Outline

- Sovereign debt and default
- A brief history of default episodes
- A Simple Model of Default
- Managing Sovereign Debt
Sovereign Debt and Default
Not only investors but also governments can borrow or lend.

- In fact, governments typically accumulate debt (called government or public debt).

**Sovereign Debt:** Is a contingent claim on a nation’s assets. Governments will repay depending on whether it is more beneficial to repay than to default.

**Sovereign Default:** Occurs when a sovereign government (i.e., one that is autonomous or independent) fails to meet its legal obligations to payments on debt.
Sometimes the Debt Grows Large...

Figure: Greek Debt to GDP 2007-2011 Source: Bloomberg
Typically Followed by the Interest Rate

Figure: Greek Spread over German Bonds, (10 Yr maturity bonds). Source: Bloomberg
A History of Default Episodes
Default Episodes

- First Recorded Default:
Default Episodes

- First Recorded Default: 4 century BC. Hellenic City-States defaulted on loans from Delian league (Winkler 1933)

- Other episodes: 1343, Edward III of England, Spain 7 times in the 19th century
  - 46 European defaults between 1501-1900
  - US states defaulted in the 1800s
Default Episodes

- First Recorded Default: 4 century BC. Hellenic City-States defaulted on loans from Delian league (Winkler 1933)

- Other episodes: 1343, Edward III of England, Spain 7 times in the 19th century
  - 46 European defaults between 1501-1900
  - US states defaulted in the 1800s
  - In modern times, Greece has defaulted five times - in 1826, 1843, 1860, 1893, and 1932
    - We are no match for the Spanish the last 300 years (but we are getting better at it!)
Default Episodes

- **In the past, defaults would sometime lead to conflicts**
  - Luckily, not in fashion any more

- **Today no particular way to enforce repayment**
  - But there are costs to defaulting
  - If there were not, none would lend in the first place!

- **Costs of Default**
  - Financial market penalties: markets will lend to you anymore. Lose consumption smoothing opportunities
  - Macroeconomic implications: disruption in financial markets may bring economic downturn, export/import declines etc
The Latin-American Debt crisis

- Evolution of Debt to GDP in some emerging economies

**Figure:** The evolution of the debt/GNP ratio in selected countries

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1982</th>
<th>1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>.48</td>
<td>.84</td>
<td>.84</td>
</tr>
<tr>
<td>Brazil</td>
<td>.31</td>
<td>.36</td>
<td>.49</td>
</tr>
<tr>
<td>Mexico</td>
<td>.30</td>
<td>.53</td>
<td>.55</td>
</tr>
</tbody>
</table>

Interest Payments in Latin American Countries

- Interest Payments in Latin America

**Figure:** Interest payments in selected Latin American countries. Average 1980-81.

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent of Debt at floating rate</th>
<th>Interest Payment to Exports ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>58</td>
<td>15</td>
</tr>
<tr>
<td>Brazil</td>
<td>64</td>
<td>28</td>
</tr>
<tr>
<td>Colombia</td>
<td>39</td>
<td>16</td>
</tr>
<tr>
<td>Chile</td>
<td>58</td>
<td>28</td>
</tr>
<tr>
<td>Mexico</td>
<td>73</td>
<td>19</td>
</tr>
<tr>
<td>All Latin America</td>
<td>65</td>
<td>28</td>
</tr>
</tbody>
</table>

Trade Balance in Latin America

- To repay debts requires running trade surpluses
  - Also implement austerity measures (lower wages, decrease fiscal deficit)

**Figure:** Trade Balance in the Latin America
A Simple Model of Default
A Simple Model of Default: Goal

- We saw a series of interesting facts about debt and defaults.
A Simple Model of Default: Goal

- We saw a series of interesting facts about debt and defaults
- We want a simple model that will explain these facts
A Simple Model of Default: Goal

- We saw a series of interesting facts about debt and defaults
- We want a simple model that will explain these facts
  - 1. High debt arises due to adverse shocks
A Simple Model of Default: Goal

- We saw a series of interesting facts about debt and defaults
- We want a simple model that will explain these facts
  - 1. High debt arises due to adverse shocks
  - 2. High debt leads to higher interest rates
A Simple Model of Default: Goal

- We saw a series of interesting facts about debt and defaults
- We want a simple model that will explain these facts
  - 1. High debt arises due to adverse shocks
  - 2. High debt leads to higher interest rates
  - 3. Combination leads some times to default
A Simple Model of Default

- **Two periods:** 1st period country gets a loan, 2nd period decides whether to repay the loan or not
  - Given decisions for 1st period, only action in the 2nd one

- **Country sells bonds** $d'$ in a price $q = 1/(1+r)$ to receive $d = qd'$ in the 1st period. World interest rate prevails $r = r^*$. **If the country defaults, it loses fraction** $c$ of its output
A Simple Model of Default

- Two periods: 1st period country gets a loan, 2nd period decides whether to repay the loan or not
  - Given decisions for 1st period, only action in the 2nd one

- Country sells bonds $d'$ in a price $q = 1/(1 + r)$ to receive $d = qd'$ in the 1st period. World interest rate prevails $r = r^*$. If the country defaults, it loses fraction $c$ of its output
  - Output, $y'(s)$, is stochastic for different states of the world $s$
A Simple Model of Default

- **Two periods:** 1st period country gets a loan, 2nd period decides whether to repay the loan or not
  - Given decisions for 1st period, only action in the 2nd one

- **Country sells bonds** $d'$ in a price $q = \frac{1}{1 + r}$ to receive $d = qd'$ in the 1st period. World interest rate prevails $r = r^*$. **If the country defaults, it loses fraction** $c$ of its output
  - **Output,** $y'(s)$, is stochastic for different states of the world $s$
  - If the country decides to repay next period $y'(s) - d'$ but if the country defaults it gets $y'(s)(1 - c)$, $c \in (0, 1)$
A Simple Model of Default

- When does country default? In the states of the world that
  \( y'(s) - d' < y'(s)(1 - c) \)
A Simple Model of Default

- When does country default? In the states of the world that 
  \[ y'(s) - d' < y'(s)(1 - c) \]
  - Solve for \( \hat{y}' \) such that 
    \[ \hat{y}' - d' = \hat{y}'(1 - c) \]

Limitation of the model: This model ignores completely lenders' expectations. In reality, 
\[ r_6 \neq r_6 \] and in fact, 
\[ r_6 = r_6(d_0) \]
A Simple Model of Default

- When does country default? In the states of the world that
  \[ y'(s) - d' < y'(s) (1 - c) \]
  - Solve for \( \tilde{y}' \) such that \( \tilde{y}' - d' = \tilde{y}' (1 - c) \)
  - If \( y'(s) < \tilde{y}' \) the country defaults (adverse shock may trigger default)
A Simple Model of Default

• When does country default? In the states of the world that
  \( y'(s) - d' < y'(s) (1 - c) \)
  
  • Solve for \( \tilde{y}' \) such that \( \tilde{y}' - d' = \tilde{y}' (1 - c) \)
  
  • If \( y'(s) < \tilde{y}' \) the country defaults (adverse shock may trigger default)
  
  • If \( d' \) is high \( \tilde{y}' \) is high (high \( d' \) may trigger default)
A Simple Model of Default

- When does country default? In the states of the world that
  \[ y'(s) - d' < y'(s)(1 - c) \]
  - Solve for \( \tilde{y}' \) such that \( \tilde{y}' - d' = \tilde{y}'(1 - c) \)
  - If \( y'(s) < \tilde{y}' \) the country defaults (adverse shock may trigger default)
  - If \( d' \) is high \( \tilde{y}' \) is high (high \( d' \) may trigger default)
  - If \( r^* \) is high \( \tilde{y}' \) increases (Increases \( d' \) in order to achieve a certain level \( d'q = d' / (1 + r^*) \))

Limitation of the model: This model ignores completely lenders expectations. In reality, \( r^6 = r^6 \) and in fact \( r^6 = r^6(d_0) \).
A Simple Model of Default

- When does country default? In the states of the world that $y'(s) - d' < y'(s)(1 - c)$
  - Solve for $\tilde{y}'$ such that $\tilde{y}' - d' = \tilde{y}'(1 - c)$
  - If $y'(s) < \tilde{y}'$ the country defaults (adverse shock may trigger default)
  - If $d'$ is high $\tilde{y}'$ is high (high $d'$ may trigger default)
  - If $r^*$ is high $\tilde{y}'$ increases (Increases $d'$ in order to achieve a certain level $d'q = d'/(1 + r^*)$)

- Limitation of the model: This model ignores completely lenders expectations. In reality, $r \neq r^*$ and in fact $r = r(d')$
The Eaton-Gersovitz Model of Default

Now we will make the simple model a tad more exciting. Accomodate possibility that bonds prices depend on the expectation that the country defaults on its debt

- Essentially study the model of Eaton-Gersovitz, 1981, Review of Economic Studies
- **Two periods:** 1st period country gets a loan, 2nd period decides whether to repay the loan or not
- Output stochastic in period 2, \( y' (s) \)
- No consumption in the first period, but some debt, \( d' \), that needs to be rolled-over using new debt, \( d'' \)
- In the second period the government has to decide whether to repay the debt \( d'' \) so that she consumes \( y' (s) - b' \) or to default in which case she will consume \( y' (s) (1 - c) \) where \( c \) is the fraction of output reduction caused as the result of the default (e.g. due to political unrest etc)
Government problem

- Government picks debt for next period

\[
\max_{d'} E \{ u (y' - d') , u (y' (1 - c)) \} \quad \text{s.t. } d = q(d') d'
\]

where \( q(d') \) is determined in equilibrium by

\[
q(d') = \frac{\Pr \{ u (y' - d') \geq u (y' (1 - c)) \}}{1 + r^*} = \frac{\Pr \{ y' - d' \geq y' (1 - c) \}}{1 + r^*}
\]

Notice that we can directly substitute out \( d' = d / q(d') \).

- For example if there are 3 states with equal probabilities and country defaults only in the worst state:

\[
q(d') = \frac{2}{3} \frac{1}{1 + r^*}
\]

- Effective interest rate

\[
(1 + r^*) \times 1.5 > 1 + r^*
\]

- Probability of default affects the interest rate!
Default Probabilities Increase in Initial Debt

- Government picks debt for next period

$$\max_{d'} E \{ u (y' - d') , u (y' (1 - c)) \} \quad \text{s.t. } d = q (d') d'$$

where $q (d')$ is determined in equilibrium by

$$q (d') = \frac{Pr \{ u (y' - d') \geq u (y' (1 - c)) \}}{1 + r^*} = \frac{Pr \{ y' - d' \geq y' (1 - c) \}}{1 + r^*}$$

Notice that we can directly substitute out $d' = d / q (d')$.

- But if Initial debt, $d$, is high, default may happen in $2/3$ states.

$$q (d') = \frac{1}{3} \frac{1}{1 + r^*}$$

- Effective interest rate (spread) is higher
Managing Sovereign Debt
Debt Reduction Schemes

- Solutions for excessive sovereign debt
Debt Reduction Schemes

- Solutions for excessive sovereign debt
  1. Unilateral Debt Forgiveness.
Debt Reduction Schemes

- Solutions for excessive sovereign debt
  1. Unilateral Debt Forgiveness.
  2. Third party buy-backs (other entities e.g. governments, institutions etc, might be willing to buy out all the debt in current low prices and ask only for partial repayments of the bonds)
Debt Reduction Schemes

- Solutions for excessive sovereign debt
  1. Unilateral Debt Forgiveness.
  2. Third party buy-backs (other entities e.g. governments, institutions etc, might be willing to buy out all the debt in current low prices and ask only for partial repayments of the bonds)
  3. Debt Restructuring (renegotiate part of your debt with the lenders, also called a ‘haircut’)
Debt Reduction Schemes

- Solutions for excessive sovereign debt
  1. Unilateral Debt Forgiveness.
  2. Third party buy-backs (other entities e.g. governments, institutions etc, might be willing to buy out all the debt in current low prices and ask only for partial repayments of the bonds)
  3. Debt Restructuring (renegotiate part of your debt with the lenders, also called a ‘haircut’)
  4. Debt swaps (issuance of new debt that has seniority –is served before– the old debt)
  5. (Partial) Unilateral Default! (the so-called nuclear option)
Debt Reduction Schemes

- Solutions for excessive sovereign debt
  1. Unilateral Debt Forgiveness.
  2. Third party buy-backs (other entities e.g. governments, institutions etc., might be willing to buy out all the debt in current low prices and ask only for partial repayments of the bonds)
  3. Debt Restructuring (renegotiate part of your debt with the lenders, also called a ‘haircut’)
  4. Debt swaps (issuance of new debt that has seniority –is served before– the old debt)
  5. ...(Partial) Unilateral Default! (the so-called nuclear option)
The Greek “Debt Reduction” Scheme

- **21 Jan 2010:** Greek-German spread for 10-year debt reaches 300 basis points.
The Greek “Debt Reduction” Scheme

- **21 Jan 2010**: Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default*.
- **2 May 2010**: Troika (European Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!)
  - Guarantee greek public debt (lenders & new issuance). At that point a *debt swap*, troika pays expiring bonds in exchange of seniority
- **27 October 2011**: Major private bond holders agreed on a 50% *' haircut'*. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private
  - The debt to the participating bond holders was backed by Troika.
- **2012-2014**: Slowly, arrangment becomes a *third-party partial buy-back*. ECB buys out large fraction of greek bonds, EC lowers interest rates
- **February 2014**: Greek debt/GDP > 170%. Clearly unsustainable...
  - Greece hopes for partial *Debt Forgiveness* from Troika
The Greek “Debt Reduction” Scheme

- **21 Jan 2010**: Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default*.

- **2 May 2010**: Troika (European Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!).
  - Guarantee greek public debt (lenders & new issuance). At that point a debt swap, troika pays expiring bonds in exchange of seniority.

- **27 October 2011**: Major private bond holders agreed on a 50% ‘haircut’. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private.
  - The debt to the participating bond holders was backed by Troika.

- **2012-2014**: Slowly, arrangement becomes a third-party partial buy-back.
  - ECB buys out large fraction of greek bonds, EC lowers interest rates.

- **February 2014**: Greek debt/GDP > 170%. Clearly unsustainable...
  - Greece hopes for partial Debt Forgiveness from Troika.
The Greek “Debt Reduction” Scheme

- **21 Jan 2010:** Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default.*
- **2 May 2010:** Troika (European Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!).
  - Guarantee greek public debt (lenders & new issuance). At that point a *debt swap*, troika pays expiring bonds in exchange of seniority.
- **27 October 2011:** Major private bond holders agreed on a 50% ‘haircut’. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private.
- **2012-2014:** Slowly, arrangement becomes a third-party partial buy-back.
  - ECB buys out large fraction of greek bonds, EC lowers interest rates.
- **February 2014:** Greek debt/GDP > 170%. Clearly unsustainable...
  - Greece hopes for partial *Debt Forgiveness* from Troika.
The Greek “Debt Reduction” Scheme

- **21 Jan 2010:** Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default*.

- **2 May 2010:** Troika (European Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!).
  - Guarantee greek public debt (lenders & new issuance). At that point a *debt swap*, troika pays expiring bonds in exchange of seniority

- **27 October 2011:** Major private bond holders agreed on a 50% ‘*haircut*’. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private
The Greek “Debt Reduction” Scheme

- **21 Jan 2010**: Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default*.

- **2 May 2010**: Troika (European Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!).
  - Guarantee greek public debt (lenders & new issuance). At that point a *debt swap*, troika pays expiring bonds in exchange of seniority.

- **27 October 2011**: Major private bond holders agreed on a 50% ‘*haircut*’. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private.
  - The debt to the participating bond holders was backed by Troika.
The Greek “Debt Reduction” Scheme

- **21 Jan 2010**: Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default.*

- **2 May 2010**: Troika (European. Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!).
  - Guarantee greek public debt (lenders & new issuance). At that point a *debt swap*, troika pays expiring bonds in exchange of seniority.

- **27 October 2011**: Major private bond holders agreed on a 50% *‘haircut’*. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private.
  - The debt to the participating bond holders was backed by Troika.

- **2012-2014**: Slowly, arrangement becomes a *third-party partial buy-back*. ECB buys out large fraction of greek bonds, EC lowers interest rates.
The Greek “Debt Reduction” Scheme

- **21 Jan 2010:** Greek-German spread for 10-year debt reaches 300 basis points.
  - At that point, without international help only option *Unilateral Default.*
- **2 May 2010:** Troika (European Commission-EC-, IMF, ECB) agree with Greek gov to a $143 bil bailout package (will increase soon!).
  - Guarantee greek public debt (lenders & new issuance). At that point a *debt swap,* troika pays expiring bonds in exchange of seniority
- **27 October 2011:** Major private bond holders agreed on a 50% ‘*haircut*’. Ultimately 83.5% of Greek bond holders will participate. By then only small part of the debt is private
  - The debt to the participating bond holders was backed by Troika.
- **2012-2014:** Slowly, arrangement becomes a *third-party partial buy-back.* ECB buys out large fraction of greek bonds, EC lowers interest rates
- **February 2014:** Greek debt/GDP > 170%. Clearly unsustainable...
  Greece hopes for partial *Debt Forgiveness* from Troika
Debt Reduction Schemes

- If probability of repayment is low it could be realistic for lenders to adjust the value of the debt.
Debt Reduction Schemes

- If probability of repayment is low it could be realistic for lenders to adjust the value of the debt
  - There is a free rider problem: how can you ensure that all the lenders reduce the debt at the same time?
Debt Reduction Schemes

- If probability of repayment is low it could be realistic for lenders to adjust the value of the debt
  - There is a free rider problem: how can you ensure that all the lenders reduce the debt at the same time?
  - From an individual lender’s point of view, it might be better if he does not forgive
Debt Reduction Schemes

- If probability of repayment is low, it could be realistic for lenders to adjust the value of the debt
  - Debt Overhang.
    - Let the debt be $D$. Consider the possibility that part of the debt is forgiven to allow for the possibility that the country recovers.
    - Let $\pi$ the probability that the good state occurs, where this probability is a function of the state, $\pi = \pi(D)$, and $\frac{d\pi(D)}{dD} < 0$. Total expected revenues of the lender are
      $$\pi(D)D + (1 - \pi(D))aD$$
      where $a < 1$ is the fraction of the money that the country will get if there is a default. There might be an optimal $a < 1$ (Given that $\pi$ is a function of $D$)