Andreas Krause

Self-fulfilling currency crises

Outline

- The importance of expectations
- Flexible exchange rate
- Fixed exchange rate
- Optimal exchange rate regime
- Summary

Outline

- We will now investigate how a currency crisis, that is a sudden devaluation of a currency, can be triggered simply by the expectations of market participants.
- It is only if market participants expect a currency crisis that it will occur; if market participants do not expect a currency crisis, then no currency crisis will occur.
- Thus the expectations of market participants become self-fulfilling; what they expect will happen.

Outline

- We will firstly explore the importance of expectations before than assessing the welfare generated from a country with a flexible exchange rate that reacts to macroeconomic changes.
- This is contrasted with a country that fixes its exchange rate, or more realistically where central interventions prevent the exchange rate to freely adjust to any macroeconomic changes.
- Comparing these two types of countries, we can then establish the conditions under which a currency crisis occurs.

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- Fixed exchange rate
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- We will first outline some basic ideas about the management of macroeconomic conditions and how expectations then can play an important role for the optimal exchange rate policy.

Managing macroeconomic variables

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→ Policy makers typucally include governments and central bankers ina macroeconomic context and these can affect a wide variety of macroeconomic variables.

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- Policy makers, such as central banks and the government, frequently affect a wide range of macroeconomic variables, either through direct intervention or indirectly through the effect these variables have on other macroeconomic variables.
- Central banks can directly affect interest rates through their decisions regarding the costs of commercial banks obtaining loans from the central bank or the interest they pay to commercial banks for maintaining deposits with them.
- Indirectly through the use of monetary policy they affect inflation, which will also be affected by government spending.
- Not only can specific macroeconomic variables be affected, but government policy might impact on growth prospects, for example, through their wider economic policy decisions.

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- All these macroeconomic variables will affect exchange rates, for example through parties.
- Thus, while it may not be the primary aim of policy makers, their decisions affect exchange rates.

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- having established the link between the variables they control and exchange rates, policy makers could decide to pursue a policy that maintains a stable exchange rate. We call this situation a 'fixed exchange rate'.
- Alternatively, they could pursue a policy devalue the currency; this is what we refer to as a 'currency crisis'. Of course, they could also seek an equivalent increase in the exchange rate, but this is neglected here as it is empirically not commonly observed and theoretically unlikely to be beneficial.

▶ We will see that giving up a fixed exchange rate, thus creating a currency crisis, can be optimal.

→ What drives this decision to abandon a stable currency and cause a currency crisis will be the subject of the model we consider.

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Crashes without information

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→ We will now distinguish a currency crisis from a market crash.

- A currency crisis is defined as a situation in which the exchange rate suddenly changes,
  - but this sudden change has no fundamental reason. Thus it would not be the result of an exogenous shock or even a specific policy decision that is not related to the exchange rate.
- Thus a currency crisis is similar to a market crash in that there is no apparent reason for it to have happened at that time.
  - However, currency crises are typically associated with a weak macroeconomic performance of the country, even though such weak macroeconomic performance would often have been apparent for a considerable period of time prior to the currency crisis and there is not meaningful change at that time.
- A market crash usually needs some trigger in the form of negative information, even if the negative information does not justify the size of the price adjustment.
- We will see here, that for a currency crisis, no new (negative) information is needed, it is sufficient that expectations about the emergence of a currency crisis become widespread.

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- We will firstly investigate the welfare in an economy which has a flexible exchange rate, that is the exchange rate will freely adjust to current macroeconomic conditions.

Minimizing costs from inflation and taxation

Minimizing costs from inflation and taxation

→ We will now consider the objective function of any policy maker, which he seeks to minimize. We use this approach as an approximation for the maximization of social welfare.

- ▶
  - People generally dislike information and hence higher inflation imposes a higher cost on society.
  - People also dislike having to pay taxes, thus making the tax burden another cost.
  - Hence a policy maker would minimize these costs jointly.
  - We can weigh the importance of the costs arising from inflation and taxation to suit the preferences of people.
- ▶ We assume that in addition to these costs, there are other costs associated with changing the inflation rate. This might arise from rising interest rates to curb spending and thus reduce inflation; the lower consumption arising from this might adversely affect people and we assume that these costs are fixed costs.
- ▶ *Formula*. We assume here that taxation and inflation is squared terms to emphasize that larger values are progressively increasing costs.
- ▶ Most countries have debt and the interest payments have to be covered by taxes. we assume here that this is the only use of taxes. We can interpret this as the part of taxation that is, as we will see, related to the exchange rate, and other taxation is considered separately outside of this model.
- ▶
  - The interest rate on the debt will include the expected inflation with the interest rate set as an appropriate real interest rate.
  - Higher inflation than expected will reduce the future debt burden and if we assume that taxation also rises with inflation, the real interest rate will be lower.
  - Thus the interest costs of the country is covered by taxation and higher-than-expected inflation, which acts like an indirect tax and pays for some part of the interest costs.
- ▶ *Formula*

→ We thus have the objective of minimizing the costs of taxation and inflation, as well as the costs of adjusting inflation rates. This minimization will only be achieved if the country can meet its interest payments. Thus this acts as a constraint to the minimization of costs.

Minimizing costs from inflation and taxation

- People prefer low inflation
- $\Pi = \pi^2$

Minimizing costs from inflation and taxation

→ We will now consider the objective function of any policy maker, which he seeks to minimize. We use this approach as an approximation for the maximization of social welfare.

▶
- People generally dislike information and hence higher inflation imposes a higher cost on society.
- People also dislike having to pay taxes, thus making the tax burden another cost.
- Hence a policy maker would minimize these costs jointly.
- We can weigh the importance of the costs arising from inflation and taxation to suit the preferences of people.

▶ We assume that in addition to these costs, there are other costs associated with changing the inflation rate. This might arise from rising interest rates to curb spending and thus reduce inflation; the lower consumption arising from this might adversely affect people and we assume that these costs are fixed costs.

▶ *Formula.* We assume here that taxation and inflation is squared terms to emphasize that larger values are progressively increasing costs.

▶ Most countries have debt and the interest payments have to be covered by taxes. we assume here that this is the only use of taxes. We can interpret this as the part of taxation that is, as we will see, related to the exchange rate, and other taxation is considered separately outside of this model.

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- The interest rate on the debt will include the expected inflation with the interest rate set as an appropriate real interest rate.
- Higher inflation than expected will reduce the future debt burden and if we assume that taxation also rises with inflation, the real interest rate will be lower.
- Thus the interest costs of the country is covered by taxation and higher-than-expected inflation, which acts like an indirect tax and pays for some part of the interest costs.

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→ We thus have the objective of minimizing the costs of taxation and inflation, as well as the costs of adjusting inflation rates. This minimization will only be achieved if the country can meet its interest payments. Thus this acts as a constraint to the minimization of costs.

Minimizing costs from inflation and taxation

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Minimizing costs from inflation and taxation

- People prefer low inflation and low taxes, which a policy maker should be minimizing, giving weights to their relative importance

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Minimizing costs from inflation and taxation

- People prefer low inflation and low taxes, which a policy maker should be minimizing, giving weights to their relative importance
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- If a country has debt, its interest payments must be covered by tax revenue

- $rB = T$

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- People prefer low inflation and low taxes, which a policy maker should be minimizing, giving weights to their relative importance
- Fixed costs from changing inflation rates are also incurred
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- If a country has debt, its interest payments must be covered by tax revenue
- Expected inflation will be priced into the interest rate, but a higher inflation reduces the value of debt

- $rB = T + \theta\left(\pi - \mathrm{E}\left[\pi\right]\right)$

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Optimal inflation and taxation

Optimal inflation and taxation

→ We can now determine the optimal taxation and the optimal rate of inflation.

- Our objective function are the costs, subject to the constraint of paying the interest; this gives as the Lagrangian as shown in the *formula*, with λ the Lagrange multiplier.
- The first order conditions for minimizing this Lagrangian need to be fulfilled.

⇒ We can solve these conditions for the optimal taxation as indicated in the *formula*; we see that the taxation is a function of inflation.

· We can solve these conditions for the optimal inflation rate as indicated in the *formula*.

⇒ Inserting these results back into the cost function, we obtain the total losses society makes.

→ We see that these losses depend on the expected inflation rate. We will now replace this inflation rate with the exchange rate.

Optimal inflation and taxation

- The objective function is $\mathcal{L} = \alpha\pi^2 + T^2 + C + \lambda\left(rB - T - \theta\left(\pi - \mathsf{E}\left[\pi\right]\right)\right)$

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Inflation and exchange rate

Inflation and exchange rate

→ We will now see how inflation and the exchange rate are connected to make the transition between these two variables.

- If we assume that purchasing power parity holds and the foreign inflation rate is constant at the same level as the country itself, then a change in inflation implies a change in the exchange rate. For simplicity assume that the inflation level currently is zero; this moves from $\Delta e = 0$ to $\Delta e = \pi$.

⇒ We thus see that inflation is the same as a change in the exchange rate.

- In this case we can interpret the costs of changing inflation as the costs of not having a fixed exchange rate. this is because a change in inflation will induce a change in the exchange rate, which therefore can no longer be fixed. Thus the two costs are equivalent and we will from now on interpret C as the costs of abandoning a fixed exchange rate.
- We can thus replace the expected inflation with the expected change in the exchange rate to obtain the costs.

→ We have now determined the costs associated with a flexible exchange rate system, where the exchange rate changes. The costs of this variable exchange rate can include the uncertainty about the revenue or costs when engaging in international trade or the uncertainty about returns on foreign investments.

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- In this case we can interpret the costs of changing inflation as the costs of not having a fixed exchange rate. this is because a change in inflation will induce a change in the exchange rate, which therefore can no longer be fixed. Thus the two costs are equivalent and we will from now on interpret C as the costs of abandoning a fixed exchange rate.
- We can thus replace the expected inflation with the expected change in the exchange rate to obtain the costs.

→ We have now determined the costs associated with a flexible exchange rate system, where the exchange rate changes. The costs of this variable exchange rate can include the uncertainty about the revenue or costs when engaging in international trade or the uncertainty about returns on foreign investments.

Inflation and exchange rate

- Using purchasing power parity, a change in inflation is equivalent to a change in the exchange rate

$\Rightarrow$ Inflation can be interpreted as a change in the exchange rate

- If there are benefits of a stable exchange rate, then the fixed costs are the costs of abandoning the fixed exchange rate

Inflation and exchange rate

→ We will now see how inflation and the exchange rate are connected to make the transition between these two variables.

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- The importance of expectations
- Flexible exchange rate
- Fixed exchange rate
- Optimal exchange rate regime
- Summary

- After we have determined the costs of flexible exchange rates, we can now determine the costs if the exchange rate is fixed.

Minimizing costs from taxation

Minimizing costs from taxation

→ We will now again seek to minimize the costs associated with such an exchange rate regime.

- We now assume that the economic policy in a country is such that the exchange is kept constant.
  - This will then imply that the inflation must be equal to that of the foreign in order for purchasing power parity to hold. This foreign inflation rate we had assumed to be zero.
- The costs of this exchange rate regime will therefore only consist of the taxation only.
- as the exchange rate is fixed and hence inflation held constant at zero, there are no costs of adjusting inflation (or the exchange rate).
- We once again have a budget constraint that requires the interest payments on any outstanding debt to be paid. The difference to the case above is that the actual inflation is zero.
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  - As before, taxation is required to cover the interest payment on any outstanding debt.
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→ We can now minimize the costs, subject to this constraint of being able to meet interest payments.

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Optimal taxation

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→ We now have only the taxation as a policy instrument as we have to keep inflation constant at zero to maintain the fixed exchange rate.
- The Lagrangian is obtained as before, with a different cost function and a different constraint.
- We will minimize this expression by solving the first order conditions.

⇒ We can solve these conditions for the optimal taxation as indicated in the *formula*.
⇒ Inserting this result back into the cost function, we obtain the total losses society makes.
- We can again replace the expected inflation by the expected change in the exchange rate due to purchasing power parity holding.

→ We have thus determined the costs associated with fixed exchange rate, where these costs arise from the taxation to pay the interest on any outstanding debt.

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- The objective function is $\mathcal{L} = T^2 + \lambda \left(rB - T + \theta \left(\mathsf{E} \left[\pi \right] \right) \right)$

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- The importance of expectations
- Flexible exchange rate
- Fixed exchange rate
- Optimal exchange rate regime
- Summary

- using our results on the flexible and fixed exchange rates, we can now determine the optimal exchange rate regime, namely the one that exhibits the lower costs.

Abandoning the fixed exchange rate

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→ We will at first look at when it is optimal for the country to abandon a fixed exchange rate.

- A country would abandon their fixed exchange rate if the costs of a flexible exchange rate are lower than that of the fixed exchange rate.

⇒ This condition can easily be solved for the expression in the *formula*.

- We easily see that this condition is fulfilled if the country has a high debt (B) or pays high interest on its debt (r).
- Even if people do not expect the exchange rate to change, $\Delta e = 0$, can this condition be fulfilled. We can exclude the possibility of a negative change of the exchange rate as all optimal inflation rates were positive. Thus if the condition in the *formula* is fulfilled, then the fixed exchange rate will always be abandoned.

→ We thus see that for high levels of debt, fixed exchange rates are not sustainable. If the debt level were to increase over time, there might be a point where this condition is met and the exchange rate regime changes. This would not constitute a currency crisis as the devaluation of the currency is the result of changing macroeconomic conditions, namely the incerase in government debt.

Abandoning the fixed exchange rate

- Exchange rates are changed if the losses are of doing so are smaller than keeping them fixed

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Abandoning the fixed exchange rate

→ We will at first look at when it is optimal for the country to abandon a fixed exchange rate.

▶ A country would abandon their fixed exchange rate if the costs of a flexible exchange rate are lower than that of the fixed exchange rate.

⇒ This condition can easily be solved for the expression in the *formula*.

▶
- We easily see that this condition is fulfilled if the country has a high debt (B) or pays high interest on its debt (r).
- Even if people do not expect the exchange rate to change, $\Delta e = 0$, can this condition be fulfilled. We can exclude the possibility of a negative change of the exchange rate as all optimal inflation rates were positive. Thus if the condition in the *formula* is fulfilled, then the fixed exchange rate will always be abandoned.

→ We thus see that for high levels of debt, fixed exchange rates are not sustainable. If the debt level were to increase over time, there might be a point where this condition is met and the exchange rate regime changes. This would not constitute a currency crisis as the devaluation of the currency is the result of changing macroeconomic conditions, namely the incerase in government debt.

Retaining the fixed exchange rate

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→ having explored the condition for abandoning the fixed exchange rate, we will now look at conditions for it to be retained.

- Under flexible exchange rates the optimal inflation, and hence the optimal change in the exchange rate due to purchasing power parity, was given as in the *formula*.
- If we assume that people make rational expectations, then their expectations are fulfilled and the expected exchange rate change is equal to the actual exchange rate change.

⇒ Using such rational expectations, we can get the exchange rate change as in the *formula*.

- Using the results from above, we know that the fixed exchange rate is retained if $rB + \theta \Delta e < \frac{\sqrt{\left(\alpha+\theta^2\right)C}}{\theta}$ and we can insert for Δe.

⇒ Solving again for the interest payments, we the condition in the *formula*.

- We thus see that if the interest payments are sufficiently low, the fixed exchange rate is retained. Thus for a low amount of debt (B), or a low interest rate (r), the fixed exchange rate is optimal.

→ While we have established that for high debt burdens any fixed exchange rate is abandoned and for low debt burdens it is retained, we will focus now on an intermediate range of the debt burden.

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Self-fulfilling expectations

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→ We will no ficus our attention on those debt burdens that fall between these two conditions for abandoning an retaining the fixed exchange rate regime.

- We will see that for intermediate debt burdens, the optimal exchange rate regime depends on the expectations about the exchange rate regime.
  - This intermediate range of debt burden is defined as the area in which the two previous conditions are both not satisfied.

- If the debt burden is in this intermediate range, then, if it is expected that the exchange rate remains fixed, $\mathsf{E}[\Delta e] = 0$, the condition to abandon the fixed exchange rate is not fulfilled. Thus the exchange rate will remain fixed.
- If the debt burden is in this intermediate range, then, if it is expected that the exchange rate becomes flexible, $\mathsf{E}[\Delta e] = \frac{\theta}{\alpha} rB$, the condition for to retain the fixed exchange rate is not fulfilled. Thus the exchange rate will become flexible.
- We thus have a situation in which we have expectations of a fixed exchange rate will lead to a fixed exchange rate being retained, while expectations of a flexible exchange rate will lead to the exchange rate becoming flexible. Whatever is expected, will occur; this is known as 'self-fulfilling expectations'.
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  - The exchange rate will increase, which is a depreciation of the currency,
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→ We thus see that if the amount of government debt is in an intermediate range, a sudden depreciation of the currency, thus a change from fixed to flexible exchange rates, can occur without any macroeconomic conditions occurring. With the sudden depreciation of the currency with no apparent reason, we have a currency crisis.

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- We thus have a situation in which we have expectations of a fixed exchange rate will lead to a fixed exchange rate being retained, while expectations of a flexible exchange rate will lead to the exchange rate becoming flexible. Whatever is expected, will occur; this is known as 'self-fulfilling expectations'.
- The exchange rate will increase, which is a depreciation of the currency,
  - which will induce inflation. This inflation will reduce the (real) debt burden. This is the benefit of abandoning the fixed exchange rate.

→ We thus see that if the amount of government debt is in an intermediate range, a sudden depreciation of the currency, thus a change from fixed to flexible exchange rates, can occur without any macroeconomic conditions occurring. With the sudden depreciation of the currency with no apparent reason, we have a currency crisis.

- The importance of expectations
- Flexible exchange rate
- Fixed exchange rate
- Optimal exchange rate regime
- Summary

- We have seen how a currency crisis can emerge merely because expectations of people are changing; these changes make it not sustainable to maintain a fixed exchange rate.
- It was that if a depreciation (abandoning the fixed exchange rate) was expected, it will occur.

Occurrence of currency crises

Occurrence of currency crises

→ We can now summarize the key findings of this model.

- This depreciation of the exchange rate, which will happen suddenly as expectations change, is interpreted as currency crisis. There is no apparent reason for the currency crisis other than that expectations change. Such expectation changes can occur for any reason, including herding.
- A depreciation of the currency will always happen if government debt is high as the resulting inflation will reduce the real value of the debt.
- The costs of the exchange rate change (C) are too high to make a depreciation beneficial if the debt burden is low. In this case the reduction in the real debt burden is too small to cover the associated costs of abandoning the exchange rate.
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  - It is the intermediate range of debt which makes countries susceptible to a currency crisis from self-fulfilling expectations.
  - It is that a currency crisis occurs if people expect it to occur; if people expect the currency to remain stable, it will remain stable.

→ We have found that currency crisis are self-fulfilling.

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Managing expectations

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→ Currency crises are about managing the expectations of people; what people expect will happen.

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  - If the exchange rate regime is not expected to change, it will not change.
  - Of course, this is true only for as long as it is sustainable to retain fixed exchange rates; once the debt burden is too high, the fixed exchange rate will be abandoned.
- Hence in such an intermediate range of debt burden, it is important for policy makers to manage the expectations of people and ensure that fixed exchange rates are credible.

→ We have seen that currency crises are not so much about poor economic conditions (high debt burden in the model), but primarily about the expectations about the stability of the exchange rate regime.

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Department of Economics
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk