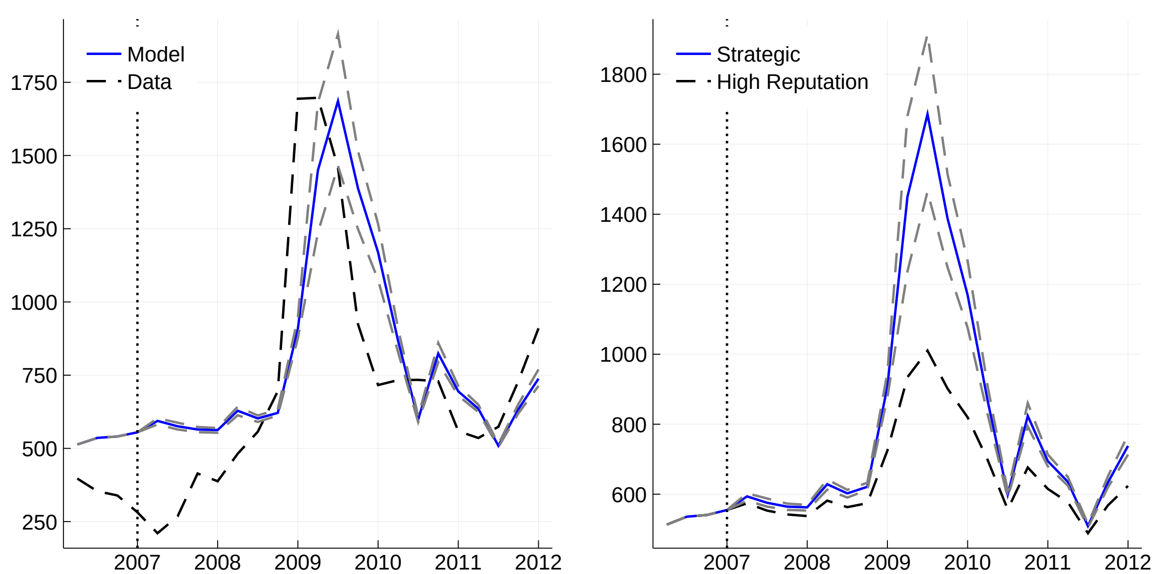
4.3. *The Relevance of Reputation*

In this section, we use the model to simulate Argentine spreads during the period 2006Q1-2011Q4. We enter the observed evolution of the HP cycle of GDP during this period and assume that the government becomes strategic starting in 2007Q1; see Appendix Figure F.4 for the path for output and government type. We simulate the economy 1,000 times and take averages across simulations. Each simulation i differs in its realized sequence of messages,

$\{m_t^i\}_{t=1}^T$. Under this setup, we conduct two exercises. First, we evaluate the model's goodness of fit by contrasting the actual vs simulated path for Argentine spreads. Second, we conduct a simulated counterfactual in which we assume the government's reputation remains constant.

Panel A of Figure 9 shows the dynamics of spreads in the data (dashed black line) and the average model-implied dynamics (solid blue line). The dashed gray lines represent the bottom and top 10 percentiles of the model simulations. Overall, the model provides a path for Argentine spreads that moves in line with that of the data. In particular, it accounts for a large share of the increase in Argentina's spreads during the 2008-10 period. This is surprising given that the model abstracts from any negative effect the Great Financial Crisis may have had on international lenders.[36] For instance, Morelli, Ottonello, and Perez (2021) find that global banks' balance sheets were significantly affected during this period and they played a critical role in the transmission of shocks to emerging countries.

FIGURE 9. Sovereign Spreads: Data vs Model Simulations



(A) Model vs Data: Spreads (in bps) (B) Counterfactual: Spreads (in bps)

Notes: The left panel shows the evolution of Argentina's observed sovereign spreads for the 2007-12 period (black dotted lines) and the model-implied dynamics under our baseline scenario (blue solid line). The right panel shows the model-implied dynamics under our baseline scenario and under a counterfactual in which reputation remains constant (black dotted lines). For the counterfactual, we assume that the C-type is in charge of the policies.

[36] In particular, in our model we assume a constant risk-free rate and no risk premium.

Next, we construct a simulated counterfactual in which the government's reputation is constant and high. We label this case the "High Reputation" benchmark. Under this counterfactual, the realizations of $\{m_t^i\}_{t=1}^T$ have no effects on spreads, because we keep the posterior ζ' fixed. Panel B of Figure 9 shows the average of the baseline simulation (solid blue line) with its bottom and top 10 percentiles (dashed gray lines) and the simulated counterfactual (dashed black line). The figure shows a decoupling that starts when the government becomes S-type and the message $m = L$ becomes more frequent. Furthermore, the simulations show a striking additional response of spreads to the crisis in the baseline case. Even after the recovery of output, spreads remain higher for the baseline than for the counterfactual. In Appendix Figure F.5, we show the model-implied paths for inflation misreport and the government's reputation, for both the baseline and counterfactual. In line with the data, the strategic government significantly misreports inflation in the first half of 2007 and continues to do so in posterior periods. This produces a strong and persistent fall in reputation that explains the excess response of the baseline simulation during the crisis.

5. Conclusion

In this paper we study how a government's reputation is shaped by its policies and quantify how markets price this reputation. To this end, we focus on a debt-repayment setting in which reputation is a first-order concern. We develop a sovereign default model with uncertainty about the government type and noisy signals. In the model, agents observe signals about the government's policies and use those signals to update their beliefs about its type (i.e., reputation). Changes in reputation affect the markets' perceived probability of default and therefore the sovereign spreads. Guided by the model, we use the 2007-12 Argentine episode of inflation misreport to provide new empirical evidence on the link between reputation and borrowing costs. We argue that this policy provided (noisy) information to lenders regarding the type of government, affecting its reputation. We find that the market priced the sequence of misreports, as reflected in a significant increase in the spreads of Argentina's dollar-denominated bonds. Our quantitative model shows that changes in reputation can have long-lasting effects. In particular, we find that the loss in Argentina's reputation due to the misreport is crucial to match the observed excess sensitivity of Argentina's spreads during the Great Financial Crisis and, to some extent, its posterior decoupling from the rest of the region.

More generally, our results stress the role of reputation as a type of gained capital that is salient for policymakers. Reputation and the existence of asymmetric information can affect other areas of policy interest, such as the effectiveness of government stabilization policies, the rule of law and a country's investment environment, international trade and relations with foreign countries and organizations, and government contracts with other entities. We leave a more detailed analysis of the role of reputation in these areas to future research.

References

Aguiar, M., M. Amador, E. Farhi, and G. Gopinath (2013): "Crisis and Commitment: Inflation Credibility and the Vulnerability to Sovereign Debt Crises," NBER Working Paper N. 19516.

Aguiar, M. and G. Gopinath (2007): "Emerging market business cycles: The cycle is the trend," Journal of political Economy, 115, 69–102.

Alfaro, L. and F. Kanczuk (2005): "Sovereign Debt as a Contingent Claim: A Quantitative Approach," Journal of International Economics, 65, 297–314.

Amador, M. and C. Phelan (2021): "Reputation and Sovereign Default," Econometrica [Forthcoming].

Arellano, C. (2008): "Default Risk and Income Fluctuations in Emerging Economies," American Economic Review, 98, 690–712.

Arellano, C., X. Mateos-Planas, and J.-V. Ros-Rull (2019): "Partial Defaul," Working Paper.

Backus, D. and J. Driffill (1985): "Inflation and Reputation," The American Economic Review, 75, 530–538.

Barret, P. (2016): "Sovereign Default, Spreads, and Reputation," Working Paper.

Barro, R. J. (1986): "Reputation in a Model of Monetary Policy with Incomplete Information," Journal of Monetary Economics, 17, 3–20.

Beim, D. and C. Calomiris (2000): "Emerging Financial Markets," New York: McGraw Hill.

Benczur, P. and C. L. Ilut (2016): "Evidence for Relational Contracts in Sovereign Bank Lending," Journal of the European Economic Association, 14, 375–404.

Benjamin, D. and M. L. Wright (2009): "Recovery Before Redemption: A Theory of Sovereign Debt Renegotiation," Unpublished.

Bernanke, B. S. and K. N. Kuttner (2005): "What Explains the Stock Market's Reaction to Federal Reserve Policy?" The Journal of Finance, 60, 1221–1257.

Board, S. and M. Meyer-Ter-Vehn (2013): "Reputation for Quality," Econometrica, 81, 2381–2462.

Bohren, J. A. (2021): "Persistence in a Dynamic Moral Hazard Game," Theoretical Economics [Forthcoming].

Borensztein, E. and U. Panizza (2009): "The Costs of Sovereign Default," IMF Staff Papers, 56, 683741.

Campbell, J. Y., A. W. Lo, and C. MacKinlay (1997): "The Econometrics of Financial Markets," Princeton University press.

Catao, L. A. and R. C. Mano (2017): "Default Premium," Journal of International Economics, 107, 91–110.

Cavallo, A. (2013): "Online and Official Price Indexes: Measuring Argentinas Inflation," Journal of Monetary Economics, 60, 152–65.

Cavallo, A., G. Cruces, , and R. Perez-Truglia (2016): "Learning from Potentially-biased Statistics: Household Inflation Perceptions and Expectations In Argentina," NBER Working Paper N0. 22103.

Chatterjee, S. and B. Eyigungor (2012): "Maturity, Indebtedness, and Default Risk," American Economic Review, 102, 2674–2699.

Cole, H. L., J. Dow, and W. B. English (1995): "Default, Settlement, and Signalling: Lending Resumption in a Reputational Model of Sovereign Debt," International Economic Review, 36, 365–385.

Cole, H. L. and P. J. Kehoe (2000): "Self-fulfilling Debt Crises," Review of Economic Studies, 67, 91–116.

Cripps, M. W., G. J. Mailath, and L. Samuelson (2004): "Imperfect Monitoring and Impermanent Reputations," Econometrica, 72, 407–432.

Cruces, J. J. and C. Trebesch (2013): "Sovereign Defaults: The Price of Haircuts," American Economic Journal: Macroeconomics, 5, 85–117.

D'Erasmo, P. (2011): "Government Reputation and Debt Repayment in Emerging Economies," Working Paper.

Dovis, A. (2019): "Efficient Sovereign Default," Review of Economic Studies, 86, 282–312.

Dovis, A. and R. Kirpalani (2020): "Fiscal Rules, Bailouts, and Reputationin Federal Governments," American Economic Review, 110, 860–888.

——— (2021): "Rules without Commitment: Reputation and Incentives," Review of Economic Studies [Forthcoming].

Du, W. and J. Schreger (2021): "Sovereign Risk, Currency Risk, and Corporate Balance Sheets," Working Paper.

Eaton, J. and M. Gersovitz (1981): "Debt with Potential Repudiation: Theoretical and Empirical Analysis," The Review of Economic Studies, 48, 289–309.

Ekmekci, M. (2011): "Sustainable Reputations with Rating Systems," Journal of Economic Theory, 146, 479–503.

ENGEL, C. AND J. PARK (2018): "Debauchery and Original Sin: The Currency Composition of Sovereign Debt," Working Paper.

ENGLISH, W. B. (1996): "Understanding the Costs of Sovereign Default: American State Debts in the 1840's," The American Economic Review, 86, 259–275.

FAINGOLD, E. (2020): "Reputation and the Flow of Information in Repeated Games," Econometrica, 88, 1697–1723.

FAINGOLD, E. AND Y. SANNIKOV (2011): "Reputation in Continuous-Time Games," Econometrica, 79, 773–876.

GELOS, G. R., R. SAHAY, AND G. SANDLERIS (2011): "Sovereign Borrowing by Developing Countries: What Determines Market Access," Journal of International Economics, 83, 243–54.

GERTLER, M. AND P. KARADI (2015): "Monetary Policy Surprises, Credit Costs, and Economic Activity," American Economic Journal: Macroeconomics, 7, 44–76.

HEBERT, B. AND J. SCHREGER (2017): "The Costs of Sovereign Default: Evidence from Argentina," American Economic Review, 107, 3119–45.

HOLMSTRM, B. (1999): "Managerial Incentive Problems: A Dynamic Perspective," Review of Economic Studies, 66, 169–182.

KREPS, D. M. AND R. WILSON (1980): "Reputation and Imperfect Information," Journal of Economic Theory, 27, 253–279.

MAILATH, G. J. AND L. SAMUELSON (2001): "Who Wants a Good Reputation," Review of Economic Studies, 68, 415–441.

MERTENS, K. AND M. O. RAVN (2013): "The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States," American Economic Review, 103, 1212–47.

MILGROM, P. AND J. ROBERTS (1982): "Limit Pricing and Entry under Incomplete Information: An Equilibrium Analysis," Econometrica, 50, 443–460.

MORELLI, J. M., P. OTTONELLO, AND D. J. PEREZ (2021): "Global Banks and Systemic Debt Crises," Accepted, Econometrica.

NAKAMURA, E. AND J. STEINSSON (2018): "High-Frequency Identification of Monetary Non-Neutrality: The Information Effect*," The Quarterly Journal of Economics, 133, 1283–1330.

NEUMEYER, P. A. AND F. PERRI (2005): "Business Cycles in Emerging Economies: the Role of Interest Rates," Journal of Monetary Economics, 52, 345–380.

OTTONELLO, P. AND D. J. PEREZ (2019): "The Currency Composition of Sovereign Debt," American Economic Journal: Macroeconomics, 11, 174–208.

Özler, S. (1993): "Have Commercial Banks Ignored History?" The American Economic Review, 83, 608–620.

Persson, T. and G. Tabellini (1997): "Political Economics and Macroeconomic Policy," Working Paper 6329, National Bureau of Economic Research.

Phan, T. (2017a): "Nominal Sovereign Debt," International Economic Review, 58, 1303–1316.

——— (2017b): "Sovereign Debt Signals," Journal of International Economics, 104, 151–165.

Phelan, C. (2006): "Public Trust and Government Betrayal," Journal of Economic Theory, 130, 27–43.

Reinhart, C. M., K. S. Rogoff, and M. A. Savastano (2003): "Debt Intolerance," Brookings Papers on Economic Activity, 1.

Rigobon, R. and B. Sack (2004): "The impact of monetary policy on asset prices," Journal of Monetary Economics, 51, 1553 – 1575.

Sandleris, G. (2008): "Sovereign Defaults: Information, Investment and Credit," Journal of International Economics, 76, 267–275.

Stock, J., M. Yogo, and J. Wright (2002): "A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments," Journal of Business and Economic Statistics, 20, 518 – 529.

Appendix A. Data Sources

In this section we describe the data sources for our empirical work and model calibration.

We start by describing the data used in the analysis of Section 2.1. Sovereign spreads are the J.P. Morgan Emerging Markets Bond Index (EMBI) spreads. We obtained these data from Thomson Reuters Datastream. Historical availability depends on the country. We obtain quarterly GDP data from Thompson Reuters' Datastream and national sources. Data on external debt is obtained from the Bank for International Settlements' (BIS) "Debt Securities Statistics." We express external debt as a share of a country's GDP in USD. Data on credit ratings used are also obtained from Bloomberg. Our sample covers the period 2003-13.

We next describe the data sources for the case study of Argentina (Section 3 in the main text). Data on official inflation are obtained from the *Instituto Nacional de Estadística y Censos* (INDEC). Actual report dates were obtained from historical articles posted online by the newspaper *La Nación*, accessible through the Wayback Machine.[37] See Appendix D.2 for the complete list of announcement dates. Data on Argentine consumption are obtained from national sources. Data on bond yields and bond characteristics are obtained from Bloomberg. Data on Argentina's stock index (Merval) and futures contracts for the Argentine peso are also obtained from Bloomberg. We retrieve these data for the period 2007-12.

For the global control variables (used throughout the paper), we retrieve from Datastream the S&P 500 index, VIX index, and MSCI Emerging Markets ETF index. These data are at daily frequency since 2003.

[37]See https://archive.org/web/.

Appendix B. Fundamentals and the Pricing of Sovereign Risk

B.1. *Robustness Analysis*

This appendix provides further details for the analysis of Section 2.1 and shows that the results are robust to different specifications.

As part of our sample, we consider all countries that at some point in time were part of the EMBI. We exclude from the sample periods in which the country was on default. From the initial sample, 28 countries have non-missing values of daily spreads, quarterly GDP, and quarterly debt-to-GDP for the period 2003-13. This is the final sample of countries we consider for our panel regression on fundamentals. For global control variables, we include the VIX index (to control for risk aversion) and the (log-detrended) S&P 500 index and MSCI Emerging Markets ETF (EEM index).

In what follows, we detail the results of various panel regressions on fundamentals. The first two columns of Table B.1 show the POLS estimates of our baseline model Equation (1), detailed in Section 2.1. The dependent variable is a country's EMBI spread and the explanatory variables are a country's GDP HP cycle, its debt-to-GDP ratio, the EEM Index, the log-linear cycle for the S&P 500, and the VIX index. Column (1) shows results for a regression with region-by-time fixed effects, and Column (2) for a regression that also has country fixed effects. In either case, the signs of the coefficients are as expected: Sovereign spreads depend negatively on domestic GDP and the EEM Index and positively on the country's stock of debt and VIX. Figure 1 in Section 2.1 shows a scatter plot of the estimated residuals against EMBI spreads. As explained in that section, the positive relation between these variables suggests the existence of a missing state. Figure B.1 shows the results for a specification similar to that in Equation (1), but in which the dependent variable is expressed in logs. Figure B.2 shows that the results hold when including interaction and quadratic terms for $\left(\frac{D}{Y}\right)_{i,t}^{q-1}$ and $Y_{i,t}^{q-1}$.[38]

Columns (3) and (4) of Table B.1 show the results when modifying Equation (1) to include credit-rating-by-time fixed effects instead of region-by-time fixed effects. In this way, we control for potential changes in risk aversion across lenders. The signs of the point estimates remain as expected, and Figure B.3 shows that we still have a positive relation between residuals and spreads, albeit weaker.

[38] For the GDP cycle, given that it can take negative values, we define the quadratic term as $Y_{i,t}^{(2),q-1} = 0$ if $Y_{i,t}^{q-1} < 0$ and $Y_{i,t}^{(2),q-1} = (Y_{i,t}^{q-1})^2$ otherwise.

Table B.1. Panel Regression: Fundamentals and External Factors

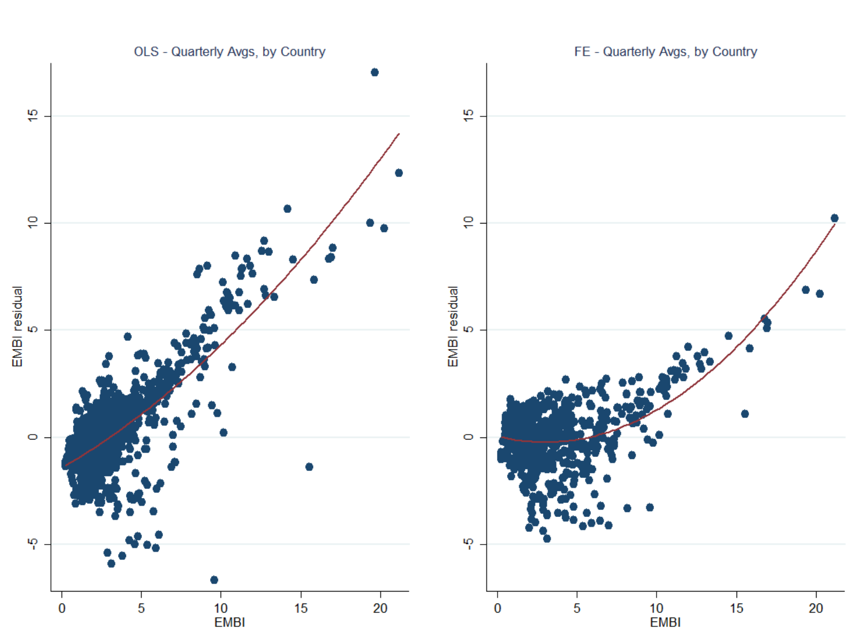
	(1)	(2)	(3)	(4)
GDP Cycle	-0.1406***	-0.2266***	-0.0285***	-0.0859**
	(0.012)	(0.057)	(0.005)	(0.038)
Debt/GDP	0.0316***	0.0222	-0.0058***	-0.0007
	(0.001)	(0.047)	(0.001)	(0.049)
EEM Index	-0.0294***	-0.0295***	-0.0295***	-0.0296***
	(0.003)	(0.003)	(0.002)	(0.003)
SP500	-0.0371***	-0.0370***	-0.0368***	-0.0370***
	(0.009)	(0.012)	(0.006)	(0.012)
VIX	-0.0022	-0.0024	-0.0024	-0.0024
	(0.007)	(0.006)	(0.005)	(0.006)
Country FE	No	Yes	No	Yes
Region-Time FE	Yes	Yes	No	No
Rating-Time FE	No	No	Yes	Yes
Observations	63481	63481	63481	63481

Notes: The table shows the POLS and FE estimates for our panel regression in Section 2.1. The dependent variable is a country's EMBI spread. The set of regressors are a country's GDP HP cycle, its debt-to-GDP ratio, the EEM Index, the log-linear cycle for the S&P 500, and the VIX index. Columns (1) and (2) show the POLS and FE estimates of our baseline model (Equation (1) in the main text). Columns (3) and (4) show the POLS and FE estimates when including credit-rating-by-time fixed effects. Sample period: 2003-13. Standard errors are in brackets. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Figure B.1. Robustness Analysis: Variables in Logs

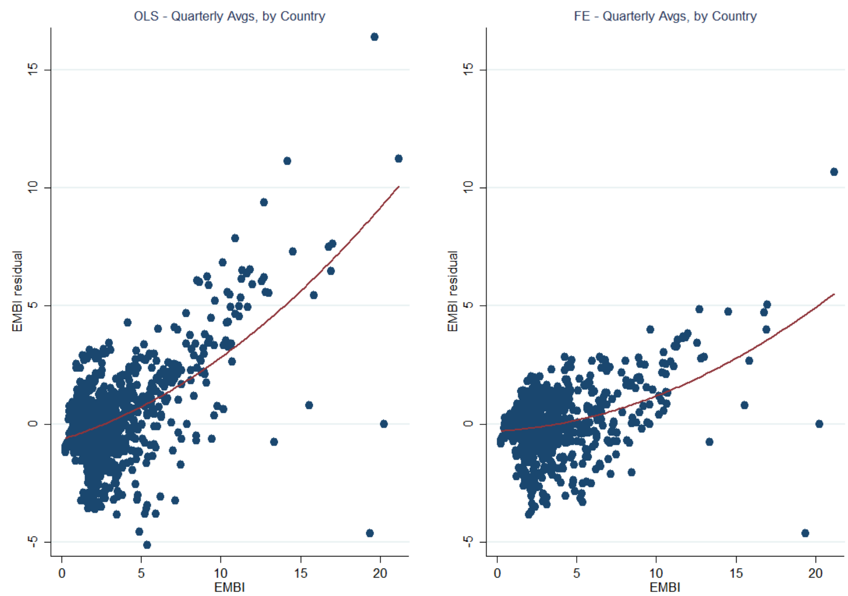
Notes: The figure shows the observed log EMBI spreads and EMBI residuals for the panel of countries in our sample. Results are quarterly averages by country. Residuals are computed from the specification in Equation (1)*. Sample period: 2003-13.*

Figure B.2. Robustness Analysis: Interactive and Quadratic Terms



Notes: The figure shows the observed EMBI spreads and EMBI residuals for the panel of countries in our sample. Results are quarterly averages by country. Residuals are computed from the specification in Equation (1), including interactive and quadratic terms for countries' debt and GDP. Sample period: 2003-13.

Figure B.3. Robustness Analysis: Credit-Rating Fixed Effects



Notes: The figure shows the observed EMBI spreads and EMBI residuals for the panel of countries in our sample. Results are quarterly averages by country. Residuals are computed from the specification in Equation (1). We include in the specification credit-rating-by-time fixed effects, instead of region-by-time fixed effects. Sample period: 2003-13.

Appendix C. The two-period Model: Additional Material and Extension

In this appendix we provide additional material for the two-period model described in Section 2.2. We first describe the algorithm and the model's parameterization. We then discuss a model in which a government's actions are perfectly observable.

C.1. *Algorithm and Model's Parameterization*

The algorithm to solve the two-period model involves finding a fixed point between the S-type's optimal $\tilde{\pi}$ and the lenders' conjecture $\tilde{\Pi}_S^\star$. The steps are as follows:

(1) We guess $\tilde{\Pi}_S^\star$.
(2) Using that conjecture, we compute $\zeta'\left(m, \tilde{\Pi}_S^\star\right)$ for $m = \{L, NL\}$, using Equation (6).
(3) We compute the price schedule $q\left(m, b, \tilde{\Pi}_S^\star\right)$ for each value of b and m, using Equation (7).
(4) We construct a grid for $\tilde{\pi}$ in $[\underline{\pi}, 0]$.
(5) For each point in the grid, we solve for the value of $\tilde{\pi}$ that maximizes $W_S\left(b, m, \tilde{\pi}, \tilde{\Pi}_S^\star\right)$, as defined in Equation (6). We use linear interpolations whenever we evaluate outside the grid.
(6) Check whether $\tilde{\pi}_S^\star$ equals $\tilde{\Pi}_S^\star$. If not, update the initial conjecture $\tilde{\Pi}_S^\star$ accordingly.

For all results presented in the main text, we use the following parameterization:

Table B.1. Parameterization

Parameter	Description	Value
β	Discount factor	0.95
γ	Risk aversion	4.0
r	Risk-free rate	1%
y_1	Endowment at $t = 1$	0.8
y_2	Endowment at $t = 2$	1.3
A	Mean of default cost	0.7
η	S.d. of default cost	0.4
b	Issuances of non-indexed bonds	0.3
B	Stock of indexed bonds	$[0., 0.3]$
ζ	Lenders' prior	0.5
$\underline{\pi}$	Maximum misreport	-0.15
λ	Inverse of signal precision	0.1

C.2. *Case with Perfectly Observed Policies*

We now briefly discuss a version of the model in which the government's actions are perfectly observable by lenders. In particular, we assume that lenders can perfectly observe the $\tilde{\pi}$ policy. This setting is equivalent to the one discussed in the main text, but the probability distribution of message m is now degenerate and given by

$$P(m = L|\tilde{\pi}) = \begin{cases} 1 & \text{if } \tilde{\pi} \neq 0 \\ 0 & \text{if } \tilde{\pi} = 0 \end{cases}$$

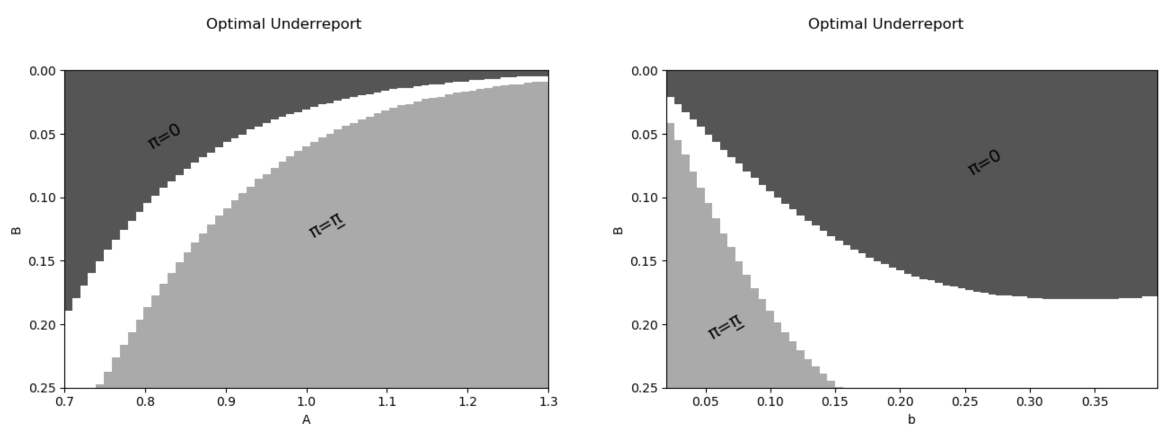
As $\tilde{\pi}$ is observable, we define the Bayesian updating in terms of $\tilde{\pi}$, instead of m. Since Bayes' rule does not always apply under this scenario, we assume $\zeta' = 0$ for all off-path information sets. Based on this assumption, we can summarize the update of beliefs as

$$\zeta'\left(\tilde{\pi};\tilde{\Pi}^{\star}_S\right) = \begin{cases} \frac{\zeta}{\zeta+(1-\zeta)I_{\left\{\tilde{\Pi}^{\star}_S=0\right\}}} & \text{if } \tilde{\pi} = 0 \\ 0 & \text{if } \tilde{\pi} \neq 0 \end{cases}$$

Figure B.1 shows the optimal $\tilde{\pi}$ policy for different combinations of B, A, and b. Notice that $\tilde{\pi} \in (\underline{\pi}, 0)$ is never optimal. This is because any $\tilde{\pi} < 0$ perfectly reveals the government's type. Hence, the cost (in terms of a lower q) is constant for $\tilde{\pi} < 0$, while the benefit is increasing in $|\ \tilde{\pi}\ |$. This implies that only $\tilde{\pi} = \underline{\pi}$ (gray area) or $\tilde{\pi} = 0$ (darker area) can be an equilibrium.

Unlike our baseline model with noisy signal, there are now points of the state space in which no solution exists (white areas of Figure B.1). In such cases, there is no equilibrium, given that the S-type always has incentives to deviate for any given $\tilde{\Pi}^{\star}_S$.

Figure B.1. Perfectly Observable $\tilde{\pi}$



Notes: Optimal policy $\tilde{\pi}$. Results for the case in which $\tilde{\pi}$ is perfectly observable by lenders. The left panel shows results for different parameterizations of (B, A). The right panel shows results for different combinations of (B, b). White areas represent combinations in which no equilibrium exists.

Appendix D. The Argentine Misreport of Inflation: Additional Material

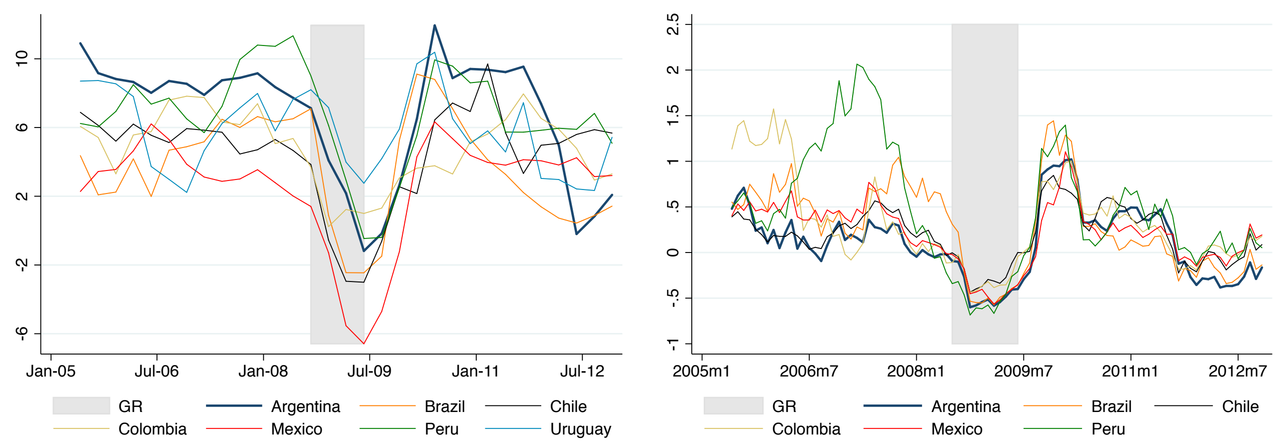
In this appendix we provide additional material for our empirical analysis of Section 3.

D.1. *Argentina's Fundamentals*

Figure D.1 shows that during the period of study, Argentina's fundamentals were in line with those of the region. The left panel of Figure D.1 shows that Argentina's GDP growth showed a behavior similar to that observed in other Latin American countries. If anything, Argentina was growing faster than the rest of the region before the Global Financial Crisis. The right panel of Figure D.1 shows that the dynamics of the stock market—a proxy for expected growth—was also aligned with the region's. Lastly, although not plotted, Argentina's stock of debt was on a downward trend since 2006.

Figure D.1. Argentina vs LATAM countries

(a) GDP growth (real, year-year in %) (b) Stocks growth (USD, year-year in %)



D.2. *List of Argentina's Historical Inflation Announcements*

Table D.1 lists all the days on which the Argentine government reported the inflation rate between 2007 and 2010. To construct the list, we accessed historical articles from the Argentine newspaper *La Nación*, using the tool provided by the Wayback Machine.

Table D.1. Reporting Dates

Event	Inflation for:	Reported Day	Monthly Rate (%)	Event	Inflation for:	Reported Day	Monthly Rate (%)
1	Jan-07	2/5/2007	1.14	25	Jan-09	2/11/2009	0.53
2	Feb-07	3/5/2007	0.30	26	Feb-09	3/11/2009	0.43
3	Mar-07	4/11/2007	0.77	27	Mar-09	4/14/2009	0.64
4	Apr-07	5/4/2007	0.74	28	Apr-09	5/13/2009	0.33
5	May-07	6/5/2007	0.42	29	May-09	6/11/2009	0.33
6	Jun-07	7/5/2007	0.44	30	Jun-09	7/14/2009	0.42
7	Jul-07	8/7/2007	0.50	31	Jul-09	8/12/2009	0.62
8	Aug-07	9/7/2007	0.59	32	Aug-09	9/4/2009	0.83
9	Sep-07	10/5/2007	0.80	33	Sep-09	10/14/2009	0.74
10	Oct-07	11/6/2007	0.68	34	Oct-09	11/12/2009	0.80
11	Nov-07	12/6/2007	0.85	35	Nov-09	12/11/2009	0.83
12	Dec-07	1/7/2008	0.93	36	Dec-09	1/15/2010	0.93
13	Jan-08	2/7/2008	0.93	37	Jan-10	2/12/2010	1.04
14	Feb-08	3/6/2008	0.47	38	Feb-10	3/12/2010	1.25
15	Mar-08	4/10/2008	1.13	39	Mar-10	4/14/2010	1.14
16	Apr-08	5/9/2008	0.83	40	Apr-10	5/12/2010	0.83
17	May-08	6/10/2008	0.56	41	May-10	6/14/2010	0.75
18	Jun-08	7/11/2008	0.64	42	Jun-10	7/14/2010	0.73
19	Jul-08	8/11/2008	0.37	43	Jul-10	8/13/2010	0.80
20	Aug-08	9/11/2008	0.47	44	Aug-10	9/15/2010	0.74
21	Sep-08	10/10/2008	0.51	45	Sep-10	10/15/2010	0.72
22	Oct-08	11/11/2008	0.43	46	Oct-10	11/12/2010	0.84
23	Nov-08	12/10/2008	0.34	47	Nov-10	12/16/2010	0.73
24	Dec-08	1/13/2009	0.34	48	Dec-10	1/14/2011	0.84

D.3. *Analysis of Bond Yields and Break-even Inflation Rate*

We provide here additional details of the Argentine government's bond yields and construction of the break-even (BE) inflation rate. Table D.2 shows static information for the Argentine bonds for which we could retrieve daily data from Bloomberg for the period 2007-12. The top panel shows the case of nominal bonds (in both dollars and pesos) and the bottom panel shows information for the inflation-indexed bonds (IIBs).

Table D.2. Static Information for Argentina's Bonds

(a) Dollar-denominated Bonds

ISIN	Maturity	Currency	Coupon Frequency
ARARGE03F482	12jun2012	ARS	S/A
ARARGE03F243	28mar2011	USD	S/A
ARARGE03F342(*)	12sep2013	USD	S/A
ARARGE03F144	03oct2015	USD	S/A
ARARGE03F441	17apr2017	USD	S/A
US040114GL81	31dec2033	USD	S/A
US040114GK09	31dec2038	USD	S/A

(b) Inflation-linked Bonds

ISIN	Maturity	Currency	Coupon Frequency
ARARGE03B309	15mar2014	ARS	Monthly
ARARGE03E931(*)	30sep2014	ARS	S/A
ARARGE035162	03jan2016	ARS	Monthly
ARBNAC030255	04feb2018	ARS	Monthly

Notes: The table shows static information for all of the bonds in our sample. The top panel shows information for nominal bonds (in both dollars and pesos). The bottom panel shows information for IIBs. Bonds with an asterisk (*) are the ones used in the main analysis.

We use the yields of these bonds to compute a measure of the break-even inflation. Let $Yield^{\$}_{m,t}$ be the annualized yield of a nominal bond (in pesos) with maturity m. Let $Yield^{IIB}_{m,t}$ be the yield of an IIB with maturity m. Then the BE inflation is defined as

$$BE_{m,t} = Yield^{\$}_{m,t} - Yield^{IIB}_{m,t}.$$

A major set back is that there are only three nominal bonds denominated in pesos actively trading during the period considered. Moreover, there is only one bond for which we have yields data during 2007, and the first observation is in July (6 months after the government started misreporting the inflation rate). To circumvent this issue, we construct a measure for the BE rate using the yields of nominal bonds in dollars (call it $Yield^{US\$,t}_{m}$) and the expected devaluation of the peso, as implied by future contracts. Let F_0 denote the spot exchange rate. Let F_j be the future exchange rate, j months from today. Let $\delta^e_j \equiv \frac{F_j - F_0}{F_0}$ be the expected devaluation rate in j-periods. We compute the annualized BE inflation rate as

$$BE_{m,t} = Yield^{US\$}_{m,t} + \delta^e_{12} - Yield^{IIB}_{t,m}.$$

Ideally, to compute the BE rate we need to consider bonds with the same maturity and frequency of coupon payments. From Table D.2, notice that all of the nominal bonds pay coupons on a semi-annual frequency. Only one IIB pays coupons at this frequency (highlighted with an asterisk). This is the bond we use in our main analysis. We choose the dollar-denominated bond whose maturity is closest to this IIB.

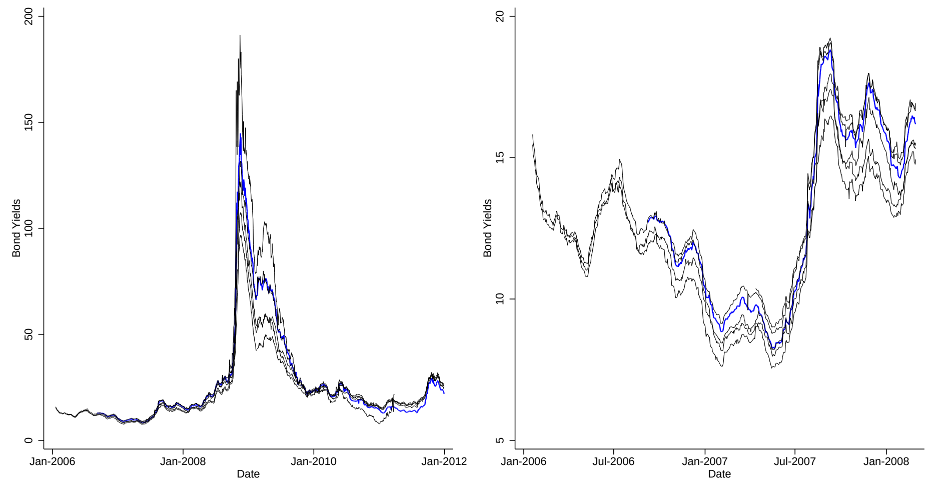
The top panel of Figure D.2 shows annual yields for the dollar-denominated bonds.[39] The bottom panel shows yields for the IIBs. Blue lines depict the bonds used in our main analysis. The left panels show the yields for the 2006-12 period, and the right panels focus on the pre-crisis period. Overall, all of the different yields move in tandem, particularly in the pre-crisis period.

Figure D.3 shows different measures of the BE inflation rate. In all of the cases depicted, we use the IIB with semi-annual payments. Thus, each line of Figure D.3 corresponds to a different dollar-denominated bond. The blue line shows the measure of the BE inflation rate used in our main analysis. Overall, all of the measures strongly comove during the sample period considered.

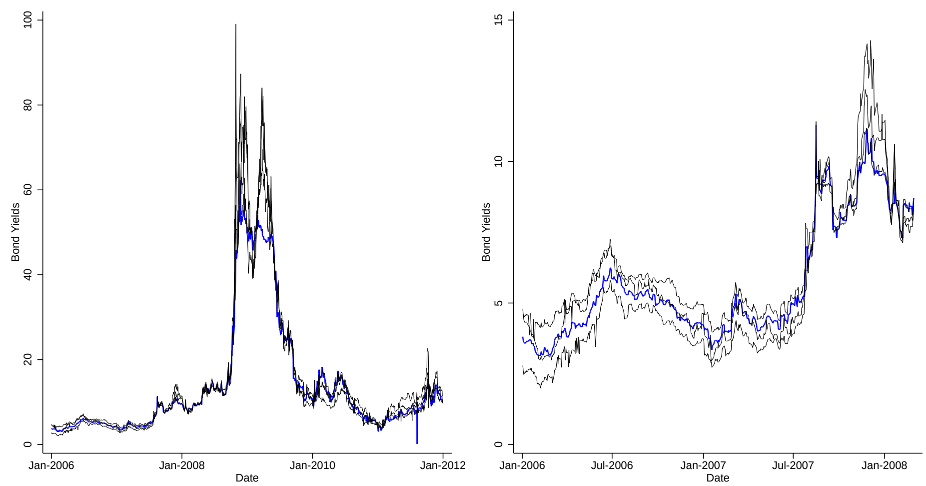
[39]Yields for the last two dollar-denominated bonds in Table D.2 are omitted because the maturity of these bonds is significantly larger.

Figure D.2. Yield of Argentina's Bonds

(a) Dollar-denominated Bonds

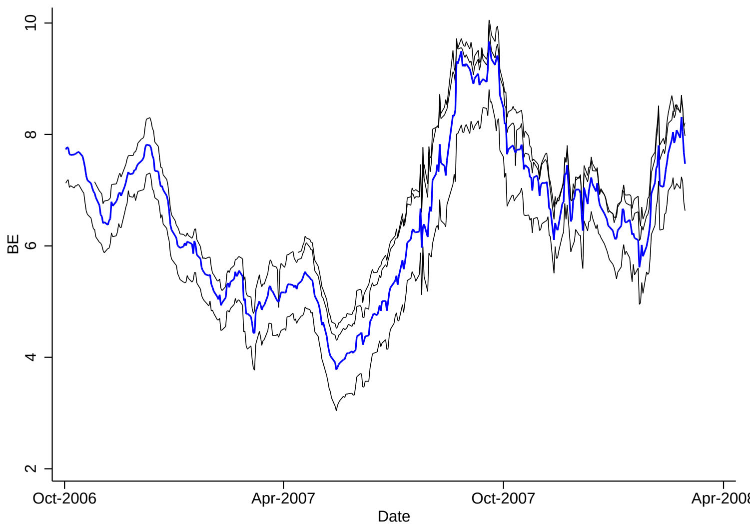


(b) Inflation-index Bonds



Notes: The figure shows the annual yields for different dollar-denominated bonds and inflation-linked bonds issued by Argentina's national government. The blue line corresponds to the bonds used in the main analysis. Left panels include the 2006-12 period. Right panels zoom in on the pre-crisis period.

FIGURE D.3. Break-even Inflation Rate-Different Measures



Notes: The figure shows different measures of the break-even inflation rate. The blue line corresponds to the measure used in the main analysis.

D.4. *Test of Identifying Assumption*

We present an F-test to verify the main assumption of the Rigobon and Sack approach—namely, that the variance of the shocks to ΔBE_t is larger on the event days. As can be seen from Equation (13) in the main text, the Rigobon and Sack instrument is relevant only under the assumption that $\lambda \equiv \sigma_{\eta,E}/\sigma_{\eta,NE} > 1$. To test this, we conduct a hypothesis test in which $\sigma(\Delta BE)_E = \sigma(\Delta BE)_N$. Our one-sided alternative hypothesis is that $\sigma(\Delta BE)_E > \sigma(\Delta BE)_N$. The F-tests reported in Table D.3 strongly reject the hypothesis of equal variances, providing evidence in favor of $\lambda > 1$. Tests based on a bias-corrected stratified bootstrap show that we can also reject the hypothesis of equal variances for our baseline specification (Window 1). Although not reported, the tests are not significant during and after the global financial crisis. We interpret this as evidence that the market was no longer surprised by the sequences of misreports after mid-2008.

Table D.3. Test of Identifying Assumption

	Window 1	Window 2	Window 3	Window 4
Window Type				
Event	3-day window	5-day window	3-day window	2-day window
Non-event	All other days	All other days	4-day window	4-day window
Standard Deviation				
Event	0.250	0.236	0.250	0.269
Non-event	0.180	0.176	0.186	0.186
Ratio Test: $\sigma_{\Delta BE,E} > \sigma_{\Delta BE,NE}$				
F-test				
F-value	1.928	1.802	1.799	2.096
$P(F > f)$	0.002	0.001	0.029	0.015
BC Bootstrap - One-Sided CI				
90% CI Lower Bound	1.105	1.099	0.997	1.043
95% CI Lower Bound	1.017	1.030	0.897	0.926

Notes: The table reports the standard deviations of the daily change in BE inflation rate. The bottom panel shows two tests for the equality of variances of changes in the BE rate. We include results for a traditional F-test and a bias-corrected bootstrap test. Different columns present the results for different event and non-event windows. Sample period: Jan 2007 - Mar 2008.

Appendix E. The Argentine Misreport of Inflation: Robustness Analysis

In this appendix we provide a robustness analysis to our empirical analysis of Section 3. First, we describe the OLS results. Second, we show the results based on an event-study type of methodology. Third, we consider different specifications for our main heteroskedasticity-based analysis and provide further evidence in favor of our reputation hypothesis. Lastly, we present the results based on an identified structural VAR.

E.1. *OLS Results*

We start by presenting the OLS results for the relation between ΔBE_t and $\Delta ln(SP_t)$. As explained in the main text, in order for the OLS to be unbiased, we need the following two conditions: (i) an exogenous change in $\Delta ln(SP_t)$ must have no effect on ΔBE_t, and (ii) there must be no omitted common shocks. While these are implausible assumptions in our context, we present the OLS estimates for completeness. The considered regression is

$$\Delta \text{ln} SP_t = \alpha_0 + \alpha_1 \Delta BE_t + \alpha_2 X_t + \epsilon_t \tag{E.1}$$

where X_t is the same vector of global controls used in the main text.

Table E.1 shows OLS estimates for the same sample period as in the main analysis. When all days are included in the sample (first column), the OLS estimates are nonsignificant. This suggests that overall, changes in the break-even inflation rate are unrelated to changes in sovereign spreads. However, when we focus on windows around the announcement of inflation, the estimates are negative and significant (in line with those presented in the main text).

Although the Argentine government kept misreporting the inflation rate during 2008-12, Table E.2 shows that the OLS estimates for 2010 are not significant, even when focusing on narrow windows around the announcement. While not reported, the results are also not significant for the 2008-09 period. In terms of our two-period reputational model, we can interpret these facts as suggesting that after mid-2008, the lenders' prior (ζ) reached its lower bound. Hence, future misreports have no impact on spreads. In other words, the market was no longer surprised by the misreports.[40]

[40] After 2007, the volatility of ΔBE_t around inflation announcements is no longer larger than during non-event windows. Because of this, we cannot use the Rigobon and Sack IV type of instrument.

Table E.1. OLS Regression

	(1)	(2)	(3)	(4)	(5)
Event Window	Full Sample	3-day Window		5-day Window	
ΔBE	-1.413	-5.302***	-0.305	-3.869**	0.088
Standard Error	(1.193)	(1.749)	(1.394)	(1.642)	(1.531)
Observations	260	35	225	57	203
Days Included	All	Event Days	Non-Event Days	Event Days	Non-Event Days
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the results for the OLS estimators. The dependent variable is $\Delta lnSP_t$. The sample period is Jan 2007 - Mar 2008. The first column includes all days in the sample. The other columns only include 3- and 5-day windows around the inflation announcement. Controls include the VIX index, S&P 500 index, and MSCI Emerging Markets ETF index. Robust standard errors are reported in parentheses. ***, **, *, denote significance at 1%, 5%, and 10%, respectively.

Table E.2. OLS Regression-Post Sample Period

	(1)	(2)	(3)	(4)	(5)
Event Window	Full Sample	3-day Window		5-day Window	
ΔBE	-0.417	-0.514	-0.335	-0.551	-0.381
Standard Error	(0.293)	(0.736)	(0.323)	(0.492)	(0.330)
Observations	228	34	194	54	176
Days Included	All	Event Days	Non-Event Days	Event Days	Non-Event Days
Controls	Yes	Yes	Yes	Yes	Yes

Notes: This table shows the results for the OLS estimators. The dependent variable is $\Delta lnSP_t$. The sample period is Jan 2010 - Mar 2011. The first column includes all the days in the sample. Other columns only include 3- and 5-day windows around the inflation announcement. Controls include the VIX index, S&P 500 index, and MSCI Emerging Markets ETF index. Robust standard errors are reported in parentheses. ***, **, *, denote significance at 1%, 5%, and 10%, respectively.

E.2. *Event Study Results*

In this section, we present a standard event-study type of analysis to estimate the effect of inflation misreporting on Argentina's sovereign spreads. The identifying assumption is that changes in Argentina's break-even inflation rate during the event windows are driven exclusively by the inflation announcement. Let NE denote the set of non-event days and let $L = \mid NE \mid$.

We first estimate a factor model on the non-event-days,

$$\Delta lnSP_t = \phi_0 + \phi_1 X_t + \nu_t, \tag{E.2}$$

where X_t is the same vector of global controls used in the main analysis. We then use those estimates to generate a time series of abnormal changes in spreads and to estimate its variance (assuming that errors are homoskedastic). That is,

$$\Delta lnSP_t^A = \Delta lnSP_t - \hat{\phi}_0 - \hat{\phi}_1 X_t$$
$$\hat{\sigma}_{SP}^2 = \frac{1}{L} \sum_{t \in NE} (\Delta lnSP_t^A)^2$$

Next, we classify our event windows into two categories, depending on the observed change in the BE inflation (ΔBE_t). Let $\mu_{\Delta BE}^{E,j}$ be the median for ΔBE_t across event window j and let ($\mu_{\Delta BE}^{NE}$) be the median of ΔBE_t for the non-event' days. From the pool of event days we create two categories:[41]

(1) If $\mu_{\Delta BE}^{E,j} < \mu_{\Delta BE}^{NE}$ we label the event window j as a bad news event (BNE).
(2) If $\mu_{\Delta BE}^{E,j} > \mu_{\Delta BE}^{NE}$ we label the event window j as a good news event (GNE).

In the first case, the drop in the break-even inflation rate during the event window is larger than the average change for non-event days. This can be interpreted as an increase in the unexpected underreport of inflation. The second case would imply a decrease in the unexpected underreport.

For each category $k = \{BNE, GNE\}$, we compute the cumulative abnormal change across all events of the same type k: $CA(SP)_k = \sum_{t \in k} \Delta lnSP_t^A$. Notice that CA(SP) adds abnormal changes in different windows (non-consecutive days). Finally, we report the $J1$ statistic described in Campbell et al. (1997):

$$J1_k \equiv \frac{CA(SP)_j}{\sqrt{L_k \times \hat{\sigma_{SP}}^2}}$$
$$= \frac{C\bar{A(SP)}_j}{L_k^{-\frac{1}{2}} \times \hat{\sigma_{SP}}}$$

where $L_k = \mid E_k \mid$ denotes the total number of days for each type of event k and $C\bar{A(SP)}_k = \frac{CA(SP)_k}{L_k}$. Under the null hypothesis that the events have no effect on $\Delta \ln SP$, $J1_k$ is asymptotically distributed as a standard normal variable. The problem is that there are few events in

[41] Ideally, we would like to have three categories: bad news, no news, and good news. Given our small sample, we decided to focus only on two broad categories. Results are similar if we classify events based on the average change (instead of the median change).

Table E.3. Event-study Approach-3 day Window

Event Type	# Events	Obs	$\Delta ln(\bar{SP^A})$	J1-stat	$\Delta \bar{B}E$
Good News Event	6	17	-0.803	-1.190	-0.010
Bad News Event	6	18	0.714	1.088	-0.046

Table E.4. Event-study Approach-5 day Window

Event Type	# Events	Obs	$\Delta ln(\bar{SP^A})$	J1-stat	$\Delta \bar{B}E$
Good News Event	6	26	-0.561	-1.064	0.060
Bad News Event	7	31	0.964	1.995	-0.067

each category, and therefore asymptotic normality is a poor approximation. With that caveat in mind, Tables E.3 and E.4 report the results.

For the 3-day window, notice that the average (daily) CA(SP) is almost 1 pp in the bad news event. This implies that Argentina's spreads increased around 1 pp (daily) every time the market realized that the government lied about inflation. The 5-day window shows that the cumulative effect after those 5 days is almost 5 pp.

E.3. *Robustness Analysis of the Reputation Channel*

In this section we provide further details on the robustness analysis supporting the reputation channel, as discussed in Section 3.4. As a starting point, we extend our baseline model and allow for the possibility that the inflation misreport can directly affect the real economy (Equations (16)-(18) in the main text). For convenience, we replicate that system of equations below:

$$\Delta BE_t = \beta_0 + \beta_1 \Delta \ln SP_t + \beta_2 R_t + \beta_3 X_t + \eta_t \tag{E.3}$$

$$\Delta \ln SP_t = \alpha_0 + \alpha_1 \Delta BE_t + \alpha_2 R_t + \alpha_3 X_t + \epsilon_t \tag{E.4}$$

$$R_t = \gamma_0 + \gamma_1 \Delta BE_t + \gamma_3 X_t + \nu_t, \tag{E.5}$$

where we assume that η_t, ϵ_t, ν_t, and X_t are uncorrelated. Substituting Equation (E.5) into Equations (E.3) and (E.4), it is straightforward to show that

$$\Delta BE_t \left(1 - \beta_2\gamma_1\right) = \left(\beta_0 + \beta_2\gamma_0\right) + \beta_1 \Delta \ln SP_t + \left(\beta_2\gamma_3 + \beta_3\right) X_t + \left(\eta_t + \beta_2\nu_t\right) \tag{E.6}$$

$$\Delta \ln SP_t = \left(\alpha_0 + \alpha_2\gamma_0\right) + \left(\alpha_1 + \alpha_2\gamma_1\right) \Delta BE_t + \left(\alpha_3 + \alpha_2\gamma_3\right) X_t + \left(\epsilon_t + \alpha_2\nu_t\right) \tag{E.7}$$

Under the same set of assumptions as in Section 3.3, while we cannot identify α_1, it is clear that our identification strategy allows us to identify $\tilde{\alpha_1} \equiv \alpha_1 + \alpha_2\gamma_1$. To the extent that $\alpha_2 \neq 0$ and $\gamma_1 \neq 0$, our baseline estimates for α_1 would be biased.

In what follows, we discuss in detail the possible signs of these biases. According to the sovereign debt literature, we would expect α_2 to be negative and significant: A fall in economic activity (as proxied by stock market returns) should increase a country's default risk. Thus, our baseline estimate for α_1 would be biased if $\gamma_1 \neq 0$.

The sign of γ_1 is a priori unclear (see the discussion in Section 3.4). A $\gamma_1 > 0$ would be consistent with negative distortions in the real economy due to the inflation misreport, or a negative aggregate demand shock that decreases both the expected inflation (and hence the BE rate) and stock returns. If that were the case, we would have $\alpha_2\gamma_1 < 0$, which produces a negative bias in our estimate for α_1. Since $\mid \tilde{\alpha_1} \mid > \mid \alpha_1 \mid$, we would then be *overestimating* the direct effects of ΔBE_t on spreads. On the other hand, $\gamma_1 < 0$ would be consistent with a positive supply shock that reduces the expected inflation and increases the stock market return. In that case, we would then be *underestimating* the direct effects of ΔBE_t on spreads.

While we cannot identify α_2, under the system of equations (E.3)-(E.5) we can identify the γ_1 parameter. By substituting Equation (E.4) into (E.3), we get the following system:

$$\Delta BE_t \left(1 - \beta_1\alpha_1\right) = \left(\beta_0 + \beta_1\alpha_0\right) + \left(\beta_2 + \beta_1\alpha_2\right) R_t + \left(\beta_3 + \beta_1\alpha_3\right) X_t + \left(\beta_1\epsilon_t + \eta_t\right) \tag{E.8}$$

$$R_t = \gamma_0 + \gamma_1 \Delta BE_t + \gamma_3 X_t + \nu_t \tag{E.9}$$

From here, it is clear that our set of identifying assumptions allows us to identify the γ_1 parameter. Table 3 (in the main text) shows the results. Across all of the different specifications, the point estimates for γ_1 are not statistically significant. That is, the misreport of inflation does not seem to have a direct effect on the Argentine stock market, which mitigates any concerns about biases in our baseline estimate for α_1. We take this as further evidence supporting our reputational channel.

We end our discussion of possible biases by considering the case in which ΔSP_t could affect R_t, as found in Hebert and Schreger (2017). To do this, we consider the following system of equations:

$$\Delta BE_t = \beta_0 + \beta_1 \Delta \ln SP_t + \beta_2 R_t + \beta_3 X_t + \eta_t \tag{E.10}$$

$$\Delta \ln SP_t = \alpha_0 + \alpha_1 \Delta BE_t + \alpha_2 R_t + \alpha_3 X_t + \epsilon_t \tag{E.11}$$

$$R_t = \gamma_0 + \gamma_1 \Delta BE_t + \gamma_2 \Delta SP_t + \gamma_3 X_t + \nu_t, \tag{E.12}$$

where we have replaced Equation (E.5) with (E.12). Under the same set of assumptions as those in the main text, it is easy to show that the following parameters can be identified: $\tilde{\alpha_1} \equiv \frac{\alpha_1+\alpha_2\gamma_1}{1-\alpha_2\gamma_2}$ and $\tilde{\gamma_1} \equiv \frac{\gamma_1+\alpha_1\gamma_2}{1-\alpha_2\gamma_2}$.

According to Hebert and Schreger (2017), we should expect a negative effect of sovereign spreads on stock returns (i.e., $\gamma_2 < 0$). Provided that $\alpha_2 < 0$—which is in line with the sovereign debt literature—and $\alpha_1 < 0$—consistent with our reputation channel—the IV estimate for γ_1 from Table 3 would have a *positive* bias. That is:

$$\tilde{\gamma_1} \equiv \frac{\gamma_1 + \overbrace{\alpha_1}^{-} \overbrace{\gamma_2}^{-}}{1 - \underbrace{\alpha_2}_{-} \underbrace{\gamma_2}_{-}} \approx \gamma_1 + BIAS_+ \tag{E.13}$$

The fact that our point estimates for $\tilde{\gamma_1}$ (i.e., those reported in Table 3) are not statistically significant suggests that $\gamma_1 \leq 0$. In that case, notice that the bias for the α_1 parameter is also positive. That is:

$$\tilde{\alpha_1} \equiv \frac{\alpha_1 + \overbrace{\alpha_2}^{-} \overbrace{\gamma_1}^{-}}{1 - \underbrace{\alpha_2}_{-} \underbrace{\gamma_2}_{-}} \approx \alpha_1 + BIAS_+ \tag{E.14}$$

Therefore, our estimates for $\tilde{\alpha_1}$ (i.e., those reported in Table 2) are upwardly biased. Given that they are negative, we should interpret them as a lower bound (in terms of magnitudes).

E.4. *Identified Structural VAR*

In this section we provide further empirical evidence that supports our baseline analysis in Section 3.3. In particular, we construct and estimate a structural VAR that incorporates the interactions between inflation misreport, spreads, and economic activity. We then identify structural shocks to misreport and study its effects on the economy.

Let $\boldsymbol{Y}_t \equiv (M_t, SPt, R_t)$, where M_t is the underreport of inflation, SP_t is the sovereign spread, and IP_t is an indicator of economic activity. Consider the following structural and reduced-form

VAR:

$$\text{Structural Form} \quad \boldsymbol{A}\boldsymbol{Y}_t = \sum_{j=1}^{p} \boldsymbol{C}_j \boldsymbol{Y}_{t-j} + \boldsymbol{\epsilon}_t$$

$$\text{Reduced Form} \quad \boldsymbol{Y}_t = \sum_{j=1}^{p} \boldsymbol{B}_j \boldsymbol{Y}_{t-j} + \boldsymbol{u}_t$$

where $\boldsymbol{u}_t = \boldsymbol{S}\boldsymbol{\epsilon}_t$ and $\boldsymbol{S} = \boldsymbol{A}^{-1}$, and $\boldsymbol{B}_j = \boldsymbol{A}^{-1}\boldsymbol{C}_j$. The vectors $\boldsymbol{\epsilon}_t$ and $\boldsymbol{u}_t$ represent structural and reduced-form shocks, respectively.

Let ϵ_t^p be the structural policy shock to inflation misreport, and $Y_t^p \in \boldsymbol{Y}_t$ the government's policy choice on misreport. Let $\boldsymbol{s}$ denote the column in $\boldsymbol{S}$ associated with ϵ_t^p. Then the response of the endogenous variables to a shock to misreport is given by

$$\boldsymbol{Y}_t = \sum_{j=1}^{p} \boldsymbol{B}_j \boldsymbol{Y}_{t-j} + \boldsymbol{s}\epsilon_t^p$$

This means that given estimates for $\{\boldsymbol{B}_j\}_{j=1}^p$, we only need to identify $\boldsymbol{s}$ to compute the impulse responses. To this end, we follow an instrumental approach similar to Mertens and Ravn (2013) and Gertler and Karadi (2015).

The method consists of finding a vector of instruments $\boldsymbol{Z}_t$ so that

$$E\left[\boldsymbol{Z}_t \epsilon_t^p\right] = \boldsymbol{\Phi}$$

$$E\left[\boldsymbol{Z}_t \boldsymbol{\epsilon^{q\prime}}_t\right] = \boldsymbol{0},$$

where $\epsilon_t^{q\prime}$ is the vector of structural shocks other than the policy shock. Given that vector of instruments, the procedure for obtaining estimates of $\boldsymbol{s}$ can be decomposed in two broad steps.[42] First, we obtain estimates of $\boldsymbol{u}_t$ by OLS. Second, we identify $\boldsymbol{s}$ using the estimated reduced-form residuals and the vector of instruments. Let u_t^p be the estimated residuals associated with the equation for inflation misreport, and let $\boldsymbol{u}_t^q$ be the residuals from the other equations. Let $\boldsymbol{s}^q$ be the vector linking $\boldsymbol{u}_t^q$ to ϵ_t^p. As discussed in Mertens and Ravn (2013) and Gertler and Karadi (2015), we can obtain an estimate of $\boldsymbol{s}^q$ and s^p from a from a two-stage OLS estimation. In the first stage, we regress u_t^p onto $\boldsymbol{Z}_t$ to get $\hat{u}_t^p$. Note that the variation in $\hat{u}_t^p$ is due to ϵ_t^p. In the second stage, we regress $\boldsymbol{u}_t^q$ onto $\hat{u}_t^p$ to obtain the estimates of $\boldsymbol{s}^q$ and s^p.

An additional complication in our application is that true inflation misreport, M_t, is not observable. Instead, market participants observe an alternative inflation measure that is centered in the true value of inflation, but subject to measurement errors. Therefore, this alternative

[42]We refer the reader to Mertens and Ravn (2013) and Gertler and Karadi (2015) for further details.

measure provides a noisy signal, $\tilde{M}_t$, of the true value of misreport. In particular, we assume that $\tilde{M}_t = M_t + \eta_t$, where η_t is i.i.d., and orthogonal to M_τ, SP_τ, and IP_τ for any $\tau \in \mathbf{Z}$ (integers set). Being measurement errors, we also assume that $E\left[\eta_t {\epsilon^p}_t\right] = 0$, $E\left[\eta_t \boldsymbol{\epsilon}^{\boldsymbol{q}'}{}_t\right] = \mathbf{0}$ and $E\left[\eta_t \boldsymbol{Z}_t\right] = \mathbf{0}$. Although strong, these are sufficient conditions to identify our parameters of interest.

It could be the case that the sufficient conditions may not hold. For instance, to the extent that the consumption baskets considered in the official and alternative measures of inflation differ, dynamics in misreport may have important seasonal components. To control for this, we seasonally adjust observed misreport before introducing it into the VAR. It could also be the case that the volatility of η_t depends on the level of misreport. To mitigate this concern, we normalize misreport at time t by the official level inflation. A more formal way to account for possible heteroskedasticity would be to estimate a VAR GARCH in mean econometric model, but we have too few observations for this to be possible.

The noisy signal could potentially affect the procedure, both in the estimation of the reduced-form VAR and identification of the structural policy shock. In what follows we argue that under the current assumptions, that would not be the case. We first focus on estimation of the reduced-form VAR. For simplicity of exposition, assume a VAR(1). Under noisy misreports, the system of equations would be given by

$$\begin{aligned}
M_t &= \tilde{B}_{11} M_{t-1} + \tilde{B}_{12} SP_{t-1} + \tilde{B}_{13} IP_{t-1} + \underbrace{\left(u_{1t} + \tilde{B}_{11}\eta_{t-1} - \eta_t\right)}_{\tilde{u}_{1t}} \\
SP_t &= \tilde{B}_{21} M_{t-1} + \tilde{B}_{22} SP_{t-1} + \tilde{B}_{23} IP_{t-1} + \underbrace{\left(u_{2t} + \tilde{B}_{21}\eta_{t-1}\right)}_{\tilde{u}_{2t}} \\
IP_t &= \tilde{B}_{31} M_{t-1} + \tilde{B}_{32} SP_{t-1} + \tilde{B}_{33} IP_{t-1} + \underbrace{\left(u_{3t} + \tilde{B}_{31}\eta_{t-1}\right)}_{\tilde{u}_{3t}},
\end{aligned}$$

or $\boldsymbol{Y}_t = \tilde{\boldsymbol{B}}_1 \boldsymbol{Y}_{t-j} + \tilde{\boldsymbol{u}}_t$, with $\boldsymbol{Y}_t = [M_t, SP_t, IP_t]'$ and $\tilde{\boldsymbol{u}}_t = [\tilde{u}_{1t}, \tilde{u}_{2t}, \tilde{u}_{3t}]'$. Since $M_{t-1} \perp \eta_{t-1}$, $SP_{t-1} \perp \eta_{t-1}$ and $IP_{t-1} \perp \eta_{t-1}$, the OLS estimator would actually return an unbiased point estimate for B_1—the matrix of coefficients in the absence of noisy misreport. A similar argument follows for a VAR(p).

We now turn to identification of the structural shock. Under the noisy misreport, the first equation of the SVAR would be

$$\boldsymbol{A}_1\boldsymbol{Y}_t = \sum_{j=0}^{p}\boldsymbol{C}_{1j}\boldsymbol{Y}_{t-j} + \underbrace{\left(\epsilon_t^p - a_{11}\eta_t + \sum_{j=0}^{p} c_{j,11}\eta_{t-j}\right)}_{\tilde{\epsilon}_t^p},$$

where $\boldsymbol{A}_1$ and $\boldsymbol{C}_{1j}$ are the first rows of $\boldsymbol{A}$ and $\boldsymbol{C}_j$, respectively. A similar specification would hold for the other equations, defining a new vector of innovations $\tilde{\boldsymbol{\epsilon}}^{q\prime}$. Given the orthogonality assumptions on η_t, we have

$$E\left[\boldsymbol{Z}_t\tilde{\epsilon}^p{}_t\right] = E\left[\boldsymbol{Z}_t\left(\epsilon_t^p - a_{11}\eta_t + \sum_{j=0}^{p} c_{j,11}\eta_{t-j}\right)\right] = E\left[\boldsymbol{Z}_t\epsilon^p{}_t\right]. \tag{E.15}$$

Thus we could still use $\boldsymbol{Z}_t$ to identify the structural shock to the misreport equation. Furthermore, under the assumed additive specification for $\tilde{M}_t$, the SVAR would be capturing the response of the true misreport (since only ϵ_t^p is realized). Therefore, under the assumed framework, the fact that we observe a noisy signal for the true value of misreport would not invalidate our analysis.

We estimate the previous SVAR using monthly data. We define inflation misreport as the difference between an alternative measure of the inflation rate (IPC 7 provincias) and the inflation rate reported by the Argentine National Institute of Statistics and Censuses (INDEC); see Figure 5. Given that Argentina is a small open economy, we control for global variables that may be affecting the results.[43] For sovereign spreads, we take the residual of a projection of daily spreads (in logs) onto the set of global factors used in Section 3.3 (VIX, SP, and EEM). We then compute the median value for each month. Our measure of economic activity is the "Estimador Mensual de Actividad Economica," as reported by the INDEC. This is a seasonally adjusted monthly variable capturing Argentine nonfinancial economic activity. We take the residual of the projection of this index onto the following set of external variables: oil price, US unemployment rate, and the US 10-year Treasury yield.

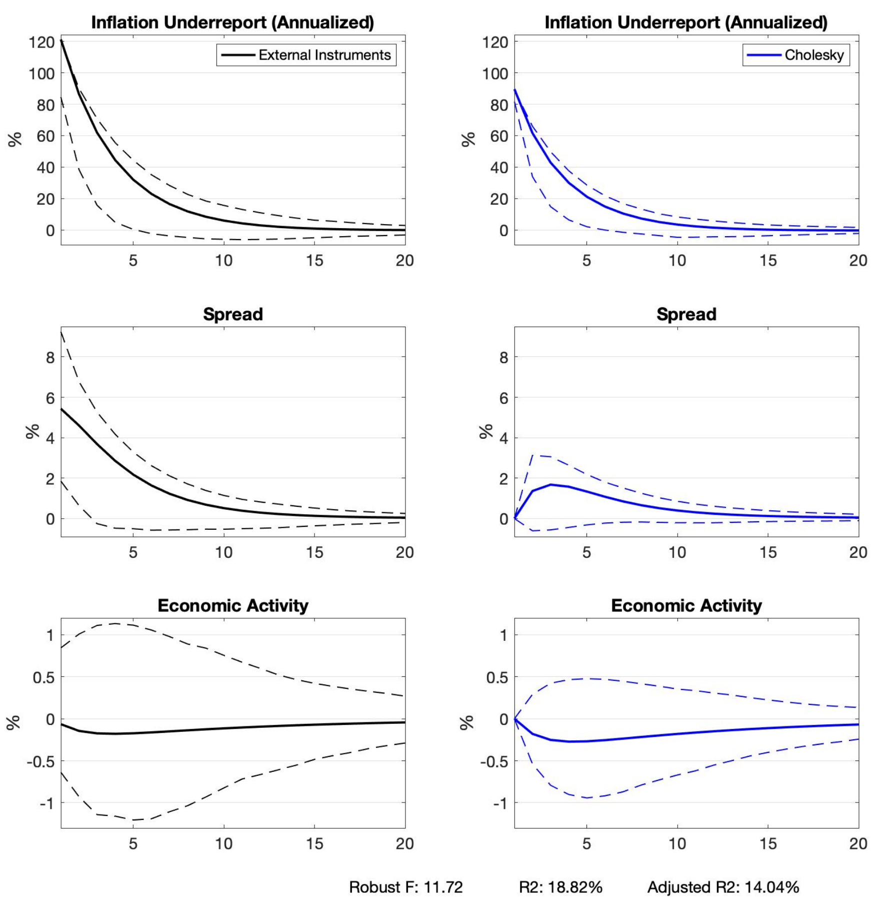
We consider log-changes in the break-even inflation rate, $\Delta\ln BE_t$, to be our instrument for the identification of structural misreport policy shocks.[44] In the first step of the procedure, we

[43] We do not introduce these global variables into the VAR because it would significantly increase the number of coefficients to estimate, while having a relatively small number of observations.

[44] Results are qualitatively similar if we instead consider changes in levels of BE. However, in that case the F-test suggests that the instrument is weak. We believe this is driven by a low variation in ΔBE_t due to a lower frequency aggregation (i.e., monthly frequency).

use monthly data for the period Feb-2006 to Dec-2010 to estimate the reduced-form VAR. Given the small number of observations, we only choose one lag for the VAR. In the second step, we use data on $\Delta \ln BE_t$ for the period Feb-2007 to Aug-2008 to identify the vector $\boldsymbol{s}$. We choose a later starting period for the instrument than for the reduced-form VAR, since the government's misreport started in Feb-2007. We also choose an earlier ending period, since in Section E.1 we show empirical evidence suggesting that after the mid-2008 the market was no longer surprised by the misreports. The results that follow are quantitatively similar when using the sample Feb-2006 to Aug-2008 for the reduced-form VAR (not shown), but less precisely estimated due to a reduction in the number of observations.

Figure E.1. Impulse Response to a Misreport Shock



Notes: This figure shows the response of inflation underreport, spreads, and economic activity to a 1–sd structural shock to misreport. See text for details on the VAR. Dashed lines denote the 90% confidence interval, constructed using wild bootstrap. The robust F-statistic from the instrument regression is above the threshold of 10 suggested by Stock et al. (2002) in order to be confident that a weak instrument problem is not present.

Figure E.1 shows the results of the estimation. The three left panels show the response of inflation underreport, spreads, and economic activity upon a 1–sd structural shock to misreport policy. As we can see, misreport increases on impact, and so do spreads. These increases are both economically and statistically significant.[45] Furthermore, the robust F-test is greater than 10, suggesting that the external instrument is valid.[46] For the response of economic activity, the identified SVAR suggests a lagged negative response but is not statistically significant.

For comparison, the right panels of Figure E.1 show the response of the endogenous variables when assuming a Cholesky decomposition for identification. The assumed (decreasing) order of exogeneity is economic activity, spreads, and inflation underreport. The response of spreads upon a 1–sd shock to misreport is still positive, albeit of smaller magnitude. The response of economic activity is similar to the identified SVAR and not statistically significant.

[45]Confidence intervals are at 90% and are computed using wild bootstrap.

[46]See Stock et al. (2002) for a discussion of the validity of instruments.

Appendix F. The Infinite-horizon Model

In this appendix, we provide details of the infinite-horizon quantitative model described in Section 4. We start by outlining the updating of beliefs and the government's recursive problem. We then explain our measure of model-implied break-even inflation and the process to compute the model-implied semi-elasticity between changes in the BE and sovereign spreads. Lastly, we provide additional figures to describe the optimal policy functions and pricing kernels.

F.1. *Description of the Model*

In what follows, we first describe how market beliefs about the government type are constructed. We then explain in detail the government's problem, given the market's belief-updating mechanism. Lastly, we derive the equilibrium bond pricing kernel and define a Perfect Bayesian Equilibrium (PBE) for this economy.

Updating of Beliefs

Beliefs about the government's type are updated twice within a period: after the outright default decision and after the message m is realized. Let $\mathbf{S} = (y, b, \zeta)$ denote the state at the beginning of the period. Let $d_j^\star \equiv d_j(\mathbf{S})$ be the lenders' conjecture about the j-type government's default decision (given the current state $\mathbf{S}$). Let $d = \{0, 1\}$ be the actual default choice. The first updating of beliefs is given by[47]

$$\tilde{\zeta}\left(d; \zeta, d_S^\star, d_C^\star\right) = \frac{Prob(d \mid d_C^\star) \times \zeta}{Prob(d \mid d_C^\star) \times \zeta + Prob(d \mid d_S^\star) \times (1 - \zeta)} \tag{F.1}$$

As in the two-period model, lenders observe a message $m = \{L, NL\}$ and update their log likelihood ratio using Bayes' rule. Regardless of the choice of $\tilde{\pi}$, we assume that both messages have positive probability, so Bayes' rule always applies and there are no off-path information sets. To ease notation, let $\tilde{\Pi}_S^\star \equiv \tilde{\Pi}_S(y, b, \tilde{\zeta})$ be the lender's conjecture about the S-type's optimal policy. After observing m, the second updating of beliefs is given by

$$\hat{\zeta}\left(m; \tilde{\zeta}, \tilde{\Pi}_S^\star\right) = \frac{Prob(m \mid 0) \times \tilde{\zeta}}{Prob(m \mid 0) \times \tilde{\zeta} + Prob(m \mid \tilde{\Pi}_S^\star) \times \left(1 - \tilde{\zeta}\right)} \tag{F.2}$$

Notice that the updating of beliefs in Equation (F.2) only happens if the government does not default. If the government defaults at the beginning of the period, then $\hat{\zeta}\left(m; \tilde{\zeta}, \tilde{\Pi}_S^\star\right) = \tilde{\zeta}$, for any message m.

[47]For off-equilibrium paths, we simply assume that $\tilde{\zeta}\left(d; \zeta, d_S^\star, d_C^\star\right) = 0$.

Let T_{ij} be the element (i, j) of the government's type transition matrix. The law of motion for the posterior is given by

$$\zeta'\left(\hat{\zeta}\right) = T_{CC} \times \hat{\zeta} + T_{SC} \times \left[1 - \hat{\zeta}\right] \tag{F.3}$$

Government's Recursive Problem

We now outline the j-type government's recursive problem. We first describe the government's optimal debt-issuance problem (stage 2). We then describe the optimal choice of $\tilde{\pi}$ (stage 1) and the outright default decision (stage 0).

Stage 2: Optimal Bond Issuance

At the beginning of stage 2, lenders have fully adjusted their beliefs based on the observed choices of d and the realized m. The economy's state is therefore $(y, b, \hat{\zeta})$, where $\hat{\zeta}$ is given by Equation (F.2).

At this stage, the government chooses its optimal debt-issuance policy. Following Amador and Phelan (2021) and for computational tractability, we assume that the S-type follows the same debt-issuance policy as the C-type. That is, we restrict the S-type to choose a level of borrowing that is identical to that which would have been chosen by a C-type facing the same endowment, debt, and reputation. In a continuous-time infinite-horizon model with *perfectly* observed actions, Amador and Phelan (2021) show that this assumption is without loss of generality. This is because the S-type does not have incentives to completely reveal itself by choosing a level of borrowing different from the C-type, without simultaneously defaulting.[48] Under this simplifying assumption, bond policies are completely uninformative about the type of government.

For the commitment type, this problem is given by

$$V^{C}\left(y, b, \hat{\zeta}\right) = \max_{b'} u\left(c\right) + \beta \int_{y} \left\{ T_{CC} W^{C}\left(y', b', \zeta'\right) + T_{CS} W^{S}\left(y', b', \zeta'\right) \right\} dF\left(y' \mid y\right) \tag{F.4}$$

$$s.t. \quad c = y - b\left[\left(1 - m_b\right) z_b + m_b\right)] + q\left(y, b', \zeta'\right)\left[b' - (1 - m_b) b\right] - B,$$

where β is the government's discount factor, $W^{j}(.)$ is the beginning-of-period value function (to be defined below), and ζ' is given by Equation (F.3). Moreover, $F(y' \mid y)$ is the cumulative distribution function for next-period's endowment, given current y. Let $b'_C \equiv b_C\left(y, b, \hat{\zeta}\right)$ represent the optimal debt policy for the commitment type, given the current state at stage 2.

[48] We could potentially address this issue by adding noisy signals on debt policies, but this would further complicate the model. The assumption, moreover, provides a tighter link between our infinite-horizon and two-period models.

Under our simplifying assumption, taking as given $\tilde{\pi}$, the value function for the strategic type at stage 2 is simply given by

$$V^S\left(\tilde{\pi}, y, b, \hat{\zeta}\right) = u\left(c\right) + \beta \int_y \left\{ T_{SS} W^S\left(y', b'_C, \zeta'\right) + T_{SC} W^C\left(y', b'_C, \zeta'\right) \right\} dF\left(y' \mid y\right) \tag{F.5}$$

$$s.t. \quad c = y - b\left[\left(1 - m_b\right) z_b + m_b\right)\right] + q\left(y, b'_C, \zeta'\right)\left[b'_C - (1 - m_b) b\right] - B\left(1 + \tilde{\pi}\right)$$

Stage 1: Optimal $\tilde{\pi}$ Policy

At the beginning of stage 1, lenders have adjusted their beliefs based on the observed choice of d. The economy's state is given by $(y, b, \tilde{\zeta})$, where $\tilde{\zeta}$ is given by Equation (F.1). If the government did not default in stage 0 ($d = 0$), the strategic type solves the following problem:

$$W_R^S\left(y, b, \tilde{\zeta}\right) = \max_{\tilde{\pi}} \sum_{M=\{L,NL\}} P(m = M|\tilde{\pi}) \times V^S\left(\tilde{\pi}, y, b, \hat{\zeta}(m = M)\right)$$

$$s.t. \quad \tilde{\pi} \in \left[\underline{\pi}, 0\right], \tag{F.6}$$

where $\hat{\zeta}(m = M) \equiv \hat{\zeta}\left(M; \tilde{\zeta}, \tilde{\Pi}_S^*\right)$ is given by Equation (F.3) and denotes the updated posterior if the realized message is m, for $M = \{L, NL\}$. Let $\tilde{\pi}_S(y, b, \tilde{\zeta})$ denote the optimal policy for the strategic type.

Since the commitment type never misreports, we can define its value function as

$$W_R^C\left(y, b, \tilde{\zeta}\right) = \sum_{M=\{L,NL\}} P(m = M|\tilde{\pi} = 0) \times V^C\left(y, b, \hat{\zeta}(m = M)\right) \tag{F.7}$$

Stage 0: Optimal Default Decision

At stage 0, assuming the country is currently out of a default, the government chooses whether to default. That is, each type j solves the following problem:

$$W^j\left(y, b, \zeta\right) = Max_{d \in (0,1)} \left\{ W_R^j\left(y, b, \zeta\right), W_D^j\left(y, b, \zeta\right) \right\}, \tag{F.8}$$

where the value of repayment, W_R^j, is defined in Equations (F.6)-(F.7). Let $d_j(y, b, \zeta)$ denote the optimal default policy for type j. The value of default, W_D^j, is given by[49]

$$
\begin{aligned}
W_D^j(y, b, \zeta) =& u\left(y - \phi^j(y)\right) + \\
&+\theta\beta \int_y \left\{ T_{jj} W^j(y', 0, \zeta') + T_{j(-j)} W^{(-j)}(y', 0, \zeta') \right\} dF(y' \mid y) \\
&+ [1-\theta]\beta \int_y \left\{ T_{jj} \tilde{W}_D^j(y', \zeta') + T_{j(-j)} \tilde{W}_D^{(-j)}(y', \zeta') \right\} dF(y' \mid y) \\
s.t. \quad & \tilde{\zeta} \equiv \tilde{\zeta}(d = 1; \zeta) \\
& \zeta' = T_{CC} \times \tilde{\zeta} + T_{SC} \times \left[1 - \tilde{\zeta}\right],
\end{aligned} \tag{F.9}
$$

where $(-j)$ refers to the type other than j and the parameter θ denotes the exogenous probability of exiting a default. With a slight abuse of notation, $\tilde{\zeta}(d = 1; \zeta)$ corresponds to the update of beliefs defined in Equation (F.1).

On the other hand, if the government is already in a default we have that

$$
\begin{aligned}
\tilde{W}_D^j(y, \zeta) =& u\left(y - \phi^j(y)\right) + \\
&+\theta\beta \int_y \left\{ T_{jj} W^j(y', 0, \zeta') + T_{j(-j)} W^{(-j)}(y', 0, \zeta') \right\} dF(y' \mid y) \\
&+ [1-\theta]\beta \int_y \left\{ T_{jj} \tilde{W}_D^j(y', \zeta') + T_{j(-j)} \tilde{W}_D^{(-j)}(y', \zeta') \right\} dF(y' \mid y) \\
s.t. \quad & \zeta' = T_{CC}\zeta + T_{SC}[1 - \zeta].
\end{aligned} \tag{F.10}
$$

Notice that the only difference between (F.9) and (F.10) is the evolution of the posterior, given that in the latter expression it evolves exogenously, while in the former it depends on the default choice.

Pricing Kernels

We assume that bonds are priced by risk-neutral investors. Let r denote the risk-free rate at which they discount payoffs. Let ζ' be the updated end-of-period posterior, as defined in

[49]Notice that the function $W_D^j(.)$ depends on the state b, given that the updated posterior $\tilde{\zeta}$ is a function of lenders' conjectures, which, in turn, depend on b.

Equations (F.1)-(F.3) The pricing kernel is

$$q\left(y, b', \zeta'\right) = \tag{F.11}$$
$$\frac{\zeta'}{1+r}\int\left(1-d_C^{\star\prime}\right)\times\left[\sum_{M=\{L,NL\}} Prob(m'=M\mid 0)\left\{m_b+(1-m_b)\left(z_b+q'_{C,M}\right)\right\}\right]dF\left(y'\mid y\right)$$
$$\frac{1-\zeta'}{1+r}\int\left(1-d_S^{\star\prime}\right)\times\left[\sum_{M=\{L,NL\}} Prob(m'=M\mid \tilde{\Pi}_S^{\star\prime})\left\{m_b+(1-m_b)\left(z_b+q'_{S,M}\right)\right\}\right]dF\left(y'\mid y\right),$$

where $d_j^{\star\prime} \equiv d_j(y', b', \zeta')$ refers to the (conjectured) next-period default choice for type j, given the next-period initial state. Similarly, $\tilde{\Pi}_S^{\star\prime} \equiv \tilde{\Pi}_S(y', b', \tilde{\zeta}')$ refers to the conjectured next-period optimal $\tilde{\pi}$ policy, with $\tilde{\zeta}' \equiv \tilde{\zeta}\left(d'=0; \zeta', d_S^{\star\prime}, d_C^{\star\prime}\right)$ (as defined in Equation (F.1)). Lastly, $q'_{j,M}$ refers to the next-period price for one unit of debt. The subscripts (j, M) denote that this price is contingent on the (conjectured) policies of type j and to the realization of message m'. Formally, the next-period price is given by

$$\begin{aligned}
q'_{jM} &= q\left(y', b'', \zeta''\right)\\
\hat{\zeta}' &\equiv \hat{\zeta}\left(M; \tilde{\zeta}', \tilde{\Pi}_S^{\star\prime}\right) \text{ [as defined in Equation (F.2)]}\\
\zeta'' &= T_{CC}\times\hat{\zeta}' + T_{SC}\times\left[1-\hat{\zeta}'\right]\\
b'' &\equiv b_C\left(y', b', \hat{\zeta}'\right).
\end{aligned}$$

Definition 2. *Perfect Bayesian Equilibrium: Infinite-Horizon Economy*

A PBE is a collection of value functions, $\left\{W^j(.), W_R^j(.), W_D^j, \tilde{W}_D^j, V^j\right\}_{j=\{C,S\}}$*, bond and default policy functions* $\{b_j(.),\ d_j(.),\}_{j=\{C,S\}}$*, a policy for the strategic type* $\tilde{\pi}_S(.)$*, lenders' conjectures* $\left\{\tilde{\Pi}_S^{*}(.), d_S^{\star}(.), d_C^{\star}(.)\right\}$*, and lenders' system of beliefs* $\left\{\hat{\zeta}(.), \tilde{\zeta}(.)\right\}$*, such that*

1. *Given* $\left(d_S^{\star}(.), d_C^{\star}(.)\right)$*, the posterior* $\tilde{\zeta}\left(d; \zeta, d_S^{\star}, d_C^{\star}\right)$*, for* $d\in\{0,1\}$*, is derived from Equation (F.1).*
2. *Given* $\tilde{\Pi}_S^{\star}(.)$*, the posterior* $\hat{\zeta}\left(m; \tilde{\zeta}, \tilde{\Pi}_S^{\star}\right)$*, for* $m=\{NL, L\}$*, is derived from Equation (F.2).*
3. *Given* $\left(y, b, \hat{\zeta}\right)$*,* $b_C(.)$ *solves the problem in Equation (F.4) and* $V^C(.)$ *is the associated value function.*
4. *Given the value function* $V^S(.)$*,* $\tilde{\pi}_S$ *solves the problem in Equation (F.6) and* $W_R^S(.)$ *is the associated value function.*
5. *For each* $j=\{C,S\}$*, given* $W_D^j(.)$ *(as defined in Equation F.9) and* $W_R^j(.)$*,* $d_j(.)$ *solves the problem in Equation (F.8) and* $W^j(.)$ *is the associated value function.*

(6) Lenders' conjectures coincide with optimal policies. That is (for each point of the space state), $\tilde{\Pi}_S^{\star}(.) = \tilde{\pi}_S(.)$, $d_S^{\star}(.) = d_S(.)$, *and* $d_C^{\star}(.) = d_C(.)$.

F.2. *Secondary Markets and Link with Empirical Analysis*

In the empirical section, the semi-elasticity between spreads and break-even inflation (α_1) is measured in a short window around the government's report of inflation. This is a moment identified at high frequency, while the quantitative model is calibrated at quarterly frequency. To address this frequency disconnect, we introduce a simple variant to the quantitative model that allows for the computation of a model elasticity similar to the data. In particular, we assume that government bonds can be traded in secondary markets (SM) in two instances within a period, as described in Figure F.1.

The first instance is at the beginning of stage 1, right after the government's repayment decision. At that point, the last period's debt is traded in secondary markets before the government makes any choice on π and before message m is realized. The second trading instance (as in the baseline model) occurs during stage 2, once message m has been realized—at which point coupon payments occur.[50]

Let $q_A(y, b, \tilde{\zeta})$ denote the price for bonds in the first instance of SM. The pricing kernel depends on the expected repayment at stage 2, once the message m is realized. In particular, the price is given by

$$q^{(A)}\left(y, b, \tilde{\zeta}\right) = \tilde{\zeta} \times q_C^{(A)}\left(y, b, \tilde{\zeta}\right) + \left(1 - \tilde{\zeta}\right) \times q_S^{(A)}\left(y, b, \tilde{\zeta}\right), \tag{F.12}$$

where for each $j = \{C, S\}$:

$$q_j^A\left(y, b, \tilde{\zeta}\right) = \int \Big[\sum_{M=\{L,NL\}} Prob(m = M \mid \tilde{\Pi}_j^{\star})) \left\{m_b + (1 - m_b)\left(z_b + q_B(y, b', \zeta_M'))\right\}\Big] dF\left(y' \mid y\right),$$

where $\tilde{\Pi}_j^{\star} \equiv \tilde{\Pi}_j(y, b, \tilde{\zeta})$ is the conjectured optimal policy for the j-type. The subscript M on the posterior ζ_M' denotes that the update of beliefs is contingent on the realization of message m. That is $\hat{\zeta_M} = \hat{\zeta}(M; \tilde{\zeta}, \tilde{\Pi}_S^{\star})$, as defined in Equation (F.2), and $\zeta_M' \equiv T_{CC} \times \hat{\zeta}_M + T_{SC} \times \left[1 - \hat{\zeta}_M\right]$. Lastly, $b' \equiv b_C(y, b, \hat{\zeta}_M)$ denotes the optimal debt policy and $q_B(y, b', \zeta')$ denotes the price for bonds in the second instance of SM.

[50]This second instance is contemporaneous to the opening of primary markets, when new bonds are issued.

FIGURE F.1. Timing of Events: Infinite-period model

	If default	If no default	
Stage 0	Stage 1	Stage 1	Stage 2
- Initial $\mathbf{S} = (y, b, \zeta)$	- Temporary exclusion from debt markets	- Trading in SM (A)	- Trading in SM (B)
- Default choice $d = \{0, 1\}$	- Output cost $\phi^j(y)$	- Choice of $\tilde{\pi}$	- Debt issuance b'
- First update of beliefs $\tilde{\zeta}(d, \zeta)$		- Message $m = \{L, NL\}$	
		- Second update of beliefs $\hat{\zeta}(m, \tilde{\zeta})$	

The pricing kernel $q_B(y, b', \zeta')$ depends on the expected next-period repayment (i.e., next-period instance A) and is given by

$$q^{(B)}(y, b', \zeta') = \frac{\zeta'}{1+r} \int (1 - d_C^{\star\prime}) \times q_C^{(A)}(y', b', \tilde{\zeta}')dF(y' \mid y) + \frac{1-\zeta'}{1+r} \int (1 - d_S^{\star\prime}) \times q_S^{(A)}(y', b', \tilde{\zeta}')dF(y' \mid y), \tag{F.13}$$

where $d_j^{\star\prime} \equiv d_j(y', b', \zeta')$ refers to the (conjectured) next-period default choice for type j, given next-period initial state. The posterior $\tilde{\zeta}'$ is given by $\tilde{\zeta}' \equiv \tilde{\zeta}\left(d' = 0; \zeta', d_S^{\star\prime}, d_C^{\star\prime}\right)$ (as defined in Equation (F.1)).

Notice that we do not assume any additional frictions in the secondary markets, so the model extension is innocuous to equilibrium quantities and prices. It is easy to show that by combining q_A and q_B, we can recover the pricing kernel of the baseline model (as defined in Equation F.11).

To have the correct link with our empirical analysis, we also construct an auxiliary IIB with the same maturity structure as our b bond, but whose payoffs depend on the government's misreport. The pricing kernel of this bond is analogous to those defined in Equations (F.12) and (F.13), with the only difference being that the terms m_b and z_b are replaced by $m_b \times \left(1 - \tilde{\Pi}_S^\star\right)$ and $z_b \times \left(1 - \tilde{\Pi}_S^\star\right)$, respectively. Let $q_{[IIB]}^{(A)}$ and $q_{[IIB]}^{(B)}$ denote these pricing kernels.

Under this setup, the model-implied measure of break-even inflation for trading instances A and B are given by

$$BE^{(A)}(y, b, \tilde{\zeta}) = Yield_{[IIB]}^{(A)}(y, b, \tilde{\zeta}) - Yield^{(A)}(y, b, \tilde{\zeta})$$
$$BE^{(B)}(y, b', \zeta') = Yield_{[IIB]}^{(B)}(y, b', \zeta') - Yield^{(B)}(y, b', \zeta'),$$

where the yields are computed directly from the pricing kernels. By evaluating the break-even inflation at trading instances A and B, we obtain the intra-period ΔBE. More precisely,

$$\Delta BE(y, b, \tilde{\zeta}) \equiv BE^{(B)}(y, b, \zeta') - BE^{(A)}(y, b, \tilde{\zeta}). \tag{F.14}$$

The advantage of this extension is that as we focus on changes in the BE rate during the same period, our measure keeps constant the level of endowment (y) and the bond policy (b). The variable ΔBE is therefore capturing changes in the BE rate due to changes in the government's reputation that affects the conjectured return of the IIB. Thus, this model-implied measure resembles the high-frequency measure of the BE rate we compute in our empirical analysis.

Similarly, to get $\Delta \ln SP$ as in the data, we compute

$$\Delta \ln SP(y, b, \tilde{\zeta}) \equiv \ln SP^{(B)}(y, b, \zeta') - SP^{(B)}(y, b, \tilde{\zeta}). \tag{F.15}$$

A final issue to consider is that in the model, changes in the government's reputation are driven by the realizations of m and these realizations are, in turn, partially driven by optimal choices of $\tilde{\pi}$ (which is an endogenous object). In the data, our estimation approach was precisely chosen to address this reverse-causality concern. In the model, we can also address this concern by computing a generalized impulse response function (GIRF) to an unexpected shock to $\tilde{\pi}$. More precisely, let ϵ_π be an exogenous shock to $\tilde{\pi}$. For any horizon h, we can then compute the GIRFs as

$$\begin{aligned}
\varphi_h^{\Delta BE}(\epsilon_\pi) =& E[\Delta BE_{t+h} | \tilde{\pi} + \epsilon_\pi] - E[\Delta BE_{t+h} | \tilde{\pi}] \\
\varphi_h^{\Delta SP}(\epsilon_\pi) =& E[\Delta \ln SP_{t+h} | \tilde{\pi} + \epsilon_\pi] - E[\Delta \ln SP_{t+h} | \tilde{\pi}].
\end{aligned} \tag{F.16}$$

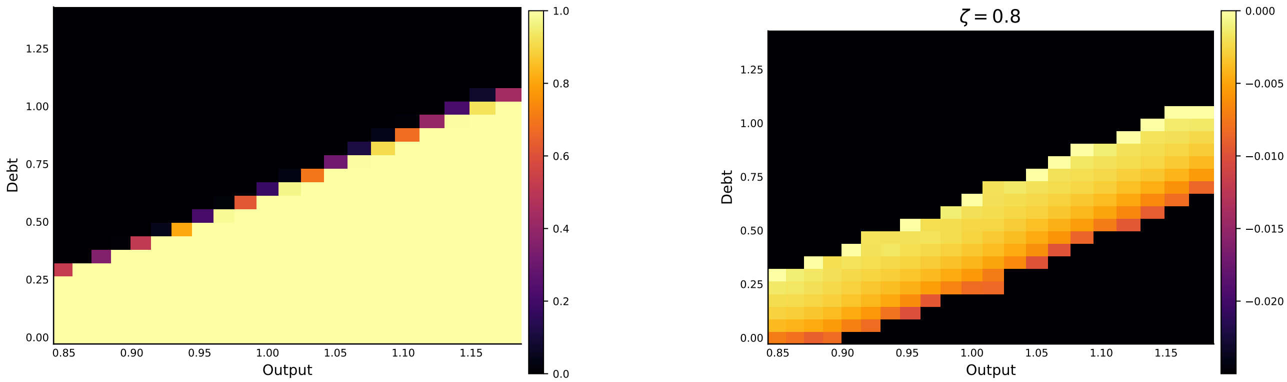
On impact, our (normalized) semi-elasticity is defined as $\frac{\varphi_0^{\Delta SP}/sd(\Delta \ln SP)}{\varphi_0^{\Delta BE}/sd(\Delta BE)}$. Our model is calibrated to precisely target this elasticity for the Argentine case.

F.3. *Additional Figures*

This section provides additional figures that complement our main analysis. We start by performing a simple characterization of the optimal policies and pricing kernel of our calibrated model. We then show the simulated paths for output and government types used in Section 4.3.

Figure F.2 shows the S-type's optimal repayment policy (panel A) and the optimal underreport of inflation (panel B) for different combinations of (y, b). The figure assumes a relatively high lenders' prior ($\zeta = 0.8$). The dark area in the upper-left corner of Panel A represents the state space in which the S-type fully defaults ($d = 1$). In these cases, panel B shows that

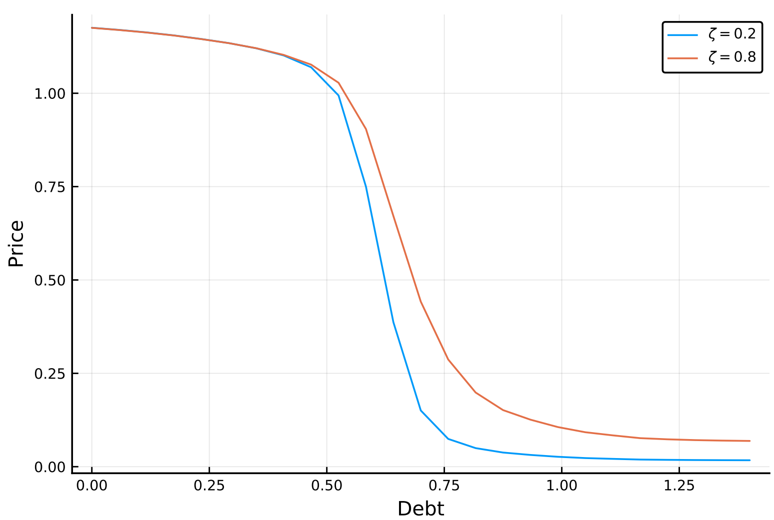
Figure F.2. Optimal Policies for the S-type



Repayment Set Inflation Misreport

Notes: The figure shows the S-type's optimal repayment policy (left) and the optimal $\tilde{\pi}$ policy (right) for different combinations of output and debt. The figure assumes a prior of $\zeta = 0.8$. The dark area in the upper-left corner of each panel represents the state space in which the S-type fully defaults ($d = 1$). In the right panel, lighter colors represent a smaller $\mid \tilde{\pi} \mid$.

Figure F.3. Pricing Kernel



Notes: The figure shows the pricing kernel $q(y, b', \zeta')$, for different combinations of b' and ζ'.

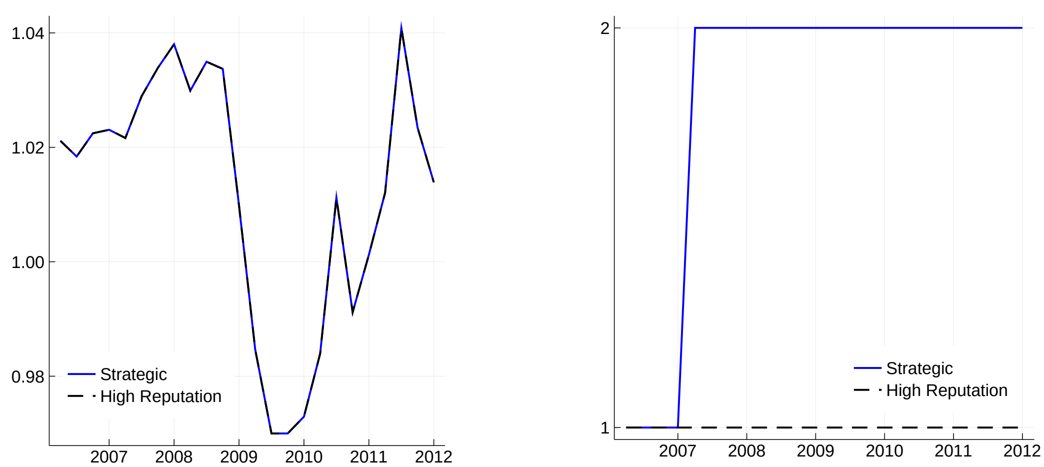
the government finds it optimal to maximize the underreport. This is because the government cannot issue b' while in default, and therefore a further decrease in its reputation does not affect its current borrowing costs.

The lighter area of Panel B shows points of the state space in which the government finds it optimal to decrease the size of the misreport. Notice that these points coincide with the area closer to the default boundary. The government finds it optimal to decrease the magnitude of $\tilde{\pi}$ at these points of the state space, because spreads are quite sensitive to reputation near the default boundary. These results are consistent with the findings from our stylized two-period model described in Section 2.2.

Figure F.3 shows the pricing kernel $q(y, b', \zeta')$ for different values of debt issuance when output is around its mean value. The blue line shows the pricing kernel under low reputation ($\zeta' = 0.2$) and the red line shows the price under high reputation ($\zeta' = 0.8$). In both cases, the price of the nominal bond falls as debt rises. But the price falls faster when reputation is low, because lenders ultimately assign a higher probability of default for a given combination of (b', y).

In the next set of figures, we show the simulated paths for output and the government's types used in the counterfactual exercise of Section 4.3. We also show the model-implied dynamics for inflation misreport and the government's reputation. The left panel of Figure F.4 shows the path for output as obtained from the data. This is the HP cycle of Argentina's (log) real GDP. The right panel shows the assumed government type for the baseline simulation and for the counterfactual. In the baseline, we assume that the government becomes S-type starting in 2007, while in the counterfactual we assume the government remains C-type.

Figure F.4. Data vs Model: Output and Spreads



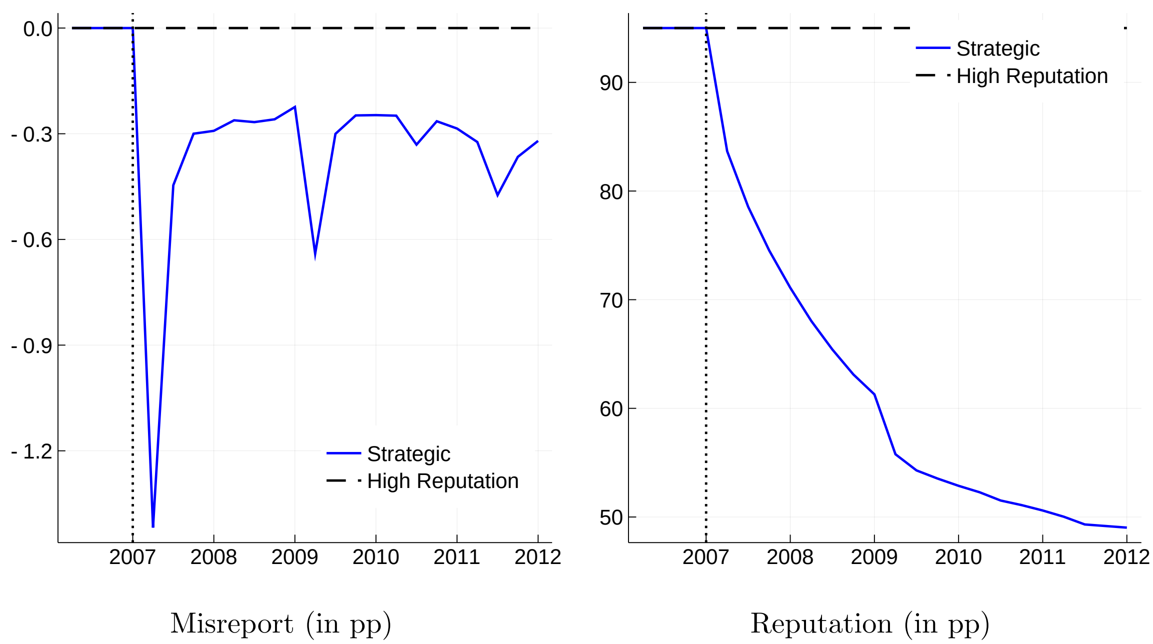
Output

Type of Government

Notes: The left panel shows the assumed evolution of output for the simulation in Section 4.3. This corresponds to Argentina's HP cycle of GDP for the period 2007:Q1-2012:Q4. The right panel shows the assumed path for the government's types for both the baseline and counterfactual simulations.

Figure F.5 shows the model-implied paths for inflation misreport $\tilde{\pi}$ (Panel A) and the government's reputation ζ' (Panel B). In line with the data, the strategic government significantly misreports inflation in the first half of 2007 and continues to do so in subsequent periods. Given the higher frquency of realizations of $m = L$, the government's reputation significantly drops (on average), which explains the excess response of the baseline simulation during the crisis. Furthermore, the persistent low reputation also explains the sustained decoupling of spreads between the baseline and counterfactual simulations.

FIGURE F.5. Simulated Counterfactual: Misreport and Reputation



Notes: The figure shows the model-implied paths for $\tilde{\pi}$ (left panel) and for ζ' (right panel).

F.4. *Solution Method*

In this section, we describe the global solution method used for the infinite-horizon model. Having a model of default, we use a combination of value function iteration with linear interpolation. The state of this economy is (y, b, ζ). We choose 21 gridpoints for y, 25 for b, and 11 for ζ.

We start by solving stage 2, the optimal bond issuance of the C-type, for each combination of $(y, b, \tilde{\zeta})$, where $\tilde{\zeta}$ is a government's reputation after choosing to repay debt. $\tilde{\zeta}$ takes the same grid as ζ. At this stage we take as given a guess for the continuation value function for both types of governments, $E[W^C(y', b', \zeta')|y]$, $E[W^S(y', b', \zeta')|y]$. We also take as given lenders' conjecture $\Pi(y, b, \tilde{\zeta})$ about the S-type government's misreport, as well as the pricing kernel $q(y, b', \zeta')$. The steps to solve for this stage are as follows.

(1) Given a state $(y, b, \tilde{\zeta})$, evaluate lenders' conjecture $\Pi(y, b, \tilde{\zeta})$.
(2) Use the conjecture to compute lenders' posteriors $\hat{\zeta}_{m=L}$ and $\hat{\zeta}_{m=NL}$ according to Equation (F.2) when the message is "L" and "NL," respectively.
(3) Find the bond policy b' that solves the C-type government's problem (F.4) when the message is "L" and when it is "NL." That way, we obtain $\{V^C_L(y, b, \tilde{\zeta}), V^C_{NL}(y, b, \tilde{\zeta}), b'_L(y, b, \tilde{\zeta}), b'_{NL}(y, b, \tilde{\zeta})\}$.
(4) For each possible value of $\tilde{\pi}$, use the solutions $\{b'_L(y, b, \tilde{\zeta}), b'_{NL}(y, b, \tilde{\zeta})\}$ to compute $\{V^S_L(\tilde{\pi}, y, b, \tilde{\zeta}), V^S_{NL}(\tilde{\pi}, y, b, \tilde{\zeta})\}$ according to Equation (F.5).

We then move to stages 1 and 0, where we solve for the optimal misreport and default for each state (y, b, ζ). At this stage, we use the solution for the C-type, $\{V^C_L(y, b, \tilde{\zeta}), V^C_{NL}(y, b, \tilde{\zeta})\}$, and for the S-type, $\{V^S_L(\tilde{\pi}, y, b, \tilde{\zeta}), V^S_{NL}(\tilde{\pi}, y, b, \tilde{\zeta})\}$, obtained from stage 2. We also need a guess for $E[W^C(y', 0, \zeta')|y]$, $E[W^S(y', 0, \zeta')|y]$, and for $E[\tilde{W}^C_D(y', \zeta')|y]$, $E[\tilde{W}^S_D(y', \zeta')|y]$. The steps to solve for these stages are as follows.

(1) For a given state (y, b, ζ), compute the posterior after the no-default decision (but before inflation misreport), $\tilde{\zeta}$, as defined in Equation (F.1).
(2) Given $\tilde{\zeta}$ and the value functions from stage 2 for the S-type, find the optimal misreport according to problem (F.6). Note that in this step, we are linearly interpolating over $V^S_L(\tilde{\pi}, y, b, \tilde{\zeta})$ and $V^S_{NL}(\tilde{\pi}, y, b, \tilde{\zeta})$ while using a solver. The solution to this optimization problem, $W^S_R(y, b, \tilde{\zeta})$, is the value of repayment for the S-type, where $\tilde{\zeta} = \tilde{\zeta}(\zeta)$, as defined in Equation (F.1).
(3) Given $\tilde{\zeta}$ and the solutions from stage 2 for the C-type, compute the value of repayment for the C-type according to Equation (F.7). In this step, we are also linearly interpolating, since we need to evaluate the value functions $\{V^C_L(\cdot), V^C_{NL}(\cdot)\}$ at values of $\tilde{\zeta}$ that are between gridpoints.
(4) For each type of government $j \in \{C, S\}$, compute:
    (a) The value of defaulting, $W^j_D(y, b, \zeta)$, according to Equation (F.9);
    (b) The value function when the government is already in default, $\tilde{W}^j_D(y, \zeta)$, according to Equation (F.10).

The last step for stage 0 is to randomize the decision on defaulting. It is a well-known fact in the sovereign debt literature with long-term bonds that without this step, it is difficult to achieve convergence on both the pricing kernel and the value functions. Following Chatterjee and Eyigungor (2012), we assume an additional noise to y. Let $\tilde{y} = y + \epsilon$, where $\epsilon \sim N(0, \nu)$. Let $\hat{y}$ be the value of y such that the government is indifferent between defaulting or not (according to Equation (F.8)). Then, under this transformation, the probability of default in a neighborhood around $\hat{y}$ is $P(\tilde{y} < \hat{y}) = P(\epsilon < \hat{y} - y) = \Phi(\hat{y} - y)$. The idea is for ν to be "small enough" for the pricing kernel to converge, without significantly altering the solution of the model. This way, we convexify the decision to default in a small neighborhood around the default threshold. This means that the out-of-default value function for a type $j \in \{C, S\}$ is going to be slightly different from that specified in Equation (F.8). In particular, it will be given by

$$W^j(y, b, \zeta) = \Phi(\hat{y} - y) \cdot W_D^j(y, b, \zeta) + (1 - \Phi(\hat{y} - y)) \cdot W_R^j(y, b, \zeta).$$

The algorithm to solve for stages 0-2 takes as given guesses on value functions, lenders' conjectures on misreport and default, and a pricing kernel. This means that as an outer algorithm, we need to iterate on each of these objects until convergence. In particular, on each iteration, after solving for stages 0-2, we update guesses on value functions, lenders' conjectures on misreport and default, and the pricing kernel. Lenders' conjectures are updated using the newest optimal policies but with a dampening coefficient to help convergence. As for the price of nominal bonds, a new kernel is computed based on Equation (F.11). Again, a dampening coefficient is used to combine the old kernel with the new one.