Part IIB
Paper 2, Revision Session

Dan Wales

University of Cambridge

9-10 May, 2019

Plan

- Question 1 - Reserve Currency (International)
- Question 4 - Sovereign Debt (International)
- Question 5 - Current Account (International)
- Question 6 - NK Model (Macroeconomic Policy)

Disclaimers

- Own "solutions" to the questions set. These may be brief, incomplete and contain typos.
- Unable to comment on the answers to past exam papers.
- Happy to answer **general** questions on material covered.

Question 1

- Classic Essay: 3 parts.
- What are the attributes of an international reserve currency?
- What are the advantages and policy trade-offs for the country issuing it?
- In your answer discuss whether the recent global financial crisis has influenced economists' views on these issues.

Attributes of an International Reserve Currency I

Immediately cite **Eichengreen (2013)** who gives three:

1. **Scale** to capture the public good nature of money.
   - **Network Externalities** are required for an asset to provide the services of money as one agent's utility from using an asset as money is increasing in the number of agents also using it as money.
   - Currencies may retain international vehicle status long after relative economic size/ power of the supplier have declined.

2. **Stability** to retain confidence of international markets.
   - Especially not subject to arbitrary manipulation.

3. **Liquidity** for easy conversion into other goods/services/assets.
   - Minimal loss of value during transactions.
   - Countries with a large share of world GDP or centrality of a given market may satisfy (1), but U.S. Treasury markets are the deepest and most liquid in the world.

Attributes of an International Reserve Currency II

- During the financial crisis **confidence** became a key issue, with (2) and (3), above, extremely important.
- The country must be able to withstand either external or internal shocks without resorting to bouts of inflation or debt defaults to repay obligations.
- **Bernanke (2016)** therefore adds **safety** as an additional consideration, alongside the ability to act as a **Lender of Last Resort** by providing funding (liquidity) through currency swaps during distress.

Advantages and Trade-off for Issuer I

- Historically, a key advantage for the issuer was the ability to borrow in its own currency at relatively low interest rates, known as the **exorbitant privilege** (a large positive differential between returns on the US foreign assets and liabilities).

- IRC issuers potentially face a trade-off between maintaining **domestic stability** and providing **international liquidity**.

Advantages and Trade-off for Issuer II

- Discussed by **Triffin (1960's)** during the Bretton Woods gold-exchange standard, where only USD was convertible into gold. All other currencies were pegged to USD.

- Rapid global growth increased demand for international payments. US had to supply dollar monetary assets at the appropriate pace or trade and growth would suffer real costs from a liquidity shortage.

- Yet, continual expansion of US dollar liabilities at the rate of world growth would was bound to lead to the stock of dollar liabilities exceeding the US stock of gold.

- To the extent that foreign central banks could ask the Federal Reserve to exchange their USD for gold, the US would become vulnerable to a "**run on the dollar**" or confidence crisis.

Influence of Recent Global Financial Crisis

- Is there a similar dilemma today? **Yes** - growing demand for safe international money and short-term assets.

- The US can expand their supply in different ways:
  - given foreign liabilities, $\uparrow$ short-term instruments, $\downarrow$ long-term;
  - given current account deficit, $\uparrow$ both gross liabilities and assets;
  - $\uparrow$ external deficit, financed by short-term USD liabilities.

- In satisfying international demand for USD denominated monetary assets, the US needs to make sure that a high issuance of own short term/monetary liabilities does not undermine its ability to pursue macroeconomic, fiscal and financial stability, or create potential confidence crises.

- Ultimately, the US must have the **capacity to stabilize** even large shocks without generating high trend inflation and depreciation, or "tampering" with its debt.

Question 4

- In contrast to the US, the UK and other advanced countries, the global crisis and great recession created a sovereign debt crisis in the euro-area. This caused large and variable interest rate differentials on public debt issued by different member countries and a large sovereign default (Greece).

(a) Explain how a sovereign debt crisis can be driven by debt and/or self-fulfilling market expectations of a default.

(b) Which features of the Eurozone as an incomplete monetary union may have contributed to the sovereign debt crisis?

Explain How a Sovereign Debt Crisis May Arise I

(a) Debt crises typically occur when **the stock of government debt is very high**, and/or **a country is hit by a large negative shock**. Under these circumstances, the government may consider restructuring the debt (imposing a haircut on debt holder) rather than raising distortionary tax rates and/or cutting spending.

- To illustrate the mechanism describe model to analyse this:
  - Agents: Government, (risk neutral) Investors.
  - States: High output, low output.
  - Periods: t and $t+1$, one-period debt.
  - Problem: Need to issue debt to cover financing needs, but may not repay if hit by large negative shock.

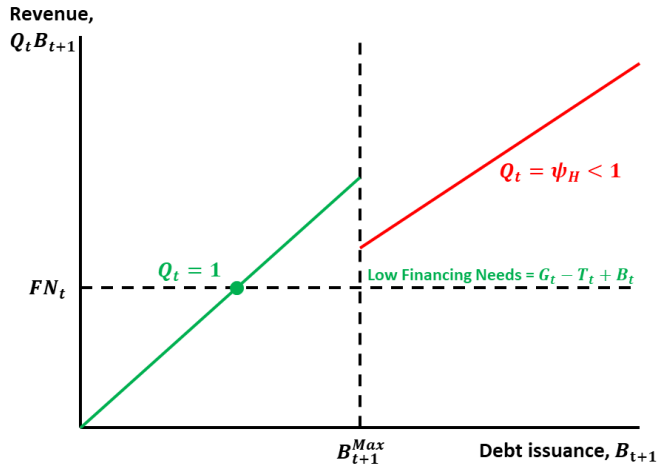
Explain How a Sovereign Debt Crisis May Arise II

- Solution Method:
  - **Sustainability**: Debt thresholds (for simplicity assume one).
  - **Prices**: Q_t^{Safe} and Q_t^{Risky}.

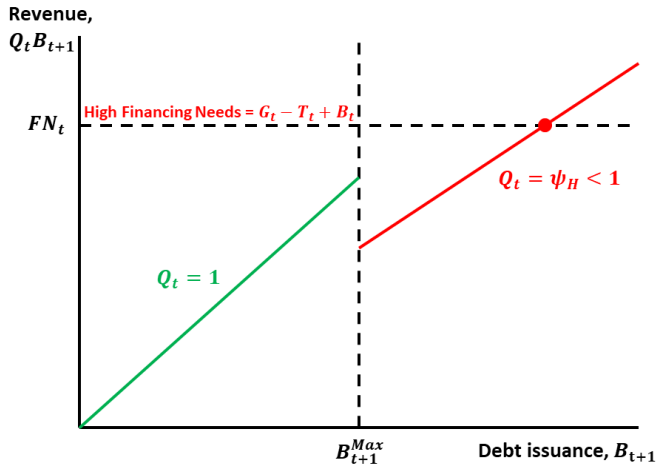
- Three Possible Solutions:
  - **Fundamental repayment**.
  - **Fundamental default**.
  - **Multiple self-validating equilibria**.

- Depend on location of FN_t and $\mathcal{B}_{t+1}^{\text{Max}}$

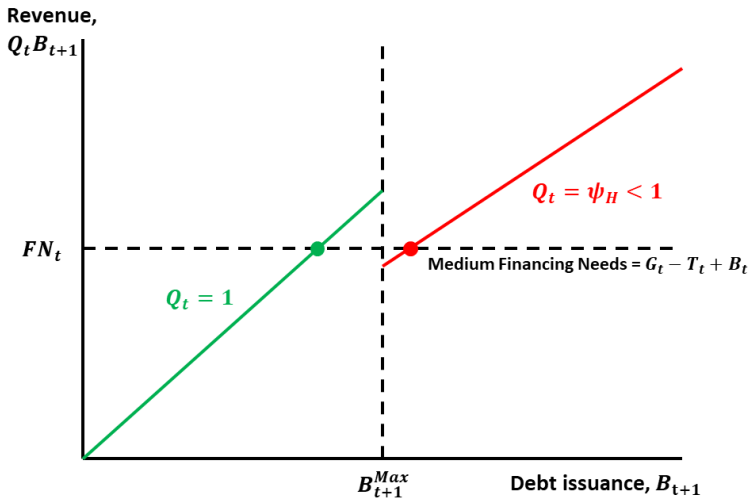
Explain How a Sovereign Debt Crisis May Arise III



Low Financing Needs (FN).

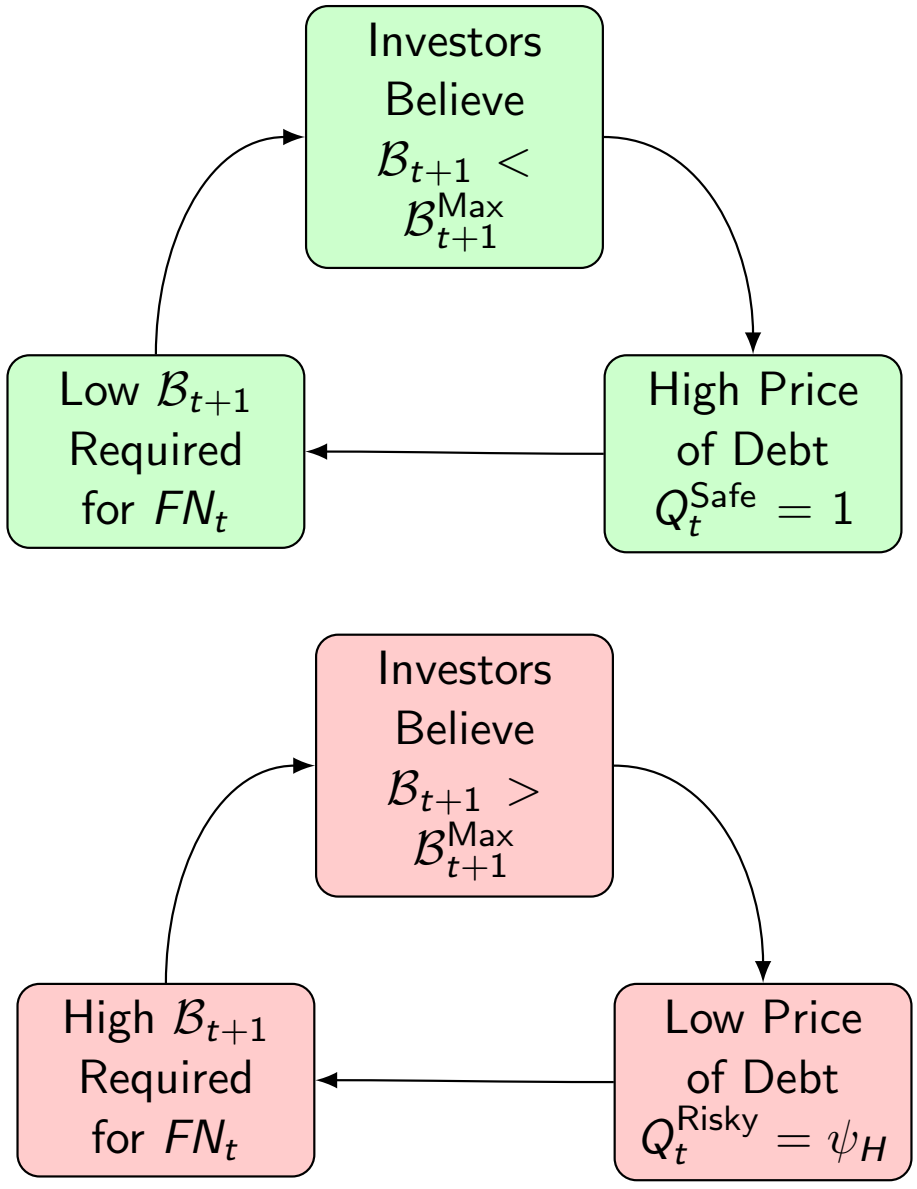


High Financing Needs (FN).



Medium Financing Needs (FN).

The Logic of Belief-Driven Debt Crises



Which Features of the EA as an incomplete monetary union may have contributed to the sovereign debt crisis?

(b) Several **institutional deficiencies** have increased vulnerability of self-fulfilling speculative attacks on sovereign debt.

- No fiscal union, and fiscal rules **ill designed and ineffective**:
  - No common eurobonds.
  - Bonds which are priced differently between states.
  - Investors may easily substitute between country-specific bonds.
  - Despite EA Growth and Stability Pact, debt grew substantially in many countries: sufficiently to induce **self-fulfilling crisis**.

Which Features of the EA as an incomplete monetary union may have contributed to the sovereign debt crisis?

- No official assistance (pre-September 2012):
  - Returning to the "good equilibrium" required **austerity programmes**.
  - Aiming to **convince markets** about the solidity of budgets.
  - With debt stocks above 80-90 % of GDP, the correction required to eliminate multiplicity far **exceeded political and economic feasibility**.
  - Austerity aggravating the contractionary macroeconomic stance of the euro area.

- Creation of the European Stability Mechanism (ESM) (post-October 2012):
  - An effective tool to reduce interest differentials not justified by fundamentals
  - Enhanced further by ECB's Outright Monetary Transaction (OMT) programme.

Question 5 - Set up

Consider a small open economy existing for two periods, 0 and 1, populated by many identical agents with preferences

$$\log C_0 + \beta \log C_1,$$

At time 0, the residents are endowed with an exogenous amount of Y_0 of output. They can invest their savings either in foreign assets, B_1, which yield the world interest rate, R, or in domestic projects, I_0, which yield output in period 1, Y_1, with decreasing returns:

$$Y_1 = A I_0^{\alpha}$$

The initial net foreign wealth is zero ($B_0 = 0$), so that B_1 coincides with the current account (i.e. $B_1 - B_0 = B_1 < 0$ represents the current account deficit, CA). Investing in project I_0 requires a specialized imported input, at the price p units of output. Hence it costs pI_0 units of output (=consumption).

Question 5

(a) Define the 'intertemporal production possibility frontier' (IPPF).

- The IPPF may be defined as **the set of intertemporal consumption options** $\{C; C_1\}$ **which may be obtained by varying investment** .
- This is usually done *under Financial Autarky*, which infers these options must be obtained **without the use of bonds** .

(i) Assuming financial autarky, write down the IPPF equation and illustrate graphically its properties.

- The budget constraints under financial autarky:

$$C = Y - pI_0,$$
$$C_1 = AI_0^{\alpha},$$

which infers:

$$C_1 = A\Big[\frac{Y - C}{p}\Big]^{\alpha}.$$

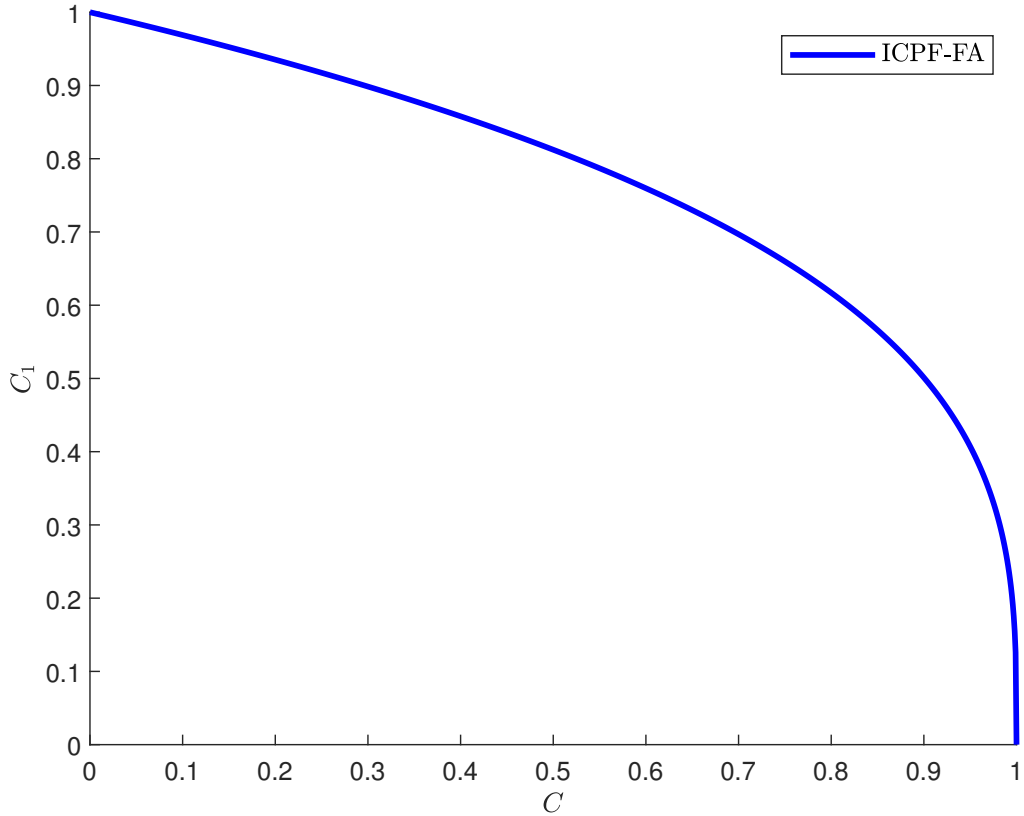
Question 5

(i) continued...

- This has a **negative slope**.

$$\frac{\partial C_1}{\partial C} = -\frac{\alpha A}{p}\left[\frac{Y - C}{p}\right]^{\alpha - 1} < 0.$$

- and may be drawn as follows:

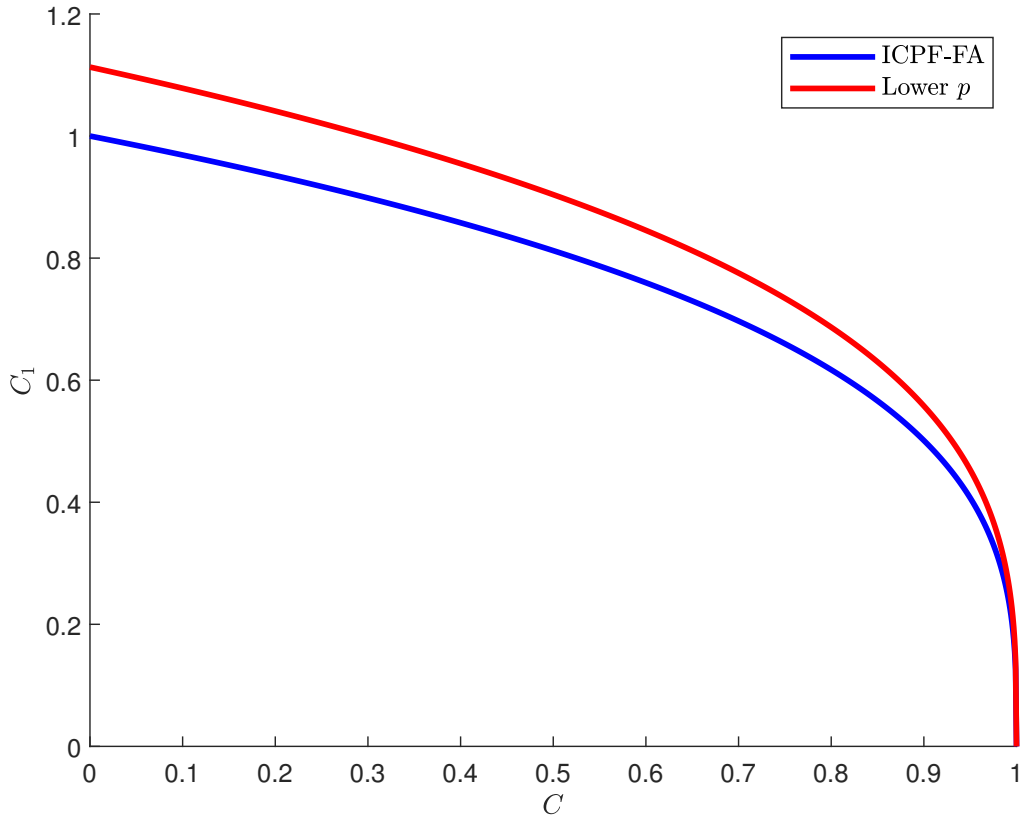


Notes: $Y = p = 1$, $\alpha = 0.6$.

Question 5

(ii) How does the IPPF change if the price of the imported input, p, falls? Explain.

- Shifts **outwards**.



Notes: $Y = p_0 = 1$, $\alpha = 0.6$, $p_1 = 0.7$.

Question 5

(ii) continued...

- C_1 is **decreasing** in p at all levels of C. Intuitively, the **higher** the price of the imported input, the **higher** the amount of current consumption the country has to give up to finance the investment required to sustain a given target of C_1.

Question 5

(b) Write down the budget constraint of the country in the two periods (including B_1) and the problem of the representative consumer. Derive the first order conditions characterising the optimal consumption and investment decisions.

- The period budget constraints are:

$$C = Y - pI - B_1,$$
$$C_1 = AI^{\alpha} + RB_1.$$

Question 5

(b) continued...

- such that the representative consumer solves:

$$\max_{I,B_1} \left\{ \log(Y - pI - B_1) + \beta \log(AI^{\alpha} + RB_1) \right\},$$

- and there are two first order conditions of the problem:

$$-\frac{p}{C} + \beta \frac{\alpha A I^{\alpha-1}}{C_1} = 0, \qquad \rightarrow \qquad C_1 = \frac{\beta \alpha A I^{\alpha-1}}{p} C$$

$$-\frac{1}{C} + \beta \frac{R}{C_1} = 0 \qquad \rightarrow \qquad C_1 = \beta R C.$$

Question 5

(c) Define and derive the interest rate under financial autarky R^{FA}. Is R^{FA} increasing/decreasing in p? And in A?

- R^{FA} is the interest rate at which **it is optimal to consume the financial autarky bundle even if trade in the international financial markets is possible**.
- An equilibrium must be both **optimal** and **feasible**.
- Using the first order conditions, **optimality** will require:

$$C_1 = \frac{\beta \alpha A I^{\alpha-1}}{p} C,$$

$$R = \frac{\alpha A I^{\alpha-1}}{p}.$$

such that we link consumption decisions with investment, and the investment decision with the level of the real interest rate.

Question 5

(c) continued...

- Using the budget constraints under financial autarky, **feasibility** will require:

$$C^{FA} = Y - pI^{FA},$$
$$C_1^{FA} = AI^{FA,\alpha}.$$

such that we have 4 equations and 4 unknowns. As every equation includes an expression for investment, I, once this is found in terms of exogenous variables all else will follow.

$$I^{FA} = \frac{\alpha\beta}{1+\alpha\beta}\frac{Y}{p},$$
$$R^{FA} = \frac{\alpha A}{p}\left(\frac{\alpha\beta}{1+\alpha\beta}\frac{Y}{p}\right)^{\alpha-1} = \alpha A\left(\frac{\alpha\beta}{1+\alpha\beta}Y\right)^{\alpha-1}p^{-\alpha}.$$

Question 5

(c) continued...

- R^{FA} is **decreasing** in p and **increasing** in A:

$$\frac{\partial R^{FA}}{\partial p} = -\alpha^2 A\left(\frac{\alpha\beta}{1+\alpha\beta}Y\right)^{\alpha-1} p^{-\alpha-1} < 0,$$

$$\frac{\partial R^{FA}}{\partial A} = \alpha\left(\frac{\alpha\beta}{1+\alpha\beta}Y\right)^{\alpha-1} p^{-\alpha} > 0.$$

- Intuitively, a higher price of imported input is akin to lower growth, as it makes future consumption more valuable at any level of current consumption.

Question 5

(d) Assume that preferences and technology are such that $R^{FA} > R$. Is the current account going to be positive or negative? Explain.

- Bookwork, from lectures: **"Residents in countries with fundamentals such that $R^{FA} > R$ will value present consumption over future consumption more than residents abroad. These countries will tend to import present consumption and thus run a CA deficit."**

Question 5

(e) Derive the consumption and investment plans if agents can trade the international bond.

- In a trading equilibrium we face a similar set of four conditions. However, now R is now given, rather than endogenous, and B_1 is to be found.

$$
\begin{aligned}
C &= Y - pI - B_1, \\
C_1 &= AI^{\alpha} + RB_1, \\
C_1 &= \frac{\beta\alpha AI^{\alpha-1}}{p} C, \\
R &= \frac{\alpha AI^{\alpha-1}}{p}.
\end{aligned}
$$

- It will again be easiest to eliminate for investment first, since all equations depend on I. Once this is found all else will follow!

Question 5

(e) continued...

- This leads to:

$$\tilde{I} = \left(\frac{\alpha A}{pR}\right)^{\frac{1}{1-\alpha}},$$

$$\tilde{C} = \frac{1}{1+\beta}\left[Y - p\tilde{I} + \frac{A\tilde{I}^{\alpha}}{R}\right].$$

- with consumption a **constant fraction** of the net present value of wealth, *after investment decisions*.
- one implication of **the functional form of utility (log)**.

Question 5

(f) Starting from an initial deficit, will a fall in p increase or decrease the deficit? Explain.

- The answer from part (c) showed that a fall in p caused R^{FA} to **increase**.
- Given R, this will therefore **increase** $R^{FA} - R$ and hence the current account deficit.
- ideally we show this mathematically...

Question 5

(f) continued...

- In the trading equilibrium:

$$B_1 = Y - \tilde{C} - p\tilde{I},$$

$$B_1 = Y - \frac{1}{1+\beta}\left[Y - p\left(\frac{\alpha A}{pR}\right)^{\frac{1}{1-\alpha}} + \frac{A}{R}\left(\frac{\alpha A}{pR}\right)^{\frac{\alpha}{1-\alpha}}\right] - p\left(\frac{\alpha A}{pR}\right)^{\frac{1}{1-\alpha}}.$$

At home: Simplify the above and show:

$$\frac{\partial B_1}{\partial p} < 0.$$

- Conclude as above.

(i) Contrast the answer to (f) with the effect of an increase in the marginal product of investment.

At home: Again, simplify and show:

$$\frac{\partial B_1}{\partial A} > 0.$$

Question 6 - Set up

Consider the three-equation model, where inflation and output are determined by:

$$\pi_t = \pi_t^e + \alpha y_t + \epsilon_t,$$
$$y_t = \gamma y_{t-1} - \delta r_t + \eta_t,$$

where r_t is the real interest rate. The Central Bank has the following loss function:

$$L_t = \beta(y_t)^2 + (\pi_t - \pi^*)^2,$$

As yet, we do not specify a process for inflation expectations. Assume that the Central Bank can perfectly control the real interest rate, and that ε_t and η_t are additive supply and demand shocks drawn from zero-mean, serially uncorrelated, noise processes with variances σ_ε^2 and σ_η^2.

Question 6

(a) Provide a brief explanation for the three equations, including the interpretation of π^*.

$$\pi_t = \pi_t^e + \alpha y_t + \epsilon_t,$$

- This equation represents **the New Keynesian (expectations augmented) Phillips curve** .
- Where $\frac{\partial \pi_t}{\partial y_t} = \alpha > 0$, such that α measures the **responsiveness of inflation to changes in the output gap**.
- When demand, y_t, increases, firms increase prices, π_t.
- ϵ_t represents an **iid cost push shock** .

Question 6

(a) continued...

$$y_t = \gamma y_{t-1} - \delta r_t + \eta_t,$$

- This equation represents **the IS curve or an aggregate demand equation** .
- Where $\frac{\partial y_t}{\partial r_t} = -\delta < 0$.
- When interest rates, r_t, increase, firms reduce investment and activity, y_t slows.
- γ is the **weight on the AR(1) component of the output gap** , as here we have **persistence** in the output gap.
- η_t represents an **iid real demand shock** .

Question 6

(a) continued...

$$L_t = \beta(y_t)^2 + (\pi_t - \pi^*)^2,$$

- This equation represents **the central bank's loss function** .
- β represents the **relative weight the central bank places on output stabilisation (compared to inflation deviation from target)** .

Question 6

(b) Derive the optimal feedback rule, conditional on information right before time t, and comment briefly on it.

- Firstly, consider timing

Period $t-1$	y_{t-1}, π_{t-1}, ϵ_{t-1} and η_{t-1}, are realised. π_t^e is set.
Period t (morning)	r_t is set.
Period t (afternoon)	ϵ_t and η_t are realised such that policy outcomes, y_t and π_t are also realised.

Question 6

(b) continued...

- Problem is therefore:

$$r_t^* = \textit{argmin}\Big\{ \mathbb{E}_{t-1}[L_t] \Big\}$$

- which may be found using:

$$\mathbb{E}_{t-1}[L_t] = \mathbb{E}_{t-1}\Big[\beta(\gamma y_{t-1} - \delta r_t + \eta_t)^2 + (\pi_t^e + \alpha\gamma y_{t-1} - \alpha\delta r_t + \alpha\eta_t + \varepsilon_t - \pi^*)^2\Big],$$

if we plug in for IS and NKPC relationships... and then (again) for the IS relationship.

Question 6

(b) continued...

- To solve, we compute either:

$$\frac{\partial}{\partial r_t}\,\mathbb{E}_{t-1}[L_t] = 0,$$

or, using (with justification) the Leibniz rule:

$$\mathbb{E}_{t-1}\left[\frac{\partial}{\partial r_t} L_t\right] = 0,$$

- We observe:

$$\frac{\partial\,\mathbb{E}_{t-1}\,L_t}{\partial r_t} = -2\beta\delta(\gamma y_{t-1} - \delta r_t) - 2\alpha\delta(\pi_t^e + \alpha\gamma y_{t-1} - \alpha\delta r_t - \pi^*),$$

$$\frac{\partial^2\,\mathbb{E}_{t-1}\,L_t}{\partial r_t^2} = 2\beta\delta^2 + 2\alpha^2\delta^2 > 0,$$

where the first equation represents the central bank's **optimality condition** .

Question 6

(b) continued...

- Finally, set the optimality condition to 0, and rearrange:

$$r_t^* = \frac{\gamma}{\delta} y_{t-1} + \frac{\alpha}{\delta(\alpha^2 + \beta)}(\pi_t^e - \pi^*),$$

- The persistent component of disturbances in output are **perfectly offset**, even as the central banker only cares about **inflation** $\beta = 0$.
- When $\beta \to \infty$, the central banker only cares about **output stabilisation** and reacts only to past output shocks.
- More?
  - If inflation expectations were $\pi_t^e = \pi_{t-1}$ **(adaptive)** the policymaker responds to previous inflationary shocks.
  - Why σ_ϵ^2, σ_η^2 do not feature? **Multiplicative (Brainard Principle) vs additive uncertainty**.

Question 6

(c) What are the equilibrium processes for output and inflation?

- Simply plug the real interest rate into the IS equation:

$$\begin{aligned} y_t &= \gamma y_{t-1} - \delta r_t + \eta_t, \\ &= \gamma y_{t-1} - \delta\left(\frac{\gamma}{\delta} y_{t-1} + \frac{\alpha}{\delta(\alpha^2+\beta)}(\pi_t^e - \pi^*)\right) + \eta_t, \\ &= \eta_t - \frac{\alpha}{\beta+\alpha^2}(\pi_t^e - \pi^*), \end{aligned}$$

- ... and then plug this into the Phillips curve:

$$\begin{aligned} \pi_t &= \pi_t^e + \alpha y_t + \epsilon_t, \\ &= \pi_t^e + \alpha\left(\eta_t - \frac{\alpha}{\beta+\alpha^2}(\pi_t^e - \pi^*)\right) + \epsilon_t, \\ &= \pi_t^e - \frac{\alpha^2}{\beta+\alpha^2}(\pi_t^e - \pi^*) + \alpha\eta_t + \epsilon_t, \end{aligned}$$

Question 6

(d) Assume rational expectations $\pi_t^e = \mathbb{E}[\pi_t]$ (on average agents are right about inflation). What is the inflation bias in this economy? Comment briefly on its value.

- To answer this we take expectations through the Phillips curve:

$$\pi_t = \pi_t^e - \frac{\alpha^2}{\beta + \alpha^2}(\pi_t^e - \pi^*) + \alpha\eta_t + \epsilon_t,$$

$$\pi_t^e \equiv \mathbb{E}[\pi_t] = \mathbb{E}\left[\pi_t^e - \frac{\alpha^2}{\beta + \alpha^2}(\pi_t^e - \pi^*) + \alpha\eta_t + \epsilon_t\right],$$

$$\pi_t^e = \pi_t^e - \frac{\alpha^2}{\beta + \alpha^2}(\pi_t^e - \pi^*),$$

$$\pi_t^e = \pi^*.$$

Question 6

(d) continued...

- such that:

$$\pi_t = \pi^* + \alpha\eta_t + \epsilon_t,$$
$$y_t = \eta_t$$

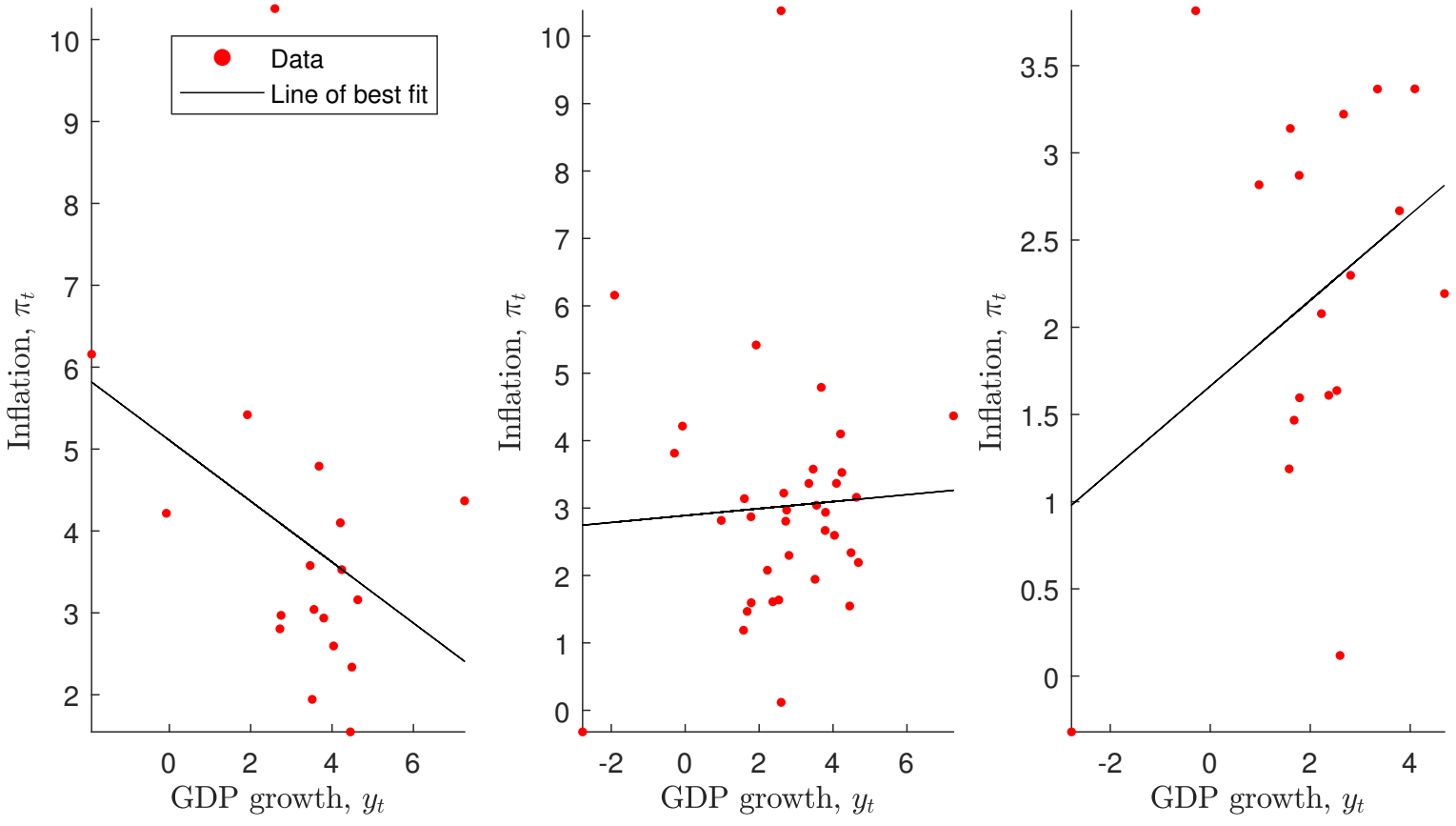
- Inflation bias is zero, such that inflation is on average at the policymakers target value.
- The policy maker lets output float around its natural rate, such that the output gap is zero on average.

Question 6

(e) If you had observations on inflation and output generated by this economy and you graphed inflation against output, how would you draw conclusions about the drivers of business cycles?

- Huh?

Question 6



Notes: US data taken from WEO.

Question 6

(e) continued...

- Consider the rational expectations form of the equations:

$$y_t = \eta_t,$$
$$\pi_t = \pi^* + \alpha\eta_t + \epsilon_t.$$

- Clearly:

$$Cov[y_t, \pi_t] = \alpha\sigma_\eta^2 > 0$$

such that aggregate demand shocks imply a positive comovement between output and inflation. (Demand shocks are the key driver - chart 3)

- Output does not respond to the cost push shock. A negative correlation may be introduced if cost push shocks are dominant. (First chart suggests cost push shocks are the key driver of business cycles).