Chapter 1

The Traditional Approach to Fluctuations

• Main references:
  – Romer [2001], Chapter 5
  – Blanchard & Quah AER, 1989

• Other references that could be read:
  – Blanchard and Fisher [1989], Chapter 10, Paragraph 3
  – Sargent [1987], Chapter 1
  – Turnovsky [2000], Chapter 2
1 Introduction

• Here I present the model of the Neoclassical synthesis, that was the standard workhorse of macroeconomics until the mid 70’s, and that is still the common wisdom among many politicians and journalists.

• IS-LM and AD-AS models

• General Equilibrium without explicit micro-foundations of individual decisions and description of markets organization

2 A First Look at the AD-AS Model

• AD: Level of aggregate demand as a function of the general price level \( (m = \text{money supply}, g = \text{govt expenditures}) \)

\[
 p = a_0 - a_1y + a_2m + a_3g
\]
• AS: Level of aggregate supply as a function of the general price level \((q = \text{productivity})\)

\[
y = b_0 + b_1 p + b_2 q
\]  

(2)

• On can compute the solution and multipliers

\[
\begin{align*}
p &= \left( \frac{a_0 - a_1 b_0}{1 + a_1 b_1} \right) + \left( \frac{a_2}{1 + a_1 b_1} \right) m + \left( \frac{a_3}{1 + a_1 b_1} \right) g - \left( \frac{a_1 b_2}{1 + a_1 b_1} \right) q \\
y &= \left( \frac{b_0 + b_1 a_0}{1 + a_1 b_1} \right) + \left( \frac{b_1 a_2}{1 + a_1 b_1} \right) m + \left( \frac{b_2 a_3}{1 + a_1 b_1} \right) g + \left( \frac{b_2}{1 + a_1 b_1} \right) q
\end{align*}
\]

• The model is mainly used for policy evaluation: \(\frac{\partial y^e}{\partial g}, \frac{\partial y^e}{\partial m}, \frac{\partial y^e}{\partial q}, \frac{\partial p^e}{\partial m}, \text{ etc...} \) (oil price shock, monetary expansion, \ldots)

• Most of the debate was then the size and signs of the multipliers.

• This model have foundations, although not micro-foundations: IS-LM for AD and the functioning of the labor market for AS.
Figure 1: Equilibrium of the AD-AS Model
Figure 2: Shocks and Policies in the AD-AS Model
3 Aggregate Demand

- How is aggregate demand determined at given prices?

3.1 The IS curve and the Keynesian Cross

Definition 1 The IS curve shows the combination of output and interest rate such that planned and actual real expenditures on output are equal.

- Planned expenditures

\[ E = E(Y, i - \pi^e, G, T) \]  \hspace{1cm} (3)

with \( 0 < E_Y < 1, E_{i-\pi^e} < 0, E_G > 0, E_T < 0 \) and \( \pi^e, G, T \) exogenously given.

- Often, planned expenditures are written

\[ E = C(Y - T) + I(i - \pi^e) + G \]
• Assume that firms production is used for consumption, investment, government expenditures (planned expenditures) and inventories for what is left. Then actual expenditures is always equal to output \( Y \). If planned expenditures are smaller that output, then firms will accumulate unwanted inventories and will therefore cut production. The equilibrium of the model is obtained for \( E = Y \). This is the keynesian cross

• From figure 3, we get that the IS curve is downward sloping in the \( (Y, i) \) space. The implicit equation defining IS is \( Y = E(Y, i - \pi^e, G, T) \) and \( \frac{dY}{di} = \frac{E_i - \pi^e}{1-E_Y} < 0 \)

• Along the IS curve, \( \frac{dY}{dG} = \frac{E_G}{1-E_Y} > 0 \) which is the keynesian expenditures multiplier.

• We need another equation to determine both \( Y \) and \( i \). It will be given by the money market equilibrium condition.
Figure 3: The Keynesian Cross
3.2 The LM Curve

- Money demand (demand for real balance): \( L = L(Y, i) \), \( L_Y > 0 \), \( L_i < 0 \)
- Money supply: exogenous in nominal terms, \( \frac{M}{P} \)

**Definition 2** The **LM curve** shows the combination of output and interest such that money supply is equal to money demand.

- The equation defining LM is \( \frac{M}{P} = L(Y, i) \)
- By fully differentiating, \( \frac{d}{dY} \frac{d}{dY} = \frac{-L_Y}{L_i} > 0 \)
Construction of the LM curve

- The LM curve accounts for money market equilibrium.
- Prices are fixed, $\bar{P}$, money supply is exogenous $M^S = \frac{M}{P}$, Money demand is given by $M^D = L(Y, i)$
- $LM$ is graphically constructed in the following way:
Figure 4: Construction of the LM curve
Figure 5: Construction of the LM curve
**Case study**
The LM Curve and **Volcker** Tight Monetary Policy

- Paul Volcker was the Chairman of the US Fed in the late 70s-early 80s
- 70s: High inflation, e.g. 11.3% in 1979
- Volcker: tight money policy to fight inflation (announced in October 1979). Why? This comes from basic classical economics:

1. Quantitative Theory of Money: \( MV = PY \sim \frac{\Delta M}{M} = \frac{\Delta P}{P} (= \pi) \) for constant velocity and output (plausible assumption in the medium run (?)

2. Fisher relation: \( i = r + \pi^e \)

- Adding up those two pieces, we obtain the **Fisher Effect**: an decrease in the money growth of 1% causes a 1% decrease in inflation (quantity theory); this 1% decrease in inflation causes a 1% decrease in the nominal interest rate (Fisher relation)
• By 1983; inflation was brought down to 3%
• That’s the medium-long run effect. What did happen in the short run? Comparing 1978 and 1980, real balances (M1/CPI) felt by 8.3%, and the nominal interest rate in commercial paper increased from 10.1 to 11.9%.
• This can be perfectly understood in a LM framework, in which prices are sticky in the short run.
Figure 6: Restrictive Monetary Policy
Figure 7: Restrictive Monetary Policy
END OF THE CASE STUDY

3.3 The IS-LM Model

- The IS-LM model is a 3 markets model (goods, money and bonds). Only 2 markets show up because of Walras Law.
Figure 8: The IS-LM Model
• At given prices, one can conduct policy experiments using the IS-LM model.

• Budget constraint of the government:

\[ G = \frac{M}{P} + T + \frac{B}{P} \]

• \( \Delta G = \Delta B/P \) and \( \Delta T = -\Delta B/P \) shift only the IS curve.

• \( \Delta M = -\Delta B \) shift only the LM curve.
Case study
The Clinton-Greenspan Policy Mix

- Keynesian policy mix is the joint manipulation of IS and LM.
- An recent example is the Clinton-Greenspan policy of 1992-2000
- 1992: The US economy is still thought to be in the 1990-91 recession (even though we know now that it was not any more) \(\sim\) historically large federal budget deficit.

Table 1: US Macroeconomic Variables, 1991-1998

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• Pb: the need to reduce deficit was likely to deepen the recession

Figure 9: Restrictive Budgetary Policy
6 years later, the deficit has disappeared, and growth is large. How can this be understood in a IS-LM setup?

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• Alan Greenspan, president of the US Fed, did implicitly commit to ease monetary policy against budgetary restrictions. Easy monetary policy, as shown in IS-LM, can undo the recessive impact of budgetary policy

• On this base, in Feb. 1993, Clinton presented to the Congress a plan of deficit reduction, with a -2.5% target in 1998, with both increase in taxes and cuts in expenditures

• The deficit reduction was kept modest because of the fear of a new recession.

• The Fed did what was expected: interest rates were continuously reduced

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Figure 10: Policy Mix
Note: This policy mix is not the only reason for the growth and deficit reduction:

1. IT boom of the 90’s + stock market boom $\rightarrow$ increases in $I$ $\rightarrow$ rightward shifts of the $IS$ curve (The Fed did in fact increase interest rates after 1994 to limit inflation)

2. Growth did automatically contribute to the deficit reduction

End of the case study
**Case study**
The German Reunification

- 1990: West and East Germany reunified.
- Even though the two countries (regions) were pretty close in 1945, DDR was way less behind in 1990 (Non productive enough firms, lack of investment,...)
- A demand boom: investment (firms, infrastructures), benefits for former workers, subsidies to the eastern firms,..etc
- Germany was already in a demand boom in 1988 and 1989.

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<td>Interest Rate (short term)</td>
<td>4.3</td>
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• Reunification increased demand, that was already high $\rightarrow$ right shift of $IS \rightarrow$ right shift of $AD \rightarrow$ risk of inflation

Figure 11: Reunification: an IS shock
As the Bundesbank feared inflation, it decides to implement a restrictive monetary policy, with large increase in the interest rates in 1990 and 1991.

Figure 12: The Bundesbank Restrictive Policy
Therefore, one observed expansion and extreme increase in interest rate $\rightarrow$ negative impact on other European countries $\rightarrow$ deep recession in 1993 in France.

Table 2: West Germany, 1988-1991

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End of the case study
3.4 The AD Curve

Definition 3 The AD curve shows the combination of output and prices such that planned expenditures are equal to output and the money market clears.

- Using IS-LM, one can show that the AD curve is downward sloping.
Figure 13: An Increase in the Price Level
Figure 14: The AD Curve
3.5 Controversies about the AD Curve

- There was little controversy about the construction of the AD curve, but many concerning the determinants on consumption, investment, money demand, money supply...

4 The AS Curve and the Model Equilibrium

**Definition 4** The AS curve shows the combination of output and prices such that transactions on the labor market is $F^{-1}(Y)$ when prices are $P$.

4.1 Labor Supply and Demand

- Firms : $F(L)$, $F' > 0$, $F'' < 0 \sim$ labor demand $F'(L) = \frac{W}{P}$.
- Labor supply is also standard $L^s \left(\frac{W}{P}\right)$, $L^s' > 0$.
- Key point : the labor market does not always clear $\sim$ unemployment.
4.2 Classical (Walrasian) Case

- Assume that the labor market clears. For a given $P$

$$L^s \left( \frac{W}{P} \right) = F^{l-1} \left( \frac{W}{P} \right) \sim (L^e, W^e, Y^e) \quad (4)$$

- The real wage (Walrasian real wage) and the level of employment are determined without any need for the AD curve. The AD curve determines the price level and the composition of aggregate demand.

- The AS curve is vertical, demand policy is ineffective.
Figure 15: The Classical Case

Increase in M, G, pi^e

Increase in T

AD

AD'

AD''

AS
Once one assumes that the labor market does not clear, one obtains non vertical AS curves.

4.3 “Pure” Keynesian Case: Flexible Prices, Sticky Wages

Assume that we start from a $\frac{W}{P}$ above the walrasian one, and that nominal wages cannot adjust downward.
Figure 16: Disequilibrium on the Labor Market
• The AS curve is given by

\[ F'(L) = \frac{W}{P} \]

For a given \( \overline{W} \), the AS curve is upward sloping with non infinite slope: higher \( P \) \( \sim \) lower \( \frac{W}{P} \)
\( \sim \) higher \( L \) \( \sim \) higher \( Y \)
Figure 17: Disequilibrium on the Labor Market
• Once $P$ has increased enough for the real wage to have reached its walrasian, any subsequent increase in $P$ is followed by an increase in $W \sim$ the AS curve becomes vertical.
Figure 18: The AD-AS Model in the Keynes’ Case
Figure 19: The AD-AS Model in the Keynes’ Case
• Note that the real wage is counter-cyclical following demand shocks, as opposed to what “observed” (to discuss) on the data

• One can construct AD-AS models with alternative assumptions on the relative rigidity of prices and nominal wages (see section 4.4., 4.5. and 4.6., as taken from ROMER)
Case study
From Keynesianism to Monetarism: **MITTERRAND 1981-1990**

1981: the newly elected socialist French President implements a classic socialist program:

1. sharp increase of the minimum wage
2. new tax on wealth
3. extensive nationalizations (banks, electronic, chemicals,...)
4. work-week reduction at constant wages
5. fiscal expansion financed by public debt and money creation (1/3)

→ shifts of AD and AS
Figure 20: The Mitterrand early 80’s Policy
• As a consequence, the country experienced higher inflation than the rest of Europe, but also higher growth
Table 3: French and German Macroeconomic performances 1980-1990

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The problem was then with the fixed exchange rate within the EMS. Even with capital controls, faster money growth leads to larger inflation, and therefore less competitiveness given the fixed exchange rate $\rightarrow$ surge in unemployment

- deterioration of the current account $\rightarrow$ 3 devaluations between 1981 and 1883
- Reversal of policy in 1983: "la politique de rigueur" $\rightarrow$ freeze govt expenditures, increase taxes, wage guidelines to reduce wages pressures, slowdown in money supply growth, reduction of the budget deficit.

End of the case study
4.4 Sticky Prices, Flexible Wages, Competitive Labor Market

• Assume $P = \bar{P}$, and that firms always meet demand at the prevailing price as long as price is larger than marginal cost (output is below a maximum level $Y^{MAX}$, think of it as a model with imperfect competition on the good market).

• Assume that workers are always on their labor supply curve $L_s$, and that the labor market clear by nominal wage adjustment.

• Then, the AS curve is horizontal $\sim$ we are in the pure IS-LM case.

• The cyclical behavior of the real wage is now very different, as it is now pro-cyclical following a demand shocks. The more unresponsive labor supply is (ie close to vertical), the higher real wage movements.

• Note that there is not strictly speaking *unemployment*, although $L$ is generically lower than its walrasian level.

• Note: Employment problems can arise even though the problem is on the good market $\sim$
Figure 21: The AD-AS Model with Sticky Prices
Figure 22: A Pro-Cyclical Real Wage
because of general equilibrium effects.

4.5 Sticky Prices, Flexible Wages, Real Labor Market Imperfections

- Let’s reintroduce unemployment
- Assume that for some reason (efficiency wage, wage bargaining with trade unions, regulations,....) that there are some real rigidities on the labor market, so that, real wage is always higher that predicted by labor supply:

\[
\frac{W}{L} = w(L) < L^{-1}
\]

- As before, the AS curve is vertical, real wage is procyclical and there is unemployment. If the real wage curve is flatter than the labor supply one, unemployment is countercyclical.
Figure 23: Real Rigidities on the Labor Market
4.6 Sticky Wages, Flexible Prices and Real Good Market Imperfections

- Let us come back to the sticky nominal wage case, but add some imperfection on the good market so that one can get pro-cyclical real wage.

- Because of imperfect competition on the good market, price is determined as a markup over marginal cost:

\[ P = \mu(L) \frac{W}{F'(L)} \quad \text{or} \quad \frac{W}{P} = \frac{F'(L)}{\mu(L)} \]

- In the case where \( \mu(L) \) is a constant function, we are in the previous Keynes’ case and real wages are counter-cyclical following a demand shock.

- If markups are counter-cyclical, then one can generate any correlation between output and real wage, depending on the degree of counter-cyclicality, which determines the slope of the labor demand curve.
Figure 24: Three Configurations for Real Wage Cyclicality
5 The Phillips Curve

- For a given level of $P$ and/or $W$, the AD-AS model predicts $Y$, $L$ and the level of unemployment $U$.
- What about dynamics? What about the adjustment of $W$ and $P$?
- The model is supplemented with a reduced for equation of the type

$$\frac{\Delta W}{W} = f(U)$$

with $f' < 0$
- This equation can be seen as a competitive price adjustment, or as a empirical regularity, as shown originally by Phillips (1958) on UK data.
Figure 25: The PHILLIPS Curve, as estimated by PHILLIPS
Figure 26: The Phillips Curve, as estimated by Phillips
• This equation closes the model as providing a price (wage) determination theory and a link between two consecutive static AD-AS equilibria.

• In the long-run, nominal rigidities vanish and the economy is classic, while it is keynesian in the short run. In the short run, there is an inflation-output tradeoff, with which a government can play around using IS-LM type policies \( \mapsto \textit{fine tuning} \) management of aggregate demand.
Figure 27: The AD-AS Model in the Short and Long Run
6 AD-AS and the Decomposition of Macroeconomic Fluctuations

- I use a Blanchard & Quah (AER 1989) (BQ) type of analysis to evaluate the relative importance of “supply” and “demand” shock
- The idea is to decompose any movement of the economy as the consequence of 2 orthogonal shocks: a demand shock and a supply one.
6.1 Identification and Economic Interpretation

• Assume that the model economy is the following AD-AS:

\[
\begin{align*}
P &= -\alpha Y + \varepsilon^D & (AD) \\
P &= \beta Y - \varepsilon^S & (AS)
\end{align*}
\]

• \( \alpha \) and \( \beta \) are positive constants

• Assume that we know \( \alpha \) and \( \beta \).

• Then, one can identify demand and supply shocks (namely \( \varepsilon^D \) and \( \varepsilon^S \))
Figure 28: Observation: The economy went from A to B and C
Figure 29: We aim at putting names (stories) on those green arrows
Figure 30: The AD-AS model provides us with a theory of economic fluctuations (the green arrows)
Figure 31: Each Observation is at the crossing of AD and AS
Figure 32: This is the structural interpretation of the move from A to B
Figure 33: This is the structural interpretation of the move from B to C
Figure 34: Counterfactual: What would have happen absent of demand shocks
• The algebra is even more simple. If one solves the model

\[
\begin{align*}
  P &= -\alpha Y + \varepsilon^D \\
  P &= \beta Y - \varepsilon^S
\end{align*}
  \tag{AD} \tag{AS}
\]

one gets

\[
\begin{align*}
  P &= \frac{\beta}{\alpha + \beta} \varepsilon^D - \frac{\alpha}{\alpha + \beta} \varepsilon^S \\
  Y &= \frac{1}{\alpha + \beta} \varepsilon^D + \frac{1}{\alpha + \beta} \varepsilon^S
\end{align*}
\]

• When one observes \( Y \) and \( P \), this is a set of 2 equations with 2 unknowns, \( \varepsilon^D \) and \( \varepsilon^S \sim \), one can recover the structural shocks.

• The problem is that in the real world, we do not know \( \alpha \) and \( \beta \)

• One way could be to estimate each of the two equations using instrumental variables (oil price when estimating AD, money supply or Gvt expenditures when estimating AS)

• But it is very unlikely that this very simple and static model captures a significant part of the economy variance
6.2 A Dynamic Model with VAR and VMA representations

- Assume that the economy is best described by the following dynamic model:

\[
\begin{align*}
P_t &= \alpha_0^D Y_t + \alpha_1^D Y_{t-1} + \alpha_2^D Y_{t-2} + \cdots + \alpha_N^D Y_{t-N} \\
&\quad + \beta_1^D P_{t-1} + \beta_2^D P_{t-2} + \cdots + \beta_N^D P_{t-N} + \varepsilon_t^D \\
\quad (AD) \\
\end{align*}
\]

\[
\begin{align*}
P_t &= \alpha_0^S Y_t + \alpha_1^S Y_{t-1} + \alpha_2^S Y_{t-2} + \cdots + \alpha_N^S Y_{t-N} \\
&\quad + \beta_1^S P_{t-1} + \beta_2^S P_{t-2} + \cdots + \beta_N^S P_{t-N} + \varepsilon_t^S \\
\quad (AS) \\
\end{align*}
\]

- Demand and Supply shocks are independent.

- making use of the lag operator notation:

\[
L X_t = X_{t-1}, \quad L^i X_t = X_{t-i}, \quad i \in \mathbb{Z}
\]

- and rearranging terms

\[
\begin{align*}
Y_t &= (\alpha_1^Y + \alpha_2^Y L + \cdots + \alpha_N^Y L^{N-1})Y_{t-1} \\
&\quad + (\beta_1^Y + \beta_2^Y L + \cdots + \beta_N^Y L^{N-1})P_{t-1} + \gamma_D^Y \varepsilon_t^D + \gamma_S^Y \varepsilon_t^S \\
&\quad (1) \\
P_t &= (\alpha_1^P + \alpha_2^P L + \cdots + \alpha_N^P L^{N-1})Y_{t-1} \\
&\quad + (\beta_1^P + \beta_2^P L + \cdots + \beta_N^P L^{N-1})P_{t-1} + \gamma_D^P \varepsilon_t^D + \gamma_S^P \varepsilon_t^S \\
&\quad (2) \\
\end{align*}
\]

- or equivalently

\[
X_t = \hat{A}(L)X_{t-1} + B \varepsilon_t
\]
with $X_t = (Y_t, P_t)'$ and $\varepsilon_t = (\varepsilon_t^D, \varepsilon_t^S)$

- This is the VAR (Vectorial Auto Regressive) representation of the equilibrium.

- It is convenient to work with the VMA (Vectorial Moving Average) representation

$$X_t = \frac{B}{I - \tilde{A}(L)L} \varepsilon_t$$

or

$$X(t) = \sum_{j=0}^{\infty} A(j) \varepsilon_{t-j}$$

with $\text{Var}(\varepsilon) = I$ and

$$A(j) = \begin{pmatrix} a_{11}(j) & a_{12}(j) \\ a_{21}(j) & a_{22}(j) \end{pmatrix}$$

- This dynamic model, if derived from a structural one, puts a lot of restrictions on the sequence of $A(\cdot)$
6.3 IRF, Variance decomposition and Historical decomposition

- Here I derive some summary statistics from the VMA representation
- Let us consider Output. We have

\[ Y_t = \sum_{j=0}^{\infty} a_{11}(j)\varepsilon^D(t + j) + \sum_{j=0}^{\infty} a_{12}(j)\varepsilon^S(t - j) \]

- The IRF to a demand shock is \( \{a_{11}(0), a_{11}(1), a_{11}(2), \ldots\} \) and the IRF to a demand shock is \( \{a_{12}(0), a_{12}(1), a_{12}(2), \ldots\} \)
- The Forecast Error in predicting \( Y \) at horizon 1 is

\[ Y_t - E_{t-1}Y_t = a_{11}(0)\varepsilon^D(t) + a_{12}(0)\varepsilon^S(t) \]

and the share of the variance of FE at horizon 1 attributable to the demand shock is

\[ \frac{a_{11}^2(0)}{a_{11}^2(0) + a_{12}^2(0)} \]

(the variances of the structural shocks is normalized to 1).
• At horizon $k$, this share is

$$\frac{\sum_{j=0}^{k} a_{11}^2(k)}{\sum_{j=0}^{k} a_{11}^2(k) + \sum_{j=0}^{k} a_{12}^2(k)}$$

• Historical decomposition: what would have happen if only demand or supply shocks have been there?

$$Y_t^D = \sum_{j=0}^{\infty} a_{11}(j)\varepsilon^D(t-j)$$

$$Y_t^S = \sum_{j=0}^{\infty} a_{12}(j)\varepsilon^S(t-j)$$

6.4 The Need For Identification Assumptions

• Let us estimate a VAR model with $Y$ and $P$.

$$X_t = \tilde{A}(L)X_{t-1} + \tilde{B}\nu_t$$
• What the econometrician does estimate is a VAR form, from which one can recover the following non structural (or reduced form) VMA representation

\[ X(t) = \sum_{j=0}^{\infty} C(j) \nu_{t-j} \]

with \( \text{Var}(\nu) = \Omega \) and \( C(0) = I \) by normalization.

• How can \( \nu \) be cut into two orthogonal pieces that we will label demand and supply shocks?

• Compare this VMA representation with the structural one

\[ X(t) = \sum_{j=0}^{\infty} A(j) \varepsilon_{t-j} \]

• Those two representations imply

\[ \nu = A(0)\varepsilon \text{ and } A(j) = A(0)C(j) \text{ for } j > 0. \]

• Once we know \( A(0) \), we have everything. We have therefore 4 unknowns: \( a_{11}(0), a_{12}(0), a_{21}(0) \) and \( a_{22}(0) \).

• How do we get \( A(0) \)? First, if \( \nu = A(0)\varepsilon \), then \( \nu \) and \( A(0)\varepsilon \) have the same variance-
covariance matrix.

- The one of $\nu$ is the $\Omega$ (estimated). The one of $\varepsilon$ is $I$ by assumption.

- Therefore, one has

$$V(A(0)\varepsilon) = V(\nu) \iff A(0)A(0)' = \Omega$$

or

$$\begin{pmatrix} a_{11}(0) & a_{12}(0) \\ a_{21}(0) & a_{22}(0) \end{pmatrix} \times \begin{pmatrix} a_{11}(0) & a_{12}(0) \\ a_{21}(0) & a_{22}(0) \end{pmatrix}' = \begin{pmatrix} \omega_{11}(0) & \omega_{12}(0) \\ \omega_{12}(0) & \omega_{22}(0) \end{pmatrix}$$

- This gives us 3 equations (because $\Omega$ and $A(0)A(0)'$ are symmetrical) for 4 unknowns (the 4 coefficients of $A(0)$)

- We need one identifying assumption, that will allow us to separate aggregate demand shocks from aggregate supply ones.

### 6.5 The Identifying Restriction

- Here only one restriction because we have a 2-variables VAR

- This restriction should come from a model.
• Blanchard-Quah propose the following restriction: *Only supply shocks affect output in the long run* or in other words *Demand shocks do not affect output in the long run*.

• The long run effect of a demand shock is $a_{11}(\infty)$

• But $A(\infty) = A(0)C'(\infty)$ or

\[
\begin{pmatrix}
  a_{11}(\infty) & a_{12}(\infty) \\
  a_{21}(\infty) & a_{22}(\infty)
\end{pmatrix}
= \begin{pmatrix}
  a_{11}(0) & a_{12}(0) \\
  a_{21}(0) & a_{22}(0)
\end{pmatrix}
\times
\begin{pmatrix}
  c_{11}(\infty) & c_{12}(\infty) \\
  c_{21}(\infty) & c_{22}(\infty)
\end{pmatrix}
\]

• The fourth restriction is therefore

\[
a_{11}(0)c_{11}(\infty) + a_{12}(0)c_{21}(\infty) = 0
\]

• Recall that the $c_{ij}(\infty)$ are known (from estimation).

• We can therefore compute $A(0)$.

• Once we have $A(0)$, and the estimated VAR, we can compute IRF to shocks and Forecast Error Variance decomposition.
6.6 Some Extra Difficulties

- Here, I have assumed that both the model and the estimated VAR could be written and estimated as

\[ X_t = \hat{A}(L)X_{t-1} + B\varepsilon_t \]

- Both theory and estimation could imply that there are some constants or trends in this expression

\[ X_t = \hat{A}(L)X_{t-1} + B\varepsilon_t + K_1 + K_2t \]

- There is also an issue about the best way to specify the VAR if the series are non stationary (ie if shocks have permanent effect, which is the case here). It might be more efficient to specify the VAR in difference

\[ (1 - L)X_t = (1 - L)\hat{A}(L)X_{t-1} + B\varepsilon_t + K_1 \]

- In each of these case, although the algebra is more tedious, the same results than the one I have presented here apply.
6.7 Data

- Data: US 1948-2000 quarterly data
- Output is Non Farm Private Business Sector GDP, Prices series is the GNP deflator.
Figure 35: US Output and Prices, 1948-2000, logs (a)
Figure 36: US Output and Prices, 1948-2000, logs (b)
Figure 37: US Growth Rates of Output and Prices, 1948-2000
6.8 Results: IRF and Variance Decomposition
Figure 38: IRF
Figure 39: Estimated Shocks

Demand Shock

Supply Shock
Figure 40: Output FE Variance Decomposition
Figure 41: Prices FE Variance Decomposition
6.9 Results: Historical Decomposition
Figure 42: Historical Decomposition: Whole Sample

- Actual
- No Shocks

- Output
- Actual
- Supply

- Output
- Actual
- Demand
Figure 43: Historical Decomposition: Whole Sample

- **Actual** vs. **No Shocks**
- **Actual** vs. **Supply**
- **Actual** vs. **Demand**

The graphs show the historical decomposition of prices over time for different scenarios: Actual with and without shocks, Actual with supply, and Actual with demand. The X-axis represents the years from 1940 to 2000, and the Y-axis represents the prices from 0 to 2. The graphs illustrate how different factors affect price fluctuations over the sample period.
Figure 44: Historical Decomposition: Whole Sample
Figure 45: Historical Decomposition: Whole Sample
Supply Shocks Only
Figure 46: Historical Decomposition: Whole Sample

Supply Shocks Only
Figure 47: Historical Decomposition: Whole Sample

Supply Shocks Only
Figure 48: Historical Decomposition: Whole Sample
Demand Shocks Only
Figure 49: Historical Decomposition: Whole Sample

Demand Shocks Only
Figure 50: Historical Decomposition: Whole Sample

Demand Shocks Only

ΔP, %
ΔY, %

-0.02 0 0.02 0.04 0.06 0.08
-0.015 -0.01 -0.005 0 0.005 0.01 0.015 0.02 0.025

-0.04 -0.02 0 0.02 0.04 0.06 0.08
Figure 51: Historical Decomposition: First Oil Shock
Figure 52: Historical Decomposition: First Oil Shock

- **Actual**
- **No Shocks**

**Prices**


**Supply**


**Demand**

Figure 53: Historical Decomposition: First Oil Shock
Figure 54: Historical Decomposition: 1990-1991 Recession

The figure illustrates the historical decomposition of economic fluctuations using the Traditional Approach to Fluctuations. It shows the output data from 1990 to 1993, broken down into actual and no shock scenarios. The graphs depict the output with actual and no shocks, as well as demand and supply components for the same period.
Figure 55: Historical Decomposition: 1990-1991 Recession

- Actual
- No Shocks

- Actual
- Supply

- Actual
- Demand
Figure 56: Historical Decomposition: 1990-1991 Recession

The charts illustrate the historical decomposition of inflation from 1990 to 1993. The graphs show the actual inflation rates alongside the no-shocks scenarios for demand and supply. The data points indicate fluctuations in inflation rates during these years, with notable changes in 1991 and 1992.
7 The Breakup of the Traditional View

• This traditional view of fluctuations has been seriously challenged in the late 60’s and early 70’s.
• Different lines of attack: inaccurate description (stagflation), theoretical internal inconsistencies (expectations?, general equilibrium consistency?, theory of price determination?).
• These attacks came from the so called New Classical School (Prescott, Lucas, Barro, Sargent, Kydland), following Friedman and Phelps on the Phillips Curve.
• Those first counter models were fully flexible – perfect competition – no voluntary employment model.
• Most macroeconomists will agree now that one can debate over the degree of price rigidities or competition, but that we need to use more micro-founded models and treat better dynamics and expectations, specifically when one is concerned with economic policy.
• The rest of the course will be devoted to the illustration of this claim.