Andreas Krause

Debt-triggered currency crises

- We now look at the impact foreign investments have on the possibility of a currency crisis.
- It is that many developing countries rely heavily on foreign investments into their economy for their economic development. We will therefore see how this reliance can trigger a currency crisis.

Reliance on foreign investments

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→ We will firstly set out the importance of foreign investments for some countries.

- Many countries, especially developing countries that undergo a rapid economic development, rely on foreign investments to finance their economic growth.
- If such foreign investments are reduced for any reason, an economic crisis in that country may emerge as the growth of the economy can no longer be supported.
- This will have consequences for the exchange rate of that country, which we will be focussing on mainly.

- While a reduction in foreign investment, capital inflow, can be related to the economic performance of that country, it often is unrelated to it.
- Reasons for reduced capital flows might be an economic crisis in the countries that provide the foreign investment, which necessitates investor to reduce their foreign investments as funds are required in their own country.
- It might also be the result of the emergence of other, more attractive, markets for investment, which now attract more funds, leaving less for the country in question.
- Reduced capital flows might also be the result of a change in investment policies of international investors, for example as a result of changed risk preferences.

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Consumption decisions

Consumption decisions

→ Let us now start by analysing the consumption decision in a country.

▶
- We firstly consider the production of the good that is to be consumed. For its production we require the use of capital
- as well as the use of labour.
- We use a Cobb-Douglas production function and the elasticities of these two production factors sum up to 1.

▶ *Formula*

▶
- As is standard in economic models, the wages that are paid are set such that they reflect the marginal product of labour.
- *Formula*

▶ The total income is then the wages multiplied by the total labour supplied and this income is then consumed. This consumption can be of the good produced domestically or a foreign, imported, good.

▶
- The demand for the good is composed of the consumption of the domestic good; a fraction μ of the consumption is of the domestic good.
- The we have the investments for which domestic goods are used; a fraction μ of the investment is through the domestic good.
- We then have the exports to which we apply the relevant exchange rate.
- Exports are used to raise funds from other countries, this can be achieved by exporting goods or by importing capital. We thus do not distinguish between goods exports and capital imports. It is therefore that the reliance on capital imports can also be interpreted as a reliance on the export of natural resources or manufactured goods.
- We can now insert the expression for the consumption from above and obtain the final *formula*.

⇒ This expression can be solved for the exchange rate,

· or the total demand for goods.

→ having now looked at the production and consumption of goods, we can now focus on the investment decisions.

Consumption decisions

- The production of goods requires capital
- $Y = K$

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Consumption decisions

- The production of goods requires capital and labour with capital and labour elasticities summing up to unity
- $Y = K^{\alpha} L^{1-\alpha}$

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- $Y = K^{\alpha} L^{1-\alpha}$
- Wages are set according to the marginal product of labour, $w = \frac{\partial Y}{\partial L} = (1-\alpha)\,\frac{Y}{L}$
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- The demand for goods consists of domestic consumption goods

- $Y = \mu C$

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- $Y = \mu C + \mu I + eX$

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- The demand for goods consists of domestic consumption goods and domestic investment goods, and the exports at the prevailing exchange rate, either in form of good exported or capital imported
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- The we have the investments for which domestic goods are used; a fraction μ of the investment is through the domestic good.
- We then have the exports to which we apply the relevant exchange rate.
- Exports are used to raise funds from other countries, this can be achieved by exporting goods or by importing capital. We thus do not distinguish between goods exports and capital imports. It is therefore that the reliance on capital imports can also be interpreted as a reliance on the export of natural resources or manufactured goods.
- We can now insert the expression for the consumption from above and obtain the final *formula*.

⇒ This expression can be solved for the exchange rate,

· or the total demand for goods.

→ having now looked at the production and consumption of goods, we can now focus on the investment decisions.

Consumption decisions

- The production of goods requires capital and labour with capital and labour elasticities summing up to unity
- $Y = K^{\alpha} L^{1-\alpha}$
- Wages are set according to the marginal product of labour, $w = \frac{\partial Y}{\partial L} = (1-\alpha)\,\frac{Y}{L}$
- The total income $wL = (1-\alpha)\,Y = C$ is fully consumed
- The demand for goods consists of domestic consumption goods and domestic investment goods, and the exports at the prevailing exchange rate, either in form of good exported or capital imported
- $Y = \mu C + \mu I + eX = \mu\,(1-\alpha)\,Y + \mu I + eX$

Consumption decisions

→ Let us now start by analysing the consumption decision in a country.

▶
- We firstly consider the production of the good that is to be consumed. For its production we require the use of capital
- as well as the use of labour.
- We use a Cobb-Douglas production function and the elasticities of these two production factors sum up to 1.

▶ *Formula*

▶
- As is standard in economic models, the wages that are paid are set such that they reflect the marginal product of labour.
- *Formula*

▶ The total income is then the wages multiplied by the total labour supplied and this income is then consumed. This consumption can be of the good produced domestically or a foreign, imported, good.

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Investments and wealth

→ We will now look at the investments in the economy and how it affects overall wealth.

- We assume that there is maximum leverage to the amount that can be invested, thus the total investment is at most a multiple of the total wealth. At most a fraction θ of the wealth can be used for investment from sources other than the country's own wealth.
- *Formula*
- We might justify this assumption by making the observation that investment opportunities exist in other countries and global funds available will be limited as well.
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  - Wealth is obtained from the return on capital investment made when producing the good. This return is determined as the marginal product of capital.
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- The wealth generated is the capital income and from this capital income, we need to pay any domestic debt, as well as any foreign debt. The foreign debt will be denominated in a foreign currency, as is common for many developing countries, and hence we need to adjust this debt by the exchange rate.
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Equilibrium investment

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- Investment increases the capital stock, which increases production and higher production would increase the development of the country; hence the country would want to obtain the highest possible investment.
- This investment will depend on the wealth the country has, thus its existing capital income.
- The capital income will in turn depend on the capital available, thus previous investments. We need to solve for this circular relationship.

- We can firstly look at how the wealth is affected by the actual investment. This derivative can be rewritten using the chain rule and from the previous equations for the wealth and the exchange rate, we can determine this expression.
- We then can also look at how the maximum possible investment is affected by the actual investment. This derivative can be rewritten using the chain rule and from the previous equations for the maximum investment and the wealth we can determine this expression.
- Let us now consider the extreme case that the maximum investment is zero, that is there is no wealth.

⇒ In this case no investment can be made and hence there will be no capital, thus the production will be zero.

⇒ Using the equilibrium production and setting this equal to zero, we see that this would imply an actually negative investment. This is, of course, not possible and the investment will be pegged at zero.

- We now make the additional assumption as stated in the *formula*.
-
  - This condition is fulfilled if the possible leverage is high, θ,
  - or we have high domestic consumption, μ,
  - or the foreign debt is high. It is the first and last condition that is typically fulfilled in many developing countries. The lack of stock markets force companies to rely on debt financing through banks, making for a high leverage. The funds for banks are often the result of obtaining foreign investments, thus a high F.

→ We can now assess potential equilibria graphically.

Equilibrium investment

- As investment increases production, the aim is to achieve the highest possible investment I^*

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  - or the foreign debt is high. It is the first and last condition that is typically fulfilled in many developing countries. The lack of stock markets force companies to rely on debt financing through banks, making for a high leverage. The funds for banks are often the result of obtaining foreign investments, thus a high F.

→ We can now assess potential equilibria graphically.

Equilibrium investment

- As investment increases production, the aim is to achieve the highest possible investment I^*, but this depends on the wealth, which in turn depends on the actual investments conducted
- $\frac{\partial W}{\partial I} = \frac{\partial W}{\partial e}\frac{\partial e}{\partial I} = -F\left(-\frac{\mu}{X}\right) = \mu\frac{F}{X}$
- $\frac{\partial I^*}{\partial I} = \frac{\partial I^*}{W}\frac{\partial W}{\partial I} = (1+\theta)\,\mu\frac{F}{X}$
- Consider the case that $I^* = 0$

→

- Investment increases the capital stock, which increases production and higher production would increase the development of the country; hence the country would want to obtain the highest possible investment.
- This investment will depend on the wealth the country has, thus its existing capital income.
- The capital income will in turn depend on the capital available, thus previous investments. We need to solve for this circular relationship.

- We can firstly look at how the wealth is affected by the actual investment. This derivative can be rewritten using the chain rule and from the previous equations for the wealth and the exchange rate, we can determine this expression.
- We then can also look at how the maximum possible investment is affected by the actual investment. This derivative can be rewritten using the chain rule and from the previous equations for the maximum investment and the wealth we can determine this expression.
- Let us now consider the extreme case that the maximum investment is zero, that is there is no wealth.

⇒ In this case no investment can be made and hence there will be no capital, thus the production will be zero.

⇒ Using the equilibrium production and setting this equal to zero, we see that this would imply an actually negative investment. This is, of course, not possible and the investment will be pegged at zero.

- We now make the additional assumption as stated in the *formula*.
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- Assume that $\frac{\partial I^*}{\partial I} > 1$
- This is the case leverage is high, domestic consumption high, or foreign debt high relative to exports

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→ We can now assess potential equilibria graphically.

Multiple equilibria

Multiple equilibria

→ We will determine the relationship between investments and the exchange rate to assess potential equilibria.

- We will at first look at the relationship between the actual investment and the maximum possible investment.
- We had established that for $I^* = 0$ the actual investment would be negative, but given the impossibility of negative investments, the actual investments are capped at zero. we see from the previous equation that for sufficiently low production (Y) and hence I^*, the actual investment will remain negative, leaving it bound at zero. Once I^* is large enough, the actual investment will become positive and it increases with a slope larger than 1 as per our assumption. The will be a maximal possible investment that cannot be exceeded, for example due to funding constraints by investors.
- We want to achieve the maximal possible investment, thus $I = I^*$, which is shown here. Note that the actual investments will cross this line, assuming the maximal investment is high enough, as the slope was assumed to be above 1.
- Possible equilibria are thus where $I = I^*$ and this is the case for no investment to occur.
- It could also be that investments are intermediate,
- or high. We thus have three possible equilibria for the amount invested.
- We can now use the relationship of the investment with the exchange rate.
- The equilibrium in the goods market suggests a negative relationship.
- Here we only mirror the actual investment onto the horizontal axis.
- We can now use these graphs to construct the relationship between the investment and the exchange rate.
- Construction gives us this graphs, with the corresponding parts shown in the same colour.
- The three equilibrium investments, correspond to equilibrium exchange rates.

→ We have thus found that three possible equilibrium exchange rates and investment amounts exist in this model.

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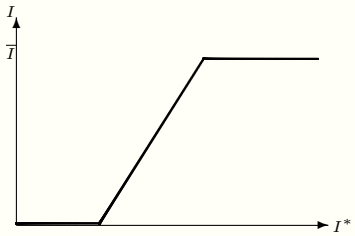

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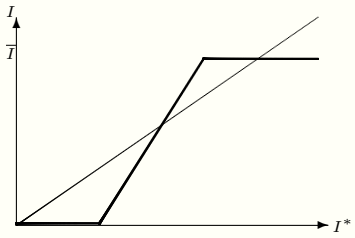

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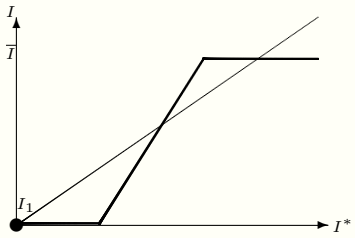

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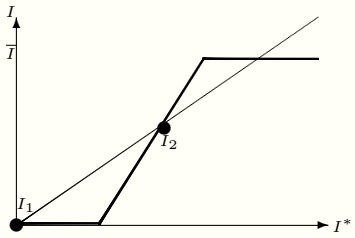

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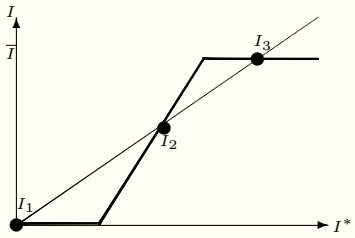

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- We can now use the relationship of the investment with the exchange rate.
- The equilibrium in the goods market suggests a negative relationship.
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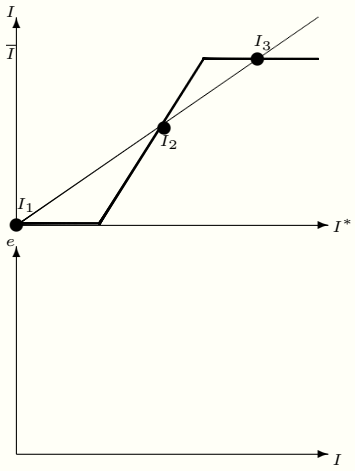
Multiple equilibria



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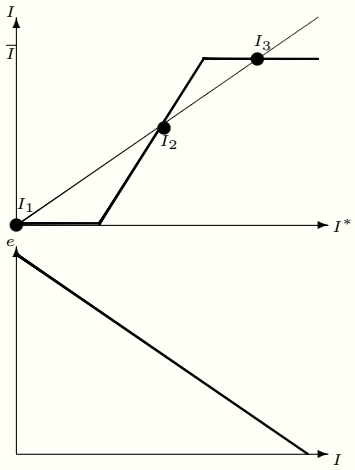

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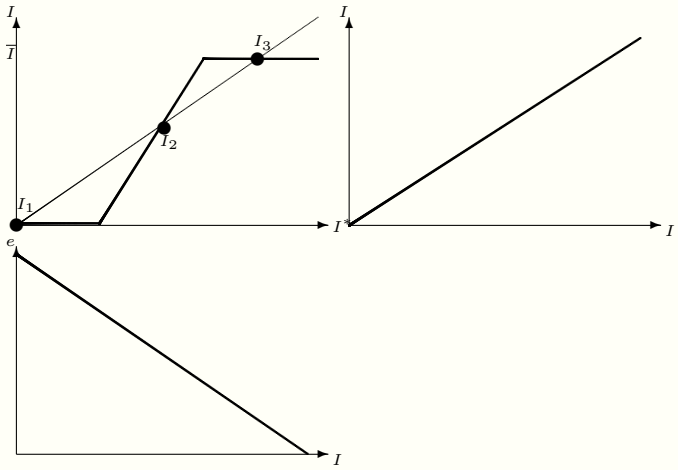

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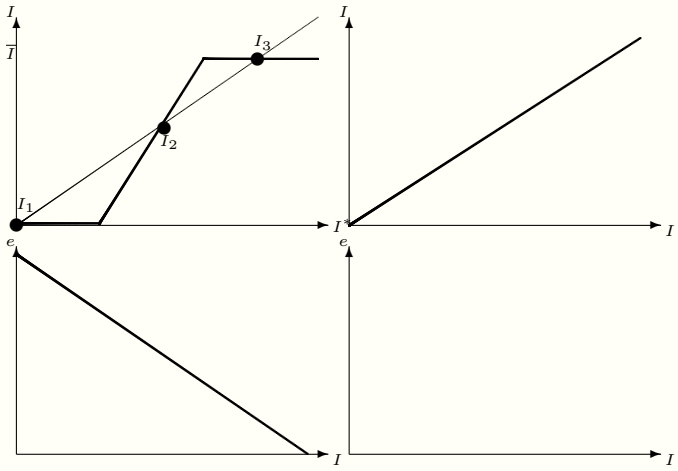

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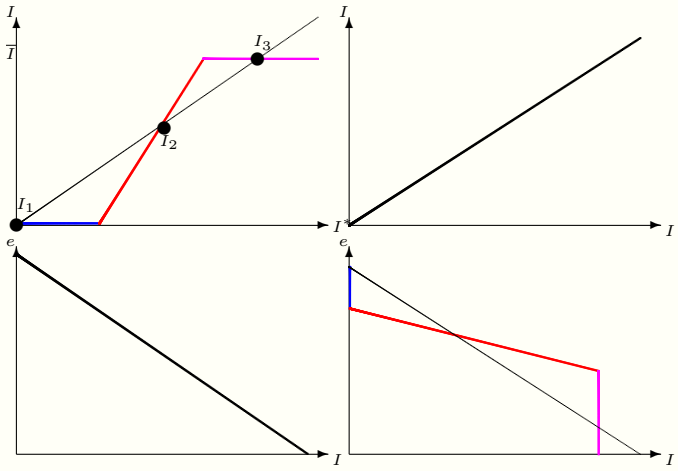

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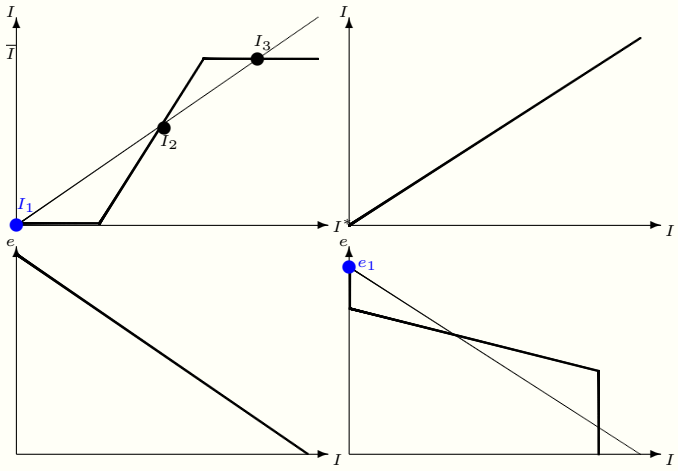

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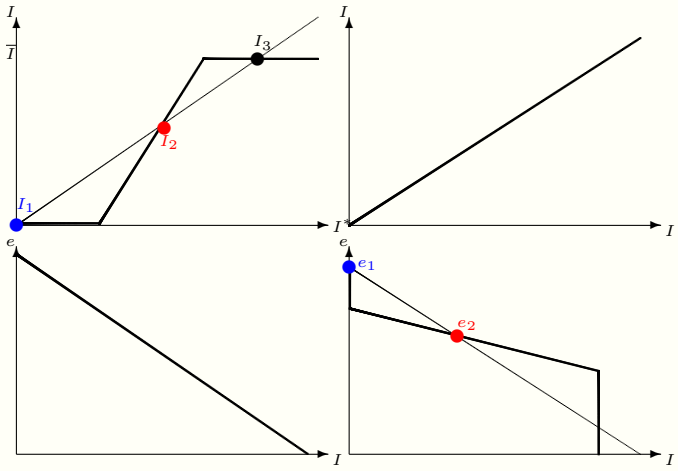

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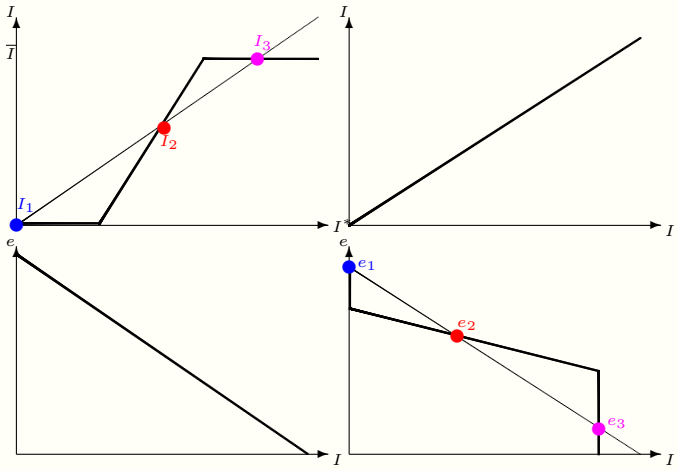

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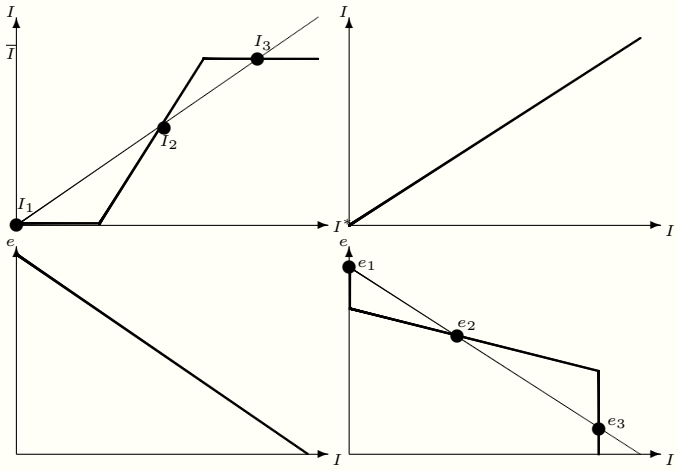

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Reduced capital inflows

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→ Having three equilibria means that we might move from one equilibrium to another as some conditions change, even though the equilibria themselves are not changing.

- We assess the impact that a reduction in capital inflow has. Thus X reduces, either actual capital flows reduce or the amount of goods exported reduce.

⇒ We use the equilibrium exchange rate as shown here and see that as X reduces, the exchange rate increases. This represent a depreciation of the exchange rate.

⇒ An increased exchange will increase the costs of foreign debt as more of their own currency is needed to service this debt. Thus the wealth reduces.

⇒ Reduced wealth will reduce the maximal possible investment, which in equilibrium is the actual investment.

⇒ We can now insert this back into the exchange rate and see that the exchange increases even more.

⇒ This process now continues with investment reducing and the exchange rate increasing

⇒ We thus move from one equilibrium with a high investment and low exchange rate to another equilibrium with low investment and a high (depreciated) exchange rate.

→ Hence the reduced capital inflows trigger a dynamics which changes the investment and exchange rate.

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⇒ This process now continues with investment reducing and the exchange rate increasing

⇒ We thus move from one equilibrium with a high investment and low exchange rate to another equilibrium with low investment and a high (depreciated) exchange rate.

→ Hence the reduced capital inflows trigger a dynamics which changes the investment and exchange rate.

Reduced capital inflows

- Assume capital inflows are reduced

$\Rightarrow$ From $e = \frac{(1-\mu(1-\alpha))Y-\mu I}{X}$, the exchange rate increases

$\Rightarrow$ From $W = rK - D - eF$ the higher costs of servicing foreign debt reduces wealth

$\Rightarrow$ From $I^* = (1+\theta)\,W$ investment will reduce

$\Rightarrow$ From $e = \frac{(1-\mu(1-\alpha))Y-\mu I}{X}$, the exchange rate increases

$\Rightarrow$ A downward spiral of reducing investment and depreciating exchange rate commences

$\Rightarrow$ A new equilibrium emerges with a devalued exchange rate

Reduced capital inflows

→ Having three equilibria means that we might move from one equilibrium to another as some conditions change, even though the equilibria themselves are not changing.

- We assess the impact that a reduction in capital inflow has. Thus X reduces, either actual capital flows reduce or the amount of goods exported reduce.

⇒ We use the equilibrium exchange rate as shown here and see that as X reduces, the exchange rate increases. This represent a depreciation of the exchange rate.

⇒ An increased exchange will increase the costs of foreign debt as more of their own currency is needed to service this debt. Thus the wealth reduces.

⇒ Reduced wealth will reduce the maximal possible investment, which in equilibrium is the actual investment.

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Reaching a new equilibrium

Reaching a new equilibrium

→ We now can determine the equilibrium.

- As the exchange rate will react very quickly to the reduced capital inflows, we can interpret the change of the equilibrium to another equilibrium point as a currency crisis as we see that adjustment of the exchange rate is more than justified by the reduced capital flow, this would only be the first step. Thus the depreciation of the currency is not fully justified by the changed macroeconomic condition (lower capital inflows), but mainly the result of the equilibrium changing.
- We thus see that a small change in a macroeconomic variable (some negative information), causes the exchange to change more than is justified by this change.
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  - It is the secondary effect the exchange rate has on the cost of servicing foreign debt that reduces the funds available for investments and this reduction in investments is then the cause for a further increase in the exchange rate.
  - It is then that the exchange rate (and the investment) reaches a new, different equilibrium, which requires a significant adjustment of the exchange rate.

→ It is thus that a small change in one variable can trigger the economy to reach a different equilibrium, causing a currency crisis.

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Vulnerability to currency crises

Vulnerability to currency crises

→ We can now use the main condition that was required for our results to hold to assess which countries are most likely to be affected by currency crises.

- The condition required for a multiple equilibria to emerge and hence a currency crisis to be possible, was the condition stated in the *formula*. If this condition is not fulfilled, there will only be a single equilibrium at $I = 0$ and hence no currency crisis can emerge; any changes to to macroeconomic conditions will have a minor impact on the exchange rate.
- We have seen that this condition is likely to be met by economies where companies operate with a high leverage and rely on sources of funding other their own wealth.
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  - For this condition to hold, we also need that there are not too many imports of goods for consumption,
  - thus it would be that mostly domestic goods are consumed.
- If foreign debt is high, relative to the income from export of goods or capital inflows, then the costs of servicing this debt is high and the country is vulnerable to a an increase in these costs from a higher exchange rate. This reduces the amount that is available for investment and hence production reduces and the exchange rate needs to adjust more to account for these deteriorating macroeconomic conditions.
- It is therefore countries that rely on exports of goods or capital import, and that have high foreign debt that are particularly vulnerable to currency crises.

→ We have established that a currency crisis can be the result of multiple equilibria, where a small change in a macroeconomic variable induces the economy to switch to a different equilibrium, which triggers a currency crisis.

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- Multiple equilibria are only possible if $\frac{\partial I^*}{\partial I} > 1$

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Department of Economics
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Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk