

## How to put off a currency collapse

As mentioned in class, with one period debt and no money, news of bad future surpluses translates instantly into a price/exchange rate collapse, and there's nothing the government can do about it.

$$\frac{B_{t-1}}{p_t} = E_t \sum_{j=0}^{\infty} \beta^j s_{t+j}$$

Thus, to be able to put off the currency collapse, we need some other ingredient.

1) *Long term debt.* (I should have gotten this one instantly in class, it's in my own paper and was on the slides I brought in!) Outstanding long term debt is one way to put off the collapse. It gives the government the option to devalue the long term debt ("inflation later") rather than the short term debt ("inflation now").

A canonical example is an outstanding nominal perpetuity that pays  $c$  coupon each time period. Then the price level at each time period  $t$  is determined by

$$\frac{c}{p_t} = s_t$$

In this case there is no presumption that the price level today ever responds to future surpluses! The lower future surpluses automatically create inflation when they occur.

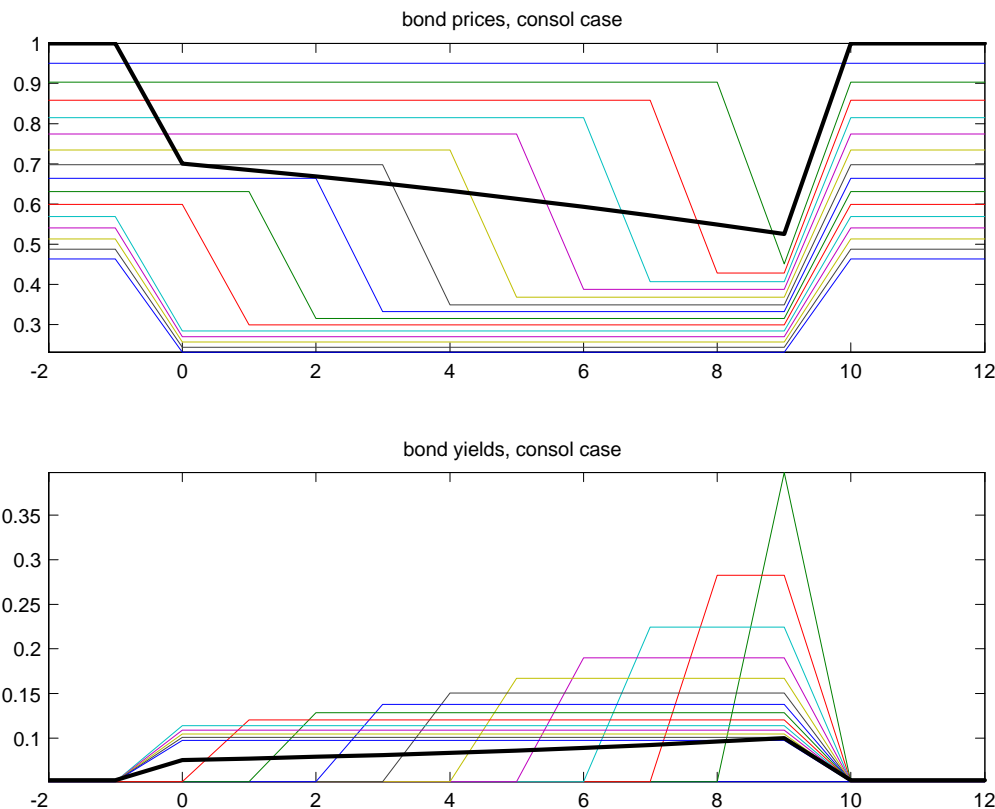
That doesn't mean nothing happens today. The present value equation now reads

$$\frac{(\text{nominal value of all debt})}{p_t} = E_t \sum_{j=0}^{\infty} \beta^j s_{t+j}$$

so the nominal value of long term debt does fall on the bad news. The plots show bond prices and yields over time to give you a sense of what happens. Starting at 0, when the news hits, long term bond prices tank and their yields rise. Short term bond prices – bonds that will mature before the "crash" (one-time inflation in period 10) – are unaffected. As the crash gets nearer, shorter and shorter bonds are affected, the value of government debt continues to fall, and its yield continues to rise. After the crash things return to normal.

This actually reminds one a lot of the data – once news comes out that there will be a crash, interest rates rise more and more before the crash comes. To observers, it would look a lot like "capital flight," evil hedge funds "pulling out money" and a central bank "raising rates to defend the peg." Except in this example, since we all know that the crash will happen exactly on date 10 and not before, long term rates rise, but short term rates are unaffected.





Bond prices and yields in the consol example. At date 0, news is received that the surplus will decline from 1 to 0.5 starting at date 10. Government debt is a perpetuity that pays  $c=1$  each period. The top panel plots the prices of 1-15 year bonds, and the thick black line gives the price of the perpetuity. The bottom panel gives the yields of 1-15 year bonds, and the thick black line gives the coupon yield ( $c/p$ ) of the perpetuity.

(More specifically, with our constant real rate, the nominal bond price at date  $t$  of a  $j$  period bond is

$$Q_t(t+j) = \beta^j E_t \left( \frac{p_t}{p_{t+j}} \right) = \beta^j E_t \left( \frac{s_{t+j}}{s_t} \right)$$

bond yields are defined as

$$y_t(t+j) = -\frac{1}{j} \log [Q_t(t+j)]$$

The perpetuity value is

$$c \sum_{j=1}^{\infty} Q_t(t+j)$$

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My “long term debt” paper gives more detailed examples, in which the government can modify the time path of inflation by actively selling debt. See also the example on the last slide (which I didn’t get to) of the money as stock slides on the class website.



The bottom line of those example is that by selling additional  $n$  year debt, when some  $n$  year debt is already outstanding, the government devalues the existing claim to  $n$  year debt. This action gives some revenue today (raising today's price level) at the expense of more inflation in year  $n$ . That revenue helps it push up the price level today. This is another example of an action the government can take to put off a crash (while making it worse when it does come).

## 2) Foreign debt.

Suppose the government only has one period domestic debt but also can borrow and lend in dollars. Can it “borrow” to put off the crash, as we speculated in class? It looks like it from the flow constraint. Let  $b_{t-1}$  = one period foreign debt coming due at  $t$ . Then the government has to pay  $b_{t-1} + B_{t-1}/p_t$  at date  $t$ , and gets surplus  $s_t$ , revenue from real bond sales  $\beta b_t$  ( $\beta$  is the price of one period real bonds) and revenue from nominal bond sales  $\beta E_t(1/p_{t+1})B_t$ .

$$b_{t-1} + \frac{B_{t-1}}{p_t} = s_t + \beta b_t + \beta B_t E_t \frac{1}{p_{t+1}}$$

So it looks like the government can raise “revenue” by selling more  $b_t$ , and use this to boost  $p_t$  if needed.

Alas, this doesn't work. You can see it in equations by iterating forward

$$\begin{aligned} b_{t-1} + \frac{B_{t-1}}{p_t} &= s_t + \beta \left( b_t + B_t E_t \frac{1}{p_{t+1}} \right) \\ &= s_t + \beta E_t s_{t+1} + \beta^2 E_t \left( b_{t+1} + B_{t+1} \frac{1}{p_{t+2}} \right) \end{aligned}$$

and finally

$$b_{t-1} + \frac{B_{t-1}}{p_t} = E_t \sum \beta^j s_{t+j}$$

With  $b_{t-1}$  fixed, there really is nothing the government can do.

What went wrong with the flow argument? Think about selling more  $B_t$ . That seems like it would help too, no? But in this case you understand that as you sell more  $B_t$ , this lowers  $E_t 1/p_{t+1}$  one for one, so that you don't get any more revenue from selling bonds. If you sell more  $b_t$ , this means more of the future surplus stream must be devoted to servicing that debt. In turn, this means less is available to service the nominal debt, so as you sell more  $b_t$ , the value of your nominal debt starts plummeting. Again, you get no net revenue from selling the debt without increasing surpluses.

## 3) Money and seigniorage.

The Sargent-Wallace example and the homework show you how present or future monetary expansion can be used to put off a crash for a while – that is the choice of “inflation now” vs. “inflation later” Consider

$$M_t v = p_t y$$



$$\frac{B_{t-1}}{p_t} = E_t \sum_{j=0}^{\infty} \beta^j \left( s_{t+j} + \frac{M_{t+j} - M_{t+j-1}}{p_{t+j}} \right) \quad (9)$$

Now, hit this with news of a future surplus shock. What if the government simply sets  $M_t = \text{constant}$  to try to keep  $p_t = \text{constant}$ . Yeah, the second equation is violated but so what? You can see the trouble in the flow equation

$$\frac{B_{t-1}}{p_t} = s_t + B_t \beta E_t \left( \frac{1}{p_{t+1}} \right) + \frac{M_t - M_{t-1}}{p_t}$$

With no money growth, what's going to happen is that the bond price  $\beta E_t \left( \frac{1}{p_{t+1}} \right)$  declines on news of the future surplus problem. Now the government gives out money in return for bonds  $B_{t-1}/p_t$  but isn't taking in enough money in bond sales, and doesn't want money to increase  $M_t$ . How can it keep money from increasing if bond sales aren't doing the trick? It can try selling more bonds, but if there is no change in surpluses, it finds  $1/p_{t+1}$  declining just as fast as  $B_t$  increases. Help, money is piling up and open market operations aren't doing any good! People don't want the money either so start bidding up prices of goods and services. That's how the fiscal equation "feels" and produces inflation.

To soak up money with debt sales (open market operations) the government has to convince people the revenue will come from somewhere in the future. The one place to do this is seignorage. You can sell a one period bond if people know you will get the seignorage revenue tomorrow (without devaluing their bond) to pay it off.

In sum, the government *can* keep  $p_t$  constant by keeping  $M_t$  constant, but only by increasing  $M_{t+j} - M_{t+j-1}$ , i.e. promising the "crash" at a future date. In this way, total surpluses really haven't changed – the government stopped the crash today by announcing it will meet the  $s$  decline with seignorage. Bond-holders rejoice because this means one-period bonds will never be hit by a surprise inflation.

I conclude that in the BER paper, the ability to put off the crash came from a combination of long-term debt (they had a consol, like my example) and this sort of sargent-wallace choice of "inflation later" via monetary policy, not by foreign borrowing. However, they describe the pre-float period as one of rising debt, and I'm not sure where that comes from



Background: in BER, Sims, we see in some sense devaluation as a choice – we want some cost of inflation plus some cost of distorting taxes, and the government will choose halfway in between

In my long-term debt, you match US time series data well only by thinking the government really wants smooth prices. Thus it meets a current deficit largely by increasing long run taxes, and borrowing to cover the cyclical deficit, with little (no in the model) inflation.

Let's quantify the costs of distorting taxes vs inflation distortions. Why does the US largely choose smooth inflation and not depreciating the debt?

Read intro – very clear.

p.201 why? It's a Lucas welfare cost story. Price sticky costs are first order. Reducing risk is second order. '

Model

Note: First “sticky price” model. Lots of microfoundations to deliver quite simple aggregates. If firms choose prices and aren't charging the same ones, we need differentiated products/monopolistic competition so that the high price ones don't sell zero. This means we lose the welfare theorems, and the models are much more complex. Hello, NK economics.

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$$E \sum \beta^t U(c_t, h_t)$$

$h$  =labor. Money from a transaction cost,

$$s(v_t); v_t = \frac{P_t c_t}{M_t}$$

(I think we could get rid of money completely in this model, at a vast simplification! This model has *two* inflation distortions, one that people have too much transactions costs under inflation, the other the product distortions of price stickiness. One is enough!)

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$c$  is a composite. Each household makes one good, using  $z_t \tilde{h}_t$ . Demand  $Y_t d(p_t)$ ;  $P_t = \tilde{P}_t / P_t$  = local price / price level. Set a price, then satisfy demand  $z_t \tilde{h}_t = Y_t d(p_t)$

Adjustment cost

$$\frac{\theta}{2} \left( \frac{\tilde{P}_t}{\tilde{P}_{t-1}} - 1 \right)^2$$

Flow budget constraint (4).  $r$  =s.d.f what we call  $m$



203-205 standard first order conditions

205 government with a standard “constraint” Interesting that they take  $R, \tau$  as policy levers, then let  $M$  and  $B$  follow.

205. First order conditions lead to NK “phillips curve” (12) Note  $\pi_t$  on the left,  $E_t\pi_{t+1}$  on the rhs, and something like output. All the monopolistic firm etc. stuff is to get here.

206 Definition of equilibrium, as usual.

206. Ramsey problem: maximize utility by choice of tax and interest rate subject to market clearing conditions as a constraint on government policy.

210 calibration Is price stickiness small? 9 months average between price changes! How big are labor distortions??? Debt/GDP of 0.44 means a small price change can give a pretty large effect.

212 no analytical solution; numerical approximation around steady state.

212 results;

1) Flex prices, perfect competition (but still transaction cost / labor income tax distortion. Note though that transactions costs depend on expected inflation so they won’t play a part here)

$R = 0$ . mean  $\pi$  negative (friedman rule) but large  $\sigma(\pi)$ .  $\pi$  is nearly iid;  $\tau$  is very autocorrelated and small variance. This is the “Sims” solution. (Why aren’t taxes constant then?)

2) Imperfect competition and flex prices. Output is lower because of monopoly. Inflation level is higher as a partial tax on monopoly (inducement to produce more). Other features are the same

3) price stickiness. Now inflation volatility drops like a stone. Taxes std dev goes up dramatically – using state-contingent taxation rather than ex-post devaluation. Taxes still highly autocorrelated.

Figure 1 only a “little” price stickiness will do. How much is much??

JC: Suppose we could introduce “government equity” that was *not* tied to the numeraire of every private contract. For example, suppose we pass a law that prices are posted in dollars, then paid in domestic currency. (I.e. eliminate price change costs). Now the government might choose much more volatile processes. *We might expect much greater volatility of “government equity” value when it is invented.*