4

Sustainable Debt

Debt trades current money for future money with interest. If wealth grows faster than the rate of interest, debt can potentially be repaid indefinitely out of rollover. This tempts self-financing bubbles of debt, which historically have ended badly. But hope springs eternal, buoyed by real prospects for growth or belt-tightening. The current era is the most hopeful yet.

Mammon, the false god of finance, is justly derided for avarice and injustice. Still, one has to admire his sense of humor. At one extreme he helps scrip pass for real wealth. At the other he buffets real wealth as if it were scrip.

Debt falls in between. As a deferred claim, it sacrifices the immediacy of cash. As a claim on money rather than profit, it insulates from many business hazards. Servicing should be semiautomatic, except when wealth falls short and forces default. Salvage after default should follow clear rules.

Nevertheless, Mammon manages to turn a square deal into a circle. A huge share of debt gets paid through refinancing. Lenders in effect lend to each other, with the borrower merely greasing the wheels. Borrowers' merit pales next to lenders' beliefs about their merit and their beliefs about other lenders' beliefs.

How sustainable is this circle? Can it twirl forever on its own anticipation? Or is it like a toy gyroscope pulled by a string, which eventually wobbles to a halt? The answer turns out to be the latter, but with a caveat on "eventually." The spin can outlast the spinners.

Let me caution that there's very little learning in this chapter, apart from ex post regrets. Borrowers promise to repay fixed amounts, lenders

know what the promises are worth, and payment circuits continue until they break. That's not very satisfying.

Still, we need this chapter as foundation for the rest. When we estimate the likelihood of default, we're not just interested in the borrower's capacity to pay on its own. We're interested in the capacity to pay out a combination of its own resources and rollover. With a finite horizon and full information, the two versions are essentially the same. In the open-ended, uncertain real world, it's not. This chapter focuses on the open-endedness.

Worthy Debt

Let us begin our analysis with worthy debt, which the borrower always repays out of its own resources. Imagine the debt is an ordinary bond, paying some riskless rB in interest every period it is outstanding and the face value B of the principal at the end. At redemption, the borrower can presumably issue another bond of equal size and duration to cover the principal repayment. In that case, the debt is said to be rolled over.

Apart from the principal changing form midway, the issuer might as well issue a single bond for twice as long. Repeat this ad infinitum and we create a perpetuity, a debt paying interest forever with no obligation to repay principal. Economic theory registers no objections, because the net present value over all interest payments matches the principal.

In practice, nothing is perfectly riskless, so the lender will demand a premium to cover the risk. However, if default is considered remote enough, the premium will be modest. Britain issued the first perpetuity in 1752. Called a consol, it paid 3.5% interest in silver, or more precisely in a pound tied to silver. Lender comfort allowed the interest rate to be reduced to 3% in 1757.

Now let us consider a twist. Suppose that when the first interest installment of rB comes due, a second perpetuity of principal rB is issued. As long as the debt remains worthy, holders of the first perpetuity shouldn't feel cheated. The issuer has simply reduced the net payment to zero in the first period, in return for paying $(1 + r)rB$ in all subsequent periods.

To repay interest in the second period, issue yet another perpetuity. Repeating this process creates a net repayment stream that is zero for the first T periods and $(1 + r)^T rB$ for every period thereafter. Since there is no limit to T, the borrower can defer net repayment forever. Voilà: something for nothing!

Clearly, something is wrong. We are banking too much on the never-redeemed principal: an infinite payment discounted infinitely to yield a present value of 1. Most theory treats that as taboo. Practice should be averse as well. If a borrower repays purely via rollover, lenders should be wary of locking in forever at zero risk premium.

To restore sanity, let us invoke the finite service capacity of the borrower. Suppose that the issuer is a sovereign country and cannot pay more than a fraction d of GDP each year for debt servicing. The maximum value of the bond stock is then d/r times GDP.

Even at this upper limit, the bond stock can still grow as fast as GDP without increasing the debt-to-GDP ratio. At a growth rate of g, the allowable increment in debt is $\dfrac{gd}{r}$ times GDP. Moreover, if debt-servicing capacity d grows, say through more efficient tax collection and public acclimation to transfers, the sustainable debt stock can grow with it. The combination helps explain why poor countries tend to default at lower debt-to-GDP ratios than rich countries.

As explained in the notes to the previous chapter, risk-free bonds often sell at a substantial premium, because they help hedge against disasters. This offers a kind of seigniorage to a worthy sovereign. Since average growth in a modern economy exceeds the risk-free rate, the sovereign can potentially earn even more seigniorage by letting the perpetuities or bond rollovers finance themselves. For example, if $r = 1\%$ and $g = 3\%$, then for every $100 the government issues this year via one-year bonds, it can issue $103 in one-year bonds the next, use $101 for servicing, and pocket the remaining $2 without worsening the servicing ratio.

If issuance stays within limits, no one need feel poorer for this. Although cash and bond holders will never on aggregate recover the assets they have lent forever, they feel reassured by the ability to redeem on demand (with money) or with interest for deferral (with bonds). They don't realize they are just lending to each other.

Hence, a state that borrows from Peter to pay Paul can look richer for its debt. Its people will feel wealthier, because their bonds and cash outweigh the marginal taxes the issuance necessitates. They will spend more, invest more, and pay more taxes. Moreover, because bond seigniorage potentially outweighs cash seigniorage, the sovereign is encouraged to keep inflation stable and bond servicing reliable. The circle of confidence that money sustains gains longer-term backing.

Keeping Faith

Harvesting bond seigniorage is a lot harder than it appears. Lenders are skittish because nominally risk-free lending is rarely free of risk. Imagine someone 2,500 years ago had lent the equivalent of $100 risk free at a 1% real interest rate, re-lent all the proceeds similarly, and persuaded all descendants to do the same. The bond portfolio would currently be worth over $6 trillion. Between default, debasement, and expropriation, financial wealth is much less secure than it appears.

On top of that, borrowing needs are strongest when the sovereign is weakest. A natural catastrophe or economic downturn crimps tax revenues when relief spending is greatest. A war destroys productive capital while demanding more support of the army. A sovereign that wants to tap cushions during crisis should pad cushions during calm.

The best way for a sovereign to reinforce lender faith is to occasionally wind down large debts, if not absolutely then at least in proportion to revenue-generating capacity. The greatest example ever came from the United Kingdom in its imperial heyday. The Napoleonic Wars left Britain with a public debt of over 250% of GDP in 1820. By the eve of World War I, nearly a century later, public debt was around 25% of GDP. This reduction was accomplished without either outright default or de facto partial default through unexpected inflation or devaluation. The pound was fixed at 113 grains of gold (7.3 grams) despite appreciation of gold relative to most other commodities. In return, British debt inspired enormous confidence around the world and helped underwrite British expansion.

In general, public debt to GDP surges in a war and retreats after. Figure 4.1 charts the gross U.S. federal debt as a percent of GDP, using data from Chantrill (2010). It shows the fiscal impact of the War of 1812, the Civil War, World War I, and World War II. The largest spike by far came in World War II. The sharp retreat after was driven in part by unexpected inflation, which can be viewed as partial default.

I have clipped the chart in 1974, when the U.S. federal debt share of GDP had fallen below previous wartime highs. Historical experience would have suggested continued retreat. Instead, debt shares headed up again on the back of entitlements expansion, tax cuts, and disinflation. The recent crisis has brought yet another spike.

Most other developed countries also show peacetime bloat, although the timing and scale differ. Figure 4.2 lists Organisation for Economic Co-operation and Development (OECD) members by gross central government
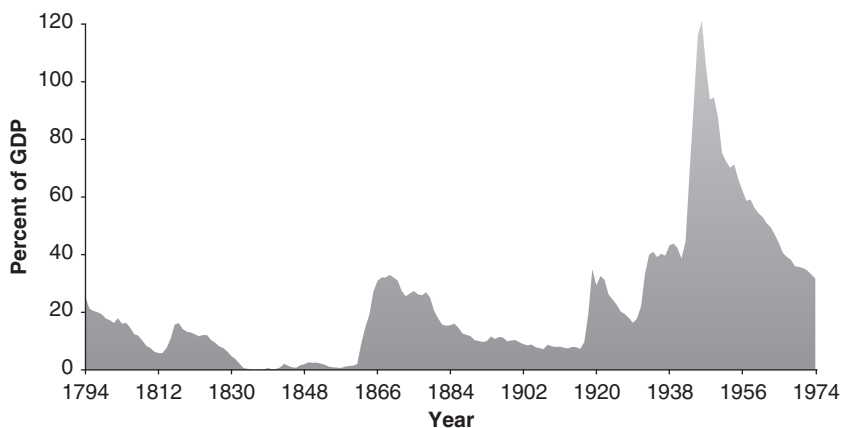
Figure 4.1
Gross U.S. Federal Debt as Percent of GDP

debt as a share of GDP, using data from OECD (2010). For clearer viewing the chart clips Japan, whose debt-to-GDP ratio exceeds 180%.

Will this debt prove worthy? We don't know. On the one hand, no fatal threshold has been crossed that guarantees default. Tax collection captures a much larger share of GDP than it used to, allowing sovereigns to whittle down big debts quickly if they make it a priority. On the other hand, few of the leading governments have made it a priority. They are relying on the public to roll over debt without reinforcing credibility through peacetime retrenchment.

Historical Perspective

The Anglo-American experience of the last two centuries is atypical. As Hoffman, Postel-Vinay, and Rosenthal (2007) note, sovereigns usually manage their fiscal affairs either much better or much worse. For example, the Ming Emperors of China often transferred huge quantities of grain from one region to another to address famine. But they did so without debt. They just seized the stockpiles, sent them where they wanted, and replenished the stockpiles through extra taxes.

Queen Elizabeth in England also managed her realm without big debts. She worked mainly with whatever Parliament provided, including when
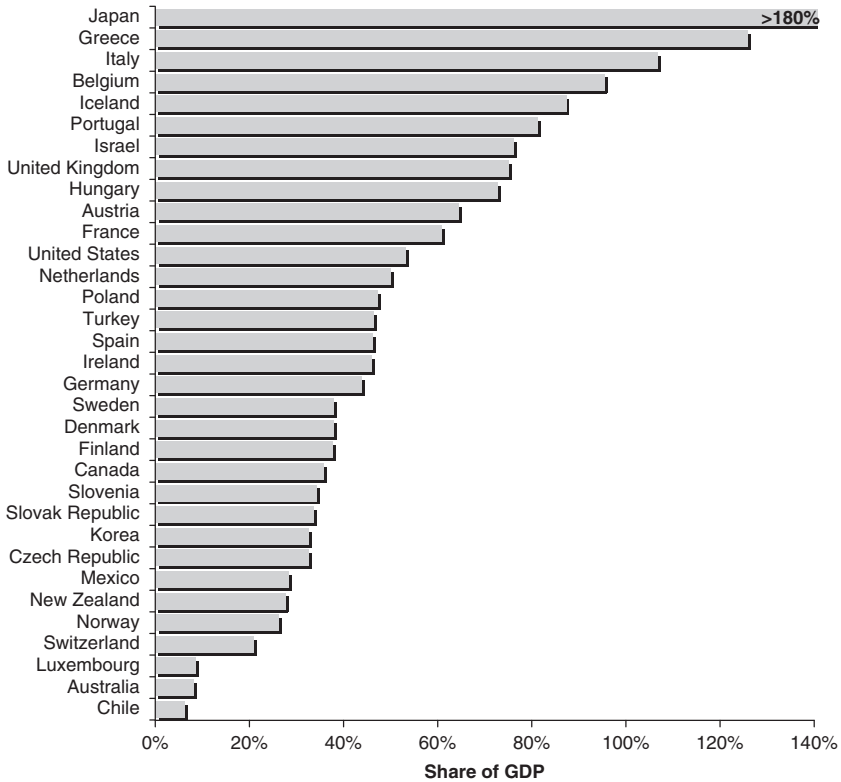
Figure 4.2
Central Government Debt in 2009 as Percent of GDP for OECD Members

battling the Spanish Armada. Granted, beating the Armada was largely luck, and she also cheated the system through grants of monopoly privileges to courtiers.

Debts remained minor until the Glorious Revolution of 1688–1689 cemented Parliamentary authority. The lender-dominated Whig Party helped keep Parliament prudent in authorizing debt and fastidious in repayment. Rates stayed low despite occasional sharp surges in debt issuance followed by long contractions while it was repaid. In war emergencies England would float short-term bills and later convert them to longer-term instruments, like the consols mentioned earlier. Without that foundation of trust, Britain's Napoleonic War debts would have been far more destabilizing.

French kings in the eighteenth century paid interest rates at least two percentage points higher than their English rivals paid, and frequently defaulted. Default reflected their chronic difficulty in covering military and court expenditures out of tax revenue. In 1788 Louis XVI convened the long dormant Estates General of elites, hoping they would vote a tax increase. Instead they insisted on constitutional reforms and hamstrung tax collection. The ensuing revolution financed itself through *assignat*s, paper money that depreciated by a factor of 100 in five years. This ruined old lenders and crippled long-term French credit markets until the 1850s.

English and French experiences suggest that debt is more a symptom of a fiscal problem than a cause. Nevertheless, it can have a huge impact on the timing of a crisis, its intensity, its duration, and the eventual outcomes. The consequences can take decades to reveal themselves.

The revelations took even longer in sixteenth- and seventeenth-century Spain because of chronic uncertainty about the state's real means. Spain's unification had come at the price of restricted domestic tax authority, so Spanish kings financed their wars with bank loans and repaid them out of silver from Mexican and Peruvian mines. Unfortunately for both kings and creditors, the mines disappointed in output, while silver ships fell prey to storms, freelance pirates, or enemy fleets. Ten times between 1557 and 1662, the kings suspended payments and forced creditors to take long-term bonds called *juros* in partial compensation.

Curiously, these forced conversions did not ruin the debt market. They just injected a credit spread into short-term debt to cover the risks. The *juros* stayed relatively liquid and secure. Eventually, however, the decline in revenues forced Spanish kings to default on the *juros*. This wrecked Spanish financial markets and associated institutions like trade fairs.

Is this Time Different?

In an extensive empirical study of financial markets around the world, Reinhart and Rogoff (2009) conclude that—

- Financial crises are far more common than most people realize. The institutions we regard as sound grew out of many stumbles before and might stumble again.
- The most common trigger is domestic government debt. The devaluation, inflation, or defaults that typically ensue after a crisis slash

the government's real obligations and often are driven with that intent.

- Financial overoptimism often prolongs a reckoning, only to make the reckoning worse. Market participants don't see the huge credit imbalance, attribute it to superior productivity of the debtor, or find some other reason to believe that "this time is different."

- The latest crisis is huge by historical standards and will likely take years to fully play out. While equities often bounce back quickly, currency crashes and debt defaults have much longer time fuses.

One ominous sign in developed countries is the growth of quasi-sovereign debt. Quasi-sovereign debt is debt that the sovereign officially denies responsibility for but unofficially protects. It comes in three main types: sovereign-owned lenders and guarantors (like Fannie Mae and Freddie Mac, which subsidize housing mortgages in the United States), private banks deemed too big to fail (increasingly redefined to mean every large private bank), and major sub-federal governments (like the various European Union members or state governments within the United States).

How much the sovereign protects quasi-sovereign debt isn't clear, even to the sovereign itself. Typically it hints of enough support to encourage rollover at low rates while insisting that debt issuers ensure solvency on their own. The outcome depends on the force of external shocks, on the internal controls of the issuers, and on the politics within the sovereign.

The crisis in 2008 exposed weak links in the banking system, which we will examine in the next few chapters. Attention is now shifting to overextended governments. The stronger sovereigns will have to either bail out the weaker or bear the fallout of default.

In Europe, commitment to the euro allowed weaker countries to piggyback on the credibility that Germany and several other European governments had built up over the decades. They borrowed at German rates without emulating German prudence. Debt-financed booms and deceptive accounting helped conceal the imbalances; crisis brought them to light.

The biggest offenders are Portugal, Italy, Ireland, Greece and Spain. Collectively they are known by the acronym PIIGS. A partial default through devaluation, followed by fiscal tightening and rejoining the euro zone at a more sustainable parity, appears the lesser evil economically but a last resort politically.

Turning to the United States, the states and leading municipalities of California, New York, and Illinois have mostly lost their fiscal bearings, with many others vying for dishonor. Ironically these tend to be rich states priding themselves on business talent and sophistication. Decades of political pressure from public-sector unions, optimism about revenues from capital gains taxes, and excessive discounting of future pension obligations encouraged profligacy.

By law U.S. states and localities are supposed to balance their operating accounts (which exclude interest payments on outstanding debt), and for most of their history they came close. However, the U.S. Government Accountability Office (GAO 2010a) estimates current state and local operating deficits at 0.8% of GDP absent federal stopgap relief, and worsening by 0.1% a year absent major policy change.

Ultimately such deficits will overwhelm the relatively modest tax take of state and local governments. And while the federal government might assume them, this compounds an already bleak outlook (GAO 2010b), summarized in Figure 4.3. Yet the bond market acts as if timely change is assured. Or does it?
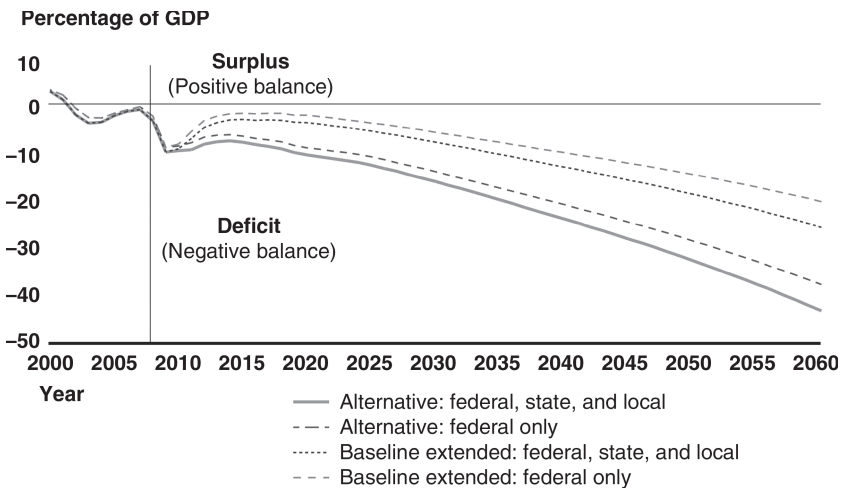

Figure 4.3
U.S. Budgetary Outlook (from GAO 2001b)

Worthless Debt

Our quick survey offers two visions of the future. In one, the world's sovereign mega-debtors keep repaying old debt with new debt and trim enough excess to retain confidence. In the other, debt eventually collapses on war, civil upheaval, or panic. Time will tell.

Given the history, financial markets seem remarkably confident in repayment. Perhaps lenders are projecting from recent decades. Perhaps they equate rollover with final repayment. Perhaps they believe that if no one else is worrying they shouldn't worry either.

To illustrate the forces at play, let us briefly examine the polar opposite of worthy debt. Worthless debt, as I will define it, cannot be repaid out of one's own resources and is not guaranteed rollover. The following model suggests that even worthless debt can be rolled over for a while, and possibly a long while, without making the debt sustainable in the long term.

To keep this simple, I will assume away every complication other than rollover. The operating budget, the risk-free interest rate, and growth will all be set at zero. The only challenge is to refinance one unit of outstanding debt.

In a full-confidence equilibrium, the sovereign pledges to reissue bonds forever. Creditors accept that pledge and refinance at the going interest rate of zero. The debt stays worthy.

Unfortunately, our economy is tinged with fear. The sovereign fears that creditors might one day redeem bonds without rollover, spend the cash on goods, and stoke a destabilizing inflation. Creditors fear that the sovereign might default and pay nothing. These fears are mutually reinforcing. The less assured creditors are of servicing, the more tempted they are to switch to goods. The less assured the sovereign is of rollover, the more tempted it is to default preemptively.

Let's assume some fear equilibrium is reached, where everyone agrees on the instantaneous default rate $\theta(t)$ at time t. That is, if the debt hasn't defaulted by time t, the chance of defaulting over the next short period dt is approximately $\theta(t)dt$. To counter the fear, the bonds offer a continuous interest rate premium $c(t)$, also known as a credit spread. Bondholders expect to lose everything under default, so their expected rate of return is $c(t) - \theta(t)$. As they are risk neutral, in equilibrium this must equal the risk-free rate, so that

$$c(t) = \theta(t). \tag{4.1}$$

Both principal and interest are paid by issuing new bonds. If $B(t)$ denotes the bond stock at time t, the growth before default can be expressed as

$$B'(t) = c(t)B(t). \tag{4.2}$$

where the $'$ denotes the first derivative.

To complete the specification of the model, let us assume the default rate is an increasing function of the bond stock. Specifically, I will model it as a power function. For some initial default rate θ_0 and positive constant m,

$$\theta(t) = \theta_0 B^m(t). \tag{4.3}$$

These equations have a unique solution. The survival rate $F(t)$, or probability of servicing without default until time t, is $(1 - m\theta_0 t)^{1/m}$, while

$$B(t) = \frac{1}{F(t)} = (1 - m\theta_0 t)^{-1/m} \tag{4.4}$$

and

$$c(t) = \theta(t) = \frac{\theta_0}{1 - m\theta_0 t}. \tag{4.5}$$

Initially, the bond stock grows so little that $\theta(t)$ stays close to θ_0. This phase may last a long time. For example, with $\theta_0 = 1\%$ and $m = 2$, it takes 25 years for θ to reach 2% and 40 years to reach 5%. See Figure 4.4.

Eventually, however, the bond stock resonates so strongly with default fears that survival rates plunge to zero. In the previous example, no debt can be refinanced for more than 50 years. More generally, the maximum rollover time is $\frac{1}{m\theta_0}$.

Hence, low interest rates don't imply that the market considers the debt worthy. They could just mean that debt hasn't yet mounted to levels that significantly jeopardize rollover. Conversely, surging interest rates and difficulties in rolling over long-term debt don't imply that creditors are trying to pressure the debtor. They could just mean that the debt has reached a tipping point.

The Appendix spices up the model to allow for economic growth, a positive risk-free rate, and a nonzero primary fiscal balance. While the expres-
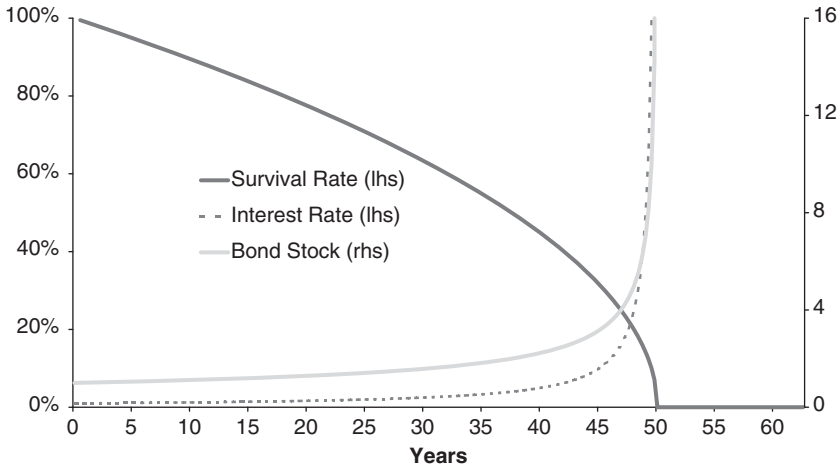
Figure 4.4
Worthless Debt for $\theta_0 = 1\%$ and $m = 2$

sions get messier, the main qualitative results stay the same. Beyond some threshold, debt becomes only temporarily sustainable. Yet for many years the market may not seem to mind.

The Appendix also explores some serious flaws in the model. Wholly worthless debt is no more viable than wholly worthless money. Nevertheless, I respect the model for clearly distinguishing between rollover risk and fundamental repayment risk, without divorcing the two completely. Models that assume either full congruence or permanent difference will face an even harder challenge in describing reality.

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Prometheus was not impressed. "His debt bubble examples are too tame. Why not refer to the Trovidians, who built government debt to 30 times GDP before defaulting on every last farthing? The repercussions echoed through the galaxy."

"Not Earth's galaxy," said Pandora. "They can learn only from the disasters they know."

"Well, they're doing a great job of stoking a new one. Half of the world focuses on creating real wealth. The other half focuses on creating nominal wealth. This can't possibly end well."

"Many of Earth's leaders agree. That's why they keep feeding the debt bubble and enlisting more reputable funders to back it. They are trying to perfect the perpetually deferred perpetuity."

"That's terrible policy. Sure, sometimes a generation will borrow for rapid growth or to tide through a crisis. But don't spin profligacy into emergencies by indulging it for decades. Zeus knows how many kingdoms have crumbled over debt."

"Prometheus, the biggest debtors aren't kingdoms. They're democracies. The debt helps a lot of people live longer and better with less work, by drafting others to work for them."

"It's so unnecessary. The very advances that let people live longer and better will also let them defer retirement and pay their own medical bills. Why do they have to loot their progeny?"

"They don't see it that way. They see the payers as someone else's progeny, who might manage to defer the burden as well."

"Whoever their grandparents are, most of them can't vote yet. Wasn't it the Americans who revolted against taxation without representation? What if a real crisis comes and doubles their burdens? As for the European Union, what makes it so confident that Germans will keep footing others' bills?

"Their assurances of safety are very risky," said Pandora. "And no one who calls herself a financial risk analyst should forget it."